



Australian Government

UETTDRDS44 Design power system substations modifications

Release: 1

UETTD RDS44 Design power system substations modifications

Modification History

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

Application

This unit covers the design of modifications within a substation. This may include busbar upgrades, equipment replacement projects and basic secondary upgrades or supervisory control and data acquisition (SCADA) modifications. The design may include civil engineering aspects and must conform to safety regulations and environmental standards and incorporate the principles of safe design.

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 licencing requirements which must be confirmed prior to commencing this unit.

Pre-requisite Unit

Common Unit Group

UEENEEE101A Apply Occupational Health and Safety regulations, codes and practices in the workplace

UEENEEE102A Fabricate, assemble and dismantle utilities industry components

UEENEEE107A Use drawings, diagrams, schedules, standards, codes and specifications

UETTDREL11 Apply sustainable energy and environmental procedures

UETTDREL16 Working safely near live electrical apparatus

UETTD RIS62 Implement and monitor the power system organisational WHS/OHS policies, procedures and programs

UETTD RIS63 Implement & monitor power system environmental & sustainable energy management policies & procedures

Competency Field

Design

Unit Sector

Not applicable.

Elements and Performance Criteria

ELEMENTS

Elements describe the essential outcomes.

1 Plan for and coordinate the design of substations

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 design of substations, are reviewed and determined
- 1.2** Purpose of the design is established and expected outcomes of the work are confirmed with appropriate personnel
- 1.3** Established organisational procedures, policies and specifications for the design 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 land owners 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 design of substations**
 - 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 system are used to analyse the effectiveness of the finished project in accordance with requirements and established procedures
 - 2.5 Technical advice is given to 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**
 - 3.1 Final inspections of the design are undertaken to ensure they comply with all requirements and include all

the design of substations

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 Companion Volume Implementation Guide.

Unit Mapping Information

This unit replaces and is equivalent to UETTDRDS44A Design power system substations modifications.

Links

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

Assessment Requirements for UETTDRDS44 Design power system substations modifications

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 six (6) compliant technical designs of different components of a substation with at least one relating to each of the following project types:
 - primary equipment upgrades or replacements
 - secondary equipment upgrades or replacements
 - supervisory control and data acquisition (SCADA) modifications
- completing designs, including:
 - activities that address the correction of errors in designs
 - 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:

- electrical computations encompassing:
 - graph functions and applications:
 - linear, non-linear, parabolic, hyperbolic, logarithmic and exponential
 - complex numbers:
 - polar form and rectangular form
 - simultaneous equations
 - quadratic equations
 - phasor diagrams
 - star-delta transformations

- working safely on or around electrical equipment through the application of risk management principles and control measures for dealing with non-electrical hazards and extra-low voltage (ELV), low voltage (LV) and high voltage (HV) hazards and high current hazards encompassing:
 - risk management and assessment of risk:
 - principle and purpose of risk management and processes for conducting a risk assessment
 - hazards associated with LV, ELV and high currents:
 - arrangement of power distribution and circuits in an electrical installation
 - parts of an electrical system and equipment that operate at LV and ELV
 - parts of an electrical system and equipment where high currents are likely
 - risks and control measures associated with HV:
 - parts of an electrical system and equipment that operate at HV
 - the terms ‘touch voltage’, ‘step voltage’, ‘induced voltage’ and ‘creepage’ as they relate to the hazards of HV and control measures used for dealing with the hazards of HV
 - optical fibre safety:
 - coherent optical sources and joining procedures and laser safety class 3a devices or their replacement
 - risks and control measures associated with LV:
 - risks associated with modifying electrical installations
 - fault finding, maintenance and repair
 - control measures before, during and after working on electrical installations, circuits or equipment
 - isolation and tagging-off procedures
 - risks and restrictions in live work and control measures for live work
 - risks and control measures associated with harmful dusts and airborne contaminants:
 - thermal insulation, fibrous cement materials and asbestos and other fibre reinforced switchboard materials
 - safety, selection, use, maintenance and care of test equipment:
 - safety characteristics of electrical testing devices
 - safe use of electrical testing device
 - checks and storage methods for maintaining the safety of testing devices
- 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
- 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, location in relation to load centres, layout of 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 reactors:
 - description and purpose
- safe working on energised LV equipment encompassing:
 - standards, codes, Commonwealth, state/territory/local government legislation, supply authority regulations and/or enterprise requirements
 - safety precautions specific to working on or near energised LV conductors:
 - safe working practices and procedures
 - identification of hazards, assessment and control of WHS/OHS risks
 - types, selection, maintenance and use of personal protective equipment (PPE)
 - work on or near energised LV conductors:
 - types and function of specialised tools
 - safe working practices when using specialised tools
 - methods of using specialised tools
 - safe procedures for work on panels and in cubicles on or near energised LV conductors
 - release and rescue procedures for work on or near exposed energised LV conductors

- 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 testing 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
 - particular reference to state and territory regulations regarding 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 and capabilities
 - schemes, overcurrent, frame leakage, cooling, buchholz, direct current (DC) supplies, restricted earth, sensitive earth fault, circuit breaker (CB) fail, reclose, DC frame leakage, CEL fail, under frequency load shed and earth fault
- 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 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
- 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:
 - relevant federal, state/territory legislation, local government by-laws, government or quasi government policies and regulations and 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:
 - identification, assessment and control of risks
 - compliance, best practice and sustainable energy
 - procedures in implementing management plans to ensure compliance
- environmental fundamentals encompassing:
 - methods of obtaining updated environmental information and data sheets on the proper use and handling of equipment and materials
 - environmental standards, codes, environmental legislation, WHS/OHS legislation, hazardous substances/dangerous goods regulations, supply authority regulations and/or enterprise requirements applicable to environmental care when handling materials, including provision of manufacturers and supplier information, such as material safety data sheets (MSDS)
 - types and application of PPE used for hazards substances and dangerous goods
 - techniques in handling equipment to eliminate/reduce risks to the environment from spillages of oils, herbicides, pesticides and chemicals from equipment such as vehicle loading crane, chainsaw, enterprise vehicles and explosive power tools
 - procedures for handling and control of spillages of herbicides
 - methods of disposing and storage of herbicides, pesticides and chemicals

- methods of cleaning mobile plant, equipment and tools
- recording of data
- substation safety practices encompassing:
 - standards, codes, Commonwealth, state/territory/local government legislation, supply authority regulations and/or enterprise requirements pertaining to substation safety practices
 - techniques in the use of protective apparatus and apparel for substations work, including responsibilities with regard to the use and maintenance of protective apparatus and apparel and the types of protective apparatus and apparel used for work in substations
 - requirements for the use of ladders and appropriate ladder types for work in substations:
 - safe work methods when carrying, erecting, collapsing and lowering different types of extension ladder against substation structures, plant and equipment
 - maintenance checks on different types of ladders
 - renewal of extension ropes and the safety issues relating to clearances from energised conductors
 - requirements for climbing and working at heights in substations:
 - attached climbing principles,
 - selection, use and operation of elevated work platforms (EWP) and any WHS/OHS requirements associated with the use of EWP
 - control of small fires:
 - the identification, selection and operation of the appropriate extinguishing mediums for various types of fires and the precautions for personal protection when fighting small fires
 - control of oil spills:
 - the identification, use and maintenance of spill oil control equipment and materials, oil containment facilities and systems
 - rescue and release procedures:
 - the rescue personnel from energised conductors
 - emergency descent from an EWP
 - rescue from confined spaces
 - enterprise requirements:
 - safe access and authorisation to work procedures
 - use of mobile extendable equipment on or near energised HV conductors
 - emergency response procedures
 - hazards associated with work in substations, including earthing systems, transfer potentials, step and touch effects, electrostatic and electromagnetic induction and dangers of near approach to energised conductors
- design principles of HV insulation systems encompassing:
 - insulation design principles:
 - common materials used
 - electrical characteristics
 - thermal characteristics

- uses and applications to substation HV plant and equipment
- grading, construction and cooling
- common contaminants and their effects:
 - internal contaminants and external contaminants
- testing and measurement of insulation quality:
 - test types and common measuring instruments and techniques
 - resistance and resistivity, losses, measurement errors, temperature corrections and safe work practices related to testing and measurement
- safety precautions when testing and measuring HV insulation systems:
 - safe working practices and procedures
 - identification of hazards
 - assessment and control of WHS/OHS risks and types
 - selection, maintenance and use of PPE
- principles to design zone substation modifications encompassing:
 - Commonwealth, state/territory and local government legislation, standards, codes, supply authority regulations and/or enterprise requirements applicable to the zone substation design principles
 - requirements for the use of zone substation system construction manuals, system diagrams/plans and drawings and for plans such as work method statements for the control of WHS/OHS risks
 - types of designs:
 - substation modification design, including replacement of one item or a small quantity of items of primary plant, secondary equipment or SCADA equipment
 - full or partial retrofit of SCADA into an existing substation
 - types of zone substation primary plant:
 - HV circuit breakers, reclosers, power, current or voltage transformers, disconnectors, surge arrestors, busbars, busbar supports, load control and frequency injection facilities
 - types of secondary equipment:
 - batteries, battery chargers, protection relays and control devices or panels
 - types of SCADA modification:
 - full or part implementation of SCADA retrofits
 - replacement of SCADA IEDs, remote terminal units (RTU) and SMUs.

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 to undertake design of a substation
- applicable documentation, including workplace procedures, relevant industry standards, equipment specifications, regulations, codes of practice and operation manuals.

Links

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