Australian Government

UEENEEK125A Solve basic problems in photovoltaic energy apparatus and systems

Release: 2

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

UEENEEK125A Solve basic problems in photovoltaic energy apparatus and systems

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor **1) Scope:**

1.1) Descriptor

This unit covers providing known solutions to predictable problems in photovoltaic energy apparatus and systems operated at ELV and LV. It encompasses working safely, problem solving procedures, including the use of basic voltage, current and resistance measuring devices, providing known solutions to predictable circuit problems.

Application of the Unit

Application of the Unit **2)**

This unit is intended for competency development in 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 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

License to practice **3)**

out installations, fault finding, repair or maintenance on 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.

Note: Those holding an 'Unrestricted Electrician's Licence' or equivalent issued in an Australian State or Territory meet the pre-requisite requirements of this unit.

UEENEEE104A	Solve problems in d.c. circuits
UEENEEE137A	Document and apply measures to control OHS risks associated with electrotechnology work

Prerequisite Unit(s) **4)**

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 work on photovoltaic energy apparatus and systems	1.1 OHS procedures for a given work area are obtained and understood
	1.2 OHS risk control work preparation measures and procedures are followed
	1.3 The nature of the apparatus problem 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 others
	1.5 Sources of materials that may be required for the work are identified and accessed in accordance with established procedures
	1.6 Tools, equipment and testing devices needed to carry out the work are obtained and checked for correct operation and safety.
2 Solve problem in photovoltaic energy apparatus and systems	2.1 OHS risk control work measures and procedures 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 are checked as being isolated where necessary in strict accordance OHS requirements and procedures
	2.4 Established routines are used to solve photovoltaic energy apparatus problems using measured and calculated values of apparatus operating parameters
	2.5 Problems are solved without damage to apparatus, circuits, the surrounding environment or services and using sustainable energy practices

ELEMENT	PERFORMANCE CRITERIA	
3 Complete work and document problem solving activities.	3.1	OHS work completion risk control measures and procedures are followed
	3.2	Work site is cleaned and made safe in accordance with established procedures
	3.3	Justification for solutions used to solve photovoltaic energy apparatus problems is documented
	3.4	Work completion is documented and appropriate person(s) notified in accordance with established routine 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 solving basic problems in photovoltaic energy apparatus and systems.

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

KS01-EK125A Photovoltaic power systems

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

T1 Daily irradiation encompassing:

- definition of the terms: declination angle, reflectance, sunshine hours, extraterrestrial irradiation, Latitude, direct and diffuse radiation, azimuth and altitude angles, radiance, solar window, tilt angle, solstice, equinox
- units and symbols for irradiation and irradiance
- interpretation of solar radiation data tables and contour maps.
- measuring solar irradiance with a solarimeter.
- how radiation varies throughout the year on the surface of a fixed collector.
- determining, using field measurements and a sun path

REQUIRED SKILLS AND KNOWLEDGE

diagram, the times and dates when a PV array will be shaded by obstacles at a particular site.

- calculation of the daily average irradiation on a horizontal plane given extraterrestrial irradiation, location constants and sunshine hour data.
- calculation of the monthly mean daily irradiation falling on a PV array for each month of the year, adjusted for the effects of shading, using irradiance and irradiation data tables and a sun path diagram and/or appropriate software.
- selection of an appropriate tilt angle for fixed and seasonally-adjustable PV arrays at an given latitude

T2 Photovoltaic modules encompassing:

- definition of the terms: cell, module, array, mono-crystalline, poly-crystalline, amorphous, band gap energy, semi-conductor
- diagram of a basic crystalline silicon PV cell, showing its physical structure, with at least five major features labelled
- major steps in the production of PV modules based on bulk silicon cells, in comparison with the production of thin film PV modules.
- basic physical principles of PV cell operation for the main types of commercially available PV modules.
- efficiency, spectral response, cost and typical applications of the main types of commercially available PV modules.
- new photovoltaic technologies currently being developed towards commercialisation, and their major features.
- mechanical and electrical features necessary for the long life of a PV module under a wide range of operating conditions.

T3 Module characteristics encompassing:

- definition of the terms: I-V curve, fill factor, operating point, maximum power point (MPP), cell temperature co-efficient, nominal operating cell temperature (NOCT), current, voltage and power output co-efficient.
- equivalent circuit for a PV cell, labelling each of the elements and the polarity of the terminals.
- family of I-V curves for a PV module, labelling major points and showing the effects of variation in irradiance and variation in cell temperature.
- major ratings of a PV module from manufacturer's information or nameplate data.
- determination of the operating point of a PV module with a

REQUIRED SKILLS AND KNOWLEDGE

resistive load, a constant voltage source or any other load with known I-V characteristics, using the load line method.

- configuration of a typical PV array, including the function, placement and ratings of blocking and bypass diodes.
- the effect of partial shading of a PV module or array, the impact of bypass diodes and the significance of their configuration on output current in typical operating conditions.
- calculation of the power at MPP, and the power under typical battery charging conditions, of a PV module, given irradiance and ambient air temperature.
- calculation of the daily energy output of a PV array in accordance with AS 4509.2, and by using "rule of thumb" de-rating factors.
- the scope and content of Australian or international standards relevant to the performance of PV modules.
- the electrical characteristics of a PV module according to relevant Australian or International standards, using an outdoor test method.

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:
  - Solve basic problems in photovoltaic energy apparatus and systems as described in 8) and including:

A	Understanding the nature of the problem
B	Using established routines to solve apparatus problems
C	Providing viable solutions to apparatus problems.
D	Documenting justification for the solutions used
E	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 solving basic problems in photovoltaic energy apparatus.

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:

UEENEEG106A	Terminate cables, cords and accessories for low voltage circuits
UEENEEE108A	Lay wiring/cabling and terminate accessories for extra-low voltage (ELV) circuits

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 photovoltaic energy apparatus as they apply to problems related to installation, fault finding, maintenance or development work functions in any of the following:

- In relation to at least three of the following types of photovoltaic energy problems and on at least two occasions:
  - determining the operating parameters of an existing apparatus
  - identifying and locating electrical faults
  - identifying and locating mechanical fault

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