



Australian Government

UETDRDS014 Prepare and manage detailed construction plans for electrical power system infrastructure

Release: 1

UETDRDS014 Prepare and manage detailed construction plans for electrical power system infrastructure

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 preparation of detailed plans to be used during the design phase and preparation of as-built drawings during the construction phase and utilised by network owners as technical reference materials to detail system infrastructure. It includes the use of computer-aided drafting (CAD) or other relevant drafting methods.

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

UEENEEE104A Solve problems in d.c. circuits

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

UEENEEG101A Solve problems in electromagnetic devices and related circuits

UEENEEG102A Solve problems in low voltage a.c. 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 for and coordinate the preparation and management of detailed construction plans for electrical system infrastructure

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, which may influence the preparation and management of detailed construction plans for electrical system infrastructure, are reviewed and determined
- 1.2** Purpose of the construction plans is established and expected outcomes of the work are confirmed with appropriate personnel
- 1.3** Established organisational procedures, policies and specifications for the construction plans are obtained or established with appropriate personnel
- 1.4** 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
- 1.5** Risk control measures are identified, prioritised and evaluated against the work schedule
- 1.6** Relevant work permits are secured to coordinate the performance of work according to requirements and/or established procedures
- 1.7** Resources, including personnel, equipment, tools and personal protective equipment (PPE), required for the job are identified, scheduled and coordinated and confirmed safe and in technical working order
- 1.8** Liaison and communication issues with others/authorised personnel, authorities, clients and landowners are resolved and activities coordinated to carry out work

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| | 1.9 | Site is prepared according to the work schedule and to minimise risk and damage to property, commerce and individuals in accordance with established procedures |
| 2 Carry out and coordinate the preparation and management of detailed construction plans for electrical system infrastructure | 2.1 | 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 |
| | 2.2 | System design decisions are made on the basis of safety and effective outcomes according to requirements and/or established procedures |
| | 2.3 | Mathematical models of the system are used to analyse the effectiveness of the finished project in accordance with requirements and established procedures |
| | 2.4 | 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 |
| | 2.5 | 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 |
| | 2.6 | Solutions to non-routine problems are identified and actioned using acquired essential knowledge and associated skills according to requirements |
| | 2.7 | Quality of work is monitored against personal performance agreement and/or established organisational and professional standards |
| 3 Complete and coordinate the preparation and management of detailed construction plans for electrical system infrastructure | 3.1 | Final inspections of the construction plans 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 construction plan 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 UETTDRDS39 Prepare and manage detailed construction plans for electrical power system infrastructure.

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 UETDRDS014 Prepare and manage detailed construction plans for electrical power system infrastructure

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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
- preparing six (6) compliant detailed plans that relate to the following project types:
 - overhead line designs
 - underground line designs
 - distribution substations designs
 - transmission and sub-transmission substation designs
 - public lighting designs
 - zone substation designs
 - customer 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:

- 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 the processes for conducting a risk assessment
 - hazards associated with LV, ELV and HV:
 - 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, joining procedures and laser safety class 3a devices or their replacement
- risks and control measures associated with LV:
 - 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 of live work
 - 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 system 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
 - assessing resources to establish and maintain WHS/OHS management systems
- transmission, distribution and rail systems encompassing:
 - relationship between the transmission, distribution and rail/tram system within an overall power system:
 - different organisations responsible for generation, transmission, distribution and rail/tram and, how they correlate and their functions

- characteristics of a transmission, distribution and rail system:
 - principal components
 - typical voltage levels and methods of transmission and distribution, including grid type transmission systems, radial, parallel and ring main feeders
- relationship between an overhead and underground supply systems within an overall power system:
 - advantages/disadvantages, applications and the basic steps for planning and installing an overhead and underground distribution system
- single line drawings and layouts:
 - drawings and layouts of transmission and distribution systems, including radial, parallel and ring main feeders and the HV equipment associated with substations
- installation of overhead distribution conductors encompassing:
 - standards, codes, legislation, supply authority regulations and/or enterprise requirements applicable to installing conductors and associated equipment
 - requirements for the use of overhead line construction manuals, system diagrams/plans and drawings:
 - material lists, conductor size, type and route length
 - constructions types and structures for distribution and sub-transmission lines
 - types, sizes and characteristics of overhead conductors
 - resources for the stringing and maintenance of conductors:
 - types of LV and HV overhead electrical conductor connections
 - causes and effects of poor electrical connections
 - reasons for and methods used to maintain standard phase sequencing, removing, repairing and replacing of damaged conductors
 - minimum clearances between overhead conductors and LV and HV structures
 - techniques for conductor installation:
 - types and application of tools, equipment and hardware
 - methods of stringing, tensioning and termination of LV and HV conductors
- powerline safety practices encompassing:
 - protective apparatus and apparel for linework:
 - responsibilities for the selection, use, maintenance and storage of protective apparatus and apparel and the types of protective apparatus and apparel used for the line worker
 - requirements for the use of ladders:
 - carrying, erecting, collapsing and lowering different types of extension ladder against a standing pole
 - maintenance checks on different types of ladders
 - renewal of extension ropes and the safety issues relating to clearances from overhead conductors
 - requirements for climbing and working aloft:
 - methods used to identify a pole is safe to climb
 - methods used to inspect a line worker's body belt

- application of knots and hitches appropriate to the requirements of a line worker
- height safety principles, including personal fall protection, prevention and related requirements
- practical procedures of climbing an overhead structure and fitting a pole chair
- traffic management:
 - purpose of traffic management and a line worker's responsibilities in accordance with relevant statutory requirements and electricity supply industry requirements
 - procedures used to provide an effective traffic management scheme and the use of a two-way radio
- control of small fires:
 - identification, selection and operation of the appropriate extinguishing mediums for various types of fires
 - general fire prevention methods
 - precautions for personal protection when fighting small fires
- rescue victims from heights and confined spaces:
 - planning and identifying procedures, and establishing responses and developing techniques
 - involvement of external emergency services
 - emergency procedures for the rescue of an electric shock victim, including cardiopulmonary resuscitation (CPR)
- requirements for aerial linework:
 - planning, establishing and implementing relevant aviation authority clearances
 - determining system requirements
 - aircrew familiarisation with network operations and equipment
 - requirements for effective communications operations for aerial work
- implementation and monitoring requirements for powerline safety encompassing:
 - identification of relevant legislation, codes and government guidelines for the implementation and monitoring of WHS/OHS in the workplace:
 - Commonwealth/state/territory legislation relevant to the workplace and the meaning of general duty of care under WHS/OHS legislation and common law
 - workplace WHS/OHS enterprise plan:
 - responsibilities of each member of the work team
 - review process for changing/improving WHS/OHS safety plan/standing instructions for the systematic management of WHS/OHS in the workplace
 - relationship between the WHS/OHS committee and employees:
 - methods used to collate and distribute/disseminate WHS/OHS information
 - staff development activities and legislation requirements with regards to WHS/OHS training
 - methods of addressing barriers such as literacy and cultural differences
 - provisions relating to WHS/OHS issue resolution
 - hazards associated with powerline industry:

- identification of hazards in the workplace
- processes used and contributing factors to a hazardous situation assessment of risks and control of WHS/OHS risks (risk management),
- the hierarchy of control and monitoring of risk control measures
- risk assessment and its management in powerline industry:
 - principles and purposes of risk management
 - processes for conducting risk assessment, including risk analysis and risk evaluation activities for selecting and implementing appropriate options for eliminating or minimising risk
- maintenance strategies for WHS/OHS programs:
 - developing processes for promoting, maintaining and improving WHS/OHS in the workplace
 - identify techniques for the evaluating and reviewing WHS/OHS education and training programs and elements of an effective WHS/OHS management system
 - WHS/OHS consultation and accident/incident investigations
- 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
- HV single wire earth return (SWER) system encompassing:
 - application and function of SWER system components
 - circuit arrangement
 - principle of operation
 - hazards and procedures associated with faulty SWER earth systems
 - procedure to isolate, energise and commission SWER substations
- enterprise-specific switching diagrams and drawing encompassing:
 - types and application of enterprise-specific switching drawings:
 - wiring and schematic diagrams and switching symbols
 - mechanical drawings dealing with switching operations, project charts, switching schedules, graphs, technical manuals and catalogues, and instructions/worksheets
 - interpretation of different system switching diagrams:
 - LV system switching diagrams
 - direct current (DC) traction supply sectioning diagrams
 - HV transmission and distribution system symbols and feeder plans
 - processes of updating switching diagrams
- 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 LV and HV systems:
 - overhead distribution extensions
 - underground distribution extensions
 - distribution substations
 - street lighting systems
- system components and layouts encompassing:
 - distribution system layouts:
 - overhead/underground
 - urban/rural
 - HV customers
 - high-rise building systems
 - three phase lines and single phase lines
 - SWER systems
 - spur, parallel and ring systems
 - typical substation types
 - transmission system layouts:
 - lines, buses, transformers and cables
 - line/bus layouts, including single, double, ring and breaker, and half systems
 - HV crossing methods
- circuit breaker auxiliary systems encompassing:
 - types and characteristics of high-pressure air systems, including air storage and air handling processes
 - types and characteristics of DC systems, including battery types, charging systems and protection systems
 - types and characteristics of special ambient gases (SF6) systems, including gas conditioning, storage and handling systems
 - types and characteristics of vacuum interrupters
 - types and characteristics of oil filled and oil handling
- DC transmission systems encompassing:
 - structure of DC transmission systems
 - types of equipment required for DC transmission systems
 - types of connections used for DC transmission systems

- principles of control of DC transmission systems
- advantages of DC transmission in comparison to alternating current (AC) transmission
- disadvantages of DC transmission in comparison to AC transmission
- AC transmission line electrical parameters encompassing:
 - typical arrangements
 - parameters of significance
 - calculation of line parameters:
 - calculation of resistive, inductive and capacitive values assuming regular transposition and solid conductors
 - comparison with actual values
 - typical parameter values and ratios for different voltage level lines
- AC transmission line models encompassing:
 - types of transmission line models based on line length
 - calculation of voltage drop, line regulation and transmission efficiency
 - load sharing between lines
- voltage control techniques encompassing:
 - conditions leading to voltage collapse
 - effects on system of HV and LV
 - voltage control devices:
 - voltage regulators applied to generators and synchronous phase modifiers
 - electromagnetic voltage regulators
 - series and parallel capacitors
 - on-load tap changer (OLTC) transformers and static VAR compensators (SVC) - SVC's include saturated reactor compensators; thyristor controlled reactor compensators and combined systems
 - production of harmonics and methods of harmonic control
 - location of voltage control devices within the system
- voltage control devices encompassing:
 - typical devices applications and capacities
 - estimation of rating of VAR regulating devices using graphical techniques
- corona encompassing:
 - factors leading to the generation of corona:
 - voltage levels
 - conductor spacings, conductor sizes and shaping
 - atmospheric conditions
 - consequences of corona
 - corona reduction:
 - conductor selection
 - conductor bundling
 - conductor surface treatment

- grading rings
- internal discharge:
 - causes of internal discharge
 - effects of internal discharge
 - testing techniques
- protection system types encompassing:
 - requirements of a protection scheme:
 - relationship to primary system design
 - purpose of protection, safety of persons and protection of plant
 - system instability
 - system break up
 - loss of customers and loss of revenue
 - protection zones
 - restricted schemes and unrestricted schemes
 - duplicate protection
 - local backup protection and remote backup protection
 - selectivity, discrimination, stability, sensitivity and reliability
 - components of a protection scheme:
 - current transformers, potential transformers, summation current transformers, interposing transformers and multi-tapped transformers
 - all-or-nothing relays, induction relays, balanced beam relays, directional relays, biased relays, solid state relays, microprocessor-based relays and gas relays
 - thermal sensors
 - hardwired communication
 - powerline carrier systems
 - microwave systems
 - fibre optic systems
 - need for isolation
 - 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.

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 detailed construction plans for electrical system infrastructure
- applicable documentation, including workplace procedures, relevant industry standards, equipment specifications, regulations, codes of practice and operation manuals.

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