



Australian Government

UETTDRDS57 Design power system overhead transmission systems

Release: 1

UETTD RDS57 Design power system overhead transmission systems

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 technical design of overhead transmission networks to relevant standards, including electrical clearances; electrical and mechanical loadings; earthing; environmental considerations; minor civil aspects; and the handling of waterway, railway and other crossings. It also includes the necessary established procedures to ensure the line design conforms to specific organisational technical standards, operational and system planning requirements, and incorporates the principles of safe design.

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

UEENEEE101A Apply Occupational Health and Safety regulations, codes and practices in the workplace

UEENEEE104A Solve problems in d.c. circuits

UEENEEE107A Use drawings, diagrams, schedules, standards, codes and specifications

UEENEEG101A Solve problems in electromagnetic devices and related circuits

UEENEEG102A Solve problems in low voltage a.c. circuits

UETTD RDS39 Prepare and manage detailed construction plans for electrical power system infrastructure

UETTD RDS45 Organise and implement ESI line and easement surveys

UETTDREL11 Apply sustainable energy and environmental procedures

UETTDREL16 Working safely near live electrical apparatus

UETTD RDS62 Implement and monitor the power system organisational WHS/OHS policies, procedures and programs

UETTD RDS63 Implement & monitor power system environmental & sustainable energy

management policies & procedures

Competency Field

Design

Unit Sector

Not applicable.

Elements and Performance Criteria

ELEMENTS

Elements describe the essential outcomes.

1 Plan for and coordinate the design of overhead transmission systems

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 design of overhead transmission systems, are reviewed and determined
- 1.2** Purpose of the design is established and expected outcomes of the work are confirmed with appropriate personnel
- 1.3** Established policies, procedures and specifications for the design are obtained or established with appropriate personnel
- 1.4** Equipment/tools and personal protective equipment (PPE) are selected and coordinated based on specified requirements and established procedures
- 1.5** Work is prioritised and sequenced for the most efficient and effective outcome following consultation with others for completion within acceptable timeframes, to a quality standard and in accordance with established procedures
- 1.6** Risk control measures are identified, prioritised and evaluated against the work schedule
- 1.7** Relevant work permits are secured to coordinate the performance of work according to requirements and/or

established procedures

- 1.8** Resources, including personnel, equipment, tools and PPE, required for the job are identified, scheduled and coordinated and confirmed safe and in technical working order
 - 1.9** Liaison and communication issues with other/authorised personnel, authorities, clients and land owners are resolved and activities coordinated to carry out work
 - 1.10** Site is prepared according to the work schedule and to minimise risk and damage to property, commerce and individuals in accordance with established procedures
 - 1.11** Personnel participating in the work, including plant operators and contractors, are fully briefed and respective responsibilities coordinated and authorised, where applicable, in accordance with established procedures
- 2 Carry out and coordinate the design of overhead transmission systems**
- 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 avoid incidents and accidents and minimise waste are incorporated into the project in accordance with requirements and/or established procedures
 - 2.3** System design decisions are made on the basis of safety and effective outcomes according to requirements and/or established procedures
 - 2.4** Mathematical models of the design are 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 | Solutions to non-routine problems are identified and actioned using acquired essential knowledge and associated skills according to requirements |
| | 2.8 | Quality of work is monitored against personal performance agreement and/or established organisational and professional standards |
| 3 Complete and coordinate the design of overhead transmission systems | 3.1 | Final inspections of the design are undertaken to ensure it complies with all requirements and includes all specifications and documentations needed to complete the design brief |
| | 3.2 | Appropriate personnel are notified of completion and reports and/or completion documents are finalised |
| | 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 design 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 UETTD RDS57A Design power system overhead transmission systems.

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 UETTDRDS57 Design power system overhead transmission systems

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
- completing six (6) compliant technical designs of an overhead transmission system with at least one (1) relating to each of the following project types:
 - multi-tower extensions
 - new installations
 - multi-circuit overhead lines
- completing designs, including all the following:
 - activities that address the correction of errors in the process
 - application of a design control checklist which lists all of the required design activities to be carried out in this process
- 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:

- generation systems encompassing:
 - methods of generating electricity - types of power stations and reasons for their location, and layout of thermal and hydroelectric power stations
 - relationship between power control and load requirements - operating speeds for thermal and hydroelectric generating sets, typical generator voltage levels and output ratings
 - the purpose and features of typical types of co-generation systems
- transmission structures and hardware encompassing:
 - requirements for the use of enterprise construction manuals, system diagrams/plans and drawings
 - types of structures

- types and function of associated hardware/equipment and insulators
- types of conductors
- location of transmission structures
- other equipment used on transmission structures, e.g. aircraft warning devices
- voltages on transmission structures
- procedures for routine maintenance on transmission structures and hardware encompassing:
 - procedures for gaining access permits
 - reasons for gaining access
 - types of maintenance procedures on transmission structures - procedure to follow for inspection/patrols according to the Transmission Supply Authority (TAS)
 - erecting and removing transmission equipment and hardware from a tower - climbing procedures, square rigging principles, calculation of forces at work within a given square rigging system and construction of a square rigging system
 - procedures for changing insulators - vertical angle suspension, strain insulator, post insulator (horizontal or vertical) and bridge insulator, and calculation of conductor forces
 - installation of temporary work platforms - types and function of installation tools and equipment, precautions and work methods to follow, and procedures for installations of temporary work platforms
 - installation of conductor protective hardware - types and selection of common dampers, tools and equipment, control of Aeolian vibration, and procedures for the installation of dampers onto conductors
 - dead line insulator washing - supply authority regulations and procedures for washing de-energised transmission lines
- procedures for installation and maintenance on transmission lines, structures and hardware encompassing:
 - standards, codes, legislation, supply authority regulations and/or enterprise requirements pertaining to the installation and maintenance of transmission lines and associated equipment
 - requirements for the use of enterprise construction manuals, system diagrams/plans and drawings - minimum construction clearances for transmission lines and sag/tension requirements
 - construction types and structures used in transmission lines
 - types, sizes and characteristics of transmission conductors - aluminium conductors, steel reinforced and earthing conductors
 - types of electrical connections used to connect transmission conductors - compression termination and bolted termination
 - causes and effects of poor electrical connections
 - types and application of specialised tools, equipment and hardware for the stringing of transmission conductors
 - techniques for stringing, tensioning and terminating transmission conductors
 - techniques for installation of associated hardware used on transmission towers
 - techniques for maintenance of damaged transmission conductors - repair and replacement
- inspection of towers and structures used for transmission lines encompassing:

- standards, codes, legislation, supply authority regulations and/or enterprise requirements
- characteristics of materials used for towers structures within the electrical transmission system - faults that occur that influence the integrity of the structure
- deterioration prevention techniques - relationship between steel and other materials, inspection procedures for deterioration, deterioration prevention procedures in steel and procedures for the repair of deterioration in steel
- inspection of transmission lines encompassing:
 - standards, codes, legislation, supply authority regulations and/or enterprise requirements
 - clearances and safety procedures
 - ground line inspection procedures of electrical transmission lines - requirements for inspection of transmission lines and insulators, use of specific equipment and testing devices during testing/inspection, techniques in transmission line inspection and methods of recording data
 - overhead line inspection procedures of electrical transmission lines - methods and requirements for overhead line inspection on electrical structures, clearances for overhead conductors, cables and structures, techniques used to obtain close inspection of transmission lines, use of specific equipment and testing devices during testing/inspection and methods of recording data
- plant, equipment and tools used for high voltage (HV) live line work encompassing:
 - Commonwealth/state/territory legislation, standards, codes, supply authority regulations and/or enterprise requirements associated with plant, equipment and tools used for HV live line work
 - safety precautions when working on plant, equipment and tools using hotstick combined - safe working clearances; WHS/OHS hazards and precautions; identification of WHS/OHS hazards; assessing and controlling risks, types; selection, maintenance, storage and uses of personnel protective equipment (PPE); and authorisation to work systems
 - identification of plant, equipment and tools used for HV live line work - types, applications, construction, characteristics, limitations and safe working load
 - serviceability of plant, equipment and tools used for HV live line work - inspection procedures, testing procedures, maintenance procedures and storage procedures
 - relationship of live line work access authority/permit, disabling auto-reclose function and ensuring correct functioning of fault current protective devices prior to live line work
 - live line access authorities, disabling auto-reclose function and ensuring fault current protective devices prior to live line work
 - conductor supports encompassing: methods, types of equipment, construction, characteristics and limitations
 - techniques in selecting appropriate conductor support method in accordance with requirements
 - calculation of loads and wind loading on conductors
 - effects of resultant forces when transferring conductor loads
 - rigging procedures for conductor support equipment
- 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; and the purpose and procedure 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 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 - purposes of operational and additional work part on-site earths, factors determining the location and effectiveness of operational earthing, acceptable industry procedures and PPE
 - 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
 - feeder automation system encompassing:
 - function of feeder automation system and the main components
 - operation procedure for a remote field device from a local control station
 - functions of supervisory control and data 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 RAT, dial up annunciated system and local control station
 - HV overhead and substation switching principles encompassing:
 - 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 - 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, and the 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 and airbreaks; switches and 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
 - 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
 - alternating current (a.c.) transmission system components encompassing:
 - support structures and reasons for selection
 - insulators and reasons for selection
 - conductors and reasons for selection
 - vibration management systems and principles
 - line ratings based on voltage, span, tension and temperature
 - a.c. transmission line electrical parameters encompassing:
 - typical arrangements
 - parameters of significance
 - calculation of line parameters - calculation of resistive, inductive and capacitive values assuming regular transposition and solid conductors
 - comparison with actual values
 - typical parameter values and ratios for different voltage level lines
 - a.c. transmission line models encompassing:
 - types of transmission line models based on line length
 - calculation of voltage drop, line regulation and transmission efficiency
 - load sharing between lines
 - basic design features and characteristics of transmission structures and associated equipment and/or components encompassing:
 - standards, codes, legislation, supply authority regulations and/or enterprise requirements applicable to installing of poles/structures and associated equipment and/or components
 - transmission systems principles - terminologies, primary and secondary, voltage levels and types of lines
 - characteristics of structure - types of structure (towers and poles, concrete and steel),

- characteristics of types of structures, installation methods and maintenance techniques
- characteristics of associated equipment used on structures - insulators and earthing, including overhead earth and communication lines
- voltage control techniques encompassing:
 - conditions leading to voltage collapse
 - effects on system of HV and low voltage (LV)
 - voltage control devices - voltage regulators applied to generators and synchronous phase modifiers; electromagnetic voltage regulators; series and parallel capacitors; on-load tap changer (OLTC) transformers; and static VAR compensators (SVCs), including saturated reactor compensators; thyristor controlled reactor compensators and combined systems
 - production of harmonics and methods of harmonic control
 - location of voltage control devices within the system
- corona encompassing:
 - factors leading to the generation of corona - voltage levels, conductor spacings, conductor sizes and shaping, and atmospheric conditions
 - consequences of corona
 - corona reduction - conductor selection, conductor bundling, conductor surface treatment and grading rings
 - internal discharge - causes of internal discharge, effects of internal discharge and testing techniques
- 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
- 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, such as:
 - variation of current, voltage, power, reactive power and power factor
 - load flows in parallel or loop operation
 - enterprise-specific network coordination tools
- 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 and PPE currently used in industry to undertake design of overhead transmission systems
- applicable documentation, including workplace procedures, relevant industry standards, equipment specifications, regulations, codes of practice and operation manuals.

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>