REGISTERED
NATIONAL STANDARD

UNIT OF COMPETENCY

Title:	**Apply tools, equipment and materials in complex tasks in RE & EE for operations and maintenance of Hybrid-wind systems** Note 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 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:	NS093-03				
Associated qualification (and code):	National Certificate in Sustainable Energy (Hybrid-wind) Level 3 (QR-03-NQ-018-04-0504-23-01)				
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 Hybrid Wind System.

Persons credited with this unit standard are able to:

1. Identify the **different types** of tools, equipment and materials used for operating, testing and maintaining of Hybrid Wind systems;
2. Demonstrate the **safe handling** of tools, equipment and materials for operating, testing and maintaining of Hybrid Wind systems;
3. Demonstrate the **operating practices** for tools, equipment and materials used for Hybrid Wind systems;
4. Demonstrate the **maintenance practices** for tools, equipment and materials used for Hybrid Wind systems.

Learning Outcome 1 (LO1)	Distinguish *Hybrid wind* from other renewable sources of energy.
Performance standards	1.1 Describe orally or in writing what *hybrid* means; 1.2 Identify the different energy generation methods which can be used in a hybrid-wind system; [Range of generation methods may include but not restricted to *solar* (in solar-wind hybrid), *diesel* (as in diesel-wind hybrid or diesel-solar-wind hybrid), etc.] 1.3 Identify the different components of a hybrid-wind system studied in this unit; 1.4 Discuss, orally or in writing, the advantages of Hybrid-wind systems over other energy generation methods; 1.5 Differentiate between hybrid-wind system and an independent Wind system (also known as *Wind energy conversion system* or WECS).
Learning Outcome 2 (LO2)	Identify the different types and uses of tools, equipment and materials used for operating, testing and maintenance of a WECS.
Performance Standards	2.1 Outline the advantages and disadvantages of a range of WECS in terms of the context of Tonga (or any other Pacific Island). *[Range includes but not limited to small-scale WECS versus medium-scale WECS, and onshore WECS versus offshore WECS]* 2.2 Name the different parts of a WECS; 2.3 Describe, orally or in writing, the functions and limitations of each part of a WECS; 2.4 Name the different types of basic tools, equipment and materials – including types of instruments and controls required for a WECS; 2.5 Name the tools, equipment, and/or materials required for the decommissioning and assembling of all parts of a WECS; 2.6 Describe orally or in writing the specific **uses** of the tools, equipment, and/or materials named (in 2.5) above; 2.7 Discuss the importance of storing and preserving tools, equipment, materials, and accessories in a safe manner.

Learning Outcome 3 (LO3)	**Demonstrate the *safe handling* of tools, equipment and materials for operating, testing and maintenance of WECS**
Performance standards	3.1 Describe, orally or in writing, what *safe handling* means (as used in this LO); 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 testing, operation, and maintenance of hybrid-wind system; 3.4 Conduct a JSA to ensure safe handling of tools, equipment and materials when testing a wind power production system; 3.5 Conduct a JSA to ensure safe handling of tools, equipment and materials during data gathering from a WECS; 3.6 Conduct a JSA to ensure safe operation of power tools, equipment and materials during maintenance and replacement of a WECS or its parts; 3.7 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 WECS or Hybrid-wind systems. [*Range safety issues include but not limited to electrical shock, fires, falls, coming in contact with moving parts, being trapped in confined spaces, etc.]* 3.8 Describe, orally or in writing, safety issues associated with end-use applications of a hybrid-wind system;
Learning Outcome 4 (LO4)	**Demonstrate the *operating* practises for tools, equipment and materials used for Hybrid-wind systems**
Performance standards	4.1 Summarise the procedures for operation of tools, equipment and materials for hybrid-wind systems; 4.2 Prepare a range of task lists appropriate for Hybrid-wind systems; *[Range task lists include but not restricted to: daily tasks, weekly/monthly tasks, and annual tasks.].* 4.3 Develop an *operation work plan* for a hybrid-wind system which includes the tasks listed in PS 4.2 above, to ensure safe use and operation of tools, equipment and materials; 4.4 Integrate relevant safety considerations into an operation work plan to ensure safety in practises and procedures while using tools, equipment and materials for Hybrid wind systems; 4.5 Use a *Hazard operations plan* to facilitate safety in maintaining power 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 Test and evaluate the efficiency of the power tools and equipment for Hybrid-wind systems;
Learning Outcome 5 (LO5)	Demonstrate the maintenance practices of tools, equipment and materials used for hybrid-wind systems
Performance standards	5.1 Summarise procedures for identifying and documenting faults in power tools, equipment and materials used in hybrid-wind systems. 5.2 Use power tools, equipment, and materials safely during maintenance activities in accordance to a 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. [Range maintenance activities include but not restricted to: • daily maintenance (such as *clean gall appliances, lubricate moving parts, check pressure release valves, service agitator, control gas applications on tightness and function, check aboveground piped – replace if required* • annual maintenance checks *(*such as *for corrosion, pressure, etc., and repair if necessary.]* 5.5 Carry out maintenance of tools, equipment and materials used for hybrid-wind systems in accordance with a maintenance work plan.
Pre-requisites	N/A
Co-requisites	N/A
Underpinning skill and knowledge	The following knowledge and skill underpin this unit standard: • Basic knowledge of *Electromagnetic induction* – including *Right-hand slap rule*; • Knowledge of basic operation of a WECS – including: ○ rotor systems, turbines, etc. ○ advantages (over other methods) and disadvantages • Knowledge of basic operation of a hybrid-wind system (how different energy generation methods work together in a hybrid system); • Knowledge of basic civil works and works involved in hybrid-

	wind production system/plant installation • Understanding of the hybrid-wind supply • Knowledge of the environmental and social impacts of hybrid-wind production system/plant. • Knowledge of basic tools and equipment for operation and maintenance of hybrid-wind systems and WECS • *Job safety analysis* (JSA) • Safe use and maintenance of tools, equipment, and materials – in Hybrid wind and WECS. • Hazard and emergency response planning
Assessment requirements	**Methods of assessment:** A range of assessment methods should be used to assess students' knowledge and application of skills, include but not restricted to the following: a) Direct observation of students performing certain tasks as described in the context of assessment. b) Oral questions to test relevant skills and knowledge during observation c) Written assessments such as: 1. Maintenance and repair reports on applications tools, equipment & materials in complex tasks in RE & EE for operations and maintenance Wind Energy Conversion System (WECS); 2. Student portfolios; 3. Review of workplace attachment reports (e.g. Supervisor/third party reports **Context 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 you have the required competence you will need to demonstrate knowledge in the workplace (or in an environment that closely resembles the workplace) in relation to the learning outcomes of the unit:

a) LO1: Distinguish Hybrid wind from other renewable sources of energy;
b) LO2: Identify the different types and uses of tools, equipment and materials used for operating, testing and maintenance of a WECS
c) LO3: Demonstrate the safe handling of tools, equipment and materials for operating, testing and maintenance of WECS
d) LO4: Demonstrate the operating practises for tools, equipment and materials used for Hybrid-wind systems
e) LO5: Demonstrate the maintenance practices of tools, equipment and materials used for hybrid-wind system

Examples:

Assessment can target:

1) Students knowledge of Wind Energy Conversion System (WECS) in terms of:
    a) Its main parts and their functions;
    b) Its types and uses;
    c) Its advantages and disadvantages when utilized in the local context;
    d) Assembling and decommissioning of all parts
    e) Its location requirements (ground conditions, topography, availability of wind resource, minimal obstruction, etc.)
2) Students' ability to identify the different tools, equipment and materials used for operating, testing and maintenance of a WECS and Hybrid-wind systems, in terms of:
    a) Types and, functions, and/or potential uses;
    b) Their advantages and disadvantages when utilized in the local context;
    c) Their maintenance, safe storing and preserving;
3) Student's knowledge of and ability to use the range of standard safe practices for tools, equipment, and materials.
    [Range include but not restricted to creating and using a Job Safety Analysis (JSA),

	developing a Hazard Operations Plan, preparing operation work plans, maintenance work plans and task lists for tools/equipment/materials, clearly outlining end-use applications of tools and equipment, Summarising procedures (for usage, maintenance and storage] **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) Wind energy conversion system (WECS): Small or Large Scale Horizontal axis wind turbine (HAWT) systems 2) Hybrid-Solar PV system; 3) Tools, equipment and materials for RE and EE (Hybrid Wind) operation and maintenance; 4) Printed resources on the applications (operation and maintenance) of relevant tools, equipment and materials for RE and EE (Hybrid-wind) at the discretion of the course/unit coordinator or trainer;

5) Computer, Printer, Internet Access
6) Conventional classroom furniture and resources: White/blackboard, tables or benches, chairs, student notice boards, A3 coloured cards or wall charts for group discussion.
7) Wind-based hybrid system
8) WECS Standards and Guidelines
9) Personal Protective Equipment (PPE)
    - Hand gloves for electrical and mechanical lab work
    - Safety helmets
    - Safety glasses
    - Ear mask for use in workshop environment
    - Dust masks
    - Body harness
    - Lock and tag out - Safety tags (out of service, do not operate, live wire)
10) Tools and Equipment
    - Drill set bits
    - Electricians Tool Kit includes but not limited to:
        - insulated screwdrivers,
        - insulated pliers,
        - electrical tester,
        - Ratchet handle with universal joint and extension bar, and coupler;
        - measuring tape.
11) Cables and cable termination tools
    - Crimping tool
    - Air blower
    - Heat gun for cable sleeving
    - Soldering iron workstation
    - Solder wire
    - Crimp lugs
    - Cables and accessories
12) Test Equipment
    - AC variable power supply
    - DC variable power supply
    - Oscilloscope
    - Frequency counter
    - Power factor tester
    - Three phase power analyzer
    - Fused low voltage test lamp
13) Measuring devices
    - Wind speed anemometer
14) Electrical parameters
    - Voltmeter
    - Ohmmeter

	• Ammeter • Multi-meter • LCR meter • Feeler gauge
Requirements to complete this unit	There are five (5) Learning Outcomes and thirty-two (32) Performance Standards to measure competence. To satisfy the competency requirements, the person studying this unit is: 1. Required to demonstrate ALL learning outcomes to expected standards of performance; 2. Required to attain an *Achieved* Grade (Competent) to fulfil the requirements of the Unit Standard. 3. Eligible to three (3) attempts to achieve the required competency within 14 days of the first attempt. Failure to achieve the required competency level after three (3) attempts of 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	**Notes** 1. Due to safety issues inherent in working with electricity and combustible substances, all training and assessment activities must be carried out in accordance with local industry and regulatory requirements; 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 the Pacific regional unit standard SE3301 (B) Apply tools, equipment & materials in complex tasks in RE & EE for operations and maintenance. **Definitions:** 1. *Balance of plant (BOP)* comprises crane pads, foundations, substation (civil and electrical), road construction, cabling to substation and grid, SCADA, transformers and miscellaneous costs 2. *Condition based maintenance* refers to maintenance activities scheduled through the availability of real time information provided by data loggers. The scheduled activities calls for implementation of preventative measures or as a forecast for corrective maintenance to reduce risks of system downtime, frequency of preventative measures and associated costs 3. *Corrective maintenance* refers to maintenance activities that involves

	resetting system, repair of any damage to system identified through monitoring activities, replacement of failed components with spare parts, etc. A corrective maintenance that is considered less urgent may fall into the preventative maintenance category. 4. *Hazard or Emergency operations plan-* is a plan that addresses a wide variety of hazards and incidents (such as accidents, unfavorable weather, pandemics, etc.) and aims to sustain and support the mission of a workplace, before, during, and after an incident. These plans must address readiness, preparedness, response, and recovery. 5. *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, 6. *Operation and Maintenance plan* refers to a written plan based on how a specific system is to be operated and maintained over a period to ensure high performance, safety and compliance with applicable regulations 7. *Preventative maintenance* refers to scheduled maintenance activities that occurs at intervals to comply with recommendations made by the manufacturer and aligned with the equipment warranties. 8. *Safe handling* - refers to the safety that is required when one is manually (or mechanical) carrying or moving or delivering or working with a tool, equipment, or materials. 9. *Turbine* - is a rotating shaft (or rotor system) that changes the energy of flowing fluid (or gas, or steam, or air) into usable work or energy. Examples include wind turbines, steam turbines, hydro turbines. 10. *Wind Energy Conversion System* refers to a system by which wind energy is converted to electricity using a wind turbines, generators, control system and interconnection apparatus.
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.