



**Australian Government**

**Department of Education, Employment and Workplace Relations**

# **UETTDRSO51A Manage network systems power flows**

**Release: 1**

## UETTDRSO51A Manage network systems power flows

### Modification History

Not applicable.

### Unit Descriptor

#### Unit Descriptor

#### 1) Scope:

##### 1.1) Descriptor

This Competency Standard Unit covers the management of electrical network active and reactive power flows ensuring the network is operated within design parameters at all times. The electrical network includes feeders from distribution to transmission voltages; substation and generation assets that can influence power flows.

### 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 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. Commonwealth, State/Territory or Local Government

**License to practice****3)**

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                                                                             |
|-------------|----------------------------------------------------------------------------------------|
| UEENEED104A | Use engineering applications software on personal computers                            |
| 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                                                        |
| UEENEEE107A | Use drawings, diagrams, schedules, standards, codes and specifications                 |
| UEENEEE124A | Compile and produce an energy sector detailed report                                   |
| UEENEEE125A | Provide engineering solutions for problems in complex multiple path circuits problems  |
| UEENEEE126A | 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 |
| UETTDRSO32A                                                    | Manage power systems network faults                                                                            |
| UETTDRSO41A                                                    | Manage power systems transmission networks                                                                     |
| UETTDRSO48A                                                    | Respond to discrete and interdependent protection operations                                                   |
| UETTDRSO49A                                                    | Coordinate power system operations in a regulated energy market                                                |
| UETTDRSO50A                                                    | Respond to complex power system protection operations                                                          |
| Generation/Distribution and Subtransmission Pathway Unit Group |                                                                                                                |
| UETTDRSO34A                                                    | Control power systems generating plant                                                                         |
| UETTDRSO37A                                                    | Develop high voltage distribution and subtransmission switching                                                |

**Prerequisite Unit(s)****4)**

programs

UETTDRSO40A Coordinate high voltage distribution  
and subtransmission networks

## Generation/Transmission Pathway Unit Group

UETTDRSO34A Control power systems generating  
plant

UETTDRSO38A Develop and evaluate power systems  
transmission switching programs

UETTDRSO47A Coordinate high voltage  
transmission network

## Distribution and Subtransmission Pathway Unit Group

UETTDRSO35A Manage high voltage distribution  
and subtransmission network  
demand

UETTDRSO37A Develop high voltage distribution  
and subtransmission switching  
programs

UETTDRSO40A Coordinate high voltage distribution  
and subtransmission networks

## Transmission Pathway Unit Group

UETTDRSO38A Develop and evaluate power systems  
transmission switching programs

UETTDRSO41A Manage power systems transmission  
networks

UETTDRSO42A Manage power systems transmission  
network demand

UETTDRSO47A Coordinate high voltage  
transmission network

**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 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 to manage network power flows | <p>1.1 OHS practices/procedures and environmental and sustainable energy procedures, which may influence preparation of any network power flow management decisions are reviewed and determined.</p> <p>1.2 Purpose of the management is established after data is analysed and expected outcomes of the work are confirmed with the appropriate personnel.</p> <p>1.3 Organisational established policies, procedures and specifications for the management of network power flows are obtained or established</p> |

**ELEMENT****PERFORMANCE CRITERIA**

with the appropriate personnel.

|   |                                             |                                                                                                                                                                                                                             |
|---|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | 1.4                                         | Network power flow management decisions are discussed with and/or directed to the appropriate personnel in order to ascertain the system conditions.                                                                        |
|   | 1.5                                         | Equipment/tools and personal protective equipment are selected based on specified Performance Criteria and established procedures.                                                                                          |
|   | 1.6                                         | Work roles and tasks are allocated according to requirements and individuals' competencies.                                                                                                                                 |
|   | 1.7                                         | Work is prioritised and sequenced for the most efficient/effective outcome, completed within an acceptable timeframe to a quality standard and in accordance with established procedures.                                   |
|   | 1.8                                         | Liaison and communication issues with other/authorised personnel, authorities and clients are resolved and activities coordinated to carry out work.                                                                        |
|   | 1.9                                         | Risk control measures are identified, prioritised and evaluated against the work schedule.                                                                                                                                  |
|   | 1.10                                        | Need for relevant operating procedures are identified to manage the performance of the network according to requirements and/or established procedures.                                                                     |
|   | 1.11                                        | Circuit/systems modelling is used to evaluate alternative proposals as per established procedures.                                                                                                                          |
| 2 | Carry out and management network power flow | 2.1 Strategic plans are developed incorporating organisational initiatives as per established procedures                                                                                                                    |
|   | 2.2                                         | OHS and sustainable energy principles, functionality and practices to reduce the incidents of accidents and minimise waste are incorporated into the project in accordance with requirements and/or established procedures. |
|   | 2.3                                         | Management decisions are made on the basis of safety and effective outcomes according to                                                                                                                                    |

| ELEMENT                                         | PERFORMANCE CRITERIA                                                                                                                                                                                                                                                             |
|-------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                 | requirements and/or established procedures.                                                                                                                                                                                                                                      |
|                                                 | 2.4 Stakeholders/customers are kept informed of current status regarding plan progress and recent developments                                                                                                                                                                   |
|                                                 | 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. |
|                                                 | 2.6 Essential knowledge and associated skills are applied to analyse specific data and compare it with compliance specifications to ensure completion of the work within an agreed timeframe according to requirements.                                                          |
|                                                 | 2.7 Testing of management decisions is undertaken according to requirements and established procedures.                                                                                                                                                                          |
|                                                 | 2.8 Work teams/groups are arranged/coordinated/evaluated to ensure planned goals are met according to established procedures.                                                                                                                                                    |
|                                                 | 2.9 Solutions to non-routine problems are identified and actioned, using acquired essential knowledge and associated skills, according to requirements.                                                                                                                          |
|                                                 | 2.10 Quality of work is monitored against personal performance agreement and/or established organisational and professional standards.                                                                                                                                           |
| 3 Complete the management of network power flow | 3.1 Final review of management decisions are undertaken to ensure it complies with all requirements and include all specifications and documentations needed to complete the work.                                                                                               |
|                                                 | 3.2 Appropriate personnel are notified of completion and reports and/or completion documents (electronic/paper) are finalised/commissioned.                                                                                                                                      |
|                                                 | 3.3 Reports and/or completion documents (electronic/paper) are submitted to relevant                                                                                                                                                                                             |

**ELEMENT****PERFORMANCE CRITERIA**

personnel/organisations for approval and, where applicable, statutory or regulatory approval.

- 3.4 Where applicable, approved copies of power flow management documents (electronic/paper) 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 developing and evaluating transmission switching programs.

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

KS01-TSO51A          Network systems power flows - management

Evidence shall show an understanding of network systems power flows – management to an extent indicated by the following aspects:

T1      Enterprise specific procedures and work practices relating to managing network demand encompassing:

- Commonwealth, State/Territory and local government legislation, supply authority regulations Standards, codes, and or enterprise requirements applicable to the procedures and work practices relating to managing network demand
- Requirements for the use of demand management manuals, system diagrams/plans and drawings
- Identify and interpret enterprise demand management procedures
- Techniques in the applying enterprise demand management procedures

T2      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.

T3      Power flow control encompassing:

- Use of system components to control power flow patterns - base load, spinning reserve, regulating machines, rapid start plant, phase shifting transformers and load shedding
- Principles of automated control
- Synchronising power
- Relationship of power and frequency
- Machine stabilisation techniques
- System oscillations and stability - damped and undamped oscillation, relationship of fault clearance times and system stability, critical clearance times.

## REQUIRED SKILLS AND KNOWLEDGE

### T4 Alternators operation and control encompassing:

- Constructional features of alternators - weights, lengths, lengths, cooling mediums, cooling systems, prime mover types, prime mover attachment, types of windings, core arrangements
- Principle of operation - induction machines, synchronous machines
- Modes of operation - island and infinite bus operation, running up of prime movers, loading the alternator, requirements for synchronising, methods of synchronising
- Use of reactive capability diagram - related diagram types, current circle diagram, performance chart, capability diagram, values represented, per unit representation, limits representation and meaning
- Automatic voltage regulators - need for voltage control, required attributes of an AVR, range, response time, constraints on AVR capability, desirable attributes of an AVR, power consumption, compensation, rotor stabilisation, automatic changeover systems, input and output requirements and components.
- Operation on an infinite bus - definition of infinite bus, power/angle dependence, reactive flow/voltage dependence, power/angle diagram, effect of saliency, transient conditions, practical and theoretical stability limits, voltage dependence of stability, control of reactive flow using AVR and generator transformer tap changer

### T5 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 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 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 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:

| <b>Range of<br/>tools/equipment/materials/procedures/workplaces/other<br/>variables</b> |                                                                    |                  |
|-----------------------------------------------------------------------------------------|--------------------------------------------------------------------|------------------|
| <b>Group No</b>                                                                         | <b>The minimum<br/>number of items on<br/>which skill is to be</b> | <b>Item List</b> |
|                                                                                         |                                                                    |                  |

|   | <b>demonstrated</b>                                                                                       |                                                                                                                                                                                                                         |
|---|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A | Develop and evaluate, on at least three (3) occasions network manipulations that encompass the following: | Maximise system reliability<br>Manage voltage<br>Minimise loss<br>Control load<br>Dispatch of Static/Synchronous VAR compensation (if applicable to enterprise)<br>Dispatch of generation (if applicable to enterprise) |
| B | Demonstrate calculations and analyse the following:                                                       | Transmission line conditions on the interconnected EHV system.<br>Distribution and Subtransmission line conditions on an interconnected system                                                                          |
| 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 preparation of HV Transmission Switching programs

Note:

Access will be needed to: relevant modelling tools, drawings, computerised electrical plant control and monitoring facilities and enterprise operational policies, procedures and work practices.

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 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 management of network power flows. These activities are required to secure the network, ensure the network operates at maximum efficiency and develop plans allowing work to be performed safely and shall be demonstrated using the following:

EHV transmission network; HV distribution and sub transmission network; transformers with EHV windings; transformers with HV windings; EHV and HV busbars; EHV and HV isolators; EHV and HV Switchgear (applicable to enterprise equipment); switching of reactors or capacitors into circuit; electricity market auto loading procedures; generator excitation systems; prime mover governing system; fuel delivery systems; switching instructions (applicable to enterprise equipment); computers (applicable to enterprise equipment); network diagrams (applicable to enterprise equipment); access authorities; regulatory requirements

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

**RANGE STATEMENT**

- 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**

|                         |                        |
|-------------------------|------------------------|
| <b>Competency Field</b> | <b>11)</b>             |
|                         | System Operation Units |