



Australian Government

UETDRSO004 Develop and evaluate power systems transmission switching programs

Release: 1

UETDRSO004 Develop and evaluate power systems 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 Release 2.0.

Application

This unit covers the development and evaluation of activities required to place the 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 for the management of the network and multiple outages. It encompasses the calculation of network loading conditions to ensure the network will operate within design parameters and in compliance with national electricity code.

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 licensing requirements which must be confirmed prior to commencing this unit.

Pre-requisite Unit

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

UEENEE149A Provide engineering solutions to problems in complex polyphase power circuits

UETDREL001 Apply environmental requirements

UETDREL005 Work safely in the vicinity of live electrical apparatus

UETDRIS005 Implement & monitor power system environmental & sustainable energy management policies & procedures

UETDRIS006 Implement and monitor the power system organisational WHS/OHS policies, procedures and programs

Competency Field

System Operations

Unit Sector

Not applicable.

Elements and Performance Criteria

ELEMENTS

Elements describe the essential outcomes.

1 Plan and coordinate for the preparation of high voltage (HV) 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 the switching program, are reviewed and determined
- 1.2** Purpose of the switching program is established after data is analysed and expected outcomes of the work are confirmed with appropriate personnel
- 1.3** Established policies, procedures and specifications for the switching program are obtained or established with appropriate personnel
- 1.4** Switching procedures are discussed with and/or directed to appropriate personnel in order to ascertain the project brief
- 1.5** Switching parameters are ascertained from established policies, procedures 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 other/authorised personnel, authorities and clients 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 and coordinate the preparation of HV 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** Decisions concerning the preparation of the HV transmission switching program are made on the basis of safety and effective outcomes according to requirements and/or established procedures
 - 2.4** The effectiveness of the finished project is analysed 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

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| | 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 |
| 3 Complete and coordinate the preparation of HV 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 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 UET Transmission, Distribution and Rail Sector Training Package Companion Volume Implementation Guide.

Unit Mapping Information

This unit replaces and is equivalent to UETTDRSO38 Develop and evaluate power systems transmission switching programs.

Links

Companion Volume Implementation Guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=229bace1-b7bc-4653-9300-dffb13ecfad7>

Assessment Requirements for UETDRSO004 Develop and evaluate power systems 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 Release 2.0.

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
- developing and evaluating at least four (4) switching programs that between them integrates all of the following:
 - a transformer with an extra-high voltage (EHV) winding
 - EHV busbars
 - EHV isolators
 - EHV switchgear (applicable to enterprise equipment)
 - phasing and phase rotation
- commissioning a project that includes more than one (1) item of EHV plant that includes a transformer:
 - a planned liaison with a high voltage (HV) customer
 - activities that address the correction of errors in the process
- preparing switching instructions, testing and earthing all of the following:
 - transformer types
 - busbar types
 - transmission line types
 - circuit breakers, isolators or switches
- conducting all of the following:
 - checking switching instructions
 - calculating plant loading
 - managing the development of multiple switching programs
- 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, distribution and 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 system 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
- substations and power transformers encompassing:
 - relationship between the substations within an overall power system - purpose and location in relation to load centres, layout of HV equipment within the substation and auxiliary equipment
 - characteristics of a power transformer - basic construction of distribution transformers, operation under load/no-load conditions, types and basic operation of tap changing switches, including solid state types, efficiency and cooling
 - auxiliary equipment used on transformers - function and basic operation
 - maintenance of a power transformer - basic connections, restrictions to parallel operation, problems and remedies associated with harmonics, and testing and fault-finding procedures
 - characteristics of a reactors - description and purpose
- 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 and 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, and 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
 - issue 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 HV
 - 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 procedure for operational forms, and 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
 - operate 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 system switching principles, including switching authorisation procedures to an extent indicated by the following aspects:
 - 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 hazard/risk assessments associated with HV switching - 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 - 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 and 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
 - operate 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 - firefighting procedures, fatigue management, and training and competency development - understanding and promotion
- enterprise-specific OHS instructions encompassing:
 - standards, codes, legislation, supply authority regulations and specific enterprise regulations pertaining to WHS/OHS policies and procedures
 - methods of obtaining the up-to-date information on enterprise OHS policies and procedures
 - specific enterprise PPE - type and application; where and when to be used; method of replacement; responsibility of maintenance, including cleaning, inspection and testing; and 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 over voltages encompassing:
 - causes and effects of transient over voltages - switching transients and lightning transients, and effects on plant items
 - control techniques and systems - diverters, shield wires and circuit breaker arc control
 - insulation systems - insulation coordination and insulation grading
- commissioning procedures associated with relevant equipment encompassing:
 - standards, codes, Commonwealth/state/territory legislation, 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
- EHV generator control systems encompassing:
 - legislation, standards, codes, supply authority regulations and/or enterprise requirements pertaining to the operation of a portable generator
 - safety precautions specific to the synchronisation of generator sets - safe working policies, practices and procedures, and synchronising procedures
 - techniques in the installation of generator sets control systems - the synchronising of generator control systems onto and off the network without interruption to supply, estimation of EHV load and assessing the appropriateness of the generator
 - operating a generator in parallel to a single EHV job - overhead systems, indoor systems, customer installations and kiosk substations
 - EHV generator set and control system to EHV distribution assets
- different types and function of transmission 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 transmission components
 - requirements for the use of transmission line construction manuals, system diagrams/plans and drawings
 - types, function and characteristics of transmission components
 - safety policies and procedures precautions related to the handling and installing transmission components
- EHV system load calculation principles encompassing:
 - structure of EHV transmission systems
 - ratings of EHV system components
 - relationship to EHV customers
 - relationship to generation sources
 - methods of determining load on EHV systems
 - records of load on EHV systems

- effect of added load on EHV transmission systems - 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, 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, modelling tools, drawings and operation manuals.

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