



Australian Government

Department of Education, Employment and Workplace Relations

UETTDRDS35A Design overhead distribution power systems

Release: 1

UETTDRDS35A Design overhead 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 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.

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

License to practice**3)**

regulations directly related to Occupational Health and 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

Prerequisite Unit(s)	4)
UEENEEG101A	Solve problems in electromagnetic 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
UETTD RIS62A	Implement and monitor the power system organisational OHS policies, procedures and programs
UETTD RIS63A	Implement and monitor the power system environmental and sustainable energy management policies and procedures
Pathway Unit Group 1	
UETTD RDS39A	Prepare and manage detailed construction plans for electrical power system infrastructure
UETTD RDS45A	Organise and implement ESI line and easement surveys
Pathway Unit Group 2	
UETTD RDS43A	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 overhead distribution systems | 1.1 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 the appropriate personnel.

1.3 Organisational established procedures, 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 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 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 safe design of overhead 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 of the distribution system are used to analyse the effectiveness of the finished project as per requirements and

ELEMENT	PERFORMANCE CRITERIA
	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.

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 overhead distribution systems.

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

KS01-TDS35A Power system overhead distribution - design

Evidence shall show an understanding of the designing of overhead 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
- Behavior 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 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.

T4 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 and high voltage overhead electrical conductor connections, causes and effects of poor

REQUIRED SKILLS AND KNOWLEDGE

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 low and high voltage structures.

- Techniques for conductor installation - types and application of tools, equipment and hardware, methods of stringing, tensioning and termination of low and high voltage conductors.

T5 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 high voltage insulators and cross arms.

T6 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, audio frequency injection relay
- Testing procedures - safety testing, polarity testing

T7 Different types and function of distribution components encompassing:

- Commonwealth/State/Territory and local government legislation, Standards, codes, Commonwealth, State/Territory and local government legislation, 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 distribution components

T8 Principles of Statutory and safety considerations encompassing:

REQUIRED SKILLS AND KNOWLEDGE

- 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.

T9 High voltage 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

T10 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 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, instruction/worksheets sheets.
- Interpretation of different diagrams and documentation on LV and HV systems - overhead distribution extensions, underground distribution extensions, distribution substation, street lighting system.

T11 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 OHS risks
- Methods in determining material, equipment and tool lists - components types and quantity required, spacing of components such as equipment, poles, cross-arms, 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 stringing and maintenance of conductors
- Types of low LV and HV overhead electrical conductor connections
- Minimum clearances between overhead conductors and low LV and/HV structures
- Estimation of the duration of overhead distribution extension project

T12 System components and layouts encompassing:

REQUIRED SKILLS AND KNOWLEDGE

- 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.

T13 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

T14 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.

T15 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.

T16 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, sinking), maintenance techniques of poles - above and below ground pole strength and loads.
- Characteristics of associated equipment used on poles and structures - crossarms (types and standard sizes), insulators.

T17 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

REQUIRED SKILLS AND KNOWLEDGE

- 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, 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:

Range of tools/equipment/materials/procedures/workplaces/other variables		
Group No	The minimum number of items on which skill is to be demonstrated	Item List
A	Completion of 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
B	Designs should also include all of 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 actual safe design of overhead distribution systems.

In addition to the resources listed above, in Context of and specific resources for assessment, evidence should show demonstrated competency working in 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 overhead distribution systems using safe design, engineering principles and schedules and may include the following equipment:

Pole (including wood, concrete, steel and composite) associated hardware including conductors (bare wire and covered), crossarms, insulators, stays, ACR, regulator, earthing, air break switches, gas switches, capacitor units, transformers, links, fuses, sectionalisers, surge arrestors, HV switchgear, LV switchgear, control boxes, communications equipment, luminaires/lanterns, signage, supervisory cable, cable TV, substations, relevant protection systems and associated civil works.

May include computer based drafting and design technologies.

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

RANGE STATEMENT

- Notification
- OHS practices
- OHS issues
- Permits and/or permits to work
- Personnel
- Quality assurance systems
- Requirements
- Safe design principles
- Testing procedures
- Work clearance systems

Unit Sector(s)

Not applicable.

Competency Field

Competency Field **11)**
Design.