



Australian Government

UETTDRDS36 Design underground distribution power systems

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 technical design of underground distribution and sub-transmission networks to relevant standards, including cable sizing and locations, soil resistivity and heat dissipation, backfill and trenching details, minor civil aspects and dynamic and cyclic ratings. It also includes the necessary established procedures to ensure the line design conforms to specific organisational technical standards, operational and system planning requirements and encompasses 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 underground 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 underground distribution systems, are reviewed and determined
- 1.2** Purpose of the design is established after data is analysed and expected outcomes of the work are confirmed with appropriate personnel
- 1.3** Organisational established procedures or 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/effective outcome, completed within an acceptable timeframe 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 design of underground distribution 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 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 for the design of the underground 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 to 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 underground distribution systems**
- 3.1 Final inspections of the design are undertaken to ensure they comply with all requirements and include 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 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 RDS36A Design underground 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 UETTDRDS36 Design underground distribution power systems

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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) technical designs of an underground distribution or sub-transmission network relating to the following project types:
 - residential subdivision developments
 - industrial/commercial subdivision developments
 - alteration to existing assets
 - underground supplies to single customers, including projects requiring substations
- 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 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:

- mathematics 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

- applications 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
 - ductility, malleability, work hardening and annealing and the conditions that lead to corrosion and the properties of timbers
- installation of underground cable encompassing:
 - requirements for the use of enterprise construction manuals, system diagrams/plans and drawings
 - safety precautions specific to the installation of underground cable:
 - excavation and trench safety regulations
 - gas detection procedures
 - working in confined spaces
 - personal protective equipment (PPE)
 - hazards for the use of liquid petroleum gas (LPG) equipment for jointing of underground cable
 - gas bottle testing procedures
 - permit to work systems and isolation procedures
 - trench excavation and reinstatement procedures
 - installation of underground cable procedures:
 - types of tools and equipment
 - methods of installing conduits
 - methods of installing cables and sealing cable ends (direct buried, ducts cleated and racked)
 - procedures for the safe use of LPG equipment for cable jointing
- construction and types of underground cables encompassing:
 - safety precautions specific to handling underground cables
 - requirements for the use of enterprise manuals, system diagrams/plans and drawings
 - types and applications of underground cables
 - construction types and structures of underground cables
 - characteristics of different types of underground cables

- ratings
- 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 (HV) systems
 - particular reference to state and territory regulations regarding working near energised conductors, electrical access, heights, confined space, testing procedures and licensing rules
- the implementation and monitoring requirements for the impact of powerline installations and operation on the environment and/or the area surrounding the powerline and/or equipment encompassing:
 - identification of relevant legislation, codes and government guidelines for the implementation and monitoring of environmental impact factors in the workplace and areas of power distribution or transmission:
 - Commonwealth/state/territory legislation relevant to the workplace and the Environment Protection Act legislation and common law
 - identification, assessment, control and monitoring of the hazards to the environment associated with the powerline industry
 - workplace environment quality standards enterprise plan:
 - setting of acceptable emission level limits from power plant equipment
 - impact of the enterprise activities on air and water quality
 - nature, impact and level of emissions from power plant, power distribution and transmission equipment and network infrastructure (noise generation, noxious gas emissions, greenhouse gas production, electromagnetic emissions, electromagnetic field strength, oil leakage and insulation breakdown products)
 - provision of manufacturer and supplier information, such as material safety data sheets (MSDS)
 - gathering of environment management information
 - maintenance of environmental records
 - risk assessment and its management in powerline industry
 - maintenance strategies for environment protection programs:
 - developing processes for promoting, maintaining and improving environmental impact in the workplace
 - identifying techniques for evaluating and reviewing environment protection education and training programs and elements of an effective environment protection management system
 - Environment Protection Authority (EPA) consultation and accident/incident investigations
- layout principles for underground mains distribution extension encompassing:
 - Commonwealth, state/territory and local government legislation, standards, codes, supply authority regulations and/or enterprise requirements applicable to underground mains distribution extension
 - requirements for the use of underground mains 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 and equipment
 - 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 laying of conductors
- determining the appropriate excavation for the location
- determining the size and depth of excavation
- determining the trench and pit layout procedures
- minimum clearances between conductors
- estimation of the duration of underground distribution extension project
- system components and layouts encompassing:
 - distribution system layouts:
 - overhead/underground and/or urban/rural
 - HV customers
 - high rise building systems
 - three phase lines
 - single phase lines
 - single wire earth return (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
 - HV crossing methods
- 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 and power losses) of conductors
 - aerial bundled cables (HV and low voltage (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 PPE currently used in industry
- applicable documentation, including workplace procedures, relevant industry standards, equipment specifications, regulations, codes of practice and operation manuals.

Links

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