



**Australian Government**

# **UEENEEK127A Diagnose and rectify faults in renewable energy control systems**

**Release 2**

# UEENEEK127A Diagnose and rectify faults in renewable energy control systems

## Modification History

Not applicable.

## Unit Descriptor

### Unit Descriptor

#### 1) Scope:

##### 1.1) Descriptor

This unit covers diagnosing and rectifying faults in renewable energy control systems. It encompasses working safely, reading circuit diagrams, sketching diagrams from traced wiring, logically applying fault finding procedures, conducting repairs and completing the necessary service documentation.

## Application of the Unit

### Application of the Unit 2)

This unit is intended to apply to any formal recognition for this standard at the aligned AQF 3 level or higher.

## Licensing/Regulatory Information

### License to practice 3)

The skills and knowledge described in this unit do not require a license to practice in the workplace provided equipment is not connected to installation wiring at voltages above 50 V a.c. or 120 V d.c. However other conditions may apply in some States/Territories subject to regulations related to electrical work.

Note.

Competency requirements to be granted a license to carry out installations, fault finding, repair or maintenance on

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

low voltage electrical installations is incorporated in unit UEENEEG105A and all prerequisite units it specifies

Practice in the workplace and during training is also subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships.

Note:

1. Compliance with permits may be required in various jurisdictions and typically relates to the operation of plant, machinery and equipment such as elevating work platforms, powder operated fixing tools, power operated tools, vehicles, road signage and traffic control and lifting equipment. Permits may also be required for some work environments such as confined spaces, working aloft, near live electrical apparatus and site rehabilitation.

2. Compliance may be required in various jurisdictions relating to currency in First Aid, confined space, lifting, risk safety measures etc.

**Pre-Requisites****Prerequisite Unit(s)****4)****Competencies****4.1)**

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

UEENEEK1 25A Solve basic problems in photovoltaic energy apparatus and systems

**Literacy and numeracy skills****4.2)**

Participants are best equipped to achieve competency in 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.

## Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1 Prepare to Diagnose and rectify faults.	1.1 OHS procedures for a given work area are identified, obtained and understood
	1.2 OHS risk control measures and procedures are followed in preparation for the work
	1.3 The likely extent of work to be undertaken is envisaged from fault/breakdown reports and/or discussions with appropriate person(s)
	1.4 Advice is sought from the work supervisor to ensure the work is coordinated effectively with others
	1.5 Sources of materials that may be required for the work are identified and accessed in accordance with established procedures.

**ELEMENT****PERFORMANCE CRITERIA**

	1.6	Tools, equipment and testing devices needed to locate faults are obtained in accordance with established procedures and checked for correct operation and safety
2 Diagnose and rectify faults.	2.1	OHS risk control measures and procedures for carrying out the work are followed
	2.2	The need to test or measure live is determined in strict accordance with OHS requirements and when necessary conducted within established safety procedures
	2.3	Circuits/machines/plant are checked as being isolated where necessary in strict accordance OHS requirements and procedures
	2.4	Safety hazards resulting from the fault or breakdown are documented and risk control measures devised and implemented in consultation with appropriate personnel
	2.5	Fault finding is approached methodically drawing on knowledge of renewable energy systems and interconnecting circuits using measured and calculated values of circuit/apparatus parameters
	2.6	Circuit/apparatus components are dismantled where necessary and parts stored to protect them against loss or damage
	2.7	Faulty circuits/components are rechecked and their fault status and confirmed
	2.8	Materials/replacement parts required to rectify faults are sourced and obtained in accordance with established procedures
	2.9	Effectiveness of the repair is tested in accordance with established procedures
	2.10	Apparatus is reassembled, finally tested and prepared for return to service
	2.11	Unexpected situations are dealt with safely and with the approval of an authorised person

<b>ELEMENT</b>	<b>PERFORMANCE CRITERIA</b>
	2.12 Fault finding and repair activities are carried out without damage to apparatus, circuits, the surrounding environment or services and using sustainable energy practices
3 Completion and report fault finding and repair activities.	3.1 OHS work completion risk control measures and procedures are followed
	3.2 Work area is cleaned and made safe in accordance with established procedures
	3.3 Written justification is made for repairs to apparatus
	3.4 Work completion is documented and appropriate person(s) notified in accordance with established procedures

## Required Skills and Knowledge

### REQUIRED SKILLS AND KNOWLEDGE

8) This describes the essential skills and knowledge and their level, required for this unit.

Evidence must show that knowledge has been acquired of safe working practices and diagnosing faults in renewable energy control systems.

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

#### **KS01-EK127 Renewable energy system electronics**

##### **A**

Evidence shall show an understanding of renewable energy systems fault finding to an extent indicated by the following aspects:

Fault finding techniques encompassing:

- Factors to consider in clarifying the nature of a fault encompassing:
  - Initial fault report
  - Confirmation of symptoms of the fault
  - Comparison of symptoms with normal operation

## REQUIRED SKILLS AND KNOWLEDGE

- Effect to cause reasoning — assumptions of possible causes
- Methods for testing assumptions encompassing:
  - Visual inspection
  - Sectional testing
  - Split-half tests
  - Component isolation
- Dealing with intermittent faults

Semiconductor components encompassing:

- symbols for common semiconductor components including rectifier diodes, LEDs, zener diodes, bipolar transistors, Darlington pairs, MOSFETs, IGBTs, SCRs, and triacs.
- basic function of these devices above.
- major rating parameters of device above.
- applications for each device.
- I-V characteristics of diodes and the current gain characteristic of bipolar transistors.

T3 Linear regulated d.c. power supplies encompassing:

- label circuit diagrams for half wave and full wave, single phase and three phase rectifiers.
- voltage and current waveforms for these rectifier circuits with and without capacitor filtering
- peak output voltages from single phase and three phase rectifier circuits.
- block diagram showing the structure of a regulated DC power supply.
- main features of linear integrated circuit voltage regulator ICs.
- each of the major components and their physical location in a regulated power supply.

T4 Switching power control circuits encompassing:

- power dissipation of a transistor when operated as a switch.
- how Pulse Width Modulation (PWM) can provide a variable output voltage from a switch mode regulator.
- advantages and disadvantages of switch mode power circuits compared with linear power circuits.
- block diagram of a basic PV switching voltage regulator for battery charging.
- applications of switch mode circuits found in renewable energy systems.

## REQUIRED SKILLS AND KNOWLEDGE

- how power control in AC circuits is achieved using SCRs and Triacs.
- methods used to reduce radio frequency interference (RFI) in DC and AC circuits utilising high speed switching.

### T5 Digital electronic circuits encompassing:

- characteristic features that distinguish analogue and digital devices and circuits.
- how numbers or text information can be represented using binary numbers and how these are represented in digital circuits.
- operation of voltage comparators, Analogue to Digital (A-D) converters, and Digital to Analogue (D-A) converters, and give one example of each one's use in a renewable energy application.
- basic function of microcontrollers, volatile and non-volatile memory devices.
- operation of a solar hot water system pump differential controller, as an example of the use of logic in digital circuits.

### T6 Inverters encompassing:

- basic function of inverters and d.c.-d.c. converters and their use in renewable power systems.
- the operation of an inverter bridge and half-bridge.
- output voltage waveforms for square wave, modified square wave and synthesised sine wave inverters showing typical voltages and timing.
- the function of PWM techniques in modified square wave and synthesised sine wave inverters.
- block diagrams showing the structure of common forms of d.c.-d.c. converters and inverters used in renewable energy applications

### T7 Maintenance encompassing:

- safety procedures for work on electronic systems, circuits and apparatus.
- hazards that may be encountered when performing tests on inverters, battery chargers or other equipment containing LV circuits.
- functionality of electronic equipment through appropriate client questioning and application of systematic tests and observation.
- various types of common faults and their causes in renewable



## REQUIRED SKILLS AND KNOWLEDGE

- energy electronic equipment.
- typical test equipment used to repair electronic and electrical equipment
- safe and correct use of tools and test equipment to locate electronic equipment faults under the direction of an electronics technician.
- replacement of circuit boards, observing appropriate handling precautions for static sensitive devices.
- replacement of socketed ICs such as EPROMs or microprocessors, using appropriate tools and methods

## Evidence Guide

### EVIDENCE GUIDE

9) This provides essential advice for assessment of the unit and must be read in conjunction with the performance criteria and the range statement of the unit and the Training Package Assessment Guidelines.

The Evidence Guide forms an integral part of this unit. It must be used in conjunction with all 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-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. In some circumstances, assessment in part or full can occur outside the workplace. However, it must be in accordance with industry and regulatory policy.

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 issues inherent in working with electricity, electrical equipment, gas or any other hazardous substance/material present a challenge for those determining competence. Sources of evidence need to be 'rich' in nature to minimise error in judgment.

Activities associated with normal everyday 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 practised. 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 must be met.

Evidence for competence in this unit must be considered holistically. Each element and associated performance criteria must be demonstrated on at least two occasions in accordance with the 'Assessment Guidelines – UEE11'. Evidence must also comprise:

- A representative body of work performance demonstrated within the timeframes typically expected of the discipline, work function and industrial environment. In particular this must 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 statement
  - Apply sustainable energy principles and practices as specified in the performance criteria and range statement
  - Demonstrate an understanding of the essential knowledge and associated skills as described in this unit. It may be required by some jurisdictions that RTOs provide a percentile graded result for the purpose of regulatory or

licensing requirements.

- Demonstrate an appropriate level of skills enabling employment
- Conduct work observing the relevant Anti Discrimination legislation, regulations, policies and workplace procedures
- Demonstrated consistent performance across a representative range of contexts from the prescribed items below:
  - Diagnose and rectify faults in renewable energy control systems as described in 8) and including:

- A Envisaging the likely extent of work from fault/breakdown reports and discussion with appropriate persons
- B Using methodical fault finding techniques
- C Finding faults efficiently
- D Rectifying faults effectively
- E Completing documentation correctly
- F Dealing with unplanned events by drawing on essential knowledge and skills to provide appropriate solutions incorporated in a 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 work as prescribed by this unit.

These should be part of the formal learning/assessment environment.

Note:

Where simulation is considered a suitable strategy for assessment, conditions must be authentic and as far as possible reproduce and replicate the workplace and be consistent with the approved

industry simulation policy.

The resources used for assessment should reflect current industry practices in relation to diagnosing faults in renewable energy control systems.

**Method of assessment**

**9.4)**

This 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 Industry to which this unit applies. This requires assessment in a structured environment which is intended primarily for learning/assessment and incorporates all necessary equipment and facilities for learners to develop and demonstrate the essential knowledge and skills described in this unit.

**Concurrent assessment and relationship with other units**

**9.5)**

There are no concurrent assessment recommendations for this unit.

The critical aspects of occupational health and safety covered in unit UEENEEE101A and other discipline specific occupational health and safety units shall be incorporated in relation to this unit.

## Range Statement

### RANGE STATEMENT

**10)** This relates to the 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 unit must be demonstrated in relation to finding and repairing any four of the following faults in renewable energy systems:

- Open-circuit
- Short-circuit
- Incorrect connections
- Insulation failure
- Unsafe condition
- Apparatus/component failure
- Related mechanical failure

Generic terms used throughout this Vocational Standard shall be regarded as part of the Range Statement in which competency is demonstrated. The definition of these and other terms that apply are given in Volume 2, Part 2.1.

## Unit Sector(s)

Not applicable.

## Competency Field

**Competency Field**            **11)**

Renewable and Sustainable Energy