



Australian Government

Department of Education, Employment and Workplace Relations

UETTDRTS31A Maintain, test and commission power systems voltage regulating equipment

Release: 1

UETTDRTS31A Maintain, test and commission power systems voltage regulating equipment

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor

1) Scope:

1.1) Descriptor

This Competency Standard Unit covers the maintenance, testing and commissioning of Distribution field devices to relevant standards, including voltage regulators, automatic circuit reclosers control boxes, line capacitors, and associated communication devices. It includes communicating with the Operating Authority, testing, clearing after test and energisation using techniques that are acceptable to the Operating Authority

Application of the Unit

Application of the Unit 2)

This competency standards unit is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 5 or higher.

Licensing/Regulatory Information

License to practice 3)

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

License to practice

3)

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
UEENEEED104A	Use engineering applications software on personal computers
UEENEEEE101A	Apply Occupational Health and Safety regulations, codes and practices in the workplace
UEENEEEE102A	Fabricate, assemble and dismantle utilities industry components
UEENEEEE104A	Solve problems in d.c. Circuits
UEENEEEE107A	Use drawings, diagrams, schedules, standards, codes and specifications
UEENEEEE124A	Compile and produce an energy sector detailed report
UEENEEEE125A	Provide engineering solutions for problems in complex multiple path circuits problems
UEENEEEE126A	Provide solutions to basic engineering computational problems

Prerequisite Unit(s)	4)	
	UEENEEG101A	Solve problems in electromagnetic devices and related circuits
	UEENEEG102A	Solve problems in electromagnetic devices and related circuits
	UEENEEG149A	Provide engineering solutions to problems in complex polyphase power circuits
	UETTDREL11A	Apply sustainable energy and environmental procedures
	UETTDREL16A	Working safely near live electrical apparatus
	UETTDRI62A	Implement and monitor the power system organisational OHS policies, procedures and programs
	UETTDRI63A	Implement and monitor the power system environmental and sustainable energy management policies and procedures

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 5 Writing 5 Numeracy 5

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

Employability Skills

5)

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.

Elements and Performance Criteria

ELEMENT

PERFORMANCE CRITERIA

1 Plan and coordinate the maintenance, testing and commissioning of Distribution field devices	1.1	OHS practices/procedures and environmental and sustainable energy procedures, which may influence the maintenance testing and commissioning of distribution field devices, are reviewed and determined.
	1.2	Purpose of the work is established and expected outcomes of the work are confirmed with the appropriate personnel.
	1.3	Established organisational procedures, policies and specifications for the work are obtained or established with the appropriate personnel.
	1.4	Equipment/tools and personal protective equipment 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.

ELEMENT

PERFORMANCE CRITERIA

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| | 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 personal protective equipment required for the job are identified, scheduled and coordinated and confirmed in a safe and technical working order. |
| | 1.9 | Liaison and communication issues with other/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. |
| 2 | Carry out and coordinate the maintenance, testing and commissioning of Distribution field devices | |
| | 2.1 | Circuit/systems modelling is used to evaluate alternative proposals as per established procedures. |
| | 2.2 | OHS and sustainable energy principles, functionality and practices to avoid the incidence of accidents and minimise waste are incorporated into the project in accordance with requirements and/or established procedures. |
| | 2.3 | Maintenance, testing and commissioning decisions are made on the basis of safety and effective outcomes according to requirements and/or established procedures. |
| | 2.4 | Mathematical models of the distribution system are used to analyse the effectiveness of the finished project as per requirements and established procedures. |
| | 2.5 | Technical advice is given regarding potential hazards, safety risks and control measures so that monitoring and preventative action can be undertaken and/or appropriate authorities consulted, where necessary, in accordance with requirements and established procedures. |

ELEMENT

PERFORMANCE CRITERIA

- | | | |
|---|--|--|
| | 2.6 | Essential knowledge and associated skills are applied to analyse specific data and compare it with compliance specifications to ensure completion of the project within an agreed timeframe according to requirements. |
| | 2.7 | Solutions to non-routine problems are identified and actioned using acquired essential knowledge and associated skills according to requirements. |
| | 2.8 | Quality of work is monitored against personal performance agreement and/or established organisational and professional standards. |
| 3 | Complete and coordinate the maintenance, testing and commissioning of Distribution field devices | |
| | 3.1 | Final inspections of the work are undertaken to ensure it complies with all requirements and includes all specifications and documentation needed to complete the 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 test documents are issued and records are updated in accordance with established procedures. |

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, testing and commissioning voltage regulating equipment.

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

KS01-TTS31A Power systems voltage regulating equipment

Evidence shall show an understanding of power systems voltage regulating equipment to an extent indicated by the following aspects:

T1 OHS enterprise responsibilities encompassing:

- Provisions of relevant health and safety legislation
- Principles and practice of effective occupational health and safety 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 occupational health and safety management
- Relevance of enterprise management systems to occupational health and safety management
- Analysis of working environment and design of appropriate occupational health and safety management systems
- Analysis of relevant data and evaluation of occupational health and safety system effectiveness
- Assess resources to establish and maintain occupational health and safety management systems.

T2 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.

T3 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, a distribution and a 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

REQUIRED SKILLS AND KNOWLEDGE

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

T4 Substations, power transformers and reactors 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 of equipment
- Maintenance of a power transformer - basic connections, restrictions to parallel operation, problems and remedies associated with harmonics, testing and fault finding procedures
- Description, purpose and characteristics of a reactors

T5 Co-ordinating access authority procedures encompassing:

- Specific enterprise processes, policies and procedures to be followed
- Processes of consultation, negotiation and co-ordination - clear and concise instructions and information, methods for the encouragement of feedback and contributions of information and ideas, responsibilities of members of the team.
- Techniques in analysing, planning, co-ordination and organising work for a safe outcome and according to statutory requirements and regulations
- Techniques in the effective utilisation of available resources
- Techniques in the development of an access authority/permit and/or access authority/permit issuing procedures
- Techniques in facilitating and co-ordinating the delivery and issuing of access authorities
- Techniques in gathering, collating and confirming data on different worksites - electrical network diagrams for the specific work site, earth access authorities, safe working area, work to be carried out in confined space or in hazardous environment, specific outsourcing procedures, specific hazard identification, risk classification and management procedures, regulatory requirements such as Occupational Health and Safety and electrical safety
- Techniques in the receiving and co-ordinating the cancellation of access authorities in readiness for restoration
- Methods of conducting audits on correct access authority procedures
- Process of issuing of other access authorities for work permits - working in confined space, if required, co-ordination of access authorities, engaging and briefing contractors on electrical and other work
- Issue and receipt of operating agreements.

REQUIRED SKILLS AND KNOWLEDGE

T6 Principles of Statutory and safety considerations encompassing:

- Commonwealth/State/Territory legislation, standards, codes, supply authority regulations and or enterprise requirements associated with working on High Voltage
- Particular reference to State and Territory regulations regarding - working near energised conductors, electrical access, heights, confined space, testing procedures, licensing rules.

T7 HV system switching principles including switching authorisation procedures to an extent indicated by the following aspects:

- Legislation, Standards, codes, legislation, supply authority regulations and or enterprise requirements applicable to system switching
- Requirements for the use of manuals, system diagrams/plans and drawings
- Types and characteristics of HV systems and equipment to be switched
- Procedures for obtaining correct HV switching authorisation - identification of OHS hazards, assessing and controlling risks, Safety procedures and precautions, safe approach distances
- responsibilities and protocols, identifying switching resources, procedures for obtaining electrical access permits authorities, Requirements for team switching, procedures for coordination of operations.
- Techniques in HV system switching - pre-switching checks, switching operational procedures, isolation procedures and proving dead de-energised, earthing procedures, switching operational procedures, emergency fault procedures, energisation procedures

T8 LV system switching principles including switching authorisation procedures encompassing:

- Legislation, Standards, codes, legislation, supply authority regulations and or enterprise requirements applicable to system switching
- Requirements for the use of manuals, system diagrams/plans and drawings
- Types and characteristics of LV systems and equipment to be switched
- Procedures for obtaining correct LV switching authorization - identification of OHS hazards, assessing and controlling risks, safety procedures and precautions, safe approach distances, responsibilities and protocols, identifying switching resources, procedures for obtaining electrical access permits authorities, requirements for team switching, procedures for coordination of operations.
- Techniques in LV system switching - isolation procedures and proving dead, earthing procedures, pre-switching checks, switching operational procedures, emergency fault procedures, energisation procedures.

T9 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

REQUIRED SKILLS AND KNOWLEDGE

- 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

T10 Principles of power transformer construction and operations encompassing:

- Transformer types - shell, core, auto, double wound, three phase, single phase and combinations of these types, step up and step down transformers, transmission and generation types
- Reactor types - shunt and series, applications and design considerations
- Iron circuit characteristics - steel types, losses and techniques used to eliminate excess eddy currents and other circulating currents
- Winding configurations and construction techniques - helical, spiral, disc, interleaved disc types
- Insulation methods and techniques - fully insulated windings and graded insulation techniques, oil filled and gas filled power transformers
- Transformer and reactor ratings, losses and efficiency - equivalent circuits and vector relationships, impedance percent
- Nameplate details - BIL, tapping winding detail, physical layout, cooling ratings, physical details
- Transformer and reactor cooling types and their effects on design and rating
- Transformer and reactor auxiliaries - temperature indicators, over pressure devices and control systems
- Winding configurations - star-star, star-delta, star-zigzag, nomenclature and common methods of diagrammatic representation of winding configuration
- Operating constraints as single units and in parallel
- Tapping windings - placement issues, tapping range, OLTC versus off load TC techniques, types in use (high speed resistor, reactor and vacuum types, Jansen mechanisms, dead tank and live tank types), control system characteristics.
- High voltage bushing selection – type, insulation system used, rating, BIL, selection criteria, testing considerations

T11 Principles of power transformer construction and operations encompassing:

- Applications of static reactive plant in high voltage networks, including voltage control, VAR control, transient response capacity
- Types of static reactive plant including high voltage capacitors, high voltage

REQUIRED SKILLS AND KNOWLEDGE

reactors, static VAR compensators and combinations of these

- Operating characteristics and operational constraints including point on wave switching issues
- Ratings, cooling systems and control systems and ancillary equipment used
- Configurations and system layout including single star, double star, bridge type
- Typical protection systems used including neutral unbalance current, neutral unbalance voltage
- Techniques used when balancing elements within static reactive plant
- Safety precautions when testing and maintaining high voltage static reactive plant - safe working practices and procedures, identification of hazards, assessment and control of OHS risks, types, selection, maintenance and use of personal protective equipment.

T12 Principles of power transformer high speed on load tap changers encompassing:

- Selector types and applications for high voltage power transformers
- Diverter switch types and applications for high voltage power transformers including live tank, dead tank, resistor type, reactor type, vacuum type, pennant flag, pennant cycle
- Ratings and construction principles
- Operating mechanism types, stored energy systems and associated control systems
- Operating principles and operating sequences of selectors and diverters
- Measurement requirements including contacts, differential wear, transition resistors and transient protection devices, rotation lag, out of sequence controls and end-of-life unit and component assessment
- Online diagnostic tools and devices
- Ancillary equipment including online filters, over pressure relays and devices
- Testing requirements including cycle timing, differential delay, energy accumulator mechanical and operational tests and control system functional tests
- Safety precautions when testing and maintaining high voltage power transformer on load tap changers - safe working practices and procedures, identification of hazards, assessment and control of OHS risks, types, selection, maintenance and use of personal protective equipment.

T13 Circuit breaker construction principles encompassing:

- Standards, codes, legislation, supply authority regulations and or enterprise requirements applicable to circuit breakers
- Requirements for the use of manuals, circuit breaker diagrams/plans and drawings
- Types, characteristics and capabilities of HV substation circuit breakers installed
- Use, characteristics and capabilities of specialised tools and equipment
- Identification of components within the circuit breaker and associated control housings
- Identification of energy sources within the circuit breaker and associated control housings

REQUIRED SKILLS AND KNOWLEDGE

- Identification of insulation paths within the circuit breaker
- Types and characteristics of operating mechanisms
- Types and characteristics of interrupter chambers
- Safety precautions when Constructing circuit breakers - safe working practices and procedures, identification of hazards, assessment and control of OHS risks, types, selection, maintenance and use of personal protective equipment

T14 Synchronous Condenser Principles encompassing:

- Standards, codes, legislation, supply authority regulations and or enterprise requirements applicable to Synchronous Condensers
- Requirements for the use of manuals, substation diagrams/plans and drawings
- Types, characteristics and capabilities of Synchronous Condensers installed
- Identification of components within the Synchronous Condensers and associated control housings
- Use, characteristics and capabilities of specialised tools and equipment
- Enterprise Specific Policies and Procedures for Synchronous Condensers
- Techniques in evaluating serviceability of Synchronous Condensers operation
- Safety precautions when testing and measuring Synchronous Condensers - 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, communicating worksite procedures

T15 Operation and maintenance procedures associated with voltage regulation schemes encompassing:

- Standards, codes, Commonwealth/State/Territory legislation, supply authority regulations and or enterprise requirements associated with the operating procedures
- Requirements for the use of operating manuals, system diagrams/plans and drawings
- Principles of operation and operating sequences - voltage control, VAR control, Live Bus/Dead Bus synchronising checks, tap changer principles, requirements for parallel operations, settings, grading
- Techniques associated with - isolation requirements, enterprise maintenance requirements, setting checks, LV injections, electrical measurements
- Ancillary equipment which may include transducers, Buswire schemes, tap position indicators, local/remote control systems, alarm systems
- Voltage regulation scheme types which may include electro mechanical, micro-processor or combinations of both.

T16 Electrical equipment associated with distribution field device protection and control schemes encompassing:

- Types and applications of electrical equipment – characteristics, capabilities (schemes: automatic circuit reclosers (ACR's), gas switches, secondary injection tests, primary injection tests, TMR Radio's, SCADA, remote control, overcurrent,

REQUIRED SKILLS AND KNOWLEDGE

earth fault, sensitive earth fault, inverse time curves, definite time curves, tripping, reclose, DC supplies, AC supplies and alarms)

T17 Voltage control techniques encompassing:

- Conditions leading to voltage collapse
- Effects on system of high and low voltage
- Voltage control devices - voltage regulators applied to generators and synchronous phase modifiers, electromagnetic voltage regulators, series and parallel capacitors, OLTC transformers and static VAR compensators (SVC's). SVC's includes 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

T18 Voltage control devices encompassing:

- Typical devices applications and capacities
- Estimation of rating of VAR regulating devices using graphical techniques

T19 Transient overvoltages encompassing:

- Causes and effects of transient overvoltages - switching transients and lightning transients, effects on plant items
- Control techniques and systems - surge diverters, shield wires and CB arc control
- Insulation systems - insulation systems, insulation coordination and insulation grading.

T20 Commissioning procedures associated with relevant equipment encompassing:

- Standards, codes, Commonwealth/State/Territory legislation, supply authority regulations and or enterprise requirements associated with the commissioning procedures
- Requirements for the use of commissioning manuals, system diagrams/plans and drawings
- Techniques in commissioning procedures – planning, policy, testing techniques, close out requirements.

T21 Procedures for the location and rectification of faults in electrical equipment up to 1000 volts AC and or 1500 volts DC, encompassing:

- Relationship of Occupational Health and Safety to the location and rectification of faults in electrical equipment - Act and regulations, identification of personal safety, workplace hazards, working with electrically operated tools and equipment, emergency First Aid/resuscitation, rescue from a live electrical situation, enterprise policies and procedures.
- Types of drawings - differentiation between symptoms, faults and causes in malfunctioning equipment, fault-finding techniques and procedures
- Fundamental electrical concepts - effects of current, practical resistors, sources of EMF, series, parallel and series-parallel circuits, electrical measurement,

REQUIRED SKILLS AND KNOWLEDGE

capacitors, inductors, magnetism.

- Fundamentals of general appliances - basic principles of appliances (non mathematical), appliance identification, appliance ratings, basic principles of operation of control equipment and protection devices, fault conditions and symptoms, safe isolation procedures, test equipment, safe testing procedures, including continuity, fault types in appliances, fault-finding procedures (prescriptive)
- Fundamentals of single phase induction motors - basic principles of operation (non mathematical), motor identification, motor ratings, basic principles of operation of control equipment and protection devices, fault conditions and symptoms, safe isolation procedures, test equipment, safe testing procedure, including continuity, fault types in “phase splitting” and universal type motors, fault-finding procedures (prescriptive).
- Fundamentals of three phase induction motors - basic principles of operation (non mathematical), motor identification, motor ratings, motor starter principles, basic principles of operation of control equipment and protection devices, fault conditions and symptoms, safe isolation procedures, safe testing procedure, fault-finding procedures (prescriptive)
- Fundamentals of single and three phase electrical heaters - basic principles of operation, types of electrical heaters, electrical heater identification, electrical heater ratings, basic principles of operation of control and protection devices, fault conditions and symptoms, safe testing procedure, fault-finding procedures (prescriptive).

T22 Disconnection and reconnection procedures for fixed wiring electrical equipment up to 1000 volts AC and or 1500 volts DC, encompassing:

- Safe electrical work practices and procedures according to standards such as AS/NZ 4836:2001 or equivalent
- Safe use of tools and plant
- Safe use of ladders and elevated work platforms
- Safe use of protective clothing
- Hazards in the (electrical) work environment - shock hazards, fire hazards, chemical hazards, other hazardous areas
- Special situations
- Procedures for dealing with fires associated with electrical equipment
- Procedures for dealing with PCBs
- Electric shock victim rescue methods and procedures - basic First Aid treatment for shock, burns and bleeding.
- Purpose of each procedure and application - expired air resuscitation (EAR), external cardiac-compression (ECC), cardio-pulmonary resuscitation (CPR), combined application of EAR and ECC (purpose of each procedure and application).
- Components of a basic electrical circuit(s) – source, control, protection, load
- Types of circuit diagrams – symbols, conventions, interpretations, free sketches

REQUIRED SKILLS AND KNOWLEDGE

- Types of circuit connections and functions - open circuit, closed circuit, short circuit
- Techniques in basic electrical measurement - use of multimeters; use of ammeter; use of voltage measuring and indicating devices; testing of measuring instruments; care of measuring instruments; voltage, current and resistance measurement; estimating values of voltage, current and resistance; using ohms law
- Fundamental principles of electrical concepts - effects of current; practical resistors; sources of EMF; simple practical circuit; series, parallel and series-parallel circuits; electrical measurement; capacitors; inductors; magnetism
- Techniques in insulation resistance measurement and requirements
- Earthing principles and systems.

T23 Disconnection and reconnection procedures for fixed wiring electrical equipment up to 1000 volts AC and or 1500 volts DC, encompassing:

- Methods for testing insulation resistance - continuity of prospective earthing conductor, continuity between exposed conductive parts and the earthing system
- Methods of recognising acceptable test results for compliance with safety requirements
- Methods of recognising unacceptable test results and require an appropriate qualified person to further investigation
- Cable types and conductor termination methods and techniques - conductors solid, stranded and flexible, colour codes
- Single and three phase systems and loads - number of active and live conductors required, line and phase voltage, typical loads
- Identification and rating of general appliances
- Single phase induction motors - motor identification, motor ratings, direction of rotation
- Three phase induction motors - motor identification, motor ratings, direction of rotation
- Single and three phase heaters - types of heaters, heater identification, heater ratings
- Electrical distribution arrangement - power systems within premises, purpose of switchboards/distribution boards (residual current devices and ELCBs)
- Circuit isolation and protection devices
- Isolation procedures - work clearance, testing for voltage, lock-off and tagging, techniques in isolation and tagging, regulation, codes of practice and procedures
- Disconnection procedures, practices and requirements
- Types of replacement equipment
- Methods of ensuring equipment is safe to connect to supply
- Methods of reconnection procedures, practices and requirements
- Methods of return equipment to service

T24 Effects of harmonics encompassing:

- Characteristics and effects of harmonics on protection device

REQUIRED SKILLS AND KNOWLEDGE

functions/malfunction

- Effects of harmonics on transformers, generators, motors, quality of supply.

T25 Procedure for the systematic fault isolation through the application of diagnostic techniques encompassing:

- Principles of analytical questioning
- Techniques in drawing valid conclusions from first observations
- Concepts of broad first-line testing
- Consideration of/responsibility for, avoidance of further damage
- Interpretation of specific test results: cause/effect
- Techniques for isolation to appropriate level - half-split, module/function isolation (kernel technique), substitution, diagnostic software, requirements for the use of manuals, system diagrams/plans, drawings, handbooks, specifications and fault pathways.
- Software/firmware functions awareness
- Factors affecting field versus workshop repair costs
- Scheduling minor/major repair activities, downtime
- Implications of temporary repairs
- Use of system knowledge and history
- Data interpretation, expected versus actual
- Feedback to design/production/installation processes
- Subsystems and system structures
- System signals/status indicators
- Known failure modes and trends
- Action threshold warnings versus catastrophic failure
- Component ratings/upgrades
- Disassembly/reassembly techniques and care
- Relative costs of repair and replacement - remaining life, ongoing maintenance, additional benefits of replacement equipment, e.g. improved productivity, quality

T26 Protection schemes encompassing:

- Standards, codes, legislation, supply authority regulations and or enterprise requirements applicable to protection schemes
- Types of protection schemes - reasons for use, application of protection zones around system elements, degree of protection
- Types of feeder protection equipment - over current protection inverse time-current operating characteristics
- Operation of over current protection equipment used on distribution systems
- Operation of ACRs and their time-current characteristics
- Types and characteristics of over-current relays
- Coordination methods of a distribution feeder protection scheme
- Earth fault protection used on a distribution feeder

REQUIRED SKILLS AND KNOWLEDGE

- Operation of a single wire earth return (S.W.E.R) system

T27 EHV generator control systems encompassing:

- Legislation, Standards, codes, legislation, supply authority regulations and or enterprise requirements pertaining to the operation of a portable generator
- Safety precautions specific to the synchronisation of generator sets - safe working policies, practices and procedures, synchronising procedures
- Techniques in the installation of generator sets control systems - the synchronising of generator control systems onto and off the network without interruption to supply, estimation of EHV load, assessing the appropriateness of the generator
- Operating a generator in parallel to a single EHV job - overhead systems, indoor systems, customer installations, kiosk substations
- EHV generator set and control system to EHV Distribution assets.

Evidence Guide

EVIDENCE GUIDE

9) This provides essential advice for assessment of the unit of competency and must be read in conjunction with the Performance Criteria and the Range Statement of the unit of competency 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 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 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	Test, on two (2) occasions, at least two (2) of the following:	ACR control box and recloser functions. Line capacitor controller Voltage regulating relay and voltage regulator
B	Commission, on two (2) occasions, at least two (2) of the following.	ACR control box and recloser. Line capacitors. Voltage regulating relay and voltage regulator
C	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.

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, testing and commissioning of Distribution field devices
- Operational access to relevant plant, protection or metering equipment, scheme drawings, manufacture's specifications/manuals and testing equipment.

In addition to the resources listed above, in Context of and specific resources for assessment, evidence should show demonstrated competency working in realistic environment and a variety of conditions.

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.

Range Statement

RANGE STATEMENT

10) This relates to the unit of competency 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 testing and commissioning of distribution field devices and may include the following equipment:

Voltage regulator, voltage regulating relays, line drop compensators, tap changers, automatic reclosers, gas switches, line capacitors, control boxes, TMR Radio, mobile phones, communications, settings, downloads, min ops, timing tests, energisation, testing, commissioning, primary injection tests, secondary injection tests, SCADA, overcurrent, earth fault. Inverse times, DC supplies, batteries.

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
- Environmental management documentation
- Established procedures
- Fall prevention
- Hazards
- Identifying hazards
- Inspect
- Legislation
- MSDS
- Notification.
- OHS practices
- OHS issues

RANGE STATEMENT

- 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)**

Testing Units