



Australian Government

UEENEEK133A Design hybrid renewable power systems

Release: 2

UEENEEK133A Design hybrid renewable power systems

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor

1) Scope:

1.1) Descriptor

This unit covers the design of hybrid renewable power systems and their installation. It encompasses following design briefs, incorporating schemes for protection of persons and property from dangers of system malfunction, ensuring other safety and performance standards and functional requirements are met and documenting design calculations and criteria.

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. It applies to any formal recognition for this standard at the aligned AQF 5 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. However, practice in this unit is subject to regulations directly related to occupational health and safety and contracts of training such as new apprenticeships.

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 28A Solve problems in stand-alone renewable energy 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 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 Prepare to design hybrid power systems	1.1 OHS processes and procedures for a given work area are identified, obtained and understood
	1.2 The extent and nature of the system is determined from design brief
	1.3 Safety and other regulatory requirements to which the electrical installation must comply are identified and understood
	1.4 Design development work is planned to meet scheduled timelines in consultation with others persons involved in the installation or associated work
2 Develop hybrid power systems design	2.1 Knowledge of hybrid power systems performance standards, compliance methods is applied to the design
	2.2 Alternative arrangements for the wind energy systems design are considered based on the requirements outlined in the design brief
	2.3 Safety, functional and budgetary considerations are incorporated in the design
	2.4 Wind energy system design draft is checked for compliance with the design brief and regulatory requirements
	2.5 Wind energy system design is documented for submission to appropriate persons for acceptance and approval
	2.6 Solutions to unplanned situation are provided consistent with organisation policy
3 Obtain approval for hybrid power systems design	3.1 Wind energy system design is presented and explained to client representative and/or other relevant persons
	3.2 Requests for alterations to the design are negotiated with relevant persons within the constraints of organisation policy

ELEMENT**PERFORMANCE CRITERIA**

- 3.3 Final design is documented and approval obtained from appropriate persons
- 3.4 Quality of work is monitored against personal performance agreement and/or established organisational or professional standards

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 designing hybrid renewable power systems.

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

KS01-EK133A Hybrid Energy Systems - design

Evidence shall show an understanding of the design of hybrid energy systems to an extent indicated by the following aspects:

Energy demand encompassing:

- end-use services and energy demand for each service.
- most appropriate energy sources for each energy service for a given application and location, taking into consideration economic, environmental and client requirements.
- greenhouse gas savings from a hybrid energy system compared to an existing non-hybrid system, resulting from energy source switching and reduction in fuel usage.
- daily load profiles illustrating average demand and maximum demand, based on time of use data for all electrical loads
- daily load profiles based on given load data, with consideration of likely variations in usage patterns.
- load management strategies and or energy source switching options to reduce the maximum and surge demand, based on load profile analysis
- load profile using a.c. power logging equipment
- daily load profiles illustrating average demand and maximum demand, based on time of use data for all electrical loads

REQUIRED SKILLS AND KNOWLEDGE

Hybrid energy system operation encompassing:

- Definition of the terms complementarily (in relation to renewable energy resources)
- availability
- advantages and disadvantages of hybrid energy systems.
- major features of typical system configurations including pure renewables; renewables and genset; series; switched; parallel (including those with nominal daily genset running)
- operation of a hybrid system over the short term (e.g. daily) and long term (e.g. seasonal, annual).
- response of a genset to a step change in load, and to an overload condition.
- calculations relating to real and apparent power, power factor, mechanical power, voltage regulation and speed droop for single and three phase gensets.
- Calculation of the average efficiency of a genset supplying a given daily load profile, given genset efficiency vs. load data.

System design encompassing:

- system design criteria in consultation with a client.
- renewable energy resources available at a site through the use of on-site measurements and pre-existing weather data as appropriate.
- Selection of a suitable hybrid power system configuration
- Selection and sizing of suitable renewable energy generators for a hybrid energy system taking into consideration available renewable energy resources and daily and seasonal load profiles consistent with AS 4509.2.
- Analysis of load data to determine preferred time of day for genset running, and required energy storage in a parallel hybrid system.
- Selection and sizing of a suitable genset for any system configuration, including a parallel system, according to AS 4509.2
- Selection and sizing of suitable balance-of-system components for a hybrid energy system including energy storage, controls and inverters consistent with AS 4509.2.
- Selection and sizing of a battery bank to meet both energy and maximum power demands in a parallel hybrid system, using an appropriate battery discharge rate and considering load data and genset running times
- Selection of an inverter for a parallel hybrid system,

REQUIRED SKILLS AND KNOWLEDGE

considering load data, genset running times and battery charging requirement.

- Selection and sizing of suitable internal combustion generators (genset) for a hybrid energy system taking into consideration genset characteristics and de-rating requirements
- performance of the system given load data, resource data, equipment specifications, configuration and control strategy.
- Calculation of the load fraction contributed from each renewable energy generator and from the genset.
- Calculation of the genset run time and fuel usage
- Optimisation of the system design based on a mix of design criteria such as cost, availability and reliability, maintenance, environmental factors, convenience etc.
- system manual according to AS4509.3 and AS4509.2, given system components and design data

Life cycle costing encompassing:

- present worth of a future payment
- major costs in the life cycle of a hybrid energy system to be considered in life cycle costing.
- Selection of an appropriate discount rate, inflation rates, and life cycle for a hybrid system life cycle cost analysis.
- life cycle cost analysis including the cost of finance and tax savings for a hybrid system using computer software
- most cost effective of a number of hybrid energy system options on the basis of life cycle costing analysis according to AS4536, AS3595 or similar standards.
- Comparison of the capital cost, simple payback time and life cycle cost of a hybrid energy system with another energy supply option, according to AS 4536, AS 3595 or similar standards.
- sensitivity analysis of life cycle costing to variations in discount rate or other major parameters

Installation, commissioning and maintenance encompassing:

- Specification of the installation and maintenance requirements for a complete hybrid energy system taking into consideration safety and relevant Australian Standards
- installation requirements for fuel storage for a given genset in accordance with AS 1940, AS 4509 and local regulations
- considerations involved in providing adequate genset vibration isolation

REQUIRED SKILLS AND KNOWLEDGE

- considerations involved in providing a genset exhaust system suitable for a given genset and installation site.
- major considerations and methods used in providing suitable noise attenuation for a genset installation.
- Specification of the physical accommodation requirements for a given genset to provide adequate air flow and noise attenuation, with due regard for safety, maintenance access, and in accordance with AS 3010 and AS 4509.
- methods used to allow extended service intervals for gensets
- main features of engine protection systems commonly used on small gensets and the genset sizes to which these are applicable.
- installation and commissioning work on a small genset and controller observing relevant OHS guidelines.
- symptoms of common genset faults
- basic fault location and rectification on a genset with the aid of troubleshooting guides or flowcharts.
- symptoms, causes and possible solutions for the phenomenon of "hunting".
- maintenance schedule for a hybrid power system.

Data communications encompassing:

- typical applications of data communications in renewable energy systems.
- different types of cables and connectors used in data communications between electronic devices and computers.
- commonly used protocols used for serial data communications
- different communications ports on palmtop, laptop or desktop computers
- Connection of an electronic device (e.g. inverter or charge controller) to a computer directly, and via modems and telephony network, using appropriate cabling, connectors and computer ports
- dial-up connection from a computer to a remote electronic device, such as an interactive inverter.
- standard terminal program or proprietary communications software to send to and receive data from an electronic device.
- Programming and retrieving data from an interactive inverter via a computer and data communications link.
- logged data downloaded from an interactive inverter.

REQUIRED SKILLS AND KNOWLEDGE

Data-logging encompassing:

- general features and operation of on-site and remote data logging systems for monitoring and control of a hybrid energy system.
- logger programming, data downloading, display and interpretation of the results

Interactive inverters encompassing:

- main features of different devices commonly used as controllers in hybrid energy systems
- function and operation of an interactive inverter.
- system control philosophies used in different interactive inverters
- program parameters for an interactive inverter, as required for the correct operation of a parallel hybrid system given system component details, load data and preferred genset running times.
- appropriate charging regime for the system battery, based on manufacturer's data and system operating conditions.
- Programming an interactive inverter through its front panel interface.
- function, operation and major features of a genset controller and how it interfaces with a system controller such as an interactive inverter.

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:
 - Design hybrid renewable power systems as described in 8) and including:

- | | |
|---|---|
| A | Developing outlines of alternative designs |
| B | Developing the design within the safety and functional requirements and budget limitations |
| C | Documenting and presenting design effectively |
| D | Successfully negotiating design alteration requests |
| E | Obtaining approval for final design |
| 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 designing hybrid renewable power 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)

For optimisation of training and assessment effort, competency

development in this unit may be arranged concurrently with unit:

UEENED10 Use computer applications relevant to a workplace
1A

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 designing at least two different hybrid renewable power systems and their installation.

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