



**Australian Government**

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

# **UETTDRDS52A Design power system transmission, sub-transmission and zone substation buildings**

Release: 1

## **UETTDRDS52A Design power system transmission, sub-transmission and zone substation buildings**

### **Modification History**

Not applicable.

### **Unit Descriptor**

#### **Unit Descriptor**

#### **1) Scope:**

##### **1.1) Descriptor**

This Competency Standard Unit covers the design of transmission, sub-transmission and zone substation buildings. This may include basic augmentations or new installations on green field sites. The design must conform to safety and building regulations and environmental standards and incorporate 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 Safety, electricity/telecommunications/gas/water industry safety and compliance, industrial relations, environmental protection, anti discrimination and training.  
Commonwealth, State/Territory or Local Government

**License to practice**

**3)**

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
UEENEEE104A	Solve problems in d.c. Circuits
UEENEEE107A	Use drawings, diagrams, schedules, standards, codes and specifications
UEENEEG101A	Solve problems in electromagnetic devices and related circuits
UEENEEG102A	Solve problems in electromagnetic devices and related circuits
UETTDRDS39A	Prepare and manage detailed construction plans for electrical power system infrastructure
UETTDRDS44A	Design power system substations modifications
UETTDREL11A	Apply sustainable energy and environmental procedures

**Prerequisite Unit(s) 4)**

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

**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.
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## Elements and Performance Criteria

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b>
1 Plan for and coordinate the design of transmission, sub-transmission and zone substation buildings	1.1 OHS practices/procedures and environmental and sustainable energy procedures, which may influence the design of substations buildings, 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 Established policies, procedures 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 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,

## ELEMENT

## PERFORMANCE CRITERIA

		commerce, and individuals in accordance with established procedures
	1.11	Personnel participating in the work, including plant operators and contractors, are fully briefed and respective responsibilities coordinated and authorised where applicable in accordance with established procedures
2	Carry out and coordinate the design of transmission, sub-transmission and zone substation buildings	
	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 system are used to analyse the effectiveness of the finished project as per 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.

**ELEMENT**

**PERFORMANCE CRITERIA**

- |   |  |     |  |
|---|--|-----|--|
| 3 | Complete and coordinate the design of transmission, sub-transmission and zone substation buildings | 3.1 | Final checks of the design are undertaken to ensure they comply with all requirements and include all specifications and documentations needed to complete the design brief. |
|   |  | 3.2 | Appropriate personnel are notified of completion and reports and/or completion documents are finalised.  |
|   |  | 3.3 | Reports and/or completion documents are submitted to relevant personnel/organisations for approval and, where applicable, statutory or regulatory approval                   |
|   |  | 3.4 | Approved copies of design documents are issued and records are updated in accordance with established procedures.  |

## 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 transmission, sub-transmission and zone substation buildings.

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

**KS01-TDS52A** Power system transmission, sub-transmission and zone substation buildings

Evidence shall show an understanding of designing power system transmission, sub-transmission and zone substation buildings to an extent indicated by the following aspects:

**T1** Electrical power circuit analysis encompassing:

- Superposition theorem
- Kirchhoff's laws
- Mesh analysis
- Thevenin's & Norton's theorems
- Maximum power transfer theorem
- Complex impedance
- Frequency domain
- Transients

**T2** Identification of basic concepts, principles and applications - Application of velocity, acceleration, force, density, torque, and pressure encompassing:

- 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** Principles to light design layout encompassing:

- Commonwealth, State/Territory and local government legislation, Standards, codes, supply authority regulations and or enterprise requirements applicable to the light design principles
- Requirements for the use of street lighting system construction manuals, system diagrams/plans and drawings and for plans such as work method statements for the control of OHS risks
- Types of tariffs and charges
- Types of street lighting components - column types, foundations, brackets, luminaires and mounting heights
- Types of electrical street lighting circuits - types of supply, lighting circuit and control circuit



## REQUIRED SKILLS AND KNOWLEDGE

- Fundamentals of lighting production - electromagnetic spectrum, visible and non-visible radiation, spectral energy distribution, infra-red, ultra-violet, radiation-safety, incandescence and phosphorescence, reflection and refraction.
- Fundamentals of lighting concepts - terms and units, purpose of reflectors and diffusers.
- Factors affecting external lighting design
- Calculation of light output
- Determining illuminance - point to point method, lumen method
- Determining rated life of luminaries
- Fundamentals of street lighting design
- Considerations for special lighting situations - security lighting, hazardous street locations, and emergency lighting.

T4 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

T5 Principles of transmission, sub-transmission and zone substation building designs encompassing

- Commonwealth, State/Territory and local government legislation, Standards, codes, supply authority regulations and or enterprise requirements applicable to the substation design management principles
- Requirements for the use of the substation system construction manuals, system diagrams/plans and drawings and for plans such as work method statements for the control of OHS risks
- Types of building designs - fixed and/or portable control, switchgear, frequency injection and miscellaneous building designs
- Types of building floor construction - concrete poured in situ, precast, elevated

## REQUIRED SKILLS AND KNOWLEDGE

- ultra floor beams with poured in situ slab, pre-manufactured steel framed floor
- Types of building walls construction - steel framed, masonry, precast tilt-up, steel framed and lined
- Types of roof construction - steel framed, sheet steel clad
- Parameters to be considered - establishment of equipment dimensions, weights and dynamic loadings, suitability of building room/compartments and door opening dimensions for the equipment to be housed, compliance with security, fire rating and safety, pressure relief, BCA and BA requirements, compliance with electrical requirements, i.e. frame leakage, earthed metal isolation, appropriateness of floor reference levels, provision of cable supports, penetrations and pulling ring requirements, building light and power design and drafting

## 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 is based, 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 two (2) compliant technical designs including each of the following:	Establishment of equipment dimensions, weights and dynamic loadings. Suitability of building room/compartments and door opening dimensions for the equipment to be housed. Compliance with security, fire rating and safety, pressure relief, BCA and BA requirements. Compliance with electrical requirements, i.e. frame leakage, earthed metal isolation. Appropriateness of floor reference levels. Provision of cable supports, penetrations and pulling ring requirements. Building light and power design and drafting.
B	Designs should also include 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.

**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 design of transmission, sub-transmission and zone substation buildings.

In addition to the resources listed above, in Context of and specific resources for assessment, evidence should show demonstrated competency working 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 concurrent assessments with this unit, however in some cases efficiencies may be gained in terms of learning and assessment effort being concurrently managed.

## 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 housekeeping components of transmission, sub-transmission and zone substations and may include the following equipment:

Primary components of a substation which may include: Electrical equipment in accordance with SLD, bays spaced in accordance with standard requirements, switchyard design in accordance with AS2067, equipment spaced so that space is available for maintenance facilities, maintenance space to fence in accordance with AS2067, switchyard equipment device codes correct, busbar earthing facilities available in appropriate positions, earth switches fitted to high busbar, portable earth attachment points in correct position, connections, busbar and flexibles, earthing points, switchgear operating handle positions, disconnecter operator earth mats, anti-vibration Pads and Transformer location, auxiliary transformer location, earth stick storage, control building equipment layout, H.V. cable layout, wiring/connection diagrams, cable schedule, pilot terminations, streamline filter supply, frame leakage CT's, VT 's and CT's, photo electric cells, earthing of plumbing, distribution feeder cable CB connection and route drawing produced by regional designer and checked. Manufacturer's data sheets, documents, drawings

Manufacturers' recommendations; Reliability performance profiles; Knowledge of local history and experience; Consultation with other Authorities; Environmental influences; Present practices.

Equipment includes; Sectionalisers, air break switches, capacitor banks, transformer taps, metering and protection equipment, data communication systems

Primary and secondary voltage and current injection equipment; time delay measuring equipment; Current transformers; Voltage transformers; Power transformers;

Tapchangers; Circuit breakers; Capacitor banks; Ring main units; Audio frequency load control; Circuit breaker auxiliary systems; Substation and metal structure

earthing systems; SCADA interfaces and transducer inputs; local opto-isolated alarms: PLC programs; Auto Reclosers (ACRs); protection relays; metering; control circuits;

Statistical metering systems; Frame leakage relays; Distance relays; Pilot wire relays; Transformer differential relays; Busbar differential relays; Impedance bus zone relays;

Overcurrent and earth fault relays; Transformer neutral check relays; Circuit breaker fail relays; Multi-trip relays; Auto recloser relays; Voltage transformer failure relays;

Surge protection relays; Buchholz relays; Winding temperature relays; Sensitive earth fault relays; Phase failure relays; Frequency relays; Load shedding relays; General

protection LV devices; Oil temperature protection devices; Oil surge protection devices; Power supplies. differential relays; power systems; multi-faceted schemes;

interactive overload schemes, distance protection (incorporating relay selection, switched/non-switched schemes; mutual coupling and teed feeder systems); protection

signalling (incorporating series, direct, permissive, distance acceleration, block interruption); telecommunication circuits and equipment.

The following constants and variables included in the element/Performance Criteria in

## **RANGE STATEMENT**

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



## **Unit Sector(s)**

Not applicable.

## **Competency Field**

<b>Competency Field</b>	<b>11)</b>
	Design