Australian Government

UEENEEK123A Carry out basic repairs to renewable energy apparatus

Release 2

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

UEENEEK123A Carry out basic repairs to renewable energy apparatus

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor **1) Scope:**

1.1) Descriptor

This unit deals with the replacement of electrical and non-electrical components of renewable energy apparatus. It encompasses safe working practices, following written and oral instructions and procedures, basic testing techniques, disconnecting and reconnecting electrical/electronic components, dismantling and assembling apparatus and reporting repair activities.

Application of the Unit

Application of the Unit **2)**

This unit is intended for competency development entry-level employment-based programs incorporated in approved contracts of training.

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 voltage above 50 V a.c. or 120 V d.c. However, practice in this unit is subject to regulations directly related to occupational health and safety and where applicable contracts of training such as apprenticeships.

License to practice **3)**

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.

UEENEEE104A	Solve problems in d.c. circuits

AND

UEENEEE108A	Lay wiring/cabling and terminate accessories for extra-low voltage (ELV) circuits

OR

UEENEEG106A	Terminate cables, cords and accessories for low voltage circuits

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 3 Writing 3 Numeracy 3

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 repair renewable energy apparatus.	1.1 OHS procedures for a given work area are identified, obtained and understood through established routines and procedures
	1.2 Established OHS risk control measures and procedures in preparation for the work are followed
	1.3 The nature of the repair is obtained from documentation or from work supervisor to establish the scope of work to be undertaken
	1.4 Advice is sought from the work supervisor to ensure the work is coordinated effectively with

ELEMENT	PERFORMANCE CRITERIA	
		others
	1.5	Sources of materials that may be required for the work are identified and accessed in accordance with established routines and procedures
	1.6	Tools, apparatus and testing devices needed to carry out the work are obtained and checked for correct operation and safety
2 Repair renewable energy apparatus.	2.1	Established 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/apparatus are checked as being isolated where necessary in strict accordance OHS requirements and procedures
	2.4	Apparatus is dismantled in accordance with manufacturer's guide and supervisor's instructions
	2.5	Component parts are tagged during the dismantling to help ensure correct and efficient reassembly and stored to protect them against loss or damage
	2.6	Repairs are affected efficiently without damage to other components, apparatus or circuits.
	2.7	Apparatus is assembled in an appropriate sequence with all parts placed, secured and connected in accordance with manufacturer guide or industry practice
	2.8	Procedures are followed for referring non-routine events to immediate supervisor for directions
	2.9	Repairs are carried out efficiently without waste of materials or damage to apparatus and the surrounding environment or services and using

ELEMENT	PERFORMANCE CRITERIA	
		sustainable energy practices
3 Complete and report repair work activities.	3.1	OHS work completion risk control measures and procedures are followed
	3.2	Repaired apparatus is prepared for testing by an appropriate person
	3.3	Work area is cleaned and made safe in accordance with established procedures
	3.4	Work supervisor is notified of the completion of the repair work 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 carrying out basic repairs to renewable energy apparatus by replacement of components.

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

KS01-EK123A Introduction to renewable energy technologies

Evidence shall show an understanding of renewable energy principles and technologies to the extent indicated by the following aspects:

T1 Major non-technical issues encompassing:

- impact of economic, social, environmental and political issues on the use of renewable energy technologies.
- how each of the non-technical issues impact on the application of a selected renewable energy technology.

T2 Energy services and demand encompassing:

- definition of the terms: energy, power, energy efficiency, end use energy, primary energy, embodied energy.
- calculation relating to energy, power and time with the

REQUIRED SKILLS AND KNOWLEDGE

appropriate number and time with the appropriate number of significant figures.

- units and symbols for energy, power, time and temperature using standard SI units and prefixes.
- conversion of energy and power quantities from one unit to another using conversion tables
- the two laws that apply to any energy conversion process.
- efficiency of a simple energy conversion process.
- energy services required by a domestic dwelling.
- power and energy consumption of individual appliances and systems using appropriate meters or other methods.
- calculation of the end use and primary energy required for these energy services.
- selection of the most appropriate energy source for each of these services.
- justification in terms of environmental, economic, social and political constraints.
- selection of appropriate energy efficient appliances and technologies.

T3 The solar resource encompassing:

- definition of the terms: irradiation, latitude, solar constant, direct and diffuse radiation, azimuth and altitude angles, irradiance, solar window, tilt angle, solstice, equinox.
- units and symbol for irradiation and irradiance and the conversion of one unit to another using conversion tables.
- measurement of solar irradiance with a solarimeter.
- solar radiation data tables and contour maps.
- position of the sun for a given date, time and latitude using a sun path diagram.
- times when an obstacle will shade a given collector.
- how radiation varies throughout the year on the surface of a collector which is either fixed, single-axis tracking or double-axis tracking.
- appropriate tilt angles for fixed and seasonally-adjustable collectors at a given latitude and given application
- calculation of the effect of single-axis tracking and double-axis tracking on collected radiation using radiation data tables.

T4 Solar thermal systems encompassing:

- definition of the terms: conduction, convection, radiation, collector heat loss co-efficient, conductivity, specific hear,

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solar fraction.

- components for a solar thermal system including collector, storage, reticulation and control.
- solar collector types suitable for low, medium and high temperature applications.
- different types of domestic solar hot water (SWH) systems.
- how the components of thermosiphon and pumped storage systems operate.
- heat loss mechanisms in collectors.
- stratification in storage tanks.
- backup energy systems.
- control and protection strategies.
- solar fraction of a domestic SHW system with the use of table or nomograms.

T5 Energy efficient building design encompassing:

- definition of the terms: thermal comfort, passive system, active system, aspect of the site, orientation of the building, thermal mass.
- the climate factors which affect building design.
- relationship between thermal comfort and climate.
- relationship between the seasonal variation of the sun's path and the heat gain of the building elements (roof, walls, windows, floor).
- effect of the thermal conductivity of building materials on heat flows to and from the building
- use of thermal mass in reducing temperature variations within the building.
- use of ventilation.
- thermal performance of a dwelling using both indoor and outdoor hourly temperature measurements over the period of at least one day.
- effect of insulation, glazing, orientation, shading devices, thermal mass and ventilation on the thermal performance of a building.
- an active solar system which could be used in a dwelling to complement passive design features in extreme climates.
- aspects of an existing dwelling that contribute to or detract from thermal performance.

T6 Photovoltaic arrays encompassing:

- definition of the terms: photovoltaic (PV) cell, module, series,

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parallel, array, maximum power point (MPP), nominal operating cell temperature (NOCT), short circuit current (ISC), open Circuit voltage (VOC), I-V curve, current at maximum power point (IMP), voltage at maximum power point (VMP).

- calculations relating to voltage, current and power with the appropriate number of significant figures and using standard SI units and prefixes.
- types of commercially available PV modules, their efficiency and typical applications.
- I-V curve for a typical PV module and label the approximate position of MPP and values of ISC, VOC, IMP and VMP.
- effect of irradiance and temperature on ISC, VOC, IMP and VMP.
- function of blocking and bypass diodes.
- current and voltage of a single module to produce the I-V characteristic curve.
- major specification criteria for a PV module.
- size and configuration of a PV array for a given load and system voltage using tables or nomograms.

T7 Wind energy resources encompassing:

- definition of the terms: kinetic energy, specific wind power, vertical wind speed profile, surface roughness, temperature inversion layer, cut in (vC), rated (vR) and furling (vF) wind speeds, rated power (PR), power co-efficient (cP), output co-efficient (cO), tip speed ratio.
- units and symbols for wind speed, specific wind power and air density.
- large scale wind patterns over the Australian continent, their causes and the effect of local terrain on wind speed, direction and turbulence.
- specific wind power for given wind speeds.
- wind speed at different heights above ground level.
- the mean wind speed based on wind speed frequency distribution data in the form of a histogram.
- suitable minimum tower height for a Wind.
- energy conversion System (WECS) sited downwind from an obstacle.
- isovent maps.
- types of wind-measuring instruments and the minimum requirements for assessing wind energy at a given site.
- measurement of wind speed and direction

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- characteristics of horizontal axis and vertical axis, upwind and downwind, lift and drag propelled wind turbines.
- power vs. wind speed curve for a typical WECS showing vC, vR, vF, and PR.
- major specification criteria for a WECS.
- sizing a WECS for a given load, efficiency and annual mean wind speed using tables or a nomogram.

T8 Micro-hydro system basis encompassing:

- definition of the terms: flow rate, gross or static head, potential energy, net or dynamic head, hydraulic efficiency, MHS efficiency, equivalent pipe length, reaction turbine, impulse turbine
- units and symbols for: flow rate, head, gravitational constant
- methods each assessing flow rate and head.
- measurement of stream flow rate and head.
- assessment from contour maps.
- different MHS in terms of their physical and operating characteristics.
- major specification criteria for an MHS for electricity generation.
- suitable type and size of MHS for a given load, efficiency, available flow rate and net head using tables or a nomogram.

T9 Energy storage encompassing:

- methods of energy storage.
- energy density of the energy storage methods above by mass and volume.
- define the following terms in relation to batteries: nominal voltage, cell, primary and secondary cells, battery, charge and discharge rate, amp hour capacity, watt hour capacity, state of charge (SOC), depth of discharge (DOD), specific gravity (SG), watt hour and amp hour efficiency, cycle life.
- major features of common types of batteries suitable for stand-alone power systems.
- state of charge of a lead-acid battery through measurement of specific gravity or battery voltage using safe working practices.

T10 Stand alone power system basis encompassing:

- d.c. sub-system efficiency.
- block diagram of a typical SPS
- function of each SPS system component

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- typical efficiencies of each component.
- major characteristics of different types of commercially available regulators, inverters and battery chargers.

T11 Biomass encompassing:

- definition of the terms: biogas, producer gas, biofuels, feedstock, gross and net calorific values.
- biofuels and their specific energy contents
- method of production of one of these five biofuels including: source of raw material/feedstock, conversion process, yield
- applications for each of the biofuels.
- assessment of the biomass resource required to meet a particular energy service e.g. cooking, hot water, space heat, transport, process heat, electricity.
- social, political and economic impact of large scale use of selected biomass resources.

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, polices and workplace procedures

- Demonstrated consistent performance across a representative range of contexts from the prescribed items below:
  - Carry out basic repairs to renewable energy apparatus by replacement of components as described in 8) and including:

A Following manufactures service instructions for access to components

B Removing at least three different types of components specified in the work instructions

C Replacing components to manufacturer requirements.

D Reassembling the apparatus correctly.

E Testing apparatus operation

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

Note:

Successful completion of relevant vendor training may be used to contribute to evidence on which competency is deemed. In these cases the alignment of outcomes of vendor training with performance criteria and critical aspects of evidence must be clearly identified

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 carrying out basic repairs to renewable energy apparatus by replacement of components.

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)

For optimisation of training and assessment effort, competency development in this unit may be arranged concurrently with unit:

UEENEEE102A	Fabricate, assemble and dismantle utilities industry components
UEENEEE104A	Solve problems in d.c. circuits
UEENEEE107A	Use drawings, diagrams, schedules, standards, codes and specifications

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 carrying out basic repairs renewable energy apparatus limited to replacement or repair of components in which the fault has been previously established. This must include at least two different renewable energy apparatus in which three different types of components are faulty one of which is mechanical.

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