Australian Government

UEENEEK138A Design micro-hydro systems rated to 6.4 kW

Release: 2

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

UEENEEK138A Design micro-hydro systems rated to 6.4 kW

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor **1) Scope:**

1.1) Descriptor

This unit covers the design of micro-hydro systems rated to 6.4 kW 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 meet 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.

UEENEEK124A	Solve basic problems in micro hydro 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 micro-hydro 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 electrical installation is determined from design brief
	1.3 Safety and other regulatory requirements to which the electrical installation must comply are identified, obtained 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 micro-hydro systems design.	2.1 Knowledge of micro-hydro systems performance standards, compliance methods is applied to the design
	2.2 Alternative arrangements for the hybrid power 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 Micro-hydro system design draft is checked for compliance with the design brief and regulatory requirements
	2.5 Micro-hydro 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 micro-hydro systems design.	3.1 Micro-hydro 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 micro-hydro systems.

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

KS01-EK138A1 Micro-hydro systems - design

Evidence shall show an understanding of micro-hydro design to an extent indicated by the following aspects:

T1 Site evaluation encompassing:

- definition of the terms: potential and kinetic energy, micro-hydro system, gross head, net head, flow rate.
- available head at a site using a dumpy level or theodolite, altimeter, pressure gauge and contour maps.
- the accuracy, advantages and disadvantages of each method for flow and head assessment.
- the flow rate of a given site using each of the following methods - catchment area calculations, water diversion to fill a container, stream velocity/area measurement and/or weir construction method.
- advantages and disadvantages of each method of head and flow measurement with particular reference to their accuracy.
- long term usable flow rate from long term stream flow if available able taking into account environmental considerations.
- effects of seasonal variation using long term weather data.
- typical daily and seasonal energy consumption profile at a given

REQUIRED SKILLS AND KNOWLEDGE

site.

- effect of the energy demand profiles both daily and seasonally at the site on the system sizing.
- government regulatory requirements such as those covered under environmental or water resource legislation.
- environmental constraints at a site including minimum stream flow rates, ecological impacts, visual and noise impacts.

T2 System design encompassing:

- suitable MHS characteristics to suit site load, hydraulic head and stream flow rate characteristics and a suitable type of commercially available MHS to suit.
- frictional losses in delivery pipes using manufacturer's data.
- calculation of the energy output of the selected MHS at the site from water flow rate, head and manufacturer's data, allowing for seasonal variations in performance and environmental constraints.
- design of any required weirs or dams, open races or penstocks, strainer and intake systems.
- optimum the position of the MHS and size of the MHS.
- suitable balance of system components including delivery pipe and fittings, transmission cable and voltage, voltage and frequency regulation, battery storage type and capacity, battery charger, inverter, back-up generator, and load dump.
- likely environmental impacts of the MHS and appropriate measures to minimise these impacts.

T3 System costing encompassing:

- major costs to be considered in the life cycle costing method.
- calculation of the capital and life cycle cost that includes the cost of various system configurations for a micro hydro application.
- external costs that might impact on the cost effectiveness of a MHS.
- most cost effective of a number of options on the basis of life cycle costing analysis

T4 Micro-hydro systems installation and maintenance processes encompassing

- Selection of an appropriate MHS taking into account the topology of the site, local council approvals, environmental considerations, site access and transport of equipment, water and power transmission distances and daily and seasonal load profiles.

REQUIRED SKILLS AND KNOWLEDGE

- Appropriate methods, using appropriate safety procedures, for: dam or weir construction; watercourse construction and/or penstock installation; turbine installation;
- Appropriate installation, commissioning, fault diagnosis and rectification procedures and maintenance methods using appropriate safety procedures.
- Maintenance schedule for the system.
- Schematic and wiring diagrams for the MHS showing the general circuit layout and protection between the MHS, batteries, inverter and loads according to Australian Standards AS/NZS3000, AS4509, and AS4086.2 requirements.
- Safety procedures for the installation, commissioning, fault diagnosis and maintenance of system components.

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, polices and workplace procedures

- Demonstrated consistent performance across a representative range of contexts from the prescribed items below:
  - Design micro-hydro 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 micro-hydro 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:

UEENEED10 Use computer applications relevant to a workplace 1A

Note:

Where dedicated application software is used in demonstrating competency this unit may be assessed concurrently with 'UEENEED101A Use computer applications relevant to a workplace

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 micro-hydro 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