UEERE0030Y Design renewable energy heating systems

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 UEERE0030 Design renewable energy (RE) heating systems. Modifications include:

- Prerequisites changed
- Significant amendments made to Elements and Performance Criteria
- Range of conditions updated
- Updates to performance and knowledge evidence requirements and CVIG content developed
- Assessment conditions updated

Application

This unit involves the skills and knowledge required to design a renewable energy (RE) heating system and its installation.

It includes determining and developing RE heating systems design, following design brief, documenting design calculations and criteria and obtaining approval for system design.

Licensing, legislative or certification requirements that apply to this unit may differ between jurisdictions and system types. They should be checked prior to commencing this unit.

Pre-requisite Unit

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

and

UEEEL0039 Design, install and verify compliance and functionality of general electrical installations

or

UEERE9993Y Apply electrical principles to renewable energy design

Competency Field

Renewable Energy

Unit Sector

Electrotechnology

Elements and Performance Criteria

ELEMENTS	PERFORMANCE CRITERIA
Elements describe the essential outcomes.	Performance criteria describe the performance needed to demonstrate achievement of the element.
1 Prepare to design RE heating system	**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 Scope of the RE heating system electrical installation is determined from design brief
	1.3 Safety and regulatory requirements to which the electrical installation must comply are identified, obtained and applied
	1.4 Design development work is planned to meet scheduled timelines in consultation with relevant person/s involved in the RE heating system installation or associated work
2 Develop heating system design	**2.1** RE heating system performance standards and compliance methods are applied to the design
	2.2 Safety, functionality and budgetary considerations are incorporated in the RE heating system design
	2.3 Power and energy management requirements are incorporated in design
	2.4 Design aspects are verified with qualified persons
	2.5 RE heating system design is drafted and checked for compliance with the design brief and regulatory requirements
	2.6 RE heating system design is documented for submission to relevant person/s for acceptance and approval

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.

Designing RE heating systems must include:	• two different RE heating systems

Unit Mapping Information

This unit replaces and is not equivalent to UEERE0030 Design renewable energy (RE) heating systems.

Links

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

Assessment Requirements for UEERE0030Y Design renewable energy (RE) heating systems

Modification History

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

Performance Evidence

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

- applying relevant workplace procedures and practices, work health and safety (WHS)/occupational health and safety (OHS) requirements, including using risk control measures
- developing Renewable Energy (RE) system design based on site survey data and within safety and functional requirements and budget limitations and meet design brief
- documenting and presenting final design.

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 the following. Additional advice and definitions for some items is provided in the UEE Training Package Companion Volume Implementation Guide (CVIG).

- heating system technologies including:
    - types and their application
    - operating parameters of common systems
    - system component parameters and specifications
    - system performance and requirements
    - installation specifications and requirements including commissioning
- design of RE heating, including:
    - heat transfer including:
        - modes of heat transfer
        - conduction through a flat plate, series flat plates, thick and thin wall pipe, and composite pipes (e.g. lagged pipes and drums)
        - convection at a flat surface or tube
        - radiation from a flat surface or tube for black or grey bodies
        - combined conduction and convection through single or multiple flat plates or thin wall tubes
        - combined convection and radiation

    - combined conduction, convection and radiation such as fluid in a tank (convection to wall), through wall and/or insulation (conduction) to outside air (convection and radiation)
    - heat exchangers - parallel, counter flow and cross flow
- combustion and fuels including:
    - the combustion process
    - fuels - desirable and undesirable characteristics, solid, liquid and gaseous types, their relative advantages and disadvantages and common methods of combustion
- steam including:
    - importance of steam for heat transfer and power production
    - steam/water properties and the interrelationship between the various properties for unsaturated or saturated water or steam either superheated, saturated or wet
    - saturation temperature and pressure, specific enthalpy, specific volume and dryness fraction
- refrigeration/heat pump including:
    - basic principles and terminology
    - vapour compression cycle
    - performance criteria
    - types of refrigerant - designation, properties advantages and disadvantages
- daily irradiation including:
    - definition of the terms: declination angle, reflectance, sunshine hours and extraterrestrial irradiation
    - solar radiation data tables and contour maps
- energy balance including:
    - definitions of the terms: transmittance, absorptance, emittance, specific heat, absorber, heat removal factor and stagnation temperature
    - ways to reduce heat losses from a collector
- solar collector including:
    - five major factors that affect the selection of materials for solar collectors
    - features of collectors for low, medium and high temperature applications in terms of heat transfer, optical properties and materials of construction
- solar collector performance including:
    - instantaneous efficiency of a solar collector for different inlet temperatures and flow rates
    - effect of varying inlet temperature and flow rate on the performance of a solar collector
- hydraulic circuits including:

- definition of the terms: equivalent length, static head, dynamic head and heat exchanger
- function of the components in the circuit
- effects of water quality on the life and performance of components in the hydraulic circuit
- suitable type and size components to minimise hydraulic and energy losses, including pipes, pumps, heat exchangers, expansion tanks, valves and filters for a hydraulic circuit with a given flow rate and head
- safety requirements of the hydraulic circuit in terms of temperature, pressure and hydrogen gas release
- requirements to balance flow through parallel/series combinations of collector arrays
- suitable types and level of insulation for system components to minimise heat losses

- domestic solar water heaters including:
  - definition of the terms: thermosiphon system, pumped storage system and sacrificial anode
  - function of the components in a domestic solar water heater, including the collector, storage tank, valves, piping, differential controllers, pumps, insulation and support frames
  - schematic diagram of different types of system configurations showing collectors, storage tank, piping, pumps, filters, valves, heat exchangers and expansion tanks
  - factors which affect system performance, including storage tank and collector design, system location and collector orientation, water quality, hot water demand and usage pattern
  - safety requirements that prevent injury from high temperature water and hydrogen gas explosions during installation, maintenance and use of solar water heaters
  - demand for hot water and irradiation for a given location and collector tilt angle, orientation and shading
  - selection a suitably sized system for a given demand and location
  - consequences of under/oversizing of solar water heating systems in terms of the effect on system performance,
  - installation, commissioning and maintenance requirements for a given situation including location and mounting of collectors, storage tanks, valves, pumps, pipes and ancillary fittings
  - the capital cost, simple pay back and life cycle cost of solar and electric or gas hot water heaters according to Industry Standards

- commercial solar hot water heaters including:
  - schematic diagrams for different types of system configurations showing collectors, storage tank, piping, pumps, filters, valves, heat exchangers and expansion tanks
  - steps involved in the design of a commercial solar water heating system

- assessment of the demand for hot water and irradiation for a given location and collector tilt angle, orientation and shading
- selection of a suitably sized system for a given demand and location
- consequences of under/oversizing of a solar water heating system in terms of system performance,
- installation, commissioning and maintenance requirements for a given situation, including location and mounting of collectors, storage tanks, valves, pumps, pipes and ancillary fittings
- the capital cost, simple payback time and life cycle cost of solar and electric or gas hot water heaters according to Industry Standards

- pool solar hot water heaters including:
  - function of the components of solar pool heating systems
  - typical system configuration
  - two factors which affect system performance
  - installation specifications and requirements
- WHS/OHS policy, workplace procedures and instructions
- relevant manufacturer specifications
- relevant Industry Standards.

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
- resources that reflect current industry practices in relation to designing RE heating systems.

Links

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

Companion Volume Implementation Guide (CVIG) Content

combustion and fuels may include:	• air/fuel ration - stoichiometric excess or insufficient air • emissions and pollutants and their control • combustion equations - element mass balance • combustion products - gravimetric basis •
steam may include:	• temperature-specific enthalpy diagram for steam/water • use of steam table to determine steam/water properties (any condition except supercritical) • steam generation - water tube and fire tube boilers, and boiler efficiency • safety devices and controls used with boilers • steam plant - steam traps, economiser, air, pre-heater, superheater, air/water separators, water treatment, feedwater pump and exhaust gas treatment • heat transfer rates to or from steam/water (any condition except supercritical) • steam throttling and formation of flash steam • steam heat exchangers and barrel calorimeters • steam plant for process heating • steam plant for power production
refrigeration/heat pump may include:	• refrigerant properties using the pH diagram • ideal vapour compression cycle on the pH diagram • energy balance and heat transfers in compressor, evaporator and condenser • actual vapour compression cycle and variations from the ideal - pressure loss in lines and non-ideal compression • superheating and sub-cooling with or without suction/liquid heat exchanger • Carnot principle applied to refrigerator and heat pump principles of evaporative refrigeration, absorption refrigeration, air cycle refrigeration and thermo-electric refrigeration
energy balance may include:	• energy balance and instantaneous efficiency equations for a collector

	• calculation of the collector constants from the instantaneous collector efficiency equation for a linear relationship
solar collector performance may include:	• scope and content of relevant sections of Industry Standards • method for testing the thermal performance of a solar collector or a solar water heater according to Industry Standards • efficiency curves for various types of solar collectors • performance of various types of solar water heaters in terms of their design, location and predicted solar fraction
hydraulic circuits may include:	• configuration of a hydraulic circuit for a pumped storage solar water heating system • suitable water and energy conservation measures, including user education, water conservation technologies and insulation