



Australian Government

UETTDRDS35 Design overhead distribution power systems

Release: 1

UETTD RDS35 Design overhead distribution power 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 distribution and sub-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

All competencies in the Common Unit Group must have been completed, plus all competencies in one (1) of the identified Pathway Unit Group(s).

Common Unit Group

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

UEENEEE102A Fabricate, assemble and dismantle utilities industry components

UEENEEE104A Solve problems in d.c. circuits

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

UEENEEE125A Provide engineering solutions for problems in complex multiple path circuits

UEENEEE126A Provide solutions to basic engineering computational problems

UEENEEG101A Solve problems in electromagnetic devices and related circuits

UEENEEG102A 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

UETTD R IS62 Implement and monitor the power system organisational WHS/OHS policies, procedures and programs

UETTD R IS63 Implement & monitor power system environmental & sustainable energy management policies & procedures

Pathway Unit Group 1

UETTD R DS39 Prepare and manage detailed construction plans for electrical power system infrastructure

UETTD R DS45 Organise and implement ESI line and easement surveys

Pathway Unit Group 2

UETTD R DS43 Develop high voltage and low voltage distribution protection systems

Competency Field

Design

Unit Sector

Not applicable.

Elements and Performance Criteria

ELEMENTS

Elements describe the essential outcomes.

1 Plan for and coordinate the safe design of overhead distribution 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 distribution 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** Organisational established procedures, policies 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 others/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
- 2 **Carry out and coordinate the safe design of overhead distribution systems**
 - 2.1 Circuit/systems modelling is used to evaluate alternative proposals as per established procedures
 - 2.2 WHS/OHS and sustainable energy principles, functionality and practices to reduce the incidence of 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 distribution system 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 safe design of overhead distribution systems**
- 3.1** Final inspections of the design are undertaken to ensure they comply with all requirements and include all specifications and documentation 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 UETTDRDS35A Design overhead distribution power 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 UETTDRDS35 Design overhead distribution power systems

Modification History

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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 distribution or sub-transmission system with at least one relating to each of the following project types:
 - multi-pole extensions
 - in-line pole relocations
 - multi-circuit overhead lines
- completing designs, including:
 - 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:

- mathematical techniques encompassing:
 - calculations involving fractions, decimals, ratios and proportions
 - calculations involving area, volume, mass and density
 - calculations involving transposition and substitution of formulae
 - calculations involving simple trigonometric problems
- engineering mechanics encompassing:
 - identification of basic concepts, principles and applications:
 - application of velocity, acceleration, force, density, torque and pressure
 - application of the International System of Units (SI) units

- the relationship between work, power and energy
- behaviour of object under force:
 - using a block and tackle under load
 - concept of mechanical advantage
 - determination of resultant forces and determining the sag in a catenary conductor and the force applied at each end
- fundamentals of the basic laws of fluid mechanics
- materials properties encompassing:
 - identification and classification of engineering materials material properties
 - types and applications:
 - properties of tensile strength
 - effects of temperature on the expansion of metals
 - ductibility, malleability, work hardening and annealing and the conditions that lead to corrosion and the properties of timbers
- installation of overhead distribution conductors encompassing:
 - standards, codes, legislation, supply authority regulations and/or enterprise requirements applicable to installing conductors and associated equipment
 - requirements for the use of overhead line construction manuals, system diagrams/plans and drawings:
 - material lists, conductor size, type and route length
 - constructions types and structures for distribution and sub-transmission lines
 - types, sizes and characterises of overhead conductors
 - resources for the stringing and maintenance of conductors:
 - types of low voltage (LV) and high voltage (HV) overhead electrical conductor connections
 - causes and effects of poor electrical connections
 - reasons for and methods used to maintain standard phase sequencing
 - removing, repairing and replacing of damage conductors
 - minimum clearances between overhead conductors and LV and HV structures
 - techniques for conductor installation:
 - types and application of tools, equipment and hardware
 - methods of stringing, tensioning and termination of LV and HV conductors
- installation of poles and/or structures and hardware encompassing:
 - standards, codes, legislation, supply authority regulations and/or enterprise requirements applicable to installing poles and associated hardware
 - requirements for the use of enterprise construction manuals, system diagrams/plans and drawings:
 - characteristics and applications of different types of poles and associated hardware
 - techniques for installing poles and associated hardware:
 - types of installation equipment/tools
 - excavation methods

- types of footings/foundations, types of attachments
- earthing systems
- clearances between conductors
- safe methods of erecting and stabling poles and/or structures and cross-arms
- techniques for maintenance of poles and associated hardware:
 - stabilisation techniques for unstable poles
 - methods of strengthen poles
 - maintenance and replacement of HV insulators and cross-arms
- installation of metering and control equipment encompassing:
 - standards, codes, legislation, supply authority regulations and/or enterprise requirements pertaining to the installation and maintenance of energy meters and associated equipment
 - types of meters:
 - kilowatt-hour meters single and polyphase
 - demand meters, recording meters and electronic recording metering systems summators
 - installation and removal methods:
 - direct connection and plug in method
 - enterprise specific
 - types of associated equipment and accessories:
 - meter boards, service fuse, links, contactors, time switch and audio frequency injection relay
 - testing procedures:
 - safety testing
 - polarity testing
- 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 of distribution components
- 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 systems
 - particular reference to state and territory regulations regarding working near energised conductors, electrical access, heights, confined space, testing procedures and licensing rules
- 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
- power distribution network documentation encompassing:
 - requirements for the use of manuals, system diagrams/plans and drawings and for plans such as work method statements for the control of WHS/OHS risks
 - types and application of power distribution network documentation drawings and documents:
 - wiring and schematic diagrams
 - drawings and switching symbols
 - mechanical drawings dealing with the power distribution network, project charts, schedules, graphs, technical manuals and catalogues, and instructions/worksheets
 - interpretation of different diagrams and documentation on LV and HV systems:
 - overhead distribution extensions
 - underground distribution extensions
 - distribution substations
 - street lighting systems
- layout principles for overhead distribution encompassing:
 - Commonwealth, state/territory and local government legislation, standards, codes, supply authority regulations and/or enterprise requirements applicable to overhead distribution layout
 - requirements for the use of overhead line construction manuals, system diagrams/plans and drawings and for plans such as work method statements for the control of WHS/OHS risks
 - methods in determining material, equipment and tool lists :
 - components types and quantity required
 - spacing of components such as equipment, poles and cross-arms
 - costings of items and components
 - purchasing and contractual arrangements, including requirements to eliminate WHS/OHS hazards, minimise risks and provide residual WHS/OHS risk information
 - determination of conductor size, type and route length
 - resources needed for the stringing and maintenance of conductors
 - types of LV and HV overhead electrical conductor connections
 - minimum clearances between overhead conductors and LV and/HV structures
 - estimation of the duration of overhead distribution extension project
- system components and layouts encompassing:
 - distribution system layouts:
 - overhead/underground, urban/rural, HV customers, high rise building systems, three phase lines, single phase lines, SWER systems, spur, parallel and ring systems, typical substation types

- transmission system layouts:
 - lines, buses, transformers and cables, line/bus layouts including single, double, ring and breaker and half systems, and HV crossing methods
- alternating current (AC) 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
- AC 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
- AC 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 poles/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
 - distribution systems principles:
 - terminologies
 - primary and secondary
 - voltage levels
 - supply quality
 - load curve profiles (residential/industrial/commercial)
 - types of feeders
 - urban and rural single-phase systems
 - SWER
 - characteristics of poles:
 - types of poles (wood, concrete and steel)
 - installation methods of poles (tooling, rake, life, labelling and sinking)
 - maintenance techniques of poles (above and below ground pole strength and loads)
 - characteristics of associated equipment used on poles and structures:
 - cross-arms (types and standard sizes)

- insulators
- basic design features and characteristics of underground cables, lines, poles/structures and associated equipment and/or components encompassing:
 - standards, codes, legislation, supply authority regulations and/or enterprise requirements applicable to installing conductors and associated equipment
 - overhead lines characteristics:
 - type of components
 - characteristics of conductor material
 - mechanical limitations and physical dimensions of lines
 - current rating factors (heating, voltage drops, power losses) of conductors
 - aerial bundled cables (HV and LV)
 - covered conductors
 - characteristics and constructional features of poles and structures:
 - types of poles and structures
 - characteristics of poles/structure materials
 - mechanical limitations of poles/structures
 - footings and additional support techniques
 - characteristics and constructional features of underground cables:
 - underground cables constructional features
 - insulation materials and abbreviations
 - cable dielectrics, electric stress and cable voltage drop
 - calculation of cable voltage drop in relation to length of cable run
 - techniques in reducing electrical stress on cables
 - cable rating factors
 - methods of joining and terminating cables
 - techniques in the installation of cables above and below ground
 - techniques in cable testing and the location of cable faults
 - techniques in cable drawing.

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 personal protective equipment (PPE) currently used in industry
- applicable documentation, including workplace procedures, relevant industry standards, equipment specifications, regulations, codes of practice and operation manuals.

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