



Australian Government

UETTDRSO37 Develop high voltage distribution and sub-transmission switching programs

Release: 1

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Modification History

Release 1. This is the first release of this unit of competency in the UET Transmission, Distribution and Rail Sector Training Package.

Application

This unit covers the preparation and/or checking of activities required to place the high voltage (HV) distribution and sub-transmission network in a state in which work can safely be performed whilst minimising customer outages. The format is typically a written sequence of switching items in a pre-defined format.

It includes planning outages and taking into account loading of network components. It also includes planning the management of multiple outages on the HV distribution and sub-transmission network and the calculation of network loading conditions to ensure the network is operating within designed parameters.

The application of the skills and knowledge described in this unit may require a licence/registration to practice in the workplace subject to regulations for undertaking of electrical work.

Other conditions may apply under state and territory legislative and regulatory licencing requirements which must be confirmed prior to commencing this unit.

Pre-requisite Unit

Common Unit Group

UEENEE104A Use engineering applications software on personal computers

UEENEE101A Apply Occupational Health and Safety regulations, codes and practices in the workplace

UEENEE102A Fabricate, assemble and dismantle utilities industry components

UEENEE104A Solve problems in d.c. circuits

UEENEE107A Use drawings, diagrams, schedules, standards, codes and specifications

UEENEE124A Compile and produce an energy sector detailed report

UEENEE125A Provide engineering solutions for problems in complex multiple path circuits

UEENEE126A Provide solutions to basic engineering computational problems

UEENEE101A Solve problems in electromagnetic devices and related circuits

UEENEE102A Solve problems in low voltage a.c. circuits

UEENEEG149A Provide engineering solutions to problems in complex polyphase power circuits

UETTDREL11 Apply sustainable energy and environmental procedures

UETTDREL16 Working safely near live electrical apparatus

UETTDRI62 Implement and monitor the power system organisational WHS/OHS policies, procedures and programs

UETTDRI63 Implement & monitor power system environmental & sustainable energy management policies & procedures

Competency Field

System Operations

Unit Sector

Not applicable.

Elements and Performance Criteria

ELEMENTS

Elements describe the essential outcomes.

1 Plan for the preparation of HV distribution and sub-transmission switching programs

PERFORMANCE CRITERIA

Performance criteria describe the performance needed to demonstrate achievement of the element.

- 1.1** Work health and safety (WHS)/occupational health and safety (OHS) practices/procedures and environmental and sustainable energy procedures, which may influence the preparation of HV distribution and sub-transmission switching system programs, are reviewed and determined
- 1.2** Purpose for the preparation of HV distribution and sub-transmission switching programs is established after data is analysed and expected outcomes of the work are confirmed with appropriate personnel
- 1.3** Organisational established procedures on policies and specifications for the preparation of HV distribution and sub-transmission switching programs are obtained or established with appropriate personnel
- 1.4** Testing/switching procedures are discussed with/directed to the appropriate personnel in order to ascertain the project brief

- 1.5 Testing/switching parameters are established from organisational established procedures and policies and specifications
 - 1.6 Equipment/tools and personal protective equipment (PPE) are selected based on specified performance criteria and established procedures
 - 1.7 Work roles and tasks are allocated according to requirements and individual competencies
 - 1.8 Work is prioritised and sequenced for the most efficient/effective outcome, completed within an acceptable timeframe, to a quality standard and in accordance with established procedures
 - 1.9 Liaison and communication issues with others/authorised personnel, authorities, clients and land owners are resolved and activities coordinated to carry out work
 - 1.10 Risk control measures are identified, prioritised and evaluated against the work schedule
 - 1.11 Relevant work permits are secured to coordinate the performance of work according to requirements and/or established procedures
- 2 Carry out the preparation of HV distribution and sub-transmission switching programs**
- 2.1 Circuit/systems modelling is used to evaluate alternative proposals in accordance with established procedures
 - 2.2 WHS/OHS and sustainable energy principles, functionality and practices to reduce the incidents of accidents and minimise waste are incorporated into the project in accordance with requirements and/or established procedures
 - 2.3 Preparation of HV distribution and sub-transmission switching program decisions are made on the basis of safety and effective outcomes according to requirements and/or established procedures
 - 2.4 Mathematical and/or engineering models of the program is used to analyse the effectiveness of the finished project in accordance with requirements and established procedures

- 2.5 Technical advice is given regarding potential hazards, safety risks and control measures so that monitoring and preventative action can be undertaken and/or appropriate authorities consulted, where necessary, in accordance with requirements and established procedures
- 2.6 Essential knowledge and associated skills are applied to analyse specific data and compare it with compliance specifications to ensure completion of the project within an agreed timeframe according to requirements
- 2.7 Testing of the program is undertaken according to requirements and established procedures
- 2.8 Work teams/groups are arranged/coordinated/evaluated to ensure planned goals are met according to established procedures
- 2.9 Solutions to non-routine problems are identified and actioned using acquired essential knowledge and associated skills according to requirements
- 2.10 Quality of work is monitored against personal performance agreement and/or established organisational and professional standards
- 2.11 Strategic plans are developed incorporating organisation initiatives in accordance with established procedures
- 3 **Complete the preparation of HV distribution and sub-transmission switching programs**
 - 3.1 Final review of the switching program is undertaken to ensure it complies with all requirements and includes all specifications and documentations needed to complete the project
 - 3.2 Appropriate personnel are notified of completion and reports and/or completion documents are finalised/commissioned
 - 3.3 Reports and/or completion documents are submitted to relevant personnel/organisations for approval and, where applicable, statutory or regulatory approval
 - 3.4 Approved copies of prepared HV distribution and sub-transmission switching program documents are issued and records are updated in accordance with established procedures

Foundation Skills

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

Range is restricted to essential operating conditions and any other variables essential to the work environment.

Non-essential conditions may be found in the Companion Volume Implementation Guide.

Unit Mapping Information

This unit replaces and is equivalent to UETTDRSO37A Develop high voltage distribution and subtransmission switching programs.

Links

UET Training Package Companion Volume Implementation Guide is found in VETNet - <https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=229bace1-b7bc-4653-9300-dffb13ecfad7>

Assessment Requirements for UETTDRSO37 Develop high voltage distribution and sub-transmission switching programs

Modification History

Release 1. This is the first release of this unit of competency in the UET Transmission, Distribution and Rail Sector Training Package.

Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements and performance criteria on at least two separate occasions and include:

- applying relevant work health and safety (WHS)/occupational health and safety (OHS) requirements, including the use of risk control measures
- applying sustainable energy principles and practices
- demonstrating at least three (3) switching programs that between them encompass the following:
 - a transformer with a high voltage (HV) winding and fixed tap
 - a transformer with a HV winding and on-load tap changer (OLTC)
 - HV busbars
 - HV isolators
 - HV switchgear (applicable to enterprise equipment)
 - phasing and phase rotation
 - commissioning an item of HV plant
 - a planned interruption to a HV customer
 - installation of a mobile generators (if applicable to enterprise equipment)
 - placing distribution feeders in parallel where special considerations are required to cope with capacitors, phase shifts between different bulk supply systems, sensitive earth fault protection and single phase switching
- preparing switching instructions to isolate, test and earth all of the following:
 - all enterprise transformer types
 - all enterprise busbar types
 - all enterprise feeder types
 - all enterprise circuit breakers, isolators or switches
- preparing, writing and checking switching sheets to do all of the following:
 - manage load
 - manage voltage
 - minimise losses
 - maximise network reliability

- checking all above types of switching instructions
- coordinating all above types of switching instructions
- calculating plant loading
- dealing with unplanned events on at least one (1) occasion.

Knowledge Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements and performance criteria and include knowledge of:

- transmission, distribution and rail systems encompassing:
 - relationship between the transmission, distribution and rail/tram system within an overall power system - different organisations responsible for generation, transmission, distribution and rail/tram; and how they correlate and their functions
 - characteristics of a transmission, a distribution and a rail system - principal components; typical voltage levels and methods of transmission and distribution, including grid type transmission systems, radial, parallel and ring main feeders
 - relationship between an overhead and underground supply systems within an overall power system - advantages/disadvantages, applications and the basic steps for planning and installing an overhead and underground distribution system
 - single line drawings and layouts - drawings and layouts of transmission and distribution systems, including radial, parallel and ring main feeders; and the HV equipment associated with substations
- different types and function of distribution components encompassing:
 - Commonwealth/state/territory and local government legislation, standards, codes, supply authority regulations and/or enterprise requirements applicable to the use and application of distribution components
 - requirements for the use of overhead line construction manuals, system diagrams/plans and drawings
 - types, function and characteristics of distribution components
 - safety policies and procedures precautions related to the handling and installing distribution components
- coordinating access authority procedures encompassing:
 - specific enterprise processes, policies and procedures to be followed
 - processes of consultation, negotiation and coordination - clear and concise instructions and information, methods for the encouragement of feedback and contributions of information and ideas, and responsibilities of members of the team
 - techniques in analysing, planning, coordination and organising work for a safe outcome according to statutory requirements and regulations
 - techniques in the effective utilisation of available resources
 - techniques in the development of an access authority/permit and/or access authority/permit issuing procedures
 - techniques in facilitating and coordinating the delivery and issuing of access authorities
 - techniques in gathering, collating and confirming data on different worksites - electrical

network diagrams for the specific worksite; earth access authorities; safe working area; work to be carried out in confined space or in hazardous environment; specific outsourcing procedures; specific hazard identification, risk classification and management procedures; regulatory requirements, such as WHS/OHS and electrical safety

- techniques in the receiving and coordinating the cancellation of access authorities in readiness for restoration
- methods of conducting audits on correct access authority procedures
- process of issuing of other access authorities for work permits - working in confined space, if required, coordination of access authorities, and engaging and briefing contractors on electrical and other work
- issuing and receipt of operating agreements
- principles of Statutory and safety considerations encompassing:
 - Commonwealth/state/territory legislation, standards, codes, supply authority regulations and/or enterprise requirements associated with working on High Voltage
 - particular reference to state and territory regulations regarding working near energised conductors, electrical access, heights, confined space, testing procedures and licensing rules
- HV switching principles encompassing:
 - standards, codes, legislation, supply authority regulations and/or enterprise requirements applicable to switching of HV to a given schedule
 - requirements for the use of manuals, system diagrams/plans and drawings - types, characteristics and capabilities of electrical apparatus; use, characteristics and capabilities of specialised tools and testing equipment; and network interconnectors source of possible back-feed
 - role of the HV switching operator
 - operational forms, access authorities and permits associated with HV switching - types of operational forms, access authorities and permits; purpose and procedures for operational forms, access authorities and permits
 - use and operation of equipment associated with HV overhead and substation equipment - test instruments, sticks, interrupters and arc strangles
 - 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 - 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 (PPE) and HV switching techniques
 - operating switching apparatus - identifying hazards, assessing and controlling risks associated with HV switchgear operation, systematic and defensive techniques, mobile radio procedures and double isolation procedures
- HV fault switching principles encompassing:
 - primary causes, effects and types of HV electrical faults

- HV protection devices - main components, types, categories, applications and functions
- basic principle of operation of HV system protection devices
- protection, coordination and protection zoning
- HV feeder auto-reclosing suppression encompassing – function and application
- circuit condition requirements and switching considerations when paralleling and separating HV feeders
- HV single wire earth return (SWER) system encompassing:
 - 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
- HV system switching principles, including switching authorisation procedures, encompassing:
 - legislation, standards, codes, 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 - identification of WHS/OHS hazards, assessing and controlling risks, safety procedures and precautions, and safe approach distances
 - responsibilities and protocols, identifying switching resources, procedures for obtaining electrical access permits authorities, requirements for team switching and procedures for coordination of operations
 - techniques in HV system switching - pre-switching checks, switching operational procedures, isolation procedures and proving dead de-energised, earthing procedures, switching operational procedures, emergency fault procedures and energisation procedures
- HV overhead and substation switching principles encompassing:
 - legislation, standards, codes, 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 - 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, and hazard/risk assessments associated with HV switching - types of operational forms, access authorities and permits hazard/risk assessments; purpose and procedures for operational forms, access authorities and hazard/risk assessments
 - use and operation of equipment associated with HV overhead and substation equipment - test instruments, sticks, interrupters and arc strangles
 - HV switchgear – types, categories, application and operating capabilities
 - operation of HV overhead switching or indicating devices - fuses, disconnect fuses, load

- switching, live line indicators, capacitors, reclosers, sectionalisers, underslung links, air-breaks, switches, disconnects, live line clamps, phasing sticks and phasing tester
- operation of protection systems and substation equipment - 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 - earthing HV electrical apparatus practices and procedures for access authority issuing, and HV switching techniques
- operating switching apparatus - identifying hazards, assessing and controlling risks associated with HV switchgear operation, systematic and defensive techniques, mobile radio procedures and double isolation procedures
- preparation of a HV switching instruction schedule encompassing:
 - legislation, standards, codes, supply authority regulations and/or enterprise requirements applicable to switching instruction schedules
 - requirements for the use of manuals, system diagrams/plans and drawings - types, characteristics and capabilities of HV electrical equipment to be switched; points of isolation and earthing locations (safety and working earths); and responsibilities of the switching operator
 - techniques in writing switching instructions - sequence of switching operations, isolation procedures, earthing procedures, and switching completion notification procedures
- enterprise-specific policies and procedure instructions encompassing:
 - responsibilities and duty of care of employer and employee relationship
 - methods of obtaining the up-to-date information on enterprise policies and procedures
 - rules and regulations
 - induction into workplace - location of work area and storage area, timetable, uniform, personal wellbeing, housekeeping rules, emergency procedures and evacuation procedures
 - techniques when dealing with others - working in teams, customer relation, and complaint and issues procedures
 - overview of enterprise professional development - fire-fighting procedures, fatigue management, and training and competency development - understanding and promotion
- enterprises-specific WHS/OHS instructions encompassing:
 - standards, codes, legislation, supply authority regulations and specific enterprise regulations pertaining to the WHS/OHS policies and procedures
 - methods of obtaining the up-to-date information on enterprise WHS/OHS policies and procedures
 - specific enterprise personal protection equipment (PPE) - type and application; where and when to be used; method of replacement; responsibility of maintenance, including cleaning inspection and testing; emergency response, rescue, evacuation and first aid procedures
 - personal wellbeing – hygiene, fatigue/stress management and drugs/alcohol
 - WHS/OHS training - induction training, specific hazard training, specific task or equipment training, emergency and evacuation training, and training as part of broader

- programs, such as equipment operation
- WHS/OHS records - audits; inspection reports; workplace health and environmental monitoring records; training and instruction records; manufacturer and supplier information, such as material safety data sheets (MSDS); registers, maintenance reports; workers compensation and rehabilitation records; and first aid/medical records
- substation switching practices encompassing:
 - standards, codes, legislation, supply authority regulations and/or enterprise requirements applicable to substation switching
 - requirements for the use of manuals, substation diagrams/plans and drawings
 - types, characteristics and capabilities of HV substation equipment to be switched
 - procedures for obtaining correct HV switching authorisation - identification of hazards and controlling risks, safety procedures and precautions, responsibilities and protocols, and identifying switching resources
 - techniques in HV substation switching - isolation procedures and proving dead, earthing procedures, pre-switching checks, switching operational procedures, emergency fault procedures and commissioning procedures
 - use, care and operation of equipment associated with HV substation equipment - test instruments and sticks
 - HV switchgear – types, categories, application and operating capabilities
 - basic operation of protection systems
 - restrictions pertaining to HV substation switching equipment
 - restrictions pertaining to enterprise-specific procedures
- transient overvoltage encompassing:
 - causes and effects of transient overvoltage - switching transients and lightning transients, and effects on plant items
 - control techniques and systems - diverters, shield wires and CB arc control
 - insulation systems - insulation coordination and insulation grading
- procedures to undertake a visual inspection of a scheme encompassing:
 - Commonwealth/state/territory legislation standards, codes, , supply authority regulations and/or enterprise requirements associated with visual inspection procedures of a scheme
 - requirements for the use of manuals, system diagrams/plans and drawings
 - identify obvious deficiencies in operating to the standard functionality
 - techniques in determining device malfunction
 - techniques in determining wiring defects
- commissioning procedures associated with relevant equipment encompassing:
 - Commonwealth/state/territory legislation standards, codes, , supply authority regulations and/or enterprise requirements associated with the commissioning procedures
 - requirements for the use of commissioning manuals, system diagrams/plans and drawings
 - techniques in commissioning procedures – planning, policy, testing techniques and close out requirements
- effects of harmonics encompassing:
 - characteristics and effects of harmonics on protection device functions/malfunction

- effects of harmonics on transformers, generators, motors and quality of supply
- different types and function of distribution underground components encompassing:
 - Commonwealth/state/territory and local government legislation, supply authority regulations, standards, codes and/or enterprise requirements applicable to the use and application of distribution underground components
 - requirements for the use of underground line construction manuals, system diagrams/plans and drawings
 - types, function and characteristics of distribution underground components
 - safety policies, procedures and precautions related to handling and installing distribution underground components
- HV system load calculation principles encompassing:
 - structure of HV systems
 - ratings of HV system components
 - relationship to HV customers
 - methods of determining load on HV systems
 - records of load on HV systems
 - effect of added load on HV feeders - variation of current, voltage, power, reactive power and power factor
 - load flows in parallel or loop operation
 - enterprise-specific network coordination tools.

Assessment Conditions

Assessors must hold credentials specified within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must satisfy the Principles of Assessment and Rules of Evidence and all regulatory requirements included within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must occur in workplace operational situations where it is appropriate to do so; where this is not appropriate, assessment must occur in simulated conditions involving realistic and authentic activities that replicate operational workplace conditions.

Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.

Resources for assessment must include access to:

- a range of relevant exercises, case studies and/or other simulations
- relevant and appropriate materials, tools, facilities, equipment, protection, control, metering and alarm equipment, computerised electrical plant control and monitoring facilities, and PPE currently used in industry
- applicable documentation, including workplace procedures, relevant industry standards, equipment specifications, regulations, codes of practice, operational event data, network drawings, crisis management procedures and operation manuals

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