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# SAFE OPERATION AND MAINTENANCE OF CIRCUIT BREAKERS AND SWITCHGEAR



## **WHAT YOU WILL LEARN:**

- Selection of appropriate type and rating of circuit breakers and switchgear
- Fundamentals of operating switchgear
- Switchgear components (CTs, VTs, relays and cable terminations)
- Safe operational policies including safety rules and safety documents
- Diagnostic tools and test equipment
- Safe maintenance policies including safe working in switch rooms, indoor and outdoor substations

## **WHO SHOULD ATTEND:**

- Managers, engineers and technicians who work with switchgear and circuit breakers and who need to update their skills and knowledge in this critical area of electrical power systems protection.

## The Workshop

Switchgear (and circuit breakers) are critical components in electrical distribution systems and their operation significantly affects the overall operation of the system. This two-day workshop will discuss application, installation, maintenance and testing issues relating to medium and high voltage switchgear and circuit breakers. Low voltage switchgear will be covered in detail. You will gain a solid understanding of the issues associated with the proper application, installation and maintenance of these critical items of equipment with an overriding emphasis on safety.

This comprehensive and practical two-day workshop emphasises medium voltage switchgear which represents most of the switchgear installed on electrical distribution systems. The focus is on air blast, oil, SF6 and vacuum circuit breakers. Case studies covering the main manufacturer's equipment will illustrate the important practical principles. Other power system protection components will be discussed as well to ensure that switchgear is understood in the correct context.

## The Program

### SWITCHGEAR- ORIGINS AND TYPES

- Single line diagrams
- Active and passive network components
- Circuit breaker utilisation
- Alternative forms of MV switchgear- ring main units and load breaking/fault making switches
- Fuse switches
- HV fuses in combination with, and as alternatives to circuit breakers
- Auto-reclosers and auto-reclose operations

### APPLICATION OF SWITCHGEAR

- Principles of current interruption
- Plain break circuit breakers
- Bulk and small oil volume circuit breakers
- Turbulator (explosion pot)
- Operating mechanisms
- Transfer earth circuit breakers
- Air break and air blast switchgear
- SF6 and vacuum
- Switchgear in association with disconnectors
- Fixed and withdraw-able designs
- Switchgear standards
- Factors affecting switchgear selection

### SPECIFICATION OF SWITCHGEAR

- Switchgear ratings- highest system and impulse withstand voltages, load and short circuit currents
- Simple and complex protection systems
- Switchgear ancillaries, measurement CTs, VTs and relays
- Cable terminations
- Indoor and outdoor operations
- Substation and switch room layouts and design

### SHORT CIRCUIT TESTING

- Symmetrical and asymmetrical breaking
- Make and break operations
- Understanding test oscillograms
- Case study- Specification for a 132 Kv Switchboard

### SAFETY POLICIES

- General safety precautions and the use of personal protective equipment
- Principles of safety rules
- Principles of personal authorisation
- Operative training for safe operation of switchgear
- Isolation in a circuit breaker context
- Safety documentation
- Operational and safety locking, caution and danger notices
- Work safety in a substation environment
- Safety interlocks
- Substation alarms
- Individual study tasks and presentation- safety policies in my company and how they might be improved

### OPERATION OF MODERN SWITCHGEAR

- Case studies
- Sprenger and Schuh
- Schneider
- ABB
- Siemens

### ASSETS MANAGEMENT IN A SWITCHGEAR CONTEXT

- Principles of time and condition based asset management
- Asset registers
- Asset management systems

### DIAGNOSTICS, TESTING AND MAINTENANCE

- Switchgear inspection methodologies
- Partial discharge measurement and survey
- Timing tests
- Thermovision
- Mechanisms of deterioration
- Principles of circuit breaker maintenance
- Maintaining oil circuit breakers
- Contact maintenance and contact wipe
- Oil testing
- Maintaining vacuum circuit breakers
- Maintaining SF6 circuit breakers
- SOPs and DINs
- Switchgear defects and defect control systems

### SUMMARY, OPEN FORUM AND CLOSING