



Australian Government

Department of Education, Employment and Workplace Relations

UETTDRTS36A Commission complex network protection and control systems

Release: 1

UETTDRTS36A Commission complex network protection and control systems

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor

1) Scope:

1.1) Descriptor

This Competency Standard Unit covers the commissioning of network protection and control systems in complex situations and includes isolation, inspection, monitoring, testing, adjustment, and repair, refurbishment and or overhaul and functional checks. It includes schemes from discrete and interdependent and also schemes such as, distance, differential, transformer differential, bus zone, bus overcurrent, revenue metering, current transformer accuracy, SCADA, communications, harmonic control, point on wave, HV plant testing.

Application of the Unit

Application of the Unit 2)

This competency standards unit is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 6 or higher.

Licensing/Regulatory Information

License to practice 3)

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

License to practice**3)**

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

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

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

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

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

Common Unit Group

Unit Code	Unit Title
UEENEED104A	Use engineering applications software on personal computers
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
UEENEEE124A	Compile and produce an energy sector detailed report
UEENEEE125A	Provide engineering solutions for problems in complex multiple path

Prerequisite Unit(s)	4)	circuits problems
	UEENEEE126A	Provide solutions to basic engineering computational problems
	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
	UETTDRTS21A	Maintain interdependent network protection and control systems
	UETTDRTS22A	Commission interdependent network protection and control systems
	UETTDRTS29A	Develop power systems secondary isolation instructional documents
	UETTDRTS35A	Maintain complex network protection and control 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 the commissioning of network protection and control systems (complex)	1.1	OHS practices/procedures and environmental and sustainable energy procedures, which may influence the commissioning of, network protection and control systems (complex) are reviewed and determined.
		1.2	Purpose of the commissioning of network protection and control systems (complex) is established after data is analysed and expected outcomes of the work are confirmed with the appropriate personnel.
		1.3	Organisational established procedures on policies and specifications for the commissioning of network protection and control systems

ELEMENT	PERFORMANCE CRITERIA
	(complex) are obtained or established with the appropriate personnel.
	1.4 Testing procedures are discussed with/directed to the appropriate personnel in order to ascertain the project brief.
	1.5 Testing parameters are established from organisational established procedures on policies and specifications
	1.6 Equipment/tools and personal protective equipment is selected based on specified Performance Criteria and established procedures.
	1.7 Work roles and tasks are allocated according to requirements and individuals' competencies.
	1.8 Work is prioritised and sequenced for the most efficient/effective outcome, completed within an acceptable timeframe to a quality standard and in accordance with established procedures.
	1.9 Liaison and communication issues with other/authorised personnel, authorities, clients and land owners are resolved and activities coordinated to carry out work.
	1.10 Risk control measures are identified, prioritised and evaluated against the work schedule.
	1.11 Relevant work permits are secured to coordinate the performance of work according to requirements and/or established procedures.
2 Carry out the commissioning of network protection and control systems (complex)	<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 incidents of accidents and minimise waste are incorporated into the project in accordance with requirements and/or established procedures.</p> <p>2.3 Commissioning of network protection and control systems (complex) decisions are made on the basis of safety and effective outcomes</p>

ELEMENT**PERFORMANCE CRITERIA**

- according to requirements and/or established procedures.
- 2.4 Mathematical and/or engineering models of the schemes 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 Testing of network protection and control systems (complex) is undertaken according to requirements and established procedures.
- 2.8 Work teams/groups are arranged/coordinated/evaluated to ensure planned goals are met according to established procedures.
- 2.9 Solutions to non-routine problems are identified and actioned, using acquired essential knowledge and associated skills, according to requirements.
- 2.10 Quality of work is monitored against personal performance agreement and/or established organisational and professional standards.
- 2.11 Strategic plans are developed incorporating organisation initiatives as per established procedures.

ELEMENT	PERFORMANCE CRITERIA
3 Complete the commissioning of network protection and control systems (complex)	<p>3.1 Final inspections of the network protection and control systems (complex) are undertaken to ensure they comply with all requirements and include all specifications and documentations needed to complete the project.</p> <p>3.2 Appropriate personnel are notified of completion and reports and/or completion documents are finalised/commissioned.</p> <p>3.3 Reports and/or completion documents are submitted to relevant personnel/organisations for approval and, where applicable, statutory or regulatory approval.</p> <p>3.4 Approved copies of the commissioning of network protection and control systems (complex) documents are issues and records are updated in accordance with established procedures.</p>

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 commissioning network protection and control systems (complex).

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

KS01-TTS36A Complex network protection and control systems - commissioning

Evidence shall show an understanding of complex network protection and control systems – commissioning to an extent indicated by the following aspects:

T1 Principles of Statutory and safety considerations encompassing:

- Commonwealth/State/Territory legislation, standards, codes, supply authority regulations and or enterprise requirements associated with working on High Voltage
- Particular reference to State and Territory regulations regarding - working near energised conductors, electrical access, heights, confined space, testing procedures, licensing rules.

T2 Electrical equipment associated with protection and control schemes encompassing:

- Types and applications of electrical equipment – characteristics, capabilities (schemes: overcurrent, frame leakage, cooling, buchholz, DC supplies, restricted earth, sensitive earth fault, CB fail, reclose, DC frame leakage, CEL Fail, under frequency load shed and earth fault)

T3 Principles of isolation and tagging procedures associated with protection testing encompassing:

- Standards, codes, Commonwealth/State/Territory legislation, supply authority regulations and or enterprise requirements associated with the installation, maintenance, isolation and tagging procedures
- Requirements for the use of, isolation and tagging, manuals, system diagrams/plans and drawings
- Techniques in documenting isolations
- Techniques in appropriate isolation and tagging procedures as per Commonwealth/State/Territory legislation, supply authority regulations and enterprise standards
- Techniques in the installation and maintenance procedures protection devices as per Commonwealth/State/Territory legislation, supply authority regulations and enterprise standards

T4 Maintenance and commissioning procedures associated with discrete

REQUIRED SKILLS AND KNOWLEDGE

protection schemes encompassing:

- Standards, codes, Commonwealth/State/Territory legislation, supply authority regulations and or enterprise requirements associated with the maintenance and commissioning procedures
- Requirements for the use of maintenance and commissioning manuals, system diagrams/plans and drawings
- Techniques in maintenance and commissioning procedures – planning, policy, testing techniques
- Close out requirements

T5 Relay manufacturer specifications encompassing:

- Standards, codes, Commonwealth, State/Territory and local government legislation, supply authority regulations and or enterprise requirements applicable to the use and application of relay manufacturer specifications
- Requirements for the use of relay manufacturer manuals, system diagrams/plans and drawings
- Types, function and characteristics of specific relays - differences between specific relays used for the same functionality

T6 Safe handling and/or disposing of insulation materials used in power distribution devices, which are potential environmental pollutants encompassing:

- Standards, codes, Commonwealth, State/Territory and local government legislation, supply authority regulations and or enterprise requirements applicable to the handling and disposing of insulation or heat dissipation materials used in power distribution devices
- Identification of environmental issues associated with the handling and disposing of insulation materials
- Safety precautions when handling and disposing of heat dissipation materials - safe working practices, Occupational Health and Safety hazards and precautions, identification of hazards, assessing and controlling risks, types, selection, maintenance and uses of personnel protective equipment, permit to work systems and isolation procedures, types and function of specialised equipment, safe working practices when using specialised equipment, emergency response and rescue including First Aid etc.
- Techniques in the handling and disposing of insulation materials - Polychlorinated Bi-Phenyls (PCB's), asbestos, insulating Oil, SF6 gas.

T7 Procedure to undertake a visual inspection of a scheme encompassing:

- Standards, codes, Commonwealth/State/Territory legislation, supply authority regulations and or enterprise requirements associated with visual inspection procedures of a scheme
- Requirements for the use of manuals, system diagrams/plans and drawings
- Identify obvious deficiencies in operating to the standard functionality
- Techniques in determining relay malfunction - targeting

REQUIRED SKILLS AND KNOWLEDGE

- Techniques in determining wiring defects

T8 Operation and maintenance procedures associated with discrete protection and control systems encompassing:

- Standards, codes, Commonwealth/State/Territory legislation, supply authority regulations and or enterprise requirements associated with operating procedures
- Requirements for the use of operating manuals, system diagrams/plans and drawings
- Techniques - gas collection and analysis, bleeding and resetting, calibration, operational and sensitivity checks, trip and alarm checks
- Surge relay types and uses, including transformer main tanks, diverter switch chambers

T9 Commissioning procedures associated with discrete protection and control systems encompassing:

- Standards, codes, Commonwealth/State/Territory legislation, supply authority regulations and or enterprise requirements associated with the commissioning procedures
- Requirements for the use of commissioning manuals, system diagrams/plans and drawings
- Techniques in commissioning procedures – planning, policy, testing techniques, close out requirements.

T10 Measurements and the interpretation and analysis of those measurements related to the plant and/or equipment type encompassing:

- Type of measurements - timing, current, voltage, capacitance, inductance, impedance, phase angle, phase shift, resistance, dielectric dissipation factor, frequency, polarisation index, ratio, vector group, temperature
- Interpretation and analysis the use of techniques - digital comparison of data, extrapolation, use of graphs and charts, statistics and tables, mathematical calculation of expected values and comparison with manufacturers data and measurements
- Techniques in the processes involved in follow-up actions and recommendations resulting from analysis and interpretation of results and measurements.

T11 Principles of power transformer construction and operations encompassing:

- Applications of static reactive plant in high voltage networks, including voltage control, VAR control, transient response capacity
- Types of static reactive plant including high voltage capacitors, high voltage reactors, static VAR compensators and combinations of these
- Operating characteristics and operational constraints including point on wave switching issues
- Ratings, cooling systems and control systems and ancillary equipment used
- Configurations and system layout including single star, double star, bridge type
- Typical protection systems used including neutral unbalance current, neutral

REQUIRED SKILLS AND KNOWLEDGE

unbalance voltage

- Techniques used when balancing elements within static reactive plant
- Safety precautions when testing and maintaining high voltage static reactive plant - safe working practices and procedures, identification of hazards, assessment and control of OHS risks, types, selection, maintenance and use of personal protective equipment.

T12 Types and applications of test equipment encompassing:

- Standards, codes, Commonwealth, State/Territory and local government legislation, supply authority regulations and or enterprise requirements applicable to the use and application of electrical and/or electronic test equipment
- Types and applications of test equipment used on discrete protection scheme
- Techniques in the use of test equipment - electronic test equipment (Doble, Ohmicrome), gas injection equipment, manufactures test equipment, multimeters, phase angle meters, meggers

T13 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

T14 Detailed operation of interdependent protection systems encompassing:

- Overcurrent and earth leakage schemes including intertripping, interlocking and blocking - logic mapping, master control, electromechanical, electronic, shading coils
- Pilot wire, phase comparison - opposed voltage schemes, circulating current schemes, location of components of a scheme, pilot supervisory techniques,
- Load shedding, voltage control, parallel operation, load rejection
- Busbar Protection and CB failure protection
- Reclose systems - applications, single shot, multishot, blocking schemes, synchronisation checking.

T15 Detailed operation of complex protection systems encompassing:

- Distance - characteristics, electromechanical, electronic, impedance, mho, offset mho, switched schemes, non-switched schemes, blocking schemes, bus zone
- Differential, transformer differential, bus overcurrent - principles, feeder protection, transformer protection, bias systems, harmonic restraint, CT

REQUIRED SKILLS AND KNOWLEDGE

connections, bus protection, low impedance schemes, high impedance schemes, bus overcurrent schemes, generator protection, CT connections, special considerations, digital systems

- Types of revenue metering
- Applications of SCADA
- Complex protection systems for communications
- Harmonic control
- Point on wave switching.

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	Do all of the following: Note: Utilise different schemes from within the complex schemes in the Range Statement of this unit.	Commissioning of a protection and control system involving five (5) complex schemes
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 commissioning of network protection and control systems (complex).

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 Transmission, Distribution and Rail Traction Industry. 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 concurrent assessment recommendations 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 commissioning of network protection and control systems (complex) and may include the following:

Discrete: overcurrent, earth fault, frame leakage, cooling, busbar, DC supplies, restricted earth, sensitive earth fault, CB fail, reclose, DC frame leakage, CEL fail, under frequency load shed;

Interdependent: instrument transformers, trip/control circuits, alarms, DC supplies, CB fail protection, master controlled earth fault, intertripping, blocking, synchronising, pilot wire, phase comparison, load shedding, voltage control, parallel operation, load rejection, circuit isolations and restorations, mechanical adjustments, calibration, function tests, reporting, signals, thermals, contraphase, backup, reverse current;

Complex: distance, differential, transformer differential, bus zone, bus overcurrent, revenue metering, current transformer accuracy, SCADA, communications, harmonic control, point on wave, HV plant testing.

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

RANGE STATEMENT

- Identifying hazards
- Inspect
- Legislation
- MSDS
- Notification
- OHS practices
- OHS issues
- Permits and/or permits to work
- Personnel
- Quality assurance systems
- Requirements
- Testing procedures
- Work clearance systems

Unit Sector(s)

Not applicable.

Competency Field

Competency Field **11)**
Testing Units