T2.4 Switching

T2.4.1 Switchgear installation

Evidence shall show an understanding of the installation of switchgear and associated equipment to an extent indicated by the following aspects:

- Types and function of various switchgear

  Note: Examples include isolators, air-break switches, gas-filled switches, vacuum type, links, fuses, oil disconnectors, fuse switches, circuit breakers, operating characteristics, advantages and disadvantages of different types switchgear, installation procedures, earthing, requirements and techniques
- Types of equipment

  Note: Examples include transformers, reactors, regulators, capacitors, relays, surge arrestors, fault indicators and mobile generators
- Installation procedures for switchgear and equipment encompassing:

  Standards, codes, legislation, supply authority regulations and or enterprise requirements

  Assembly and erecting procedures

  Earthing requirements and techniques

  Pole mounted locations
- Maintenance procedures for switchgear and equipment encompassing:

  Diagnosing and rectifying faults according to electricity supply industry standards and procedures
- Testing and commissioning encompassing:

  Electricity supply industry standards and procedures

T2.4.2 Low voltage switching principles

Evidence shall show an understanding of low voltage switching principles to an extent indicated by the following aspects:

- Standards, codes, legislation, supply authority regulations and or enterprise requirements applicable to switching of low voltage to a given schedule
- Requirements for the use of manuals, system diagrams/plans and drawings encompassing:

  Types, characteristics and capabilities of electrical apparatus

  Use, characteristics and capabilities of specialised tools and testing equipment

  LV network interconnectors source of possible backfeed
- Low voltage switching techniques encompassing:

  Identifying hazards, assessing and controlling risks associated with LV switching operations

  Electrical access permit(s)

  Operational procedures

  Earthing procedures
- Personnel protective equipment (PPE) for LV switching

T2.4.3 High voltage switching principles

Evidence shall show an understanding of high voltage switching principles to an extent indicated by the following aspects:

- Standards, codes, legislation, supply authority regulations and or enterprise requirements applicable to switching of high voltage to a given schedule

- Requirements for the use of manuals, system diagrams/plans and drawings encompassing:
  Types, characteristics and capabilities of electrical apparatus
  Use, characteristics and capabilities of specialised tools and testing equipment
  Network interconnectors source of possible backfeed
- Role of the HV switching operator
- Operational forms, access authorities and permits associated with HV switching encompassing:
  Types of operational forms, access authorities and permits
  Purpose and procedure for operational forms, access authorities and permits
- Use and operation of equipment associated with HV overhead and substation equipment encompassing:
  Test instruments
  Sticks
  Interrupters
  Arc stranglers
- Types and categories of HV switchgear
- Application, function and operating capabilities of switchgear
- Restrictions pertaining to HV switching equipment
- Procedures for the isolation of HV transmission main and working earths
- Earthing HV electrical apparatus practices and procedures for access encompassing::
  - Purposes of "Operational" and additional work part "on-site" earths
  - Factors determining the location and effectiveness of "Operational" earthing
  - Acceptable industry procedures
  - Personal protective equipment
- High voltage switching techniques
- Operate switching apparatus encompassing:
  - Identifying hazards, assessing and controlling risks associated with HV switchgear operation
  - Systematic and defensive techniques
  - Mobile radio procedures
  - Double isolation procedures

T2.4.4 High voltage fault switching principles

Evidence shall show an understanding of high voltage fault switching principles to an extent indicated by the following aspects:

- Primary causes, effects and types of HV electrical faults
- HV protection devices encompassing::
  - Main components
  - Types
  - Categories
  - Applications
  - Functions
- Basic principle of operation of HV system protection devices
- Protection co-ordination and protection "zoning"
- HV feeder auto-reclosing suppression encompassing:
  - Function
  - Application
- Circuit condition requirements and switching considerations when paralleling and

separating HV feeders

T2.4.5 High voltage distribution transformer principles

Evidence shall show an understanding of high voltage distribution transformer principles to an extent indicated by the following aspects:

- Operation of HV distribution transformers encompassing::
  - Principle governing factors for transformer ratings
  - Protection and alarms
  - Operating limitations and the relationship between transformer and HV fuse rating
  - Purpose and principle operation of HV distribution transformer tap changers
  - HV distribution transformer and transformer — cable combination switching practices
  - Paralleling requirements
  - Isolation and earthing procedures for access
  - Common distribution transformer and associated electrical apparatus faults
- HV underground switching equipment

  Note: Examples include arc stranglers, switch operation, load break elbows, switching cubicles, canister fuses, bayonet fuses, F and G switching cubicles, voltage indicators and phasing testers

T2.4.6 High voltage SWER system

Evidence shall show an understanding of high voltage SWER system to an extent indicated by the following aspects:

- Application and function of SWER system components
- Circuit arrangement
- Principle of operation
- Hazards and procedures associated with faulty SWER earth systems
- Procedure to isolate, energise and commission SWER substations

T2.4.7 Feeder automation system

Evidence shall show an understanding of feeder automation system to an extent indicated by the following aspects:

- Function of feeder automation system and the main components
- Operation procedure for a remote field device from a local control station
- Functions of “System Control and Date Acquisition” (SCADA) (or any other relevant Data Acquisition and Control) systems and its main components
- SCADA system security interlocks and access restrictions
- SCADA system operation when switching apparatus or retrieving data via a remote access device such as; Remote Access Terminal (RAT), Dial Up Voice Annunciated System and Local Control Station
- Function of the main components of a local/remote control system
- Operation of a field devices using SCADA systems via a Remote Access Terminal (RAT), Dial Up Annunciated System and Local Control Station

T2.4.8 System switching operations and authorisation procedures — HV

Evidence shall show an understanding of HV system switching principles including

switching authorisation procedures to an extent indicated by the following aspects:

- Legislation, Standards, codes, legislation, supply authority regulations and or enterprise requirements applicable to system switching
- Requirements for the use of manuals, system diagrams/plans and drawings
- Types and characteristics of HV systems and equipment to be switched
- Procedures for obtaining correct HV switching authorisation encompassing:
  Identification of OHS hazards, assessing and controlling risks
  Safety procedures and precautions
  Safe approach distances
  Responsibilities and protocols
  Identifying switching resources
  Procedures for obtaining electrical access permits authorities
  Requirements for team switching
  Procedures for coordination of operations
- Techniques in HV system switching encompassing:
  Pre-switching checks
  Switching operational procedures
  Isolation procedures and proving dead de-energised
  Earthing procedures
  Pre-switching checks
  Switching operational procedures
  Emergency fault procedures
  Energisation procedures

T2.4.9 System switching operations and authorisation procedures — LV

Evidence shall show an understanding of LV system switching principles including switching authorisation procedures to an extent indicated by the following aspects:

- Legislation, Standards, codes, legislation, supply authority regulations and or enterprise requirements applicable to system switching
- Requirements for the use of manuals, system diagrams/plans and drawings
- Types and characteristics of LV systems and equipment to be switched
- Procedures for obtaining correct LV switching authorisation encompassing:
  Identification of OHS hazards, assessing and controlling risks
  Safety procedures and precautions
  Safe approach distances
  Responsibilities and protocols
  Identifying switching resources
  Procedures for obtaining electrical access permits authorities
  Requirements for team switching
  Procedures for coordination of operations
- Techniques in LV system switching encompassing:
  Isolation procedures and proving dead
  Earthing procedures (comment not aware of any electricity network that earths LV)
  Pre-switching checks
  Switching operational procedures
  Emergency fault procedures
  Energisation procedures

T2.4.10 Co-ordinating and directing switching instructions

Evidence shall show an understanding of coordinating and directing switching instructions to an extent indicated by the following aspects:

- Legislation, Standards, codes, legislation, supply authority regulations and or enterprise requirements applicable to switching sheet instructions
- Specific enterprise processes, policies and procedures to be followed
- Processes of consultation, negotiation and coordination encompassing:
  - Clear and concise instructions and information
  - Methods for the encouragement of feedback and contributions of information and ideas
  - Responsibilities of members of the team
- Techniques in analysing, planning, co-ordination and organising work for a safe outcome and according to statutory requirements and regulations
- Techniques in the effective utilisation of available resources
- Techniques in the co-ordination and directing of switching schedules instructions
- Relationship between the operating authorities and HV customers, operating agreements
- Techniques in co-ordinating and directing HV and LV switching of electrical networks
- Requirements for the use of manuals, system diagrams/plans and drawings encompassing:
  - Types, characteristics and capabilities of LV and HV electrical equipment to be switched
- Responsibilities of the switching operator
- Techniques in writing switching instructions encompassing:
  - Sequence of switching operations
  - Isolation procedures
  - Earthing procedures
  - Switching completion notification procedures
- Techniques in gathering, collating and confirming data on switching procedures

T2.4.11 High voltage overhead and substation switching principles

Evidence shall show an understanding of HV overhead and substation switching principles to an extent indicated by the following aspects:

- Legislation, Standards, codes, legislation, supply authority regulations and or enterprise requirements applicable to HV overhead and substation switching
- Requirements for the use of manuals, system diagrams/plans and drawings encompassing:
  - Types, characteristics and capabilities of HV electrical equipment to be switched
  - Use, characteristics and capabilities of specialised tools and testing equipment
- Role and responsibilities of the HV switching operator
- Operational forms, access authorities and permits hazard/risk assessments associated with HV switching encompassing:
  - Types of operational forms, access authorities and permits hazard/risk assessments
  - Purpose and procedure for operational forms, access authorities and hazard/risk assessments
- Use and operation of equipment associated with HV overhead and substation equipment encompassing:

Test instruments
Sticks
Interrupters
Arc stranglers

- HV switchgear encompassing:
  Types
  Categories
  Application
  Operating capabilities
- Operation of HV overhead switching or indicating devices

  Note: Examples include fuses; disconnect fuses; load switching; live line indicators; capacitors; reclosers; sectionalisers, underslung links, airbreaks; switches, disconnects; live line clamps; phasing sticks; phasing tester
- Operation of protection systems and substation equipment

  Note: Examples include fault levels and settings; types and applications; protection systems and substation equipment fault levels and settings; types and applications
- Restrictions pertaining to HV switching equipment
- Procedures for the isolation of HV mains and working earths encompassing:
  Earthing HV electrical apparatus practices and procedures for access authority issuing;
- HV switching techniques;
- Operate switching apparatus encompassing:
  Identifying hazards, assessing and controlling risks associated with HV switchgear operation
  Systematic and defensive techniques
  Mobile radio procedures
  Double isolation procedures

T2.4.12 Low voltage overhead and substation switching principles

Evidence shall show an understanding of low voltage overhead and substation switching principles to an extent indicated by the following aspects:

- Legislation, Standards, codes, legislation, supply authority regulations and or enterprise requirements applicable to low voltage overhead and substation switching
- Requirements for the use of manuals, system diagrams/plans and drawings encompassing:
  Types, characteristics and capabilities of LV electrical equipment to be switched
  Use, characteristics and capabilities of specialised tools and testing equipment
- Role and responsibilities of the LV switching operator
- Operational forms, access authorities and hazard/risk assessments associated with HV switching encompassing:
  Types of operational forms, access authorities and hazard/risk assessments
  Purpose and procedure for operational forms, access authorities and hazard/risk assessments
- Use and operation of equipment associated with LV overhead and substation equipment encompassing:
  Test instruments
  Sticks
  Interrupters
  Arc stranglers; (not a common term)
- LV switchgear encompassing:
  Types

Categories
Application
Operating capabilities

- Operation of LV overhead switching or indicating devices:
  Note: Examples include fuses; disconnect fuses; load switching; underslung links, air break switches; disconnects; live line clamps; phasing sticks; phasing tester
- Operation of protection systems and substation equipment
  Note: Examples include fault levels and settings; types and applications, protection systems and substation equipment fault levels and settings; types and applications
- Restrictions pertaining to LV switching equipment
- Procedures for the isolation of LV distributions main and working earths
- Earthing LV electrical apparatus practices and procedures for access authority issuing
- Low voltage switching techniques
- Operate switching apparatus encompassing:
  Identifying hazards, assessing and controlling risks associated with LV switchgear operation
  Systematic and defensive techniques
  Mobile radio procedures
  Double isolation procedures

T2.4.13 High voltage switching instruction preparation

Evidence shall show an understanding of the preparation of a HV switching instruction schedule to an extent indicated by the following aspects:

- Legislation, Standards, codes, legislation, supply authority regulations and or enterprise requirements applicable to switching instruction schedules
- Requirements for the use of manuals, system diagrams/plans and drawings encompassing:
  Types, characteristics and capabilities of HV electrical equipment to be switched
- Points of isolation and earthing locations (safety and working earths)
- Responsibilities of the switching operator
- Techniques in writing switching instructions encompassing:
  Sequence of switching operations
  Isolation procedures
  Earthing procedures
  Switching completion notification procedures

T2.4.14 Low voltage switching instruction preparation

Evidence shall show an understanding of the preparation of a LV switching instruction to an extent indicated by the following aspects:

- Legislation, Standards, codes, legislation, supply authority regulations and or enterprise requirements applicable to switching sheet schedules
- Requirements for the use of manuals, system diagrams/plans and drawings encompassing:
  Types, characteristics and capabilities of LV electrical equipment to be switched
  Isolation points and earthing (if considered necessary)
  Responsibilities of the switching operator
- Techniques in writing switching schedules encompassing:
  Sequence of switching operations

Isolation procedures
Earthing procedures — if necessary
Switching completion notification procedures