



Australian Government

UEENEEK140A Develop engineering solutions to renewable energy (RE) problems

Release: 2

UEENEEK140A Develop engineering solutions to renewable energy (RE) problems

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor

1) Scope:

1.1) Descriptor

This unit covers developing engineering solutions to resolve problems with renewable energy. It encompasses working safely, applying extensive knowledge of renewable energy systems and components and their operating parameters, gathering and analysing data, and applying problem solving techniques, developing and documenting alternatives solutions.

Application of the Unit

Application of the Unit 2)

This unit is intended to apply to any recognised development program that leads to the acquisition of a formal award at AQF level 6.

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 31A Design wind energy conversion systems (WECS) rated to 10 kW

UEENEEK1 32A Develop strategies to address environmental and sustainability issues in the energy sector

UEENEEK1 35A Design grid connected photovoltaic power supply systems

UEENEEK1 38A Design micro-hydro systems rated to 6.4 kW

UEENEEK1 39A Design stand-alone renewable energy (RE) 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

Employability Skills

5)

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 develop engineering solution for renewable energy problems	1.1	OHS processes and procedures for a given work area are identified, obtained and understood
	1.2	Established OHS risk control measures and procedures are followed in preparation for the work
	1.3	The extent of the renewable energy problem is determined from performance specifications and situation reports and in consultation with relevant persons
	1.4	Activities are planned to meet scheduled timelines in consultation with others involved in the work
	1.5	Effective strategies are determined to ensure solution development and implementation is carried out efficiently
2 Develop engineering solution for renewable energy problems	2.1	OHS risk control measures and procedures are followed for carrying out the work
	2.2	Knowledge of renewable energy systems and components, their construction, operation, characteristics and applications are applied to developing solutions to renewable energy problems

ELEMENT	PERFORMANCE CRITERIA
3 Test, document and implement engineering solution for renewable energy problem	2.3 Parameters, specifications and performance requirements in relation to each renewable energy problem are set in accordance with established procedures
	2.4 Approaches to resolving renewable energy problems are analysed to provide most effective solutions
	2.5 Unplanned events are dealt with safely and effectively consistent with regulatory requirements and enterprise policy
	2.6 Quality of work is monitored against personal performance agreement and/or established organisational or professional standards
	3.1 Solutions to renewable energy problems are tested to determine their effectiveness and modified where necessary
	3.2 Adopted solutions are documented, including instructions for implementation that incorporates risk control measures to be followed
	3.3 Appropriately competent and qualified persons required to implement solutions to renewable energy problems are coordinated in accordance with regulatory requirements and enterprise policy (See Note)
	3.4 Justification for solutions used to solve renewable energy problems is documented for inclusion in work/project development records in accordance with professional standards

Note

A licence or permit to practise in the workplace is required for specified work on building and premises

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 developing engineering solutions to renewable energy problems.

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

KS01-EK140A Renewable Energy Engineering

Evidence shall show an understanding of renewable energy engineering problem solving to an extent indicated by the following aspects:

T1 Energy and humanity encompassing:

- Need for energy and relationship between energy usage and standard of living
- Energy conversion - typical processes and efficiencies
- Sources of energy
- Solar energy - direct heating, photosynthesis, solar cells, power tower, hydrogen for solar energy, ocean thermal energy collector, solar ponds, wind and wave energy, hydro-electric power
- Geothermal energy
- Tidal energy
- Nuclear energy - fission and fusion, burner and breeder reactors
- Stored fuel reserves
- Fuel conservation - reduction in wastage, recycling, greater usage efficiency and use of waste heat
- Thermodynamics

T2 Basic Concepts encompassing:

- Nature of matter - atoms, molecules, inter-molecular forces, molecular motion, states of matter
- Mass and conservation of mass principle
- Volume, density, specific volume, relative density
- Force, weight, pressure (atmospheric, gauge and absolute)
- Temperature (Celsius and Kelvin)
- Systems and black box analysis
- Reciprocating piston and cylinder mechanism – pressure

REQUIRED SKILLS AND KNOWLEDGE

ratio and compression ratio

T3 Energy encompassing:

- Definition and principles
- Potential energy
- Kinetic energy
- Work (linear and rotational), constant and variable force, relationship to pressure and volume change
- Power (linear and rotational)
- Sensible heat - specific heat capacity (constant pressure and constant volume)
- Latent heat
- Chemical energy - energy content of a fuel
- Internal energy

T4 Energy transfer in closed and open systems encompassing:

- Definition of a closed system
- Calorimetry as an example of a closed system (with or without phase change)
- Thermodynamics 1
- Non-flow energy equation - typical applications such as stirring with simultaneous heating or cooling
- Definition of an open system
- Mass and volume flow rate and continuity equation
- Steady flow energy equation (negligible change in kinetic or potential energy) leading to the concept of enthalpy - typical applications such as turbines, compressors, boilers and heat exchangers.

T5 Gases encompassing:

- Definition of a perfect or ideal gas in terms of the molecular model
- General gas equation
- Characteristic gas equation (equation of state)
- Constant pressure process
- Constant volume process
- Isothermal process
- Polytropic process
- Adiabatic process

T6 Heat engines encompassing:

REQUIRED SKILLS AND KNOWLEDGE

- Definition of a heat engine
 - Essentials of a heat engine - heat source, heat sink, working substance, mechanical power output, working cycle
 - Energy balance for a heat engine (as a black box) and efficiency
 - Maximum possible efficiency (Carnot efficiency)
 - Types of heat engines according to working substance, heat source, mechanical arrangement and working cycle
 - Typical practical cycles - Stirling, Otto, Diesel, dual, two stroke (spark and compression ignition. Joule cycle.
 - Thermodynamics 1
- T7 Heat engine performance encompassing:
- Measurement of torque and power output - rope brake, shoe brake, hydraulic dynamometer, electric dynamometer
 - Heat supply rate, efficiency, specific fuel consumption
 - Measurement of indicated power - mechanical indicator, electric/electronic indicator, Morse test
 - Friction power, mechanical efficiency, indicated thermal efficiency
 - Volumetric efficiency
 - Energy balance
 - Performance curves - variable load constant speed, variable speed constant throttle setting.
- T8 Structure of the existing generation, transmission and distribution system
- T9 Benefits, issues and impacts
- T10 Distributed generation technologies
- T11 Electrical power distribution systems operation encompassing:
- Electrical characteristics of feeders
 - Causes of voltage problems in a power distribution system
 - Voltage regulation limits
 - Calculations for feeder voltage drops
 - Methods of voltage control
 - Fault types, causes and effects
 - Determination of fault levels
 - Fault level limitation

REQUIRED SKILLS AND KNOWLEDGE

T12 Protection and relaying encompassing:

- Protection system purpose and features
- Application of protection in a distribution network
- Protection system terminology
- Feeder protection systems

T13 Distributed generation issues encompassing:

- Utility requirements for interconnection
Safety of personnel
Islanding
Grid Stability
- Voltage regulation
- Potential benefits of DG
- Limitations in design of distribution circuits (designed for 1-way operation)
- Match between supply and demand
- Operation: dispatchable and non-dispatchable supplies
- Factors affecting the sizing of distributed generation
- Use of energy storage
- Case studies

T14 Renewable energy supplies issues encompassing:

- Limits to penetration
- Factors affecting the value of renewables on the grid
- Implications of renewable input on power system operation
- Connection of energy systems via inverters: AS 4777

T15 Factors affecting the uptake of distributed generation encompassing:

- Institutional factors
- Regulatory factors
- Policy including mandated targets
- Green power market
- Financial issues
- Contractual issues
- Case studies

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:
 - Develop engineering solutions to renewable energy problems as described in 8) and including:

A	Understanding the extent of the renewable energy problem
B	Forming effective strategies for solution development and implementation

- C Obtaining renewable energy system/component parameters, specifications and performance requirements appropriate to each problem.
- D Testing and solutions to renewable energy problems
- E Documenting instruction for implementation of solutions that incorporate risk control measure to be followed.
- F Documenting justification of solutions implemented in accordance with professional standards
- G 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 developing engineering solutions to renewable energy problems.

**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 developing engineering solution for at least four renewable energy problems.

Note.

Typical renewable energy problems are those encountered in meeting performance requirements and compliance standards, revising a system operating parameters and dealing with system malfunctions

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