Australian Government

Department of Education, Employment and Workplace Relations

UETTDRSB27A Maintain high current DC equipment and switchgear

Release: 1

UETTDRSB27A Maintain high current DC equipment and switchgear

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor **1) Scope:**

1.1) Descriptor

This Competency Standard Unit covers the maintenance of DC switchgear and other equipment which may include rectifier transformers, rectifiers, invertors, isolators and links, harmonic filters, negative reactors and EDRs. It encompasses the maintenance, including the diagnosing of faults and replacement and repair to ensure correct maintenance to prescribed procedures and standards. It also encompasses the isolation of systems and/or circuits for safe working according to work plans and the visual inspection and necessary checks to ensure safe energisation, as well as updating of maintenance data and relevant quality assurance documentation.

Application of the Unit

Application of the Unit **2)**

This Competency Standard Unit is intended to augment formally acquired competencies. It is suitable for employment-based programs under an approved contract of training.

Licensing/Regulatory Information

License to practice **3)**

The skills and knowledge described in this unit requires a licence/registration to practice in the work place subject to regulations for undertaking of electrical work. Practice in

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License to practice **3)**

workplace and during training is also subject to regulations directly related to Occupational Health and Safety, electricity/telecommunications/gas/water industry safety and compliance, industrial relations, environmental protection, anti discrimination and training. Commonwealth, State/Territory or Local Government legislation and regulations may exist that limits the age of operating certain equipment.

Pre-Requisites

Prerequisite Unit(s) **4)**

Competencies **4.1)**

Granting of competency in this unit shall be made only after competency in the following unit(s) has/have been confirmed.

Where pre-requisite pathways have been identified. All competencies in the Common Unit Group must be have been completed plus all the competencies in one (1) of the identified Pathway Unit Group(s):

Common Unit Group

Unit Code	Unit Title
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
UEENEEE105A	Fix and secure electrotechnology equipment
UEENEEE107A	Use drawings, diagrams, schedules, standards, codes and specifications
UEENEEE137A	Document and apply measures to control OHS risks associated with

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Prerequisite Unit(s) **4)**

	electrotechnology work
UEENEEG006A	Solve problems in single and three phase low voltage machines
UEENEEG033A	Solve problems in single and three phase electrical apparatus and circuits
UEENEEG063A	Arrange circuits, control and protection for general electrical installations
UEENEEG101A	Solve problems in electromagnetic devices and related circuits
UEENEEG102A	Solve problems in electromagnetic devices and related circuits
UEENEEG106A	Terminate cables, cords and accessories for low voltage circuits
UEENEEG108A	Trouble-shoot and repair faults in low voltage electrical apparatus and circuits
UEENEEG109A	Develop and connect electrical control circuits
UEENEEK142A	Apply environmentally and sustainable energy procedures in the energy sector
Pathway 1 - Electrician	
UEENEEG103A	Install low voltage wiring and accessories
UEENEEG104A	Install appliances, switchgear and associated accessories for low voltage electrical installations
UEENEEG105A	Verify compliance and functionality of low voltage general electrical installations
UEENEEG107A	Select wiring systems and cables for low voltage general electrical

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Prerequisite Unit(s) **4)**

	installations
Pathway 2 – Electrical Fitter	
UEENEEG199A	Conduct compliance and functional verification of electrical apparatus and existing circuits

Literacy and numeracy skills **4.2)**

Participants are best equipped to achieve this unit if they have reading, writing and numeracy skills indicated by the following scales. Description of each scale is given in Volume 2, Part 3 "Literacy and Numeracy"

Reading 4 Writing 4 Numeracy 4

Employability Skills Information

Employability Skills **5)**

The required outcomes described in this unit of competency contain applicable facets of Employability Skills. The Employability Skills Summary of the qualification in which this unit of competency is packaged will assist in identifying Employability Skill requirements.

Elements and Performance Criteria Pre-Content

6) Elements describe the essential outcomes of a competency standard unit	Performance Criteria describe the required performance needed to demonstrate achievement of the element. Assessment of performance is to be consistent with the Evidence Guide.

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Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1 Prepare/plan to maintain high current DC switchgear and equipment	1.1 Work schedules including drawings, plans, requirements procedures and material lists are acquired, analysed and the extent of work determined.
	1.2 Relevant requirements and established procedures for the work are communicated to all personnel and identified for all work sites.
	1.3 Hazards are identified, OHS risks assessed and control measures are prioritised, implemented and monitored including emergency exits kept clear, to ensure safe systems of work are followed and according to established procedures.
	1.4 Work is prioritised and sequenced for the most efficient and effective outcome following consultation with others for completion within acceptable timeframes, to agreed quality standards and in accordance with established policies and procedures.
	1.5 Risk control measures are identified, prioritised, implemented and evaluated against the work schedule.
	1.6 Resources including personnel, equipment, tools and personal protective equipment required for the job are identified, acquired and confirmed in safe/technical working order.
	1.7 Liaison issues with other personnel and/or authorities are resolved and activities coordinated to facilitate the work.
	1.8 Personnel participating in the work including plant operators and contractors are fully briefed, their respective responsibilities explained and coordinated and appropriate authorisation checked in accordance with established procedures.
	1.9 Work site is prepared according to the work schedule and to minimise risk and damage to

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ELEMENT	PERFORMANCE CRITERIA	
		property and personnel in accordance with established procedures.
2 Carry out the maintenance of high current DC switchgear and equipment	2.1	OHS and sustainable energy principles and practices to reduce the incidence of accidents and minimise waste are implemented and monitored in accordance with established procedures.
	2.2	CPR, Rescue from live electrical apparatus and other related safety procedures are in place according to requirements and established procedures.
	2.3	Safe working documentation is acquired and requirements completed in accordance with established procedures.
	2.4	Lifting, climbing and working aloft, use of power tools/equipment techniques and practices are safely exercised in accordance with established procedures.
	2.5	Hazard warnings and safety signs are recognised and hazards and assessed OHS risks are reported to the immediate authorised persons for directions according to established procedures.
	2.6	Maintenance and repair of high current DC switchgear and equipment is carried out, in accordance with the work schedule and requirements and/or established procedures.
	2.7	Essential knowledge and associated skills are applied for the safe maintenance of high current DC switchgear and equipment to ensure completion in an agreed timeframe and to quality standards with a minimum of waste according to requirements.
	2.8	Unplanned events or conditions are responded to in accordance with established procedures.

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ELEMENT	PERFORMANCE CRITERIA
3 Complete the maintenance of high current DC switchgear and equipment	3.1 Work undertaken is checked against work schedule for conformance with requirements, anomalies reported and solutions identified in accordance with established procedures.
	3.2 Safe working documentation is surrendered and equipment made ready for service.
	3.3 Work site is rehabilitated, cleaned up and confirmed safe in accordance with established procedures.
	3.4 Tools, equipment and any surplus resources and materials are cleaned, checked and returned to storage in accordance with established procedures.
	3.5 Required works completion records, reports and/or documentation and information are completed, processed and appropriate personnel notified in accordance with established procedures.

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Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

8) Essential Knowledge and Associated Skills (EKAS): This describes the essential skills and knowledge and their level, required for this unit.

Evidence shall show that knowledge has been acquired of maintaining high current DC switchgear and equipment.

All knowledge and skills detailed in this unit should be contextualised to current industry practices and technologies.

KS01-TSB27A High current DC equipment and switchgear - maintenance

Evidence shall show an understanding of high current DC equipment and switchgear - maintenance to an extent indicated by the following aspects:

T1 Safe working on energised low voltage 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 low voltage conductors - safe working practices and procedures, identification of hazards, assessment and control of OHS risks, types, selection, maintenance and use of personal protective equipment
- 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.

T2 Enterprise specific — policy and procedure instructions encompassing:

- Responsibilities and duty of care of employer and employee relationship
- Methods of obtaining the up-to-date information on enterprise policy and procedures
- Rules and regulations
- Induction into workplace - location of work area and storage area, timetable, uniform, personal well-being, housekeeping rules, emergency procedures, evacuation procedures
- Techniques when deal with others - working in teams, customer relation, complaint and issues procedures.
- Overview of enterprise professional development - fire fighting procedures, fatigue management, training and competency development - understanding and promotion

T3 Enterprises specific — OHS instructions encompassing:

- Standards, codes, legislation, supply authority regulations and specific enterprise regulations pertaining to the OHS policies and procedures
- Methods of obtaining the up-to-date information on enterprise OHS policy and procedures

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REQUIRED SKILLS AND KNOWLEDGE

- Specific enterprise personal protection equipment - type and application, where and when to be used, method of replacement, responsibility of maintenance including cleaning inspection and testing, emergency response, rescue, evacuation and First Aid procedures
- Personal well-being – hygiene, fatigue/stress management, drugs/alcohol
- OHS training - induction training, specific hazard training, specific task or equipment training, emergency and evacuation training, training as part of broader programs such as equipment operation
- OHS records including audits, inspection reports, workplace health and environmental monitoring records, training and instruction records, manufacturers and suppliers information such as MSDSs, registers, maintenance reports, workers compensation and rehabilitation records and First Aid/medical records

T4 Enterprises specific — technical drawing and documents encompassing:

- Types and application of enterprise specific drawings and documents - electrical and electronic drawings, mechanical drawings, project charts, schedules, graphs, technical manuals and catalogues
- Instruction/worksheets sheets - types and application of enterprise specific symbols and diagrams
- Title box - description of parts and version control.

T5 Enterprise specific switching diagrams and drawing encompassing:

- Types and application of enterprise specific switching drawings and documents - wiring and schematic diagrams and switching symbols, mechanical drawings dealing with switching operations, project charts, switching schedules, graphs, technical manuals and catalogues, instruction/work sheets.
- Interpretation of different system switching diagrams - LV system switching diagrams, DC traction supply sectioning diagrams, HV transmission and distribution system symbols and feeder plans, processes of updating switching diagrams

T6 Enterprises specific specialised tools encompassing:

- Legislation, Standards, codes, legislation, supply authority regulations and specific enterprise regulations pertaining to the use and care of specialised tools (voltage detectors; polarity testers, phase rotation)
- Characteristics, capabilities and application of specialised tools for a particular job
- Safety policies, procedures and precautions with regards to using, transporting and storage of specialised tools
- Selection methods for obtaining the correct specialised tool for the particular job including during procurement, purchasing and or hiring arrangements
- Techniques in pre-use inspection on the serviceability of specialised tools
- Techniques in the selection, use, maintenance, and care and storage of specialised tools
- Identifying OHS hazards, assessing and controlling risks associated with their use
- Techniques for the safe use of specialised power tools.

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REQUIRED SKILLS AND KNOWLEDGE

T7 Enterprise Specific Equipment Installation Procedures encompassing:

- Standards, codes, legislation, supply authority regulations and or enterprise requirements applicable to equipment installation
- Requirements for the use of manuals, substation diagrams/plans and drawings
- Types, characteristics and capabilities of HV substation equipment to be installed
- Identification of components within the equipment to be Installed and associated control housings
- Use, characteristics and capabilities of specialised tools and equipment
- Enterprise Specific Policies and Procedures for equipment to be installed
- Control equipment and auxiliary relays, flags and alarms
- Techniques in evaluating serviceability of equipment to be Installed
- Safety precautions when testing and measuring equipment to be Installed - safe working practices and procedures, identification of hazards, assessment and control of OHS risks, types, selection, maintenance and use of personal protective equipment, responsibilities and protocols, safe working clearances
- Remote and local operating principles and conventions

T8 Enterprise Specific Data Management Processes encompassing:

- Standards, codes, legislation, supply authority regulations and or enterprise requirements applicable to Data Management
- Requirements for the use of manuals, substation diagrams/plans and drawings
- Types of enterprise specific computer software
- Techniques in storing and retrieving data and reports from the computer
- Techniques in using the Data Management systems in following necessary commands and protocols in accordance with the Enterprise Specific Procedures
- Calculation of results and data measurements using the computer
- Techniques in the preparation of preliminary works creation and closure.

T9 Substation DC circuit breaker principles encompassing:

- Standards, codes, Commonwealth/State/Territory legislation, supply authority regulations and or enterprise requirements associated with the DC circuit breakers
- Types of DC CB’s - self and withdrawable types
- Characteristics of DC CB’s - purpose of DC CB’s, application of DC CB’s
- Principles of operation of different types of DC CB’s - arc expulsion versus arc containment, latched versus magnetically held, advantages and disadvantages of different types, fixed or withdrawable, protection/diagnostic technology.
- Principles of operation of high speed DC CB – characteristics, calibration
- How DC CB’s are designated - feeder, rectifier, EDR, bus-section and negative breakers, auto-reclose or non auto-reclose type
- Type and function of DC CB peripheral components - delta I relays, busbar, control wiring, trunk and associated plug/receptacle
- Identification, characteristics, application and care of DC CB components - holding coils, closing coils, contactors, resistors, arc chutes, blow-out coils, arcing

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REQUIRED SKILLS AND KNOWLEDGE

contacts, main contacts, braids, moving arm, pole face, arcing horns, electronic cards, dashpots, fingers, diode strings, fuses, insulators, latching mechanisms, motors, wiring, relays

- Characteristics, application and care of hand and specialised tools used on DC CB's - combination/multigrips/long nose pliers, side cutters, screwdrivers, wire strippers, crimpers, knife, hacksaw, hammers, mallets, levels, tape measures, spanners, T-wrench, pistol drills, battery drills, heat gun, de-soldering tools and soldering iron/torches, Allen keys, socket spanners, gauges, feeler gauges and specialist tools supplied by the manufacturers
- Characteristics, application and care of test and measurement instruments used on DC CB's - multimeters, tong testers, ammeters, voltmeters, ohmmeters, test lamps, high and low voltage insulation resistance/ continuity testers, earth resistance tester, Ductor, drop-out test sets.

T10 Maintenance of substation DC circuit breakers and associated equipment encompassing:

- Standards, codes, Commonwealth/State/Territory legislation, supply authority regulations and or enterprise requirements associated with the maintenance of DC circuit breakers
- Requirements for the use and interpretation of manuals, system diagrams/plans and drawings - 1500V sectioning diagrams, substation HV operating diagrams, substation arrangement diagrams and layout drawings, technical/manufactures' specifications, maintenance instructions/schedules.
- Relationship and function of DC CB's equipment/component interface - DC CB frame, connection fingers, associated busbar, physical arrangements and clearances.
- Safety precautions when undertaking maintenance procedures on DC CB's - safe working practices, Occupational Health and Safety hazards and precautions, identification of hazards, assessing and controlling risks, types, selection, maintenance and uses of personnel protective equipment, permit to work systems and isolation procedures, types and function of specialised equipment, safe working practices when using specialised equipment, emergency response and rescue including First Aid etc.
- Techniques in maintenance of DC CB's - closing and opening operations, range settings, adjustments and calibration, spring settings, main contact arrangement and auxiliary contact arrangement, arc chute inspection and procedures, basic fault finding and repair/adjustment techniques, control cards, their uses, application and fault finding, earthing requirements and techniques
- Techniques in testing and commissioning of DC CB's - supply authority regulations and or enterprise requirements, standards and procedures.

T11 Installation of substation Direct Current circuit breakers (DC CB's) and associated equipment encompassing:

- Standards, codes, legislation, supply authority regulations and or enterprise requirements pertaining to the installation of substation Direct Current circuit

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REQUIRED SKILLS AND KNOWLEDGE

breakers (DC CB's)

- Safety precautions when installing substation Direct Current circuit breakers (DC CB's) - safe operation procedures, Occupational Health and Safety hazards and precautions, identification of hazards, assessing and controlling risks, types, selection, maintenance and uses of personnel protective equipment, permit to work systems and isolation procedures, safe working practices when using specialised equipment, emergency response and rescue including First Aid etc.
- Use and interpretation of technical manuals and diagrams - manufacturer/Enterprise Manuals, block, wiring and schematic diagrams, 1500 V sectioning diagrams, substation HV operating diagrams, substation arrangement diagrams and layout drawings, technical/manufactures' specifications, maintenance instructions/schedules
- Techniques in the safe installation of DC CB's.

Evidence Guide

EVIDENCE GUIDE

9) This provides essential advice for assessment of the competency standard unit and must be read in conjunction with the Performance Criteria and the Range Statement of the competency standard unit and the Training Package Assessment Guidelines.

The Evidence Guide forms an integral part of this Competency Standard Unit and shall be used in conjunction with all component parts of this unit and, performed in accordance with the Assessment Guidelines of this Training Package.

Overview of Assessment **9.1)**

Longitudinal competency development approaches to assessment, such as Profiling, require data to be reliably gathered in a form that can be consistently interpreted over time. This approach is best utilised in Apprenticeship programs and reduces assessment intervention. It is the Industry's preferred model for apprenticeships. However, where summative (or final) assessment is used it is to include the application of the competency in the normal work environment or, at a minimum, the application of the competency in a realistically simulated work environment. It is recognised that, in some circumstances, assessment in part or full can occur outside the workplace. However, it must be in accord with Industry and, Regulatory policy in this regard.

Methods chosen for a particular assessment will be influenced by various factors. These include the extent of the assessment, the

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most effective locations for the assessment activities to take place, access to physical resources, additional safety measures that may be required and the critical nature of the competencies being assessed.

The critical safety nature of working with electricity, electrical equipment, gas or any other hazardous substance/material carries risk in deeming a person competent. Hence, sources of evidence need to be 'rich' in nature so as to minimise error in judgment.

Activities associated with normal every day work have a bearing on the decision as to how much and how detailed the data gathered will contribute to its 'richness'. Some skills are more critical to safety and operational requirements while the same skills may be more or less frequently practiced. These points are raised for the assessors to consider when choosing an assessment method and developing assessment instruments. Sample assessment instruments are included for Assessors in the Assessment Guidelines of this Training Package.

Critical aspects of evidence required to demonstrate competency in this unit

9.2)

Before the critical aspects of evidence are considered all prerequisites shall be met.

Evidence for competence in this unit shall be considered holistically. Each element and associated Performance Criteria shall be demonstrated on at least two occasions in accordance with the "Assessment Guidelines – UET12". Evidence shall also comprise:

- A representative body of Performance Criteria demonstrated within the timeframes typically expected of the discipline, work function and industrial environment. In particular this shall incorporate evidence that shows a candidate is able to:
  - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the Performance Criteria and range; and
  - Apply sustainable energy principles and practices as specified in the Performance Criteria and range; and
  - Demonstrate an understanding of the essential knowledge and associated skills as described in this unit to such an extent that the learner's performance outcome is reported in

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accordance with the preferred approach; namely a percentile graded result, where required by the regulated environment; and

- Demonstrate an appropriate level of employability skills; and

- Conduct work observing the relevant Anti Discrimination legislation, regulations, policies and workplace procedures; and
  - Demonstrated performance across a representative range of contexts from the prescribed items below:

Range of tools/equipment/materials/procedures/workplaces/other variables		
Group No	**The minimum number of items on which skill is to be demonstrated**	**Item List**
A	All of the following:	Multimeters Low resistance high current Megger tester Ammeter Voltmeter 1500 V drop out tester Wiring diagrams Schematic drawings Operating and substation arrangement diagrams Building layouts Cable block and schedule diagrams
B	At least six of the following:	Direct current circuit breakers Rectifier transformers Rectifiers Isolators and links Harmonic filters

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		Negative reactors Energy dissipation resistors
C	At least ten of the following:	DC feeders Surge arresters Isolating links Busbar Cables Cable supports Pits and enclosures Protection/alarm systems Control wiring Metering Supervisory interface Cabinets REC
D	All of the following:	Cable terminations Busbar termination/joint Alignment of electrical contacts of withdrawable equipment
E	At least one occasion	Dealing with an unplanned event by drawing on essential knowledge and associated skills to provide appropriate solutions incorporated in the holistic assessment with the above listed items.

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Context of and specific resources for assessment **9.3)**

This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace. This should include:

- OHS policy and work procedures and instructions.
- Suitable work environment, facilities, equipment and materials to undertake actual maintenance of high current DC switchgear and equipment.

In addition to the resources listed above, in Context of and specific resources for assessment, evidence should show demonstrated competency working:

Below ground, in limited spaces, with different structural/construction types and method and in a variety of environments.

Method of assessment **9.4)**

This Competency Standard Unit shall be assessed by methods given in Volume 1, Part 3 “Assessment Guidelines”.

Note:

Competent performance with inherent safe working practices is expected in the Transmission, Distribution and Rail Traction Industry. This requires that the specified essential knowledge and associated skills are assessed in a structured environment which is primarily intended for learning/assessment and incorporates all necessary equipment and facilities for learners to develop and demonstrate the essential knowledge and associated skills described in this unit.

Concurrent assessment and relationship with other units **9.5)**

There are no concurrent assessment recommendations for this unit.

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Range Statement

RANGE STATEMENT

10) This relates to the competency standard unit as a whole providing the range of contexts and conditions to which the Performance Criteria apply. It allows for different work environments and situations that will affect performance.

This Competency Standard Unit shall be demonstrated in relation to the maintenance of high current DC switchgear and equipment.

DC switchgear and other equipment includes but is not limited to Direct Current Circuit Breakers, rectifier transformers, rectifiers, invertors, isolators and links, harmonic filters, negative reactors and energy dissipating resistors (EDR's) and rail earth contactor.

Associated equipment may include DC feeders, surge arresters, isolating links, busbar, cables, cable supports, pits and enclosures, protection/alarm systems, control wiring, metering, supervisory interface, cabinets,

Associated components may include main and auxiliary contacts, holding coils, contactor, busbar fingers, diodes, heatsinks, capacitors, fuses, metering, shunts, resistors banks, resistor bank housing.

Test and measurement equipments may include multimeters, low resistance high current, megger tester, ammeter, voltmeter, 1500V drop out test set, feeler gauge.

Drawings can refer to wiring, schematic, operating and substation arrangement diagrams, cable block and schedule diagrams and building layouts.

Confined Spaces may apply to pits, cable tunnels, false floors, and cable basements.

The following constants and variables included in the element/Performance Criteria in this unit are fully described in the Definitions Section 1 of this volume and form an integral part of the Range Statement of this unit:

- Appropriate and relevant persons (see Personnel)
- Appropriate authorities
- Appropriate work platform
- Assessing risk
- Assessment
- Authorisation
- Confined space
- Diagnostic, testing and restoration
- Documenting detail work events, record keeping and or storage of information
- Drawings and specifications
- Emergency
- Environmental and sustainable energy procedures
- Environmental legislation

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RANGE STATEMENT

- Environmental management documentation
- Established procedures
- Fall prevention
- Hazards
- Identifying hazards
- Inspect
- Legislation
- MSDS
- Notification
- OHS practices
- OHS issues
- Permits and/or permits to work
- Personnel
- Quality assurance systems
- Requirements
- Testing procedures
- Work clearance systems

Unit Sector(s)

Not applicable.

Competency Field

Competency Field **11)**

Substation Units

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