REGISTERED
NATIONAL STANDARD

UNIT OF COMPETENCY

Title:	Apply tools, equipment and materials in complex tasks for operation and maintenance of Biogas systems Notes: 1) Due to safety issues inherent in working with electricity, all training and assessment activities must be in accordance with local industry and regulatory requirements; 2) This unit of competency has been adapted from the Pacific regional unit standard SE3301 (B) *Apply tools, equipment & materials in complex tasks in RE & EE for operations and maintenance*.				
TQF Level:	3	**Credits:**	6	**Version:**	1
National standard code:	NS099-03				
Associated qualification (and code):	National Certificate in Sustainable Energy (Biomass) Level 3 (QR-03-NQ-018-03-0504-23-01)				
Approval date:	27 April 2023	**Review date:**	27 April 2028		
Purpose:	This unit standard involves working with renewable energy systems tools and equipment used for biogas. Persons credited with this unit standard are able to: 1. Identify the **different types** and **uses** of tools, equipment and materials (including *feedstock* and *digestate*) used for operating, testing and maintenance of biogas systems; 2. Demonstrate the **safe handling** of tools, equipment and materials (including feedstock and digestate) for operating, testing and maintenance of biogas systems; 3. Demonstrate the **operating practises** for tools, equipment and materials (including feedstock and digestate) used for biogas systems; 4. Demonstrate the **maintenance practises** for tools, equipment and materials (including feedstock and digestate) used for biogas systems				

Learning Outcome 1 (LO1)	**Distinguish biomass energy from other renewable sources of energy**
Performance standards	1.1 Describe orally or in writing what *biomass* means; 1.2 Identify different types of *biomass energy*; [Range of types may include but not restricted to *firewood, biogas, biodiesel, ethanol, etc.]* 1.3 Identify the different components of a *biogas plant*; 1.4 Discuss orally or in writing what a *biogas system* is; 1.5 Discuss orally or in writing the advantages of biomass energy over other sources of renewable energy. 1.6 Distinguish between *traditional biomass energy* and *modern bioenergy*.
Learning Outcome 2 (LO2)	Identify the different types and uses of tools, equipment and materials, for operating, testing and maintenance of biogas systems.
Performance standards	2.1 Recognize the different types of biogas plants which are used in Tonga and other Pacific Islands; *[Range of types of biogas plants include but not restricted to 'Balloon' plants, 'Fixed dome' plants, 'Floating drum' plants; 'Horizontal' plants, 'Earth-pit' plants, 'Ferrocement' plants.]* 2.2 Name the different types of basic tools, equipment and materials (including types of instruments and controls, *feedstock* and *digestate*) required for operating, testing and maintenance of a biogas system; 2.3 Describe, orally or in writing, the uses of the tools, equipment and materials identified in 2.2 when operating, testing and maintenance of a biogas system; 2.4 Describe, orally or in writing, the importance of preserving and safe storing of tools, equipment, and materials (including feedstocks and digestate), and accessories. 2.5 Describe, orally or in writing, the range of requirements for assembling and decommissioning of all parts of a biogas system; *[Range requirements include but not restricted to the availability of suitable site or location, availability of key resources such as feedstock (e.g. livestock pens), groundwater, suitable piping material and of the required size, slurry pump, safety shutoff/isolating equipment such as ball or cock valves; appropriate agitator].* 2.6 Describe, orally or in writing, treatment processes which may be required of materials (including feedstock and digestate) involved in the operations, system testing and maintenance of biogas systems.

Learning Outcome 3 (LO3)	Demonstrate the **safe handling** of tools, equipment and materials (including feedstock and digestate) for operating, testing and maintenance of biogas systems
Performance Standards	3.1 Describe, orally or in writing, what *safe-handling* means; 3.2 Describe, orally or in writing, what a *job safety analysis* (JSA) is; 3.3 Describe the JSA which may be required during the operation, testing and maintenance of a biogas plant or system; 3.4 Conduct a JSA to ensure safe handling of tools, equipment and materials during testing and maintenance of a biogas plant or system; 3.5 Conduct a JSA to ensure safe handling of tools, equipment and materials when operating a biogas plant or system; 3.6 Develop a *Hazard (or Emergency) operations plan* to address a range of potential safety issues related to the use of tools, equipment, and materials in a biogas plant or system; *[Range safety issues include but not limited to explosion, asphyxiation, disease, and hydrogen sulfide poisoning. etc.]* 3.7 Describe, orally or in writing, safety issues associated with end-use applications of biogas; 3.8 Use correct tools, equipment, and materials to safely charge a biogas digester.
Learning Outcome 4 (LO4)	Demonstrate the operating practises of tools, equipment and materials (including feedstock and digestate) used for biogas systems
Performance standards	4.1 Summarise procedures for operation of tools, equipment and materials required in a biogas system; *4.2* Prepare a range of task lists appropriate for biogas systems; *[Range task lists include but not restricted to: daily tasks (e.g. digester feeding, agitation, pressure check, checking of gas production, checking of overflow, digestate distribution), weekly/monthly tasks (e.g. mixing swimming and sinking layers of fixed dome plant expansion chambers, checking and re-filling water, sealing lid of fixed dome plants, cleaning floating dome plants, checking of porosity of above ground pipes, checking and emptying digestate collectors), and annual tasks (e.g. removing of swimming layers, pressure testing of the plant, etc.].* 4.3 Devise an appropriate *operation work plan* for a biogas system that include the task lists in 4.2, to ensure safe use and operation of tools, equipment and materials; 4.4 Use a *Hazard operations plan* to facilitate safety in maintaining power tools, equipment and materials;

	4.5 Apply an operation work plan for a biogas production system to demonstrate safe use and operation of tools, equipment and materials; 4.6 Safely handle maintenance tools and testing equipment while fixing the minor defects in tools, equipment and material; 4.7 Safely test and evaluate the efficiency of biogas system tools and equipment
Learning Outcome 5 (LO5)	Demonstrate the maintenance practises of tools, equipment and materials (including feedstock and digestate) used for biogas systems
Performance standards	5.1 Summarise procedures for identifying and documenting faults in power tools, equipment and materials used in biogas systems; 5.2 Use power tools, equipment, and materials safely during maintenance activities in accordance with an appropriate Hazard operations plan; 5.3 Conduct testing and evaluation of power tools and equipment using minimal time and resources; 5.4 Develop a maintenance work plan for tools, equipment and materials to include a range of maintenance activities: *[Range maintenance activities include but not restricted to **daily activities** (e.g. cleaning gall appliances, lubricating moving parts, checking pressure release valves, servicing agitator, controlling gas applications on tightness and function, checking and repairing aboveground pipes), and **annual activities** (e.g. checking for any corrosion, pressure checking and other repair tasks)].* 5.5 Carry out maintenance of tools, equipment and materials used for biogas systems in accordance with a maintenance work plan.
Pre-requisites	N/A
Co-requisites	N/A
Underpinning skills and knowledge	The following skills and knowledge are required: a) Knowledge of basic tools and equipment for a biogas system; b) Knowledge of basic operation of a biogas system; c) Knowledge of basic civil works and works involved in biogas production system/plant installation; d) Understanding of the biomass/feedstock supply; e) Knowledge of the environmental and social impacts of a biogas production system/plant; f) Job safety analysis; g) Work planning (operational, maintenance, hazard/emergency).

Assessment requirements	**Methods of assessment:** A range of assessment methods should be used to assess students' knowledge and application of skills. These shall include but not restricted to the following: a) Direct observation of students performing a seminar or performing certain tasks stated under context of assessment; b) Oral questions to test relevant skills and knowledge during observation (e.g. Interviews); c) Written assessment such as: 1) Maintenance and repair reports; 2) Student Portfolios – containing other activities that demonstrate what a student can do – e.g. annotated photographs, video records, completed Activity logs, marked quizzes and assignments, etc., etc. 3) Reviews of workplace attachment reports (e.g. Supervisor/third party reports; testimonials from Project manager or supervisor) **Context of assessment:** To support student assessment and to ensure they are valid, reliable, flexible, and fair, a training provider is encouraged to make the necessary arrangements to involve the relevant key industry organisations such as *Tonga Electricity Commission* (TEC), *Tonga Power Limited* (TPL) and other trusted licensed private energy and electricity entrepreneurs in the assessment of the required competencies. Such collaboration between provider institutions and the industry may include but not restricted to the following: • Experts from the industry contribute to the design and implementation of the curriculum and assessment activities; • Experts from the industry are engaged as trainers, assessors, or assessment moderators; • Students are placed in relevant industry organizations for workplace attachment; • Industry experts act as supervisors of students on workplace attachment • Etc. To show that learners have the required competence they will need to **demonstrate** and **apply** their knowledge in the workplace (or in an environment that closely resembles the workplace) in relation to: a) LO1: Distinguishing biomass energy from other renewable sources of energy; b) LO2: Identifying the different types and uses of tools, equipment and materials used for operating, testing and maintenance of biogas systems

	c) LO3: Demonstrating the safe handling of tools, equipment and materials for operating, testing and maintenance of biogas systems d) LO4: Demonstrate the operating practises of tools, equipment and materials used for biogas systems e) LO5: Demonstrate the maintenance practises of tools, equipment and materials used for biogas systems **Re-assessment** Candidates of assessment are eligible to three (3) attempts to achieve the required competency within 14 days of their first attempt: 1. Feedback must be provided to the candidate and sufficient time provided to prepare for re-assessment. 2. The trainer/assessor has the discretion to vary the assessment tasks used in each assessment attempt as long as the: a) same competencies are being assessed; b) principles of assessment are adhered to. Failure to achieve the required competency after three (3) attempts on the exam or specific part of the assessment will require the person studying this Unit to re-enrol for the same Unit.
Moderation arrangements	1. Training providers must have their own moderation system approved by TNQAB before accreditation is granted: a. Relevant internal moderation processes are documented; b. Assessment is planned for each unit, and moderation processes are integrated into such plan. 2. External moderation is conducted by the national qualifications unit of TNQAB for all unit components of national qualifications; a. Samples of assessed activities are submitted for moderation; b. Moderation (external) forms are available on request from the National qualifications unit of TNQAB.
Resource requirements	1) A biogas plant: At least one of the following types: • Balloon plant • Fixed dome plant • Floating drum plant • Horizontal plant • Earth-pit plant • Ferro-cement plant 2) Relevant tools and equipment
Requirements to complete this unit	There are five (5) Learning outcomes and thirty-two (32) Performance standards to measure competence.

	To demonstrate the required level of competence, the person studying this unit is: a. Required to attain ALL learning outcomes to the expected standards of performance; b. Required to attain an *Achieved* Grade (Competent) to fulfil the requirements of the Unit Standard; c. Eligible to three (3) attempts to achieve the required competency within 14 days of the first attempt (refer to *Re-assessment* in the *Assessment requirements* section). Failure to achieve the required competency after three (3) attempts on the exam or specific part of the assessment will require the person studying this Unit to re-enrol for the same Unit.
Important notes and definitions	Important notes: 1. All training and assessment activities must be in accordance with Tonga's health and safety legislation and related regulations; 2. In the event that local legislations and/or regulatory requirements are not available, relevant legislations/regulatory requirements from New Zealand and/or Australian should be used for training; 3. This unit of competency has been adapted from the Pacific regional unit standard SE3301 (B) *Apply tools, equipment & materials in complex tasks in RE & EE for operations and maintenance*. **Definitions:** 1. *Anaerobic digestion* (or anaerobic decomposition) refers to breaking down of organic matter under low oxygen conditions; 2. *Asphyxiation* refers to when a living system (e.g. body) is deprived of oxygen leading to unconsciousness or death; 3. *Bagasse* refers to plant residue (as of sugarcane or kava, or grated-coconut, etc.) left after a product (such as juice) has been extracted. 4. *Biogas* is a mixture of different gases produced by the breakdown of organic matter in the absence of oxygen. Biogas can be produced from raw materials (feedstock) such as agricultural waste, manure, municipal waste, plant material, sewage, green waste or food waste. Biogas is a renewable energy source and in many cases exerts a very small carbon footprint. 5. *Biogas plant* is an anaerobic digester that produces biogas from feedstock. 6. *Biogas system* refers to the complete unit required for biogas production at a household level (apparatus and materials from feedstock collection through biogas production to storage/end use - including digestate collection/end use and may also include the use of a compressor for transfer and storage of gas).

7. *Biomass energy* is energy from the burning of plant materials such as firewood, agricultural by-products and animal dung. These are traditional biomasses and are still widely used today in many developing countries for cooking and heating purposes.
8. *Civil work* refers to work that involves civil engineering and construction of concrete base and digester including ducting for the biogas system, construction of digestate collection tanks and livestock pens.
9. *Digestate* refers to the material remaining after the anaerobic digestion of a biodegradable feedstock. It is mainly left over indigestible material and dead micro-organisms - the volume of digestate will be around 90-95% of what was fed into the digester.
10. *Feedstock* refers to any renewable raw material that can be used directly as a fuel, or converted to another form of fuel or energy product;
11. *Hazard (or Emergency) operations plan* is a document that assigns responsibility to organizations and individuals for carrying out specific actions at projected times and places in an emergency or disaster. This plan:
    a. sets forth lines of authority and organizational relationships, and shows how all actions will be coordinated.
    b. describes how people and property will be protected in emergencies and disasters;
    c. identifies personnel, equipment, facilities, supplies, and other resources available for use during response and recovery operations.
    d. identifies steps to address mitigation concerns during response and recovery activities
12. *Job safety analysis (JSA) or Job hazard analysis (JHA)* is a procedure that helps integrate accepted safety and health practices into a particular task or job operation. It involves the breaking down of a job to its main steps, identifying the potential hazards for each main step, and recommending the safest way to do complete each step;
13. *Modern bioenergy* - includes liquid biofuels produced from *bagasse* and other plants; bio-refineries; biogas produced through anaerobic digestion of residues; wood pellet heating systems; and other technologies.
14. *Safe handling* refers to any act that make the use (including storing) of something safe.
15. *Traditional biomass* – this includes wood fuels (i.e. firewoods), agricultural by-products and dung which are burned for cooking and heating purposes. This source of energy is easily available and caters for the energy need of a lot of people (mostly in developing countries including Tonga and the rest of the Pacific Islands).

Public comments on unit	Please contact TNQAB National Qualifications Unit (email EnquireNQ@tnqab.to or Telephone 28136) if you like to discuss or suggest changes to the details of this unit.