



Australian Government

Assessment Requirements for UETDRDS003 Design power system distribution substations

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.

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 six (6) technical designs of a distribution substation relating to at least two of the following project types:
 - multi-transformer substations
 - residential developments
 - industrial/commercial developments
 - alteration to existing assets
- completing designs, including:
 - activities that address the correction of errors in the process
 - application of a design control checklist, which lists all of the required design activities to be carried out in this process
- 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:

- mathematics techniques encompassing:
 - calculations involving fractions, decimals, ratios and proportions
 - calculations involving area, volume, mass and density
 - calculations involving transposition and substitution of formulae
 - calculations involving simple trigonometric problems
- engineering mechanics encompassing:
 - identification of basic concepts, principles and applications:
 - application of velocity, acceleration, force, density, torque and pressure

- applications of the International System of Units (SI) units
- the relationship between work, power and energy
- behaviour of object under force:
 - using a block and tackle under load
 - concept of mechanical advantage
 - determination of resultant forces and determining the sag in a catenary conductor and the force applied at each end
- fundamentals of the basic laws of fluid mechanics
- materials properties encompassing:
 - identification and classification of engineering materials material properties
 - types and applications:
 - properties of tensile strength
 - effects of temperature on the expansion of metals
 - ductility, malleability, work hardening and annealing and the conditions that lead to corrosion and the properties of timbers
- generation systems encompassing:
 - methods of generating electricity:
 - types of power stations and reasons for their location
 - layout of thermal and hydroelectric power stations
 - relationship between power control and load requirements:
 - operating speeds for thermal and hydroelectric generating sets
 - typical generator voltage levels and output ratings
 - the purpose and features of typical types of co-generation systems
- substations and power transformers encompassing:
 - relationship between the substations within an overall power system:
 - purpose and location in relation to load centres
 - layout of high voltage (HV) equipment within the substation and auxiliary equipment
 - characteristics of a power transformer:
 - basic construction of distribution transformers
 - operation under load/no load conditions
 - types and basic operation of tap changing switches, including solid state types, efficiency and cooling
 - auxiliary equipment used on transformers:
 - function and basic operation
 - maintenance of a power transformer:
 - basic connections
 - restrictions to parallel operation
 - problems and remedies associated with harmonics
 - testing and fault-finding procedures
 - characteristics of a power transformer:

- description and purpose
- the installation of metering and control equipment encompassing:
 - standards, codes, legislation, supply authority regulations and/or enterprise requirements pertaining to the installation and maintenance of energy meters and associated equipment
 - types of meters:
 - kilowatt-hour meters single and polyphase
 - demand meters
 - recording meters and electronic recording metering systems summators
 - installation and removal methods:
 - direct connection and plug in method
 - enterprise specific
 - types of associated equipment and accessories:
 - meter boards, service fuse, links, contactors, time switch and audio frequency injection relay
 - testing procedures:
 - safety and polarity testing
- principles of statutory and safety considerations encompassing:
 - Commonwealth/state/territory legislation, standards, codes, supply authority regulations and/or enterprise requirements associated with working on HV systems
 - particular reference to state and territory regulations regarding working near energised conductors, electrical access, heights, confined space, testing procedures and licensing rules
- the 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, including:
 - 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 (ESI) standards and procedures

- testing and commissioning:
 - ESI standards and procedures
- HV distribution transformer principles encompassing:
 - operation of HV distribution transformers:
 - principle governing factors for transformer ratings, protection and alarms
 - operating limitations and the relationship between transformer and HV fuse rating
 - purpose and principle operation of HV distribution transformer tap changers
 - HV distribution transformer and transformer - cable combination switching practices, paralleling requirements, isolation and earthing procedures for access, common distribution transformer and associated electrical apparatus faults
 - HV underground switching equipment:
 - arc strangles, switch operation, load break elbows, switching cubicles, canister fuses, bayonet fuses, F and G switching cubicles, voltage indicators and phasing testers
- feeder automation system encompassing:
 - function of feeder automation system and the main components
 - operation procedure for a remote field device from a local control station
 - functions of supervisory control and data acquisition (SCADA) (or any other relevant data acquisition and control) systems and its main components
 - SCADA system security interlocks and access restrictions
 - SCADA system operation when switching apparatus or retrieving data via a remote access device, such as remote access terminal (RAT), dial up voice annunciated system and local control station
 - function of the main components of a local/remote control system
 - operation of a field devices using SCADA systems via a RAT, dial up annunciated system and local control station
- environmental fundamentals encompassing:
 - environmental standards, codes, environmental legislation, supply authority regulations and/or enterprise requirements applicable to the control of environment associated with the worksite encompassing, relevant federal legislation, relevant state/territory legislation, relevant local government by-laws, relevant government or quasi government policies and regulations and relevant community planning and development agreements (land care agreements)
 - employer and employee responsibilities
 - methods of obtaining information on environmental issues and updates
 - methods of identifying environmental impacts from work related activities
 - meaning of environmental terms encompassing:
 - identification, assessment and control of risks
 - compliance and best practice and sustainable energy
 - procedures in implementing management plans to ensure compliance
- layout principles for a distribution substation minor upgrade encompassing:
 - Commonwealth, state/territory and local government legislation, standards, codes, supply authority regulations and/or enterprise requirements applicable to a distribution substation

minor upgrade

- requirements for the use of distribution substation minor upgrade construction manuals, system diagrams/plans and drawings and for plans such as work method statements for the control of WHS/OHS risks
- methods in determining material, equipment and tool lists:
 - components types and quantity required
 - spacing of components and equipment
 - costings of items and components
- purchasing and contractual arrangements, including requirements to eliminate WHS/OHS hazards, minimise risks and provide residual WHS/OHS risk information
- determination of conductor size, type and route length
- resources needed for the laying of conductors, cables and equipment
- determining the appropriate installation sequence
- minimum clearances between conductors and equipment
- estimation of the duration of underground distribution extension project
- fundamentals of distribution transformers encompassing:
 - standards, codes, legislation, supply authority regulations and/or enterprise requirements pertaining to the safe operation and testing of distribution transformers and auxiliary equipment
 - drawing layouts, conventions and symbols:
 - vector group of transformers
 - three phase transformers
 - construction of a distribution transformer
 - characteristics when operated under load and no-load conditions
 - percentage impedance determinations by test and calculation
 - function and operation of tap changing switches, including solid state tap changing equipment
 - function and operation of transformer auxiliary equipment
 - problems caused by harmonics in transformers
 - methods and equipment used to overcome harmonics in transformers
- testing procedures of distribution transformers encompassing:
 - safety precautions specific to the testing of distribution transformers
 - procedures for safely connecting distribution transformers for testing
 - testing of distribution transformers to determine losses
 - calculation of transformer's efficiency
 - methods and types of equipment used to cool transformers:
 - properties of transformer oil and tests performed on transformer oil
 - techniques in performing selected tests on transformer oil
 - techniques in performing testing procedures on armer
 - techniques in testing distribution transformers
 - distribution transformer parallel connections:

- conditions and restrictions for parallel operations
- calculations of loading on transformers operating in parallel
- connection of transformer in parallel to supply a common load
- distribution earthing system encompassing:
 - standards, codes, legislation, supply authority regulations and/or enterprise requirements applicable to the distribution earthing system
 - reason and types of distribution earthing systems
 - terminologies used in the earth systems including touch and step potential
 - conditions associated when an active HV conductor fails to earth
 - selection of earthing electrodes and grids
 - determination of the earthing resistance of copper clad rods using earthing monograms.

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.

Links

Companion Volume Implementation Guides are found in VETNet -

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