



**Australian Government**

# **UETDRTS001 Commission complex network protection and control systems**

**Release: 1**

# **UETDRTS001 Commission complex network protection and control systems**

## **Modification History**

Release 1. This is the first release of this unit of competency in the UET Transmission, Distribution and Rail Sector Training Package Release 2.0.

## **Application**

This 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 schemes, such as distance, differential, transformer differential, bus zone, bus overcurrent, revenue metering, current transformer accuracy, supervisory control and data acquisition (SCADA), communications, harmonic control, point on wave and high voltage (HV) plant testing.

The application of the skills and knowledge described in this unit may require a licence/registration to practice in the workplace subject to regulations for undertaking of electrical work.

Other conditions may apply under state and territory legislative and regulatory licensing requirements which must be confirmed prior to commencing this unit.

## **Pre-requisite Unit**

UEENED104A 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 circuits

UEENEEE126A Provide solutions to basic engineering computational problems

UEENEEG101A Solve problems in electromagnetic devices and related circuits

UEENEEG102A Solve problems in low voltage a.c. circuits

UEENEEG149A Provide engineering solutions to problems in complex polyphase power circuits

UETDREL001 Apply environmental requirements

UETDREL005 Work safely in the vicinity of live electrical apparatus

UETDRIS005 Implement & monitor power system environmental & sustainable energy management policies & procedures

UETDRIS006 Implement and monitor the power system organisational WHS/OHS policies, procedures and programs

UETDRTS004 Commission interdependent network protection and control systems

UETDRTS010 Develop power systems secondary isolation instructional documents

UETDRTS015 Maintain complex network protection and control systems

UETDRTS017 Maintain interdependent network protection and control systems

## Competency Field

Testing

## Unit Sector

Not applicable.

## Elements and Performance Criteria

### ELEMENTS

Elements describe the essential outcomes.

#### **1 Plan for the commissioning of network protection and control systems (complex)**

### PERFORMANCE CRITERIA

Performance criteria describe the performance needed to demonstrate achievement of the element.

- 1.1** Work health and safety (WHS)/occupational health and safety (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 appropriate personnel
- 1.3** Organisational established procedures on policies and specifications for the commissioning of network protection and control systems (complex) are obtained or established with appropriate personnel
- 1.4** Testing procedures are discussed with/directed to appropriate personnel in order to ascertain the project

brief

- 1.5** Testing parameters are established from organisational established procedures and policies and specifications
  - 1.6** Equipment/tools and personal protective equipment (PPE) are selected based on specified performance criteria and established procedures
  - 1.7** Work roles and tasks are allocated according to requirements and individual 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 others/authorised personnel, authorities, clients and landowners 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)**
- 2.1** Circuit/systems modelling is used to evaluate alternative proposals in accordance with established procedures
  - 2.2** WHS/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
  - 2.3** Commissioning of network protection and control systems (complex) decisions are made on the basis of safety and effective outcomes 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 in accordance with 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 in accordance with established procedures
- 3 Complete the commissioning of network protection and control systems (complex)**
- 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
  - 3.2 Appropriate personnel are notified of completion and reports and/or completion documents are finalised/commissioned
  - 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 the commissioning of network protection and control systems (complex) documents are issued and records are updated in accordance with established procedures

## Foundation Skills

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

## Range of Conditions

Range is restricted to essential operating conditions and any other variables essential to the work environment.

Non-essential conditions may be found in the UET Transmission, Distribution and Rail Sector Training Package Companion Volume Implementation Guide.

## Unit Mapping Information

This unit replaces and is equivalent to UETTDRTS36 Commission complex network protection and control systems.

## Links

Companion Volume Implementation Guides are found in VETNet -  
<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=229bace1-b7bc-4653-9300-dffb13ecfad7>

# **Assessment Requirements for UETDRTS001 Commission complex network protection and control systems**

## **Modification History**

Release 1. This is the first release of this unit of competency in the UET Transmission, Distribution and Rail Sector Training Package Release 2.0.

## **Performance Evidence**

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements and performance criteria on at least two separate occasions and include:

- applying relevant work health and safety (WHS)/occupational health and safety (OHS) requirements, including the use of risk control measures
- applying sustainable energy principles and practices
- commissioning of a protection and control system, including at least five (5) complex schemes
- dealing with unplanned events on at least one (1) occasion.

## **Knowledge Evidence**

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements and performance criteria and include knowledge of:

- 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 (HV)
  - particular reference to state and territory regulations - working near energised conductors, electrical access, heights, confined space, testing procedures and licensing rules
- electrical equipment associated with protection and control schemes encompassing:
  - types and applications of electrical equipment – characteristics, capabilities (schemes: overcurrent, frame leakage, cooling, buchholz, direct current (d.c.) supplies, restricted earth, sensitive earth fault, circuit breaker fail, reclose, d.c. frame leakage, CEL fail, under frequency load shed and earth fault)
- 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 in accordance with Commonwealth/state/territory legislation, supply authority regulations and enterprise standards
- techniques in the installation and maintenance procedures protection devices in accordance with Commonwealth/state/territory legislation, supply authority regulations and enterprise standards
- maintenance and commissioning procedures associated with discrete 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 and testing techniques
  - close out requirements
- 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
- 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; WHS/OHS hazards and precautions; identification of hazards; assessing and controlling risks; types, selection, maintenance and uses of personnel protective equipment (PPE); permit to work systems and isolation procedures; types and function of specialised equipment; safe working practices when using specialised equipment; and emergency response and rescue including first aid e
  - techniques in the handling and disposing of insulation materials - polychlorinated biphenyl (PCB), asbestos, insulating oil and sulphur hexafluoride (SF6) gas
- 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
  - identifying obvious deficiencies in operating to the standard functionality

- techniques in determining relay malfunction - targeting
- techniques in determining wiring defects
- 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, and trip and alarm checks
  - surge relay types and uses, including transformer main tanks and diverter switch chambers
- 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 and close out requirements
- 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 and 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 manufacturer data and measurements
  - techniques in the processes involved in follow-up actions and recommendations resulting from analysis and interpretation of results and measurements
- principles of power transformer construction and operations encompassing:
  - applications of static reactive plant in HV networks, including voltage control, volt-ampere reactive (VAR) control and transient response capacity
  - types of static reactive plant, including HV capacitors, HV reactors, static VAR compensators (SVC) 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 and bridge type
  - typical protection systems used, including neutral unbalance current and neutral unbalance voltage
  - techniques used when balancing elements within static reactive plant
  - safety precautions when testing and maintaining HV static reactive plant - safe working practices and procedures; identification of hazards; assessment and control of WHS/OHS risks; types, selection, maintenance and use of PPE

- 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 and Ohmmicrome), gas injection equipment, manufacturer test equipment, multimeters, phase angle meters and meggers
- 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 and backup protection
  - overcurrent protection - feeder overcurrent protection, instantaneous overcurrent schemes, inverse timed overcurrent schemes, types and location of components of an overcurrent scheme, current transformer summation, time graded discrimination and backup protection
  - alarms and controls - auxiliary relays, voltage regulating relays, line drop compensation, gas relay types, gas relay scheme operation and setting, and over temperature schemes
- detailed operation of interdependent protection systems encompassing:
  - overcurrent and earth leakage schemes, including inter-tripping, interlocking and blocking - logic mapping, master control, electromechanical, electronic and shading coils
  - pilot wire and phase comparison - opposed voltage schemes, circulating current schemes, location of components of a scheme and pilot supervisory techniques
  - load shedding, voltage control, parallel operation and load rejection
  - busbar protection and circuit breaker failure protection
  - reclose systems - applications, single shot, multi-shot, blocking schemes and synchronisation checking
- detailed operation of complex protection systems encompassing:
  - distance - characteristics, electromechanical, electronic, impedance, mho, offset mho, switched schemes, non-switched schemes, blocking schemes and bus zone
  - differential, transformer differential and bus overcurrent - principles, feeder protection, transformer protection, bias systems, harmonic restraint, current transformer connections, bus protection, low impedance schemes, high impedance schemes, bus overcurrent schemes, generator protection, current transformer connections, special considerations and digital systems
  - types of revenue metering
  - applications of supervisory control and data acquisition (SCADA)
  - complex protection systems for communications
  - harmonic control
  - point on wave switching.

## Assessment Conditions

Assessors must hold credentials specified within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must satisfy the Principles of Assessment and Rules of Evidence and all regulatory requirements included within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must occur in workplace operational situations where it is appropriate to do so; where this is not appropriate, assessment must occur in simulated conditions involving realistic and authentic activities that replicate operational workplace conditions.

Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.

Resources for assessment must include access to:

- a range of relevant exercises, case studies and/or other simulations
- relevant and appropriate materials, tools, facilities, equipment and PPE currently used in industry
- applicable documentation, including workplace procedures, relevant industry standards, equipment specifications, regulations, codes of practice and operation manuals.

## Links

Companion Volume Implementation Guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=229bace1-b7bc-4653-9300-dffb13ecfad7>