



Australian Government

UETDRDS006 Develop high voltage and low voltage distribution protection systems

Release: 1

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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 development of appropriate protection systems for high voltage (HV) and low voltage (LV) distribution networks, including calculations of fault levels, selection of appropriate protection devices and automation requirements, and protection coordination schemes. It 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.

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

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

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

Design

Unit Sector

Not applicable.

Elements and Performance Criteria

ELEMENTS

Elements describe the essential outcomes.

1 Plan and coordinate for the development of HV and LV protection systems

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 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 appropriate personnel
- 1.3** Organisational established procedures on policies and specifications for the development are obtained or established with appropriate personnel
- 1.4** Equipment/tools and personal protective equipment (PPE) 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
- 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 PPE, required for the job are identified, scheduled and coordinated and confirmed safe and in technical working order
- 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** 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

- 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 incidence of accidents and minimise waste are incorporated into the project in accordance with requirements and/or established procedures
- 2.3** System design decisions are made on the basis of safety and effective outcomes according to requirements and/or established procedures
- 2.4** Mathematical models of the HV and LV protection systems 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	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

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 UETTDRDS43 Develop high voltage and low voltage distribution protection 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 UETDRDS006 Develop high voltage and low voltage distribution protection systems

Modification History

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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
- completing at least two (2) designs from two (2) of the following project types:
 - distribution overhead designs
 - distribution underground designs
 - distribution substation designs
- 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 systems
 - analysis of relevant data and evaluation of WHS/OHS system effectiveness
 - assess resources to establish and maintain WHS/OHS management systems
- 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
- installation of switchgear and associated equipment encompassing:
 - types and function of various switchgear:
 - isolators, air-break switches, gas-filled switches, vacuum type, links, fuses, oil disconnectors, fuse switches and circuit breakers
 - operating characteristics
 - advantages and disadvantages of different types of switchgear
 - installation procedures
 - earthing requirements and techniques
 - types of equipment:
 - transformers, reactors, regulators, capacitors, relays, surge arrestors, fault indicators and mobile generators
 - installation procedures for switchgear and equipment:
 - 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 (ESI) standards and procedures
 - testing and commissioning:
 - ESI standards and procedures
- 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 (ACRs), gas switches, secondary injection tests, primary injection tests, TMR radios, supervisory control and data acquisition (SCADA), remote control, overcurrent, earth fault, sensitive earth fault, inverse time curves, definite time curves, tripping, reclose, direct current (DC) supplies, alternating current (AC) supplies and alarms
- 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
- 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
- polyphase systems and its application towards the calculation of circuit conditions encompassing:
 - structure of a three phase system:
 - components, sequence of phases and balanced and unbalanced load conditions
 - 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
- 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
 - identification by observation of harmonic components present in a waveform
- calculation of effective value of non-sinusoidal waves
- calculation of 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
 - 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
- 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:
 - overcurrent protection inverse time-current operating characteristics
 - operation of overcurrent protection equipment used on distribution systems
 - operation of ACRs and their time-current characteristics
 - types and characteristics of overcurrent relays
 - coordination methods of a distribution feeder protection scheme
 - earth fault protection used on a distribution feeder

- operation of a single wire earth return (SWER) system.

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 for high voltage (HV) and low voltage (LV) distribution protection systems
- applicable documentation, including workplace procedures, relevant industry standards, equipment specifications, regulations, codes of practice and operation manuals.

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