



REGISTERED NATIONAL STANDARD

UNIT OF COMPETENCY

Title:	Diagnose and rectify faults in solar PV systems		
	<u>Note:</u>		
	<ol style="list-style-type: none"> 1. Due to safety issues inherent in working with electricity and combustible substances, 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 SE3304 (B) <i>Diagnose and rectify faults in renewable energy control systems (Biomass)</i>. 		
TQF Level:	3	Credits:	4
		Version:	1
National standard code:	NS090-03		
Associated qualification (and code):	National Certificate in Sustainable Energy (Solar) Level 3 (QR-03-NQ-018-05-0504-23-01)		
Approval date:	31 August 2023	Review date:	31 August 2028
Purpose:	<p>This unit standard is for people who work, or intend to work with <i>solar photovoltaic (PV)</i> systems.</p> <p>Persons credited with this unit standard are able to:</p> <ol style="list-style-type: none"> 1. Identify and prepare to diagnose technical faults in solar PV systems including those which are used in hybrid systems; 2. Identify and rectify technical faults within a solar PV system; 3. Compile reports on fault-finding and repair activities in solar PV systems. 		

Learning Outcome 1 (LO1)	Prepare to diagnose and rectify technical faults in solar PV systems
Performance standards	<ul style="list-style-type: none"> 1.1 Identify and obtain relevant <i>Occupational health and safety</i> (OHS) procedures for a given work area; 1.2 Identify and obtain fault reports from specific work area in solar PV systems; 1.3 Assess the likely extent of work to be undertaken in a solar PV system from fault/breakdown reports and/or discussions with appropriate person(s); 1.4 Use specific examples to describe the importance of strict adherence to OHS control measures in solar PV systems; 1.5 Organise with others involved directly or indirectly to ensure the work is coordinated effectively; 1.6 Identify sources of materials that may be required for the work and make them available in accordance with established procedures; 1.7 Select and obtain tools, equipment and testing devices needed to locate faults in accordance with established procedures; 1.8 Check required tools, equipment and testing devices (in PS 1.7 above) for correct operation and safety.
Learning Outcome 2 (LO2)	Identify and understand technical faults within a solar PV system.
Performance standards	<ul style="list-style-type: none"> 2.1 Ascertain the need for rectification of technical faults within a solar PV system; 2.2 Identify relevant OHS risk control measures and procedures for rectifying faults in solar PV systems; 2.3 Emphasize the importance of strict adherence to OHS control measures using specific examples from rectification work at hand; 2.4 Identify fault methodically, drawing on knowledge of solar PV systems using measured and calculated values of components/apparatus parameters; 2.5 Identify the likely impact of specific technical faults on the solar PV system; 2.6 Identify and document <i>hazards</i> resulting from fault or breakdown and devise <i>risk control measures</i>; 2.7 Determine the need to test or measure live in strict accordance with OHS requirements; 2.8 Isolate and check solar PV system where necessary in strict accordance with OHS requirements and procedures; 2.9 Arrange for procurement of materials and replacement parts required to rectify faults in accordance with established procedures.

Learning Outcome 3 (LO3)	Rectify technical faults in solar PV systems.
Performance standards	<p>3.1 Identify and obtain relevant fault reports;</p> <p>3.2 Identify and strictly adhere to OHS risk control measures and procedures for carrying out the work on rectifying faults in solar PV systems;</p> <p>3.3 Isolate and check solar PV system where necessary in strict accordance with OHS requirements and procedures;</p> <p>3.4 Conduct live tests or measures within established safety procedures;</p> <p>3.5 Repair fault without damage to apparatus, components, the surrounding environment or services and using sustainable energy practices;</p> <p>3.6 Reassemble apparatus and conduct final test in preparation for return to service;</p> <p>3.7 Assess and handle unexpected situations safely and with the approval of an authorised person;</p> <p>3.8 Clean and make safe work area in accordance with established procedures.</p> <p>3.9 Appraise the effectiveness of the repair in accordance with established procedures.</p>
Learning Outcome 4 (LO4)	Compile report on fault-finding and repair activities conducted within a solar PV system.
Performance standards	<p>4.1 Employ OHS work completion risk control measures and procedures;</p> <p>4.2 Identify requirements for fault reporting and obtain reporting template;</p> <p>4.3 Complete relevant forms as required and consult line supervisors where necessary;</p> <p>4.4 Justify through written statement the rationale for repairs done on components;</p> <p>4.5 Compile a written report on work completed and appropriate person(s) notified in accordance with established procedures.</p>
Pre-requisites	N/A
Co-requisites	N/A
Underpinning skill and knowledge	<p>The following knowledge and skill underpin this unit standard;</p> <p>Knowledge:</p> <ol style="list-style-type: none"> 1. Knowledge of basic operation of a solar PV system; 2. Knowledge of diagnosis and reporting of faults in solar PV systems; 3. Knowledge of rectification work in solar PV systems;

	<ol style="list-style-type: none"> 4. Knowledge of the basic geography of Tonga and the Pacific region 5. Knowledge of occupational hazards and risks associated with solar PV systems 6. Knowledge of OHS control measures in solar PV systems 7. Knowledge of the nature of use of a solar PV system in a particular location; 8. Knowledge of the environmental and social impacts of solar PV systems development 9. Knowledge of the Tongan culture, norms and values <p><u>Skills:</u></p> <ol style="list-style-type: none"> 10. Identifying faults in solar PV systems 11. Diagnosing faults in solar PV systems 12. Rectifying faults in solar PV systems 13. Writing technical reports re solar PV systems
<p>Assessment requirements</p>	<p><u>Methods of assessment:</u></p> <p>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:</p> <ol style="list-style-type: none"> 1) Direct observation of students performing certain tasks stated under context of assessment 2) Oral questions to test relevant skills and knowledge during observation (e.g. Interviews) 3) Written assessment such as: <ol style="list-style-type: none"> a) Reports – such as fault report; rectification report; maintenance report; b) 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.; c) Reviews of workplace attachment reports (e.g., Supervisor/third party reports; testimonials from Project manager or supervisor). <p><u>Context of assessment:</u></p> <p>To support student assessment and to ensure they are valid, reliable, flexible, and fair, provider institutions are encouraged to make the necessary arrangements to involve the relevant key industry organisations such as <i>Tonga Electricity Commission (TEC)</i>, <i>Tonga Power Limited (TPL)</i> and other trusted licensed private energy and electricity entrepreneurs in the assessment of the required standards and competencies. Such collaboration between provider institutions and the industry may include but not restricted to the following:</p> <ul style="list-style-type: none"> • Experts from the industry have input to the design and implementation of the

	<p>curriculum and assessment activities;</p> <ul style="list-style-type: none"> • Experts from the industry are engaged as trainers, assessors, or assessment moderators; • Students are placed in relevant industry organisations for workplace attachment; • Industry experts act as supervisors of students on workplace attachment • Etc. <p>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:</p> <ol style="list-style-type: none"> a) LO1: Prepare to diagnose and rectify technical faults in solar PV systems; b) LO2: Identify and understand technical faults within a solar PV control system; c) LO3: Rectify technical faults in solar PV systems; d) LO4: Compile report on fault-finding and repair activities conducted within a solar PV system. <p><u>Re-assessment</u></p> <p>Candidates of assessment are eligible to three (3) attempts to achieve the required competency within 14 days of their first attempt:</p> <ol style="list-style-type: none"> 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: <ol style="list-style-type: none"> a) same competencies are being assessed; b) principles of assessment are adhered to. <p>Failure to achieve the required competency after three (3) attempts on the assessment or specific part of it will require the person studying this Unit to re-enrol for the same Unit.</p>
<p>Moderation arrangements</p>	<ol style="list-style-type: none"> 1. Training providers must have their own moderation system approved by TNQAB before accreditation is granted; <ol style="list-style-type: none"> 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;

	<ul style="list-style-type: none"> a. Samples of assessed activities are submitted for moderation; b. Moderation (external) forms are available on request from the National qualifications unit of TNQAB. c. Requests for staff professional development on moderation are welcome by TNQAB.
<p>Resource requirements</p>	<ul style="list-style-type: none"> 1) Solar PV system – containing at least the following components: <ul style="list-style-type: none"> (i) solar panels; (ii) racking/mounting; (iii) batteries; (iv) inverter; (v) cables (vi) charge controllers 2) Storage batteries: <ul style="list-style-type: none"> i. Lithium-ion batteries, ii. Lead acid batteries, etc.; 3) Charge controllers: <i>Pulse width modulation (PWM)</i> or <i>Maximum power point tracking (MPPT)</i>; 4) Text Books (or printed resources) on Solar PV control system fault analysis, at the discretion of the course/unit coordinator or trainer, 5) Student computers, Printer, Internet access; 6) Flash drive (or external hard drive) for <i>supervisory control and data acquisition (SCADA)</i> 7) Conventional classroom furniture and resources: White/blackboard, tables or benches, chairs, student notice boards. 8) Cables and cable termination tools <ul style="list-style-type: none"> (i) Crimping tool (ii) Air blower (iii) Heat gun for cable sleeving (iv) Soldering iron workstation (v) Solder wire (vi) Crimp lugs (vii) Cables and accessories 9) Test Equipment <ul style="list-style-type: none"> (i) AC Variable Power Supply (ii) DC variable Power Supply (iii) Oscilloscope (iv) Frequency counter (v) Power factor tester

	<ul style="list-style-type: none"> (vi) Three Phase power Analyzer (vii) Fused Low Voltage Test Lamp <p>10) <i>Personal protective equipment (PPE)</i></p> <ul style="list-style-type: none"> (i) Hand gloves for electrical and mechanical lab work (ii) Safety helmet (iii) Safety glasses/goggles (iv) Ear mask/muff for use in noisy work environment (v) Dust masks (vi) Body harness (vii) Lock and tag out - Safety tags (out of service, do not operate, live wire) <p>12) Electrician's tool kit includes:</p> <ul style="list-style-type: none"> (i) Drill and set bits (ii) Ratchet handle, extension bar, universal joint, coupler, sockets (iii) Insulated screwdrivers, pliers, electrical tester, (iv) Measuring tape
<p>Requirements to complete this unit</p>	<p>There are four (4) Learning outcomes and thirty-one (31) Performance standards to measure competence.</p> <p>To satisfy this requirement for competency, the person studying this unit is:</p> <ol style="list-style-type: none"> 1. Required to demonstrate ALL learning outcomes to the expected standards of performance; 2. Required to attain an <i>Achieved</i> 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. <p>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.</p>
<p>Important notes and definitions</p>	<p><u>Notes:</u></p> <ol style="list-style-type: none"> 1. All activities associated with this unit standard must comply with the requirements of national codes of practice, regulations and legislation for workplace health, safety, and environmental protection and any subsequent amendments. 2. In the event that local legislations are not available, relevant legislations or policies from New Zealand or Australian are to be used for training. 3. Assessors must comply with Tonga national assessment and moderation

requirements.

Definitions:

1. *Hazard* is a potential source of harm or adverse health effect on a person or persons.
2. *Job safety analysis* 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;
3. *Occupational Health and Safety (OHS)* includes the laws, standards and programs that aim to making the workplace and work activities safer. OHS aims at protecting the health, safety, and well-being of employees, employers, clients and the public using that workplace.
4. *OHS control measures* are actions that can be taken to reduce the potential of exposure to workplace hazards. It could be as simple as removing a hazard (so as to reduce the likelihood of the risk of exposure to that hazard).
5. *Silicon* is a chemical element with the symbol Si and atomic number 14. It is a semiconducting materials from which most solar panels are made.
6. *Solar panel* (or solar photovoltaic panel) is a piece of flat semiconducting material (usually Silicon) that transforms the sun's rays into electricity
7. *Solar photovoltaics (PV) system* or *solar power system* is an electric power system designed to supply solar power by means of *photovoltaics*. It is composed of one or more *solar panels* combined with an inverter and other electrical and mechanical components that use energy from the Sun to generate electricity.
8. *Photovoltaics (PV)* is the conversion of light into electricity using semiconducting materials that exhibit the *photovoltaic effect*
9. *Photovoltaic effect* is the generation of voltage and electric current in a material when it is exposed to light.
10. *Repair of technical fault* refers to measures taken to ensure that the fault is corrected for smooth operation of system.
11. *Risk* is the likelihood that a person may be harmed or suffers adverse health effects if exposed to a hazard.

**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.