



Australian Government

UEERE0033 Develop engineering solutions to renewable energy (RE) problems

Release: 1

UEERE0033 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.

Application

This unit involves the skills and knowledge required to develop engineering solutions to renewable energy (RE) problems.

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

UEERE0011 Design grid-connected photovoltaic power supply systems

UEERE0013 Develop strategies to address environmental and sustainability issues in the energy sector

UEERE0029 Design micro-hydro systems rated to 6.4 kW

UEERE0031 Design stand-alone renewable energy (RE) systems

UEERE0032 Design wind energy conversion systems (WECS) rated to 10 kW

Competency Field

Renewable Energy

Unit Sector

Electrotechnology

Elements and Performance Criteria

ELEMENTS

PERFORMANCE CRITERIA

Elements describe the essential Performance criteria describe the performance needed to

outcomes.

demonstrate achievement of the element.

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|---|--|
| 1 Determine RE problems | 1.1 Work health and safety (WHS)/occupational health and safety (OHS) processes and workplace procedures for a given work area are identified, obtained and applied |
| | 1.2 Hazards are identified, WHS/OHS risks are assessed, and control measures and workplace procedures are implemented in preparation for work |
| | 1.3 Scope of the RE problem is determined from performance specifications, situation reports and in consultation with relevant person/s |
| | 1.4 Activities are planned to meet scheduled timelines in consultation with person/s involved in the work |
| | 1.5 Strategies are determined and solutions developed and implemented in accordance with workplace procedures |
| 2 Develop engineering solutions for RE problems | 2.1 WHS/OHS risk control measures and workplace procedures are followed for carrying out work |
| | 2.2 RE systems, components, construction, operation characteristics and applications are applied to develop engineering solutions to RE problems |
| | 2.3 Parameters, specifications and performance requirements in relation to each RE problem are determined in accordance with workplace procedures |
| | 2.4 Engineering solution/s to resolve RE problem/s is analysed to provide most effective solution/s |
| | 2.5 Unplanned events are dealt with safely and effectively in accordance with regulatory requirements and workplace policies |
| | 2.6 Quality of work is monitored in accordance with performance agreement and/or workplace procedures or relevant industry standards |
| 3 Test, document and implement engineering solution for RE problem | 3.1 Engineering solution/s to RE problem/s is 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 to RE problems is identified and coordinated in accordance with regulatory requirements and workplace policies
- 3.4** Justification for engineering solution/s used to solve RE problems is 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.

Developing engineering solutions to RE problems must include at least the following:

- two RE problems

Unit Mapping Information

This unit replaces and is equivalent to UEENEEK140A Develop engineering solutions to renewable energy (RE) problems.

Links

Companion Volume implementation guides are found in VETNet - -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b8a8f136-5421-4ce1-92e0-2b50341431b6>

Assessment Requirements for UEERE0033 Develop engineering solutions to renewable energy (RE) problems

Modification History

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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 one occasion and include:

- understanding the extent of the renewable energy (RE) problem
- forming effective strategies for solution development and implementation
- obtaining RE system/component parameters, specifications and performance requirements appropriate to each problem
- testing and solutions to RE problems
- documenting instruction for implementation of solutions that incorporate risk control measures to be followed
- documenting justification of solutions implemented in accordance with professional standards
- dealing with unplanned events
- applying problem-solving techniques
- applying relevant work health and safety (WHS)/occupational health and safety (OHS) requirements, including:
 - implementing workplace procedures and practices
- applying sustainable energy principles and practices
- preparing to develop engineering solution for RE problems.

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:

RE engineering, including:

- 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, and 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
- basic concepts encompassing:
 - nature of matter - atoms, molecules, inter-molecular forces, molecular motion and states of matter
 - mass and conservation of mass principle
 - volume, density, specific volume and relative density
 - force, weight and pressure (atmospheric, gauge and absolute)
 - temperature (Celsius and Kelvin)
 - systems and black box analysis
 - reciprocating piston and cylinder mechanism – pressure ratio and compression ratio
- 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
- 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
- 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
- heat engines encompassing:
 - definition of a heat engine
 - essentials of a heat engine - heat source, heat sink, working substance, mechanical power output and 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) and Joule cycle
 - thermodynamics 1
- heat engine performance encompassing:
 - measurement of torque and power output - rope brake, shoe brake, hydraulic dynamometer and electric dynamometer
 - heat supply rate, efficiency and specific fuel consumption
 - measurement of indicated power - mechanical indicator, electric/electronic indicator and Morse test
 - friction power, mechanical efficiency and indicated thermal efficiency
 - volumetric efficiency
 - energy balance
 - performance curves - variable load constant speed, and variable speed constant throttle setting
- structure of the existing generation, transmission and distribution system
- benefits, issues and impacts
- distributed generation technologies
- 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
- protection and relaying encompassing:
 - protection system purpose and features
 - application of protection in a distribution network
 - protection system terminology
 - feeder protection systems
- distributed generation issues encompassing:
 - utility requirements for interconnection
 - safety of personnel
 - islanding
 - grid stability
 - voltage regulation
 - potential benefits of distributed generation
 - limitations in design of distribution circuits (designed for one-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
- RE 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 Grid connection of energy systems via inverters
- 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
- engineering solutions to RE problems
- relevant job safety assessments or risk mitigation processes
- relevant manufacturer specifications
- relevant WHS/OHS legislated requirements
- relevant workplace documentation
- relevant workplace policies and procedures
- RE engineering principles

- sustainable energy principles and practices

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.

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