



Australian Government

Department of Education, Employment and Workplace Relations

UETDRDS43A Develop high voltage and low voltage distribution protection systems

Release: 1

UETTDRDS43A Develop high voltage and low voltage distribution protection systems

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor

1) Scope:

1.1) Descriptor

This Competency Standard Unit covers the development of appropriate protection systems for HV and LV distribution networks, including calculations of fault levels, selection of appropriate protection devices and automation requirements and protection coordination schemes. This also includes recommendations to support the calculations and must ensure conformance to specific organisational operational and system planning requirements, and compliance with national or supply authority codes.

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
UETTDRI62A	Implement and monitor the power system organisational OHS policies, procedures and programs
UETTDRI63A	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

Employability Skills**5)**

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 and coordinate for the development of HV and LV protection systems

- 1.1 OHS practices/procedures and environmental and sustainable energy procedures, which may influence the development of HV and LV protection systems, are reviewed and determined.
- 1.2 Purpose of the development is established and expected outcomes of the work are confirmed with the appropriate personnel.
- 1.3 Organisational established procedures on policies and specifications for the development 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.

ELEMENT**PERFORMANCE CRITERIA**

- | | | |
|---|--|--|
| | 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. |
| | 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 development of HV and LV protection systems | <p>2.1 Circuit/systems modelling is used to evaluate alternative proposals as per established procedures.</p> <p>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.</p> <p>2.3 System design decisions are made on the basis of safety and effective outcomes according to requirements and/or established procedures.</p> <p>2.4 Mathematical models of the HV/LV protection system are used to analyse the effectiveness of the finished project as per requirements and established procedures.</p> <p>2.5 Technical advice is given to potential hazards, safety risks and control measures so that</p> |

ELEMENT**PERFORMANCE CRITERIA**

		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 development of HV and LV protection systems	3.1 Final inspections of the system 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 developing HV and LV distribution protection systems.

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

KS01-TDS43A HV and LV distribution protection systems

Evidence shall show an understanding of the for the development of HV and LV distribution protection systems to an extent indicated by the following aspects:

T1 OHS enterprise responsibilities encompassing:

- Provisions of relevant health and safety legislation
- 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 systems 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.

T2 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

T3 Installation of switchgear and associated equipment encompassing:

- Types and function of various switchgear: note; examples include isolators, air-break switches, gas-filled switches, vacuum type, links, fuses, oil disconnectors, fuse switches, circuit breakers, operating characteristics, advantages and disadvantages of different types switchgear, installation procedures, earthing, requirements and techniques

REQUIRED SKILLS AND KNOWLEDGE

- Types of equipment - transformers, reactors, regulators, capacitors, relays, surge arrestors, fault indicators and mobile generators
- Installation procedures for switchgear and equipment encompassing: standards, codes, legislation, supply authority regulations and or enterprise requirements, assembly and erecting procedures, earthing requirements and techniques and pole mounted locations
- Maintenance procedures for switchgear and equipment - diagnosing and rectifying faults according to electricity supply industry standards and procedures
- Testing and commissioning - electricity supply industry standards and procedures

T4 Electrical equipment associated with distribution field device protection and control schemes encompassing:

- Types and applications of electrical equipment: characteristics and capabilities - schemes, automatic circuit reclosers (ACR's), gas switches, secondary injection tests, primary injection tests, TMR Radio's, SCADA, remote control, overcurrent, earth fault, sensitive earth fault, inverse time curves, definite time curves, tripping, reclose, DC supplies, AC supplies and alarms

T5 Calculation of fault levels encompassing:

- Calculation of fault levels in symmetrical and asymmetrical fault conditions - types of faults, interconnected and radial systems, symmetrical components, representation of voltages and currents, sequence impedances of system plant, calculation/determination of sequence impedance networks, determination of operative sequence impedances, fault or arc impedances, first approximation techniques
- Interrupting device capabilities - determination of fault current breaking capability and let through energy capability of fuses and circuit breakers, DC offset and transient condition effects

T6 Detailed operation and setting of discrete protection systems encompassing:

- Earth fault protection - master earth leakage schemes, sensitive earth fault relays and schemes, residual earth fault scheme, core balance earth fault scheme, frame/structure earth leakage scheme, time graded discrimination, backup protection
- Overcurrent protection - feeder overcurrent protection, instantaneous overcurrent schemes, inverse timed overcurrent schemes, types and location of components of an overcurrent scheme, CT summation, time graded discrimination, backup protection
- Alarms and controls - auxiliary relays, voltage regulating relays, line drop compensation, gas relay types, gas relay scheme operation and setting, over temperature schemes

T7 Polyphase systems and its application towards the calculation of circuits' conditions encompassing:

- Structure of a three phase system - components, sequence of phases and balanced and unbalanced load conditions

REQUIRED SKILLS AND KNOWLEDGE

- Calculations of phase and line voltages for a specified phase sequence
- Calculation of voltage, current, power, power factor in a three phase system - balanced three phase systems, unbalanced delta connected loads, unbalanced four-wire star connected loads, unbalanced three-wire star connected loads and unbalanced four-wire star connected systems
- Calculation of the neutral displacement voltage in unbalanced three-wire star connected systems
- Selection and connection of meters to confirm calculations
- Control of harmonics - harmonic analysis of non-sinusoidal waves of voltage and current, production of harmonics in three phase power systems, effects of harmonics on three power systems and loads, types of harmonics commonly encountered on three phase power systems and identification by observation of harmonic components present in a waveform
- Calculation of effective value of non-sinusoidal waves
- Calculate the current/voltage in a complex load given a voltage/current with a Fourier analysis of up to 3 terms
- Pre-unit system in calculations - reasons for use, groups of parameters commonly represented, common applications of the per-unit system to represent device specifications and applications of per-unit quantities in simple electrical calculations
- Method of symmetrical components - reasons for the use, types of components used to represent a three phase system, reasons for difference in the impedance of a component to the various symmetrical components and commonly occurring relationships between different sequence impedances for common component groups

T8 Protection schemes encompassing:

- Standards, codes, legislation, supply authority regulations and or enterprise requirements applicable to protection schemes
- Types of protection schemes - reasons for use, application of protection zones around system elements and degree of protection
- Types of feeder protection equipment - over current protection inverse time-current operating characteristics
- Operation of over current protection equipment used on distribution systems
- Operation of ACRs and their time-current characteristics
- Types and characteristics of over-current relays
- Coordination methods of a distribution feeder protection scheme
- Earth fault protection used on a distribution feeder
- Operation of a single wire earth return (S.W.E.R) system

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 – UET12”. 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 at least two (2) designs from each of two (2) of the following project types:	Distribution overhead designs Distribution underground designs Distribution substations 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 development of high voltage and low voltage distribution protection systems

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 development of high voltage and low voltage distribution protection systems and may include the following equipment:

ACR, regulator, earthing, air break switches, gas switches, capacitor units, transformers, links, fuses, sectionalisers, lighting arrestors, HV Switchgear, LV Switchgear, control boxes, communications equipment, , supervisory cable, cable TV, Substations, relevant protection systems 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

RANGE STATEMENT

- 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.