# UEERE0033Y Develop engineering solutions to renewable energy (RE) problems

## Modification History

Release 1. This is the first release of this unit of competency in the UEE Electrotechnology Training Package.

This unit replaces and is not equivalent to UEERE0033 Develop engineering solutions to renewable energy (RE) problems. Modifications include:

- Prerequisites changed
- Significant amendments made to Elements and Performance Criteria
- Range of conditions updated
- Significant amendments to Performance and Knowledge Evidence and CVIG content developed.

## Application

This unit involves the skills and knowledge required to apply engineering principles to renewable energy projects.

It includes determining and applying engineering solutions to RE systems and components and their operating parameters. It also includes applying problem-solving techniques, and testing and documenting alternative engineering solutions to RE problems.

No licensing, legislative or certification requirements apply to this unit at the time of publication.

## Pre-requisite Unit

UEECD0062 Write specifications for renewable energy engineering projects

UEERE9991Y Conduct site survey for off-grid photovoltaic/generating set systems

UEERE9993Y Apply electrical principles to renewable energy design

UEERE0031Y Design off-grid photovoltaic/generating set systems

## Competency Field

Renewable Energy

# Unit Sector

Electrotechnology

# Elements and Performance Criteria

| ELEMENTS | PERFORMANCE CRITERIA |
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| Elements describe the essential outcomes. | Performance criteria describe the performance needed to demonstrate achievement of the element. |
| **1 Determine RE problem and plan work** | **1.1** Nature and scope of the RE problem is determined from relevant documentation and consultation with relevant person/s |
| | **1.2** Relevant work health and safety (WHS)/occupational health and safety (OHS) processes and workplace procedures are identified |
| | **1.3** Established technical and practical engineering methods are identified for application to solution development |
| | **1.4** Technical and practical techniques, tools and resources appropriate for solution development are identified and planned |
| | **1.5** Personnel required to support solution development and implementation are identified, consulted and roles and responsibilities confirmed |
| | **1.6** Project plan including quality measures is developed and tested in consultation with relevant person/s |
| **2 Develop engineering solutions for RE problem** | **2.1** WHS/OHS risk control measures and workplace procedures are followed for carrying out work |
| | **2.2** Information/data is gathered and analysed in accordance with project plan |
| | **2.3** RE systems, components, construction, operation characteristics and applications are analysed in accordance with project plan |
| | **2.4** Parameters, specifications and performance requirements in relation to RE work are determined in accordance with project plan |

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| | **2.5** | Systematic synthesis and design processes are applied to development of engineering solution options to achieve project requirements |
| | **2.6** | Work is monitored in accordance with established quality measures, relevant industry standards and project plan |
| **3 Test, document and implement engineering principles** | **3.1** | Engineering solution/s are tested to determine their effectiveness and modified, as required |
| | **3.2** | Engineering solutions are documented and instructions for implementation that incorporate risk control measures included |
| | **3.3** | Competent person/s to implement engineering solutions are identified and coordinated in accordance with regulatory requirements and workplace policies |
| | **3.4** | Justification for engineering solution/s used are documented and included in work/project records in accordance with relevant industry standards |

# Foundation Skills

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

# Range of Conditions

Range is restricted to essential operating conditions and any other variables essential to the work environment.

Non-essential conditions may be found in the UEE Electrotechnology Training Package Companion Volume Implementation Guide.

Demonstration of competency must include:

- developing at least two different solutions to solve the problem. The solutions must involve at least two of the following areas:
  - energy efficiency
  - demand management
  - heat loss management
  - electrical equipment options
  - renewable energy
  - non-electrical resource management.

# Unit Mapping Information

This unit replaces and is not equivalent to UEERE0033 Develop engineering solutions to renewable energy (RE) problems.

# Links

UEE - Electrotechnology Training Package Companion Volume Implementation Guide at: [sector webpage link here]

# Assessment Requirements for UEERE0033Y Develop engineering solutions to renewable energy (RE) problems

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## Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions on at least two occasions and include:

- determining the nature and scope of renewable energy (RE) problem
- developing and implementing a project plan appropriate for the nature and scope of the RE problem
- identifying and applying technical and practical engineering methods, techniques, tools and resources to development of solution
- identifying and consulting personnel and stakeholders required to support solution development and implementation
- developing and testing effective engineering solution/s and modifying as/if required
- selecting, documenting and implementing engineering solution/s.

## Knowledge Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions and include knowledge of (refer UEE Training Package Companion Volume Implementation Guide for more detail about each item):

- energy resources
- energy and humanity
- basic energy concepts
- monitoring, measurement and verification of data management and cyber security
- energy application technologies
- electrical application technologies

- energy transfer in closed and open systems
- AC v DC power generation/transmission
- Gases
- heat engines and their performance
- electrical power distribution systems operation
- protection and relaying
- distributed generation issues
- RE supply issues
- factors affecting the uptake of distributed generation
- asset management
- life-cycle management
- impact of climate change on electrical infrastructure
- benefits, issues and impacts of options and solutions to problems
- relevant manufacturer specifications
- jurisdictional Electrical Licencing requirements relevant to RE
- technical and non-technical jurisdictional requirements related to grid connection
- relevant workplace documentation, policies and procedures
- relevant WHS/OHS requirements including:
    - risk assessment and mitigation
    - legislated requirements
    - design and implementation of site specific guidelines for access to apparatus
    - requirements for working with HV versus LV
    - safe systems of work
- engineering methods, tools and techniques relevant to solving RE problems.

## Assessment Conditions

Assessors must hold credentials specified within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must satisfy the Principles of Assessment and Rules of Evidence and all regulatory requirements included within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must occur in suitable workplace operational situations where it is appropriate to do so; where this is not appropriate, assessment must occur in simulated suitable workplace operational situations that replicate workplace conditions.

Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.

Resources for assessment must include access to:

- a range of relevant exercises, case studies and/or simulations
- relevant and appropriate materials, tools, facilities and equipment currently used in industry

- resources that reflect current industry practices in relation to developing engineering solutions to RE problems
- applicable documentation, including workplace procedures, equipment specifications, regulations, codes of practice and operation manuals.

# Links

UEE - Electrotechnology Training Package Companion Volume Implementation Guide at: [sector webpage link here]

# Companion Volume Implementation Guide Content:

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| energy resources may include: | • energy transfer in closed and open systems<br>• alternative energy sources<br>• existing and emerging technologies and applications<br>• structure of the existing generation,<br>• distributed generation technologies<br>• electrical power distribution systems operation<br>• RE supplies issues<br>• factors affecting the uptake of distributed generation<br>• grid connected and micro-grid systems<br>• distributed energy implementation |
| energy and humanity including: | • need for energy and relationship between energy usage and standard of living<br>• energy conversion - typical processes and efficiencies<br>• sources of energy<br>• solar energy - direct heating, photosynthesis, solar cells, power tower, hydrogen for solar energy, ocean thermal energy collector, solar ponds, wind and wave energy, and hydro-electric power<br>• geothermal energy<br>• tidal energy<br>• nuclear energy - fission and fusion, burner and breeder reactors<br>• stored fuel reserves<br>• fuel conservation - reduction in wastage, recycling, greater usage efficiency and use of waste heat<br>• thermodynamics |
| basic concepts including: | • nature of matter - atoms, molecules, inter-molecular forces, molecular motion and states of matter<br>• mass and conservation of mass principle |

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| | • volume, density, specific volume and relative density<br>• force, weight and pressure (atmospheric, gauge and absolute)<br>• temperature (Celsius and Kelvin)<br>• systems and black box analysis<br>• reciprocating piston and cylinder mechanism – pressure ratio and compression ratio |
| energy including: | • definition and principles<br>• potential energy<br>• kinetic energy<br>• work (linear and rotational), constant and variable force, relationship to pressure and volume change<br>• power (linear and rotational)<br>• sensible heat - specific heat capacity (constant pressure and constant volume)<br>• latent heat<br>• chemical energy - energy content of a fuel<br>• internal energy<br>• energy storage |
| electrical application technologies may include: | • control systems<br>• power electronics enablement<br>• smart devices<br>• static var compensator (SVR)<br>• stat comm<br>• transformers<br>• internet of things<br>• transmission and distribution systems<br>• protection and relaying<br>• superconducting<br>• synchronisation<br>• power quality |
| energy transfer in closed and open systems including: | • definition of a closed system<br>• calorimetry as an example of a closed system (with or without phase change)<br>• thermodynamics 1<br>• non-flow energy equation - typical applications such as stirring with simultaneous heating or cooling<br>• definition of an open system<br>• mass and volume flow rate and continuity equation |

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| | • 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 |
| gases including: | • definition of a perfect or ideal gas in terms of the molecular model<br>• general gas equation<br>• characteristic gas equation (equation of state)<br>• constant pressure process<br>• constant volume process<br>• isothermal process<br>• polytropic process<br>• adiabatic process |
| heat engines including: | • definition of a heat engine<br>• essentials of a heat engine - heat source, heat sink, working substance, mechanical power output and working cycle<br>• energy balance for a heat engine (as a black box) and efficiency<br>• maximum possible efficiency (Carnot efficiency)<br>• types of heat engines according to working substance, heat source, mechanical arrangement and working cycle<br>• typical practical cycles - Stirling, Otto, diesel, dual, two-stroke (spark and compression ignition) and Joule cycle<br>• thermodynamics |
| heat engine performance including: | • measurement of torque and power output - rope brake, shoe brake, hydraulic dynamometer and electric dynamometer<br>• heat supply rate, efficiency and specific fuel consumption<br>• measurement of indicated power - mechanical indicator, electric/electronic indicator and Morse test<br>• friction power, mechanical efficiency and indicated thermal efficiency<br>• volumetric efficiency<br>• energy balance<br>• performance curves - variable load constant speed, and variable speed constant throttle setting |
| electrical power distribution systems operation including: | • electrical characteristics of feeders<br>• causes of voltage problems in a power distribution system<br>• voltage regulation limits<br>• calculations for feeder voltage drops<br>• methods of voltage control<br>• fault types, causes and effects |

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| | • determination of fault levels<br>• fault level limitation |
| protection and relaying including: | • protection system purpose and features<br>• application of protection in a distribution network<br>• protection system terminology<br>• feeder protection systems |
| distributed generation issues including: | • utility requirements for interconnection<br>• safety of personnel<br>• islanding<br>• grid stability<br>• voltage regulation<br>• potential benefits of distributed generation<br>• limitations in design of distribution circuits (designed for one-way operation)<br>• match between supply and demand<br>• operation: dispatchable and non-dispatchable supplies<br>• factors affecting the sizing of distributed generation<br>• use of energy storage<br>• case studies |
| RE supply issues including: | • limits to penetration<br>• factors affecting the value of renewables on the grid<br>• implications of renewable input on power system operation<br>• connection of energy systems via inverters: AS 4777 Grid connection of energy systems via inverters |
| factors affecting the uptake of distributed generation including: | • institutional factors<br>• regulatory factors<br>• policy including mandated targets<br>• green power market<br>• financial issues<br>• contractual issues<br>• case studies |