

INSPECTION, TESTING AND COMMISSIONING OF ELECTRICAL SWITCHBOARDS, CIRCUIT BREAKERS, PROTECTIVE RELAYS, CABLES AND PLCs



WHAT YOU WILL LEARN:

- Nuts and bolts of electrical inspection, testing and commissioning
- Detailed principles and rules for inspection, testing and commissioning of switchboards, switchgear, cabling and protection relays
- Selection of appropriate type and rating of switchgear and circuit breakers
- The different standards and specifications used for switchgear and circuit breakers
- Asset management of switchgear and protective relays
- Safe maintenance policies including safe working in switch rooms, indoor and outdoor substations

WHO SHOULD ATTEND:

- Design engineers
- Electrical engineers and technicians
- Electrical maintenance engineers, technicians and supervisors
- Electricians
- Field and service technicians
- Instrumentation engineers and technicians
- Plant operators
- Project engineers

And... managers, engineers, technicians and electricians who work with switchgear, circuit breakers, switchboards and cabling who need to update their skills and knowledge in this critical area of inspection, testing and commissioning



The Workshop

Whether you are designing, specifying, installing, testing or commissioning electrical equipment from small to large commercial and industrial installations, you need to have a thorough understanding of switchboards, switchgear, circuit breakers and associated protective relays. The overall focus of this workshop is on electrical inspection, testing and commissioning and will commence with a detailed examination of switchgear (and circuit breakers). Circuit breakers are critical components in electrical distribution systems and their operation significantly affects the overall operation of the system. Protection relays are then discussed. These are used in power systems to maximise continuity of supply and are found in both small and large power systems from generation, through transmission, distribution and utilisation of power in plant, industrial and commercial equipment.

Day two will cover commissioning and periodic inspection of cables and their various failure modes and how to detect these faults. The often neglected topic of switchboards will be detailed next, followed by the interesting topic of interfacing to the control system (either PLCs or other control devices). The course will be concluded with a number of practical case studies which will pull together the materials examined over the past two days.

This workshop will cover the key elements in a practical and project focussed way. Many people assume (wrongly) that inspecting, testing and commissioning is a fairly straightforward process and is simply a rubber stamp confirmation of a so-called outstanding design. Our experience in the field demonstrates quite the opposite; where the litany of problems ranges from design and installation errors to equipment manufacturing defects. It is best that these problems are identified and corrected before the inevitable downtime comes in an operational installation where many thousands of dollars are lost in correcting the faults. The situation today is made more challenging by the heightened safety requirements and interfacing to low powered electronic control and monitoring devices (such as PLCs) using software that has to also be verified.

Practical Demonstrations, Videos and Exercises

We (and you) know that no matter how good the instructor is (and ours are very good!) no one learns from listening to a lecture. The best way of learning and gaining real skills is a high level of interaction with your peers and your instructor and also in undertaking hands-on exercises which relate to the real practical world. Hence we have a busy and enjoyable schedule of useful activities to help you really learn, including:

- 31 short, punchy videos on switchgear, circuit breakers, protective relays and cables
- 32 short, practical design exercises on each topic using simulation software and calculators
- 4 case studies on switchgear, circuit breakers, protective relays and cables where you will work in small groups to solve real electrical engineering problems

To gain full value from this workshop, please bring your calculator and laptop/notebook computer.

The Program

DAY ONE

FUNDAMENTALS OF SWITCHGEAR

- Single line diagrams
- Typical construction – LV/MV and HV
- Active and passive network components
- Circuit breaker utilisation
- Fuse switches
- HV fuses in combination with and as alternatives to circuit breakers
- Auto-reclosers and auto-reclose operations

Practical Session

SPECIFICATION OF SWITCHGEAR

- Switchgear ratings – highest system and impulse withstand voltages, load and short circuit currents
- Simple and complex protection schemes
- Switchgear ancillaries, measurement CTs, VTs and relays
- Cable terminations
- Indoor and outdoor operation

Practical Session

SHORT CIRCUIT TESTING

- Symmetrical and asymmetrical breaking
- Make and break operations
- Understanding test oscillograms
- Case study – specification for a 132kV switchboard

Practical Session

SWITCHGEAR DIAGNOSTICS, TESTING AND MAINTENANCE

- Asset records
- Condition Based Maintenance (CBM)
- Reliability Centred Maintenance (RBM)
- Switchgear inspection methodologies
- Insulation deterioration
- Diagnostic techniques:
 - Partial discharge measurement and survey
 - Partial discharge – transient earth voltage (TEV) monitoring
 - Partial discharge by acoustic methods
 - Timing tests
 - Thermovision
 - Tan delta testing
- Principles of circuit breaker maintenance
- Contact maintenance and contact wipe
- Oil testing
- Maintenance of vacuum circuit breakers and SF6
- Switchgear defects and defect control
- Switchgear installations

Practical Session

POWER SYSTEM PROTECTION PRINCIPLES AND RELAYS

- Principles of protection
- Types of faults
- Types of protection systems
- Types of protective relays
- Electromechanical and static relays
- Numerical relays

Practical Session

CONFIGURATION OF NUMERICAL RELAYS

- Setting approach in conventional relays
- Configuration of relays
- Troubleshooting typical problems

DAY TWO

CABLING COMMISSIONING AND PERIODIC TESTING

- Review of codes for testing
- Drum length checks
- Post installation checking
- Pre-commissioning and periodic tests
- Tests as tools for condition monitoring and early failure alarm
- HV tests using DC and very low frequency AC

- Partial discharge tests and mapping of results

- Dielectric dissipation factor measurements
- Micro destructive and non-destructive tests for life assessment
- Operation and maintenance of cables

Practical Session

CABLE FAILURE MODES AND FAULT DETECTION

- Types of failure
- Reasons for failure
- Fault location
- Electrical tests for detection of cable faults
- Safety issues in fault detection
- Analysis of failures

Practical Session

SWITCHBOARD INSTALLATION, INSPECTION AND COMMISSIONING

- Inspection
- Routine, type, acceptance and pre-commissioning tests
- High voltage equipment test techniques
- Commissioning procedures

Practical Session

INTERFACE TO CONTROL EQUIPMENT (PLCS)

- Overview of PLC
- PLC I/O modules
- Pre-commissioning tests
- Commissioning procedures
- Typical faults

Practical Session

CASE STUDIES OF TYPICAL PROBLEMS

- Improper circuit breaker trip unit and relay settings
- Motor overload protection
- Medium voltage distribution system installation problems
- Switchboard metering problems
- Emergency distribution problems
- Noisy transformers
- Incorrect earthing and neutrals
- And many others...

Practical Session

SUMMARY, OPEN FORUM AND CLOSING