Introduction:

Circuit breakers, fused switches, and switchgear are essential components in the electrical management of any plant, commonly housed in Motor Control Centres (MCC). Their safety and reliability depend on proper selection, installation, operation, and maintenance.

This course focuses on equipping participants with the skills and knowledge required for the safe operation and maintenance of circuit breakers and switchgear. It emphasizes the importance of understanding local substation and system ratings and the operating mechanisms of various breakers to facilitate troubleshooting and repairs effectively.

Participants will gain practical insights into diagnosing faults, analyzing their root causes, and implementing strategies to prevent recurring failures. The course also covers essential guidelines for safe process operations, maintenance, and adherence to industry standards.

Targeted Groups

This training is designed for:

- Electricians
- Electrical supervisors
- Plant electricians
- Operations and maintenance engineers, supervisors, and technicians
- Maintenance technicians

Course Objectives

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

- Understand the operational dynamics of circuit breakers and switchgear.
- Apply advanced troubleshooting protocols for circuit breakers and switchgear.
- Utilize diagnostic test equipment proficiently.
- Analyze failure modes for air brake, vacuum, and SF6 devices and conduct accurate failure analyses.
- Address electrical safety concerns in substations and control centers.
- Calculate fault levels within substations for optimal system performance.

Targeted Competencies

Participants will develop competencies in:

- Identifying and understanding different types of switchgear and

disconnectors.
- Analyzing electrical systems with load and fault requirements.
- Understanding substation layouts and equipment (0.4 to 36kV).
- Maintaining, inspecting, testing, and certifying switching plants.
- Recognizing electrical hazards, ensuring safe earthing, and implementing lockout/tagout procedures.
- Identifying and mitigating hazardous situations.

Course Content

Unit 1: The Technology of Circuit Breakers and Switchgear

- Overview of substation arrangements and MCCs.
- Definitions and industry-specific terminology.
- Fault level calculations and their importance.
- Contributions of motors and generators to faults.
- Low, medium, and high-voltage equipment.
- Nameplate ratings interpretation.
- The role of CTs (Current Transformers) and VTs (Voltage Transformers).
- Case studies on protection requirements and practical applications.

Unit 2: Operation of Various Types of Interrupting Equipment

- Types of fuses and their applications (e.g., motor starting fuses).
- Operation of fused switches and molded case circuit breakers.
- Air break switches and vacuum contactors.
- Vacuum circuit breakers, SF6 puffer, and rotating arc devices.
- Insulation requirements for high voltage (up to 36kV).
- Challenges with solid and gaseous insulation systems.

Unit 3: Operation and Maintenance of Circuit Breakers and Switchgear

- Diagnostic tools: Digital Voltmeters (DVM), oscilloscopes, Meggers, and frequency meters.
- Temperature probes, IR pyrometers, ammeters, and power meters.
- Load bank testing and cable fault locators.
- Best practices in equipment maintenance and fault analysis.

Unit 4: Special Techniques

- NEC checklists for correct installation.
- Advanced troubleshooting and diagnostic methods.
- Techniques for addressing unique problems.
- Single-line drawing interpretation for troubleshooting and planning.

Unit 5: Interpretation and Use of Drawings

- Single-line electrical system overviews.
- Control schematics for maintenance and operations.
- Understanding generic wiring lists and nameplate data.
- Logic symbols and safety considerations, including step and touch

potentials.

Unit 6: Development of a Job Plan

- Step-by-step troubleshooting sequences.
- Documentation of operational best practices.
- Establishing safety-focused maintenance frameworks.
- Training and case study analyses for practical learning.

Unit 7: Identification and Repair of Problems/Failures

- Investigating and mitigating common-mode failures.
- Addressing phase imbalance and sequence issues.
- Analyzing contact pitting/arcing causes and solutions.
- Evaluating load and fault ratings.
- Diagnosing electronic component failures, ground faults, and busbar issues.
- Reviewing safety requirements and adhering to NEC electrical codes.

Conclusion

This training program ensures participants gain the technical knowledge and practical skills needed to safely and effectively operate and maintain circuit breakers and switchgear. By fostering proficiency in troubleshooting, diagnostics, and system analysis, attendees will be equipped to optimize electrical system reliability and safety in their respective workplaces.