



Australian Government

Department of Education, Employment and Workplace Relations

UETTDRDS39A Prepare and manage detailed construction plans for electrical power system infrastructure

Release: 1

UETTDRDS39A Prepare and manage detailed construction plans for electrical power system infrastructure

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor

1) Scope:

1.1) Descriptor

This Competency Standard Unit covers the preparation of detailed plans to be used during the design phase and preparation of as-built drawings during the construction phase, and utilised by network owners as technical reference materials, to detail system infrastructure. It includes the use of CAD or other relevant drafting methods.

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.

License to practice

3)

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
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
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

Prerequisite Unit(s) 4)

UETTDSDS63A	Implement and monitor the power system environmental and sustainable energy management policies and procedures
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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
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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

ELEMENT	PERFORMANCE CRITERIA
1 Plan for and coordinate the preparation and management of detailed construction plans for electrical system infrastructure	1.1 OHS practices/procedures, which may influence the preparation and management of detailed construction, plans for electrical system infrastructure are reviewed and determined.
	1.2 Purpose of the construction plans is established and expected outcomes of the work are confirmed with the appropriate personnel.
	1.3 Established organisational procedures, policies and specifications for the construction plans are obtained or established with the appropriate personnel.
	1.4 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.
	1.5 Risk control measures are identified, prioritised and evaluated against the work schedule.
	1.6 Relevant work permits are secured to coordinate the performance of work according to requirements and/or established procedures.
	1.7 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.
	1.8 Liaison and communication issues with other/authorised personnel, authorities, clients and land owners are resolved and activities coordinated to carry out work.
	1.9 Site is prepared according to the work schedule and to minimise risk and damage to property, commerce, and individuals in accordance with established procedures.

ELEMENT	PERFORMANCE CRITERIA
2 Carry out and coordinate the preparation and management of detailed construction plans for electrical system infrastructure	2.1 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
	2.2 System design decisions are made on the basis of safety and effective outcomes according to requirements and/or established procedures.
	2.3 Mathematical models of the system are used to analyse the effectiveness of the finished project as per requirements and established procedures.
	2.4 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.
	2.5 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.
	2.6 Solutions to non-routine problems are identified and actioned using acquired essential knowledge and associated skills according to requirements.
	2.7 Quality of work is monitored against personal performance agreement and/or established organisational and professional standards.
3 Complete and coordinate the preparation and management of detailed construction plans for electrical system infrastructure	3.1 Final inspections of the construction plans 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

ELEMENT

PERFORMANCE CRITERIA

for approval and, where applicable, statutory or regulatory approval.

- 3.4 Approved copies of construction plan 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 preparing and managing detailed construction plans for electrical system infrastructure

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 preparation and management of detailed construction plans for electrical power system to an extent indicated by the following aspects:

T1 Working safely on or around electrical equipment through the application of risk management principles and control measures for dealing with non-electrical hazards and extra-low voltage, low-voltage and high-voltage hazards and high-current hazards encompassing:

- Risk management and assessment of risk encompassing, principle and purpose of risk management and the processes for conducting a risk assessment
- Hazards associated with low-voltage, extra-low voltage and high-currents - arrangement of power distribution and circuits in an electrical installations, parts of an electrical system and equipment that operate at low-voltage and extra-low voltage, parts of an electrical system and equipment where high-currents are likely.
- Risks and control measures associated with high-voltage - parts of an electrical system and equipment that operate at high-voltage, the terms 'touch voltage', 'step voltage', 'induced voltage' and 'creepage' as they relate to the hazards of high-voltage and control measures used for dealing with the hazards of high-voltage
- Optical fibre safety - coherent optical sources and joining procedures and laser safety class 3a devices or their replacement.
- Risks and control measures associated with low voltage encompassing modifying electrical installations, fault finding, maintenance and repair, control measures before, while and after working on electrical installations, circuits or equipment, isolation and tagging-off procedures, risks and restrictions in working live and control measures for working live.
- Risks and control measures associated with harmful dusts and airborne contaminants - thermal insulation, fibrous cement materials and asbestos and other fibre reinforced switchboard materials.
- Safety, selection, use, maintenance and care of test equipment encompassing safety characteristics of electrical testing devices, safe use of electrical testing device and checks and storage methods for maintaining the safety of testing devices.

T2 OHS enterprise responsibilities encompassing:

- Provisions of relevant health and safety legislation

REQUIRED SKILLS AND KNOWLEDGE

- Principles and practice of effective occupational health and safety management
- Management arrangements relating to regulatory compliance
- Enterprise hazards and risks, control measures and relevant expertise required
- Characteristics and composition of workforce and their impact on occupational health and safety management
- Relevance of enterprise management system to occupational health and safety management
- Analysis of working environment and design of appropriate occupational health and safety management systems
- Analysis of relevant data and evaluation of occupational health and safety system effectiveness
- Assess resources to establish and maintain occupational health and safety management systems.

T3 Transmission, distribution and rail systems encompassing:

- Relationship between the transmission, distribution and rail/tram system within an overall power system - different organisations responsible for generation, transmission, distribution and rail/tram and, how they correlate and their functions
- Characteristics of a transmission, a distribution and a rail system - principal components, typical voltage levels and methods of transmission and distribution including grid type transmission systems, radial, parallel and ring main feeders
- Relationship between an overhead and underground supply systems within an overall power system, note examples include advantages/disadvantages, applications and the basic steps for planning and installing an overhead and underground distribution system
- Single line drawings and layouts - drawings and layouts of transmission and distribution systems including, radial, parallel and ring main feeders and the HV equipment associated with substations

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 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.

REQUIRED SKILLS AND KNOWLEDGE

T5 Powerline safety practices encompassing:

- Protective apparatus and apparel for linework - responsibilities for the selection, use, maintenance and storage of protective apparatus and apparel and the types of protective apparatus and apparel used for the line worker
- Requirements for the use of ladders - practical demonstration of carrying, erecting, collapsing and lowering different types of extension ladder against a standing pole, maintenance checks on different types of ladders, renewal of extension ropes and the safety issues relating to clearances from overhead conductors
- Requirements for climbing and working aloft - methods used to identify a pole is safe to climb, methods used to inspect a line worker's body belt, application of knots and hitches appropriate to the requirements of a line worker, height safety principles including personal fall protection, prevention and related requirements, and the practical procedure of climbing an overhead structure and fitting a pole chair
- Traffic management - purpose of traffic management and a line worker's responsibilities in accordance with relevant statutory requirements and electricity supply industry requirements, demonstration of the procedure used to provide an effective traffic management scheme and the use of a two-way radio
- Control of small fires - the identification, selection and operation of the appropriate extinguishing mediums for various types of fires, general fire prevention methods and the precautions for personal protection when fighting small fires
- Rescue victims from heights and confined spaces - planning, identifying, the procedures, and establishing responses, developing techniques, involvement of external emergency services and practical demonstration/rehearsals of rescuing a person from heights and from confined spaces and emergency procedures for the rescue of an electric shock victim including CPR
- Requirements for aerial linework - planning, establishing and implementing relevant aviation authority clearances, determining system requirements, aircrew familiarisation with network operations and equipment, requirements for effective communications operations for aerial work

T6 Implementation and monitoring requirements for powerline safety encompassing:

- Identification of relevant legislation, codes and government guidelines for the implementation and monitoring of OHS in the workplace - Commonwealth/ State/ Territory legislation relevant to the workplace and the meaning of general duty of care under OHS legislation and common law
- Workplace OHS enterprise plan - responsibilities of each member of the work team, review process for changing/improving OHS safety plan/standing instructions for the systematic management of OHS in the workplace
- Relationship between the OHS committee and employees - methods used to collate and distribute/disseminate OHS information, staff development activities and legislation requirements with regards to OHS training, methods of addressing barriers such as literacy and cultural differences and provisions relating to OHS

REQUIRED SKILLS AND KNOWLEDGE

issue resolution

- Hazards associated with Powerline industry - identification of hazards in the workplace, processes used and contributing factors to a hazardous situation assessment of risks and control of OHS risks (risk management), the hierarchy of control and monitoring of risk control measures
- Risk assessment and its management in Powerline industry - principles and purposes of risk management, processes for conducting risk assessment including risk analysis and risk evaluation activities for selecting and implementing appropriate options for eliminating or minimising risk
- Maintenance strategies for OHS programs - developing processes for promoting, maintaining and improving OHS in the workplace and identify techniques for the evaluating and reviewing OHS education and training programs and elements of an effective OHS management system, OHS consultation and accident/incident investigations

T7 Principles of safe design encompassing:

- Commonwealth/State/Territory legislation, standards, codes, supply authority regulations and or enterprise requirements associated with safe design principles
- Particular reference to state and territory regulations regarding: working near energised conductors, electrical access, heights, confined space, testing procedures and licensing rules
- Application of safe design principles - safe design duty related information, safe design process related information and safe design evaluations

T8 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

T9 Enterprise specific switching diagrams and drawing encompassing:

- Types and application of enterprise specific switching drawings and documents - wiring and schematic diagrams and switching symbols, mechanical drawings dealing with switching operations, project charts, switching schedules, graphs, technical manuals and catalogues, instruction/work sheets.
- Interpretation of different system switching diagrams - LV system switching diagrams, DC traction supply sectioning diagrams, HV transmission and distribution system symbols and feeder plans, processes of updating switching diagrams

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

REQUIRED SKILLS AND KNOWLEDGE

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 systems.

T11 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.

T12 Circuit breaker auxiliary systems encompassing:

- Types and characteristics of high pressure air systems including air storage and air handling processes
- Types and characteristics of DC systems including battery types, charging systems, protection systems
- Types and characteristics of special ambient gases (SF6) systems including gas conditioning, storage and handling systems
- Types and characteristics of vacuum interrupters
- Types and characteristics of oil filled and oil handling

T13 DC transmission systems encompassing:

- Structure of DC transmission systems
- Types of equipment required for DC transmission systems
- Types of connections used for DC transmission systems
- Principles of control of DC transmission systems
- Advantages of DC transmission in comparison to AC transmission
- Disadvantages of DC transmission in comparison to AC transmission

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

REQUIRED SKILLS AND KNOWLEDGE

- Calculation of voltage drop, line regulation, and transmission efficiency
- Load sharing between lines.

T16 Voltage control techniques encompassing:

- Conditions leading to voltage collapse
- Effects on system of high and low voltage
- Voltage control devices - voltage regulators applied to generators and synchronous phase modifiers, electromagnetic voltage regulators, series and parallel capacitors, OLTC transformers and static VAR compensators (SVC's). SVC's includes saturated reactor compensators; thyristor controlled reactor compensators and combined systems
- Production of harmonics and methods of harmonic control
- Location of voltage control devices within the system

T17 Voltage control devices encompassing:

- Typical devices applications and capacities
- Estimation of rating of VAR regulating devices using graphical techniques

T18 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.

T19 Corona encompassing:

- Factors leading to the generation of corona - voltage levels, conductor spacings, conductor sizes and shaping, atmospheric conditions
- Consequences of corona
- Corona reduction - conductor selection, conductor bundling, conductor surface treatment, grading rings
- Internal discharge - causes of internal discharge, effects of internal discharge, testing techniques

T20 Protection system types encompassing:

- Requirements of a protection scheme - relationship to primary system design, purpose of protection, safety of persons, protection of plant, system instability, system break up, loss of customers, loss of revenue, protection zones, restricted schemes, unrestricted schemes, duplicate protection, local backup protection, remote backup protection, selectivity, discrimination, stability, sensitivity, reliability
- Components of a protection scheme - current transformers, potential transformers, summation current transformers, interposing transformers, multi tapped transformers, all-or-nothing relays, induction relays, balanced beam relays,

REQUIRED SKILLS AND KNOWLEDGE

- directional relays, biased relays, solid state relays, microprocessor based relays, gas relays, thermal sensors, hardwired communication, powerline carriers systems, microwave systems, fibre optic systems, need for isolation, need for interfacing
- Protection applied to buses - overload, differential, earth leakage, structure leakage, combined schemes, protection overlap
 - Protection applied to transformers - biased differential, gas, winding temperature, oil temperature
 - Protection applied to single/radial lines - overcurrent, earth leakage, slow earth leakage, distance, auto reclose, sectionalising, over voltage
 - Protection applied to interconnected lines - overcurrent, pilot wire, directional, directional overcurrent, current differential, phase comparison, current comparison, distance, impedance, admittance, offset.

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	Preparation of six (6) compliant detailed plans that relate to the following project types:	Overhead line designs Underground line designs Distribution substations designs Transmission and subtransmission substations designs Public lighting designs Zone substation designs Customer Substation designs
B	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 preparation and management of detailed construction plans for electrical system infrastructure

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 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 preparation and management of detailed construction plans for electrical infrastructure and may include the following equipment:

Drafting software, Computer hardware, Reference manuals, Design sketches

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
- Personnel
- Quality assurance systems

RANGE STATEMENT

- Requirements
- Safe design principles
- Testing procedures
- Work clearance systems

Unit Sector(s)

Not applicable.

Competency Field

Competency Field	11)
	Design.