



**Australian Government**

# **UETDRTS006 Conduct evaluation of power system substation faults**

**Release: 1**

# **UETDRTS006 Conduct evaluation of power system substation faults**

## **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 procedure in evaluating power system incidents by following a process of downloading event and disturbance record information from protection relays. This includes interpreting items, such as alarms, relay targets, relay settings, event records, disturbance records and sequence of events records. It also encompasses the evaluation and/or investigation of relay operation, relay schemes functionality and relay settings.

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**

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 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

## Competency Field

Testing

## Unit Sector

Not applicable.

## Elements and Performance Criteria

### ELEMENTS

Elements describe the essential outcomes.

#### **1 Plan for the evaluation of power system events**

### 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 evaluation of power system failures, are reviewed and determined
- 1.2** Purpose of the evaluation of power system events are 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 evaluation of power system failures 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 on 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 evaluation of power system events**
  - 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** Following evaluation of power system events, 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 evaluation of power system events 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 power system 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 evaluation of power system events**
- 3.1** Final evaluation of all relevant data pertaining to the power system event is undertaken to ensure the recommendations 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 evaluation of power system event 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 UETTDRTS23 Conduct evaluation of power system substation faults.

## 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 UETDRTS006 Conduct evaluation of power system substation faults

## 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
- demonstrating at least two (2) downloads from protection relays or recording equipment from each of the following:
  - relay panel
  - remote location
- developing five (5) evaluation reports on power system events, including all of the following:
  - interpretation of targets in a substation
  - interpretation of fault reports
  - interpretation of downloaded event data
  - development of valid conclusions and recommendations
- 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:

- WHS/OHS enterprise responsibilities encompassing:
  - provisions of relevant WHS/OHS legislation
  - principles and practice of effective WHS/OHS 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 WHS/OHS management
  - relevance of enterprise management systems to WHS/OHS management
  - analysis of working environment and design of appropriate WHS/OHS management

systems

- analysis of relevant data and evaluation of WHS/OHS system effectiveness
- assess resources to establish and maintain WHS/OHS management systems
- 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 WHS/OHS risks
  - types and application of power distribution network documentation drawings and 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, and instructions/worksheets
  - interpretation of different diagrams and documentation on low voltage (LV) and high voltage (HV) systems - overhead distribution extensions, underground distribution extensions, distribution substations and street lighting systems
- 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 of 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
- system components and layouts encompassing:
  - distribution system layouts - overhead/underground, urban/rural, HV customers, high-rise building systems, three phase lines, single phase lines, single wire earth return (SWER) systems, spur, parallel and ring systems, and typical substation types
  - transmission system layouts - lines, buses, transformers and cables; line/bus layouts, including single, double, ring and breaker and half systems, and HV crossing methods
- 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 and first approximation techniques
  - interrupting device capabilities - determination of fault current breaking capability and let through energy capability of fuses and circuit breakers, direct current (d.c.) offset and transient condition effects
- 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 and 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, 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 and need for interfacing
- protection applied to buses - overload, differential, earth leakage, structure leakage, combined schemes and protection overlap
- protection applied to transformers - biased differential, gas, winding temperature and oil temperature
- protection applied to single/radial lines - overcurrent, earth leakage, slow earth leakage, distance, auto reclose, sectionalising and over voltage
- protection applied to interconnected lines - overcurrent, pilot wire, directional, directional overcurrent, current differential, phase comparison, current comparison, distance, impedance, admittance and offset
- 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, 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, 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 personal protective equipment (PPE) currently used in industry
- applicable documentation, including workplace procedures, relevant industry standards, equipment specifications, regulations, codes of practice and operation manuals
- working at realistic heights above ground, i.e., above three metres, in limited spaces, with different structural/construction types and method and in a variety of environments.

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