



**Australian Government**

**Department of Education, Employment and Workplace Relations**

# **UETTDRDS36A Design underground distribution power systems**

**Release: 1**

## UETTDRDS36A Design underground distribution power systems

### Modification History

Not applicable.

### Unit Descriptor

#### Unit Descriptor

#### 1) Scope:

##### 1.1) Descriptor

This Competency Standard 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.

### Application of the Unit

#### Application of the Unit 2)

This Competency Standard Unit is intended to augment formally acquired competencies. It is suitable for employment-based programs under an approved contract of training.

### Licensing/Regulatory Information

#### License to practice 3)

The skills and knowledge described in this unit may require a licence/registration to practice in the work place subject to regulations for undertaking of electrical work. Practice in workplace and during training is also subject to regulations directly related to Occupational Health and

**License to practice****3)**

Safety, electricity/telecommunications/gas/water industry safety and compliance, industrial relations, environmental protection, anti discrimination and training.

Commonwealth, State/Territory or Local Government legislation and regulations may exist that limits the age of operating certain equipment.

**Pre-Requisites****Prerequisite Unit(s)****4)****Competencies****4.1)**

Granting of competency in this unit shall be made only after competency in the following unit(s) has/have been confirmed.

Where pre-requisite pathways have been identified. All competencies in the Common Unit Group must be have been completed plus all the competencies in one (1) of the identified Pathway Unit Group(s):

**Common Unit Group**

Unit Code	Unit Title
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 problems
UEENEEE126A	Provide solutions to basic engineering computational problems
UEENEEG101A	Solve problems in electromagnetic

<b>Prerequisite Unit(s)</b>	<b>4)</b>	
		devices and related circuits
	UEENEEG102A	Solve problems in electromagnetic devices and related circuits
	UEENEEG149A	Provide engineering solutions to problems in complex polyphase power circuits
	UETTDREL11A	Apply sustainable energy and environmental procedures
	UETTDREL16A	Working safely near live electrical apparatus
	UETTDNIS62A	Implement and monitor the power system organisational OHS policies, procedures and programs
	UETTDNIS63A	Implement and monitor the power system environmental and sustainable energy management policies and procedures
	Pathway Unit Group 1	
	UETTDARDS39A	Prepare and manage detailed construction plans for electrical power system infrastructure
	UETTDARDS45A	Organise and implement ESI line and easement surveys
	Pathway Unit Group 2	
	UETTDARDS43A	Develop high voltage and low voltage distribution protection systems

**Literacy and numeracy skills 4.2)**

Participants are best equipped to achieve this unit if they have reading, writing and numeracy skills indicated by the following scales. Description of each scale is given in Volume 2, Part 3 “Literacy and Numeracy”

Reading 5      Writing 5      Numeracy 5

## Employability Skills Information

### Employability Skills 5)

The required outcomes described in this unit of competency contain applicable facets of Employability Skills. The Employability Skills Summary of the qualification in which this unit of competency is packaged will assist in identifying Employability Skill requirements.

## Elements and Performance Criteria Pre-Content

6) Elements describe the essential outcomes of a competency standard unit      Performance Criteria describe the required performance needed to demonstrate achievement of the element. Assessment of performance is to be consistent with the Evidence Guide.

## Elements and Performance Criteria

### ELEMENT

### PERFORMANCE CRITERIA

1	Plan for and coordinate the safe design of underground distribution systems	1.1	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 the appropriate personnel.
		1.3	Organisational established procedures or policies and specifications for the design are obtained or established with the appropriate personnel.
		1.4	Equipment/tools and personal protective equipment are selected and coordinated based on specified requirements and established

**ELEMENT****PERFORMANCE CRITERIA**

- 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 personal protective equipment required for the job are identified, scheduled and coordinated and confirmed in a safe and 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.
- 2 Carry out and coordinate the design of underground distribution systems
- 2.1 Circuit/systems modelling is used to evaluate alternative proposals as per established procedures.
- 2.2 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

**ELEMENT****PERFORMANCE CRITERIA**

- as per 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.

## Required Skills and Knowledge

### REQUIRED SKILLS AND KNOWLEDGE

**8) Essential Knowledge and Associated Skills (EKAS):** This describes the essential skills and knowledge and their level, required for this unit.

Evidence shall show that knowledge has been acquired of designing underground distribution systems.

All knowledge and skills detailed in this unit should be contextualised to current industry practices and technologies.

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Evidence shall show an understanding of the designing of underground distribution power systems to an extent indicated by the following aspects:

T1      Mathematics techniques encompassing:

- Calculations involving fractions, decimals, ratios, proportions
- Calculations involving area, volume, mass and density
- Calculations involving transposition and substitution of formulae
- Calculations involving simple trigonometric problems.

T2      Engineering mechanics encompassing:

- Identification of basic concepts, principles and applications - Application of velocity, acceleration, force, density, torque, and pressure
- Applications of the 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.

T3      Evidence shall show an understanding of 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.

T4      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, hazards for the use of 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,



## REQUIRED SKILLS AND KNOWLEDGE

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.

T5 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 UC
- Construction types and structures of underground cables
- Characteristics of different types of underground cables
- Ratings

T6 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, licensing rules.

T7 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, insulation breakdown products)
- Provision of manufacturers and suppliers information such as material safety data sheets (MSDSs)
- 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

## REQUIRED SKILLS AND KNOWLEDGE

workplace and identify techniques for the evaluating and reviewing environment protection education and training programs and elements of an effective environment protection management system, EPA consultation and accident/incident investigations.

T8 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 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 to include a requirement to eliminate OHS hazards, minimise risks and provide residual 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

T9 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, HV crossing methods.

T10 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

## REQUIRED SKILLS AND KNOWLEDGE

cables constructional features, insulation materials and abbreviations, cable dielectrics, electric stress, cable voltage drop.

- Calculation of cable volt 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.

## Evidence Guide

### EVIDENCE GUIDE

9) This provides essential advice for assessment of the unit of competency and must be read in conjunction with the Performance Criteria and the range statement of the unit of competency and the Training Package Assessment Guidelines.

The Evidence Guide forms an integral part of this Competency Standard Unit and shall be used in conjunction with all component parts of this unit and, performed in accordance with the Assessment Guidelines of this Training Package.

### Overview of Assessment 9.1)

Longitudinal competency development approaches to assessment, such as Profiling, require data to be reliably gathered in a form that can be consistently interpreted over time. This approach is best utilised in Apprenticeship programs and reduces assessment intervention. It is the Industry's preferred model for apprenticeships. However, where summative (or final) assessment is used it is to include the application of the competency in the normal work environment or, at a minimum, the application of the competency in a realistically simulated work environment. It is recognised that, in some circumstances, assessment in part or full can occur outside the workplace. However, it must be in accord with Industry and, Regulatory policy in this regard.

Methods chosen for a particular assessment will be influenced by various factors. These include the extent of the assessment, the most effective locations for the assessment activities to take place, access to physical resources, additional safety measures that may be required and the critical nature of the competencies being

assessed.

The critical safety nature of working with electricity, electrical equipment, gas or any other hazardous substance/material carries risk in deeming a person competent. Hence, sources of evidence need to be 'rich' in nature so as to minimise error in judgment.

Activities associated with normal every day work have a bearing on the decision as to how much and how detailed the data gathered will contribute to its 'richness'. Some skills are more critical to safety and operational requirements while the same skills may be more or less frequently practiced. These points are raised for the assessors to consider when choosing an assessment method and developing assessment instruments. Sample assessment instruments are included for Assessors in the Assessment Guidelines of this Training Package.

**Critical aspects  
of evidence  
required to  
demonstrate  
competency in  
this unit** 9.2)

Before the critical aspects of evidence are considered all prerequisites shall be met.

Evidence for competence in this unit shall be considered holistically. Each element and associated Performance Criteria shall be demonstrated on at least two occasions in accordance with the "Assessment Guidelines – UET12UET12". Evidence shall also comprise:

- A representative body of Performance Criteria demonstrated within the timeframes typically expected of the discipline, work function and industrial environment. In particular this shall incorporate evidence that shows a candidate is able to:
  - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the Performance Criteria and range; and
  - Apply sustainable energy principles and practices as specified in the Performance Criteria and range; and
  - Demonstrate an understanding of the essential knowledge and associated skills as described in this unit to such an extent that the learner's performance outcome is reported in accordance with the preferred approach; namely a percentile graded result, where required by the regulated

- environment; and
- Demonstrate an appropriate level of employability skills; and
  - Conduct work observing the relevant Anti Discrimination legislation, regulations, policies and workplace procedures; and
  - Demonstrated performance across a representative range of contexts from the prescribed items below:

<b>Range of tools/equipment/materials/procedures/workplaces/other variables</b>		
<b>Group No</b>	<b>The minimum number of items on which skill is to be demonstrated</b>	<b>Item List</b>
A	Completion of 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.
B	Designs should also included 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.
C	At least one occasion	Dealing with an unplanned event by drawing on essential knowledge and associated skills to provide appropriate

		solutions incorporated in the holistic assessment with the above listed items.
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**Context of and specific resources for assessment** 9.3)

This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace. This should include:

- OHS policy and work procedures and instructions.
- Suitable work environment, facilities, equipment and materials to undertake the design of underground distribution systems.

In addition to the resources listed above, in Context of and specific resources for assessment, evidence should show demonstrated competency working in a realistic environment and a variety of conditions.

**Method of assessment** 9.4)

This Competency Standard Unit shall be assessed by methods given in Volume 1, Part 3 “Assessment Guidelines”.

Note:

Competent performance with inherent safe working practices is expected in the Industry to which this Competency Standard Unit applies. This requires that the specified essential knowledge and associated skills are assessed in a structured environment which is primarily intended for learning/assessment and incorporates all necessary equipment and facilities for learners to develop and demonstrate the essential knowledge and associated skills described in this unit.

**Concurrent assessment and relationship with other units** 9.5)

There are no recommended concurrencies for this unit.



## Range Statement

### RANGE STATEMENT

**10)** This relates to the unit of competency as a whole providing the range of contexts and conditions to which the Performance Criteria apply. It allows for different work environments and situations that will affect performance.

This Competency Standard Unit shall be demonstrated in relation to the design of underground distribution systems and may include the following equipment:

Underground cable, terminations, joints, Substations, mechanical protection, HV Switchgear, LV Switchgear, signage, relevant protection systems, relevant protection systems including fuses and circuit breakers and associated civil works.

The following constants and variables included in the element/Performance Criteria in this unit are fully described in the Definitions Section 1 of this volume and form an integral part of the Range Statement of this unit:

- Appropriate and relevant persons (see Personnel)
- Appropriate authorities
- Appropriate work platform
- Assessing risk
- Assessment
- Authorisation
- Confined space
- Diagnostic, testing and restoration
- Documenting detail work events, record keeping and or storage of information
- Drawings and specifications
- Emergency
- Environmental and sustainable energy procedures
- Environmental legislation
- Environmental management documentation
- Established procedures
- Fall prevention
- Hazards
- Identifying hazards
- Inspect
- Legislation
- MSDS
- Notification
- OHS practices
- OHS issues
- Permits and/or permits to work



**RANGE STATEMENT**

- Personnel
- Quality assurance systems
- Requirements
- Safe design principles
- Testing procedures
- Work clearance systems

**Unit Sector(s)**

Not applicable.

**Competency Field**

**Competency Field**            **11)**  
Design.