Title	**Demonstrate knowledge of grid-connected photovoltaic system components, distributor requirements and metering**		
Level	**4**	**Credits**	**7**

Purpose	This unit standard is for people who work with renewable energy systems and covers knowledge of operation and metering of grid-connected photovoltaic systems, including electricity distributor requirements for connection to the public electricity network. People credited with this unit standard are able to demonstrate knowledge of: – the operation of a grid-connected renewable energy system; – grid-connected inverters; – grid protection devices; – monitoring and control for grid-connected renewable energy systems; – electricity distributor requirements in relation to grid-connected renewable energy systems; and – the purpose and operation of metering for grid-connected renewable energy systems.

Classification	Renewable Energy Systems > Renewable Energy Systems - Design

Available grade	Achieved

Guidance information

1 References
All Australian Standards (AS) may be found at https://www.standards.org.au;
All Australian/New Zealand Standards (AS/NZS) may be found at http://www.standards.org.nz;
AS 4777.1:2005, *Grid connection of energy systems via inverters – Part 1: Installation requirements*;
AS 4777.2:2005, *Grid connection of energy systems via inverters – Part 2: Inverter requirements*;
AS 4777.3:2005, *Grid connection of energy systems via inverters – Part 3: Grid protections requirements*;
AS/NZS 3000:2007, *Electrical Installations (known as the Australian/New Zealand Wiring Rules)*;
AS/NZS 5033:2012: *Installation and safety requirements for photovoltaic (PV) arrays;*
Electricity Act 1992;
Electricity Industry Participation Code 2010 – Part 6 Connection of distributed

generation, available at https://www.ea.govt.nz/;
Electricity (Safety) Regulations 2010;
Health and Safety at Work Act 2015, and associated regulations;
and all subsequent amendments and replacements.

2 Definitions

a.c. – alternating current.
Current regulations and standards – in this unit standard this term is used to refer to the requirements of the above references.
CO_2-e – carbon dioxide equivalent.
d.c. – direct current.
Enterprise policies and procedures – those practices and procedures that have been promulgated by the company or enterprise for use by their employees.
GSM – global system for mobile communications.
HF – high frequency.
Industry practice – those practices that competent practitioners within the industry recognise as current industry best practice.
ISDN – integrated services digital network.
kWh – kilowatt-hour.
LF – low frequency.
MPPT – maximum power point tracking.
RCD – residual current device.
RS-232, RS-485 – standards for transmission of data.
SPYCE – satellite photovoltaic yield control and evaluation.
USB – universal serial bus.

3 Range

a All measurements are to be expressed in Système Internationale (SI) units, and where required, converted from Imperial units into SI units.
b Candidates shall be supplied by the assessor with formulae involving more than three quantities.
c Use of a calculator during assessment is permitted.
d All activities and evidence presented for all outcomes and performance criteria in this unit standard must be in accordance with legislation, enterprise policies and procedures, ethical code, current regulations and standards, industry practice; and where appropriate, manufacturer's instructions, specifications, and data sheets.

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of the operation of a grid-connected renewable energy system.

Performance criteria

1.1 Draw a labelled block diagram of a grid-connected renewable energy system that meets the requirements of AS 4777.

1.2 Explain the characteristic operational features of grid-connected renewable energy systems with and without energy storage.

Range synchronisation, safety features, power flow control, passive and active anti-islanding, energy system metering.

1.3 Describe the function of the main system components of a grid-connected renewable energy system.

Range a.c. isolator, grid protection device, inverter, d.c. isolator, PV array, monitoring.

1.4 Describe the New Zealand certification requirements for grid-connected system components.

1.5 Describe grid-connected system topologies.

Range a.c. module systems (micro-inverter systems), string inverter systems, central inverter systems.

Outcome 2

Demonstrate knowledge of grid-connected inverters.

Range inverter types, symbols, functions, diagrams.

Performance criteria

2.1 Describe the basic function and operation of an inverter.

2.2 Identify the standard symbol for a low voltage inverter.

2.3 Describe the types, applications, and differences of inverters used in grid-connected systems.

Range inverter types – LF transformer, HF transformer, transformerless; differences – capacitive earth leakage currents, earthing requirements, functional earthing of the array.

2.4 Draw a labelled block diagram of a typical inverter used in a grid-connected system.

2.5 Draw and label schematic diagrams of common grid-connected inverter circuit configurations.

Range metering arrangements, isolation and connection with respect to RCDs.

2.6 Describe the functionality commonly found in grid-connected inverters.

Range d.c. isolator, MPPT tracker, d.c. earth leakage monitoring, a.c. earth leakage monitoring, grid protection device, a.c. isolator, data logging, communication interface.

2.7 Define the parameters that describe inverter power quality.

Range harmonic content, d.c. injection, power factor.

2.8 Describe the inverter parameters required for system design that are commonly found in inverter data sheets.

Outcome 3

Demonstrate knowledge of grid protection devices.

Performance criteria

3.1 Describe the functional operation of grid protection devices.

3.2 Describe the external factors affecting the correct operation of grid protection devices.

Range voltage at connection point, a.c. cable impedance to grid connection point.

Outcome 4

Demonstrate knowledge of monitoring and control for grid-connected renewable energy systems.

Performance criteria

4.1 State the purpose of monitoring of grid-connected systems.

4.2 List the parameters that are commonly monitored and logged.

4.3 Explain the relationship between CO_2-e and kWh.

4.4 Discuss the different types of PV monitoring devices and their advantages and disadvantages.

Range analog modem, ISDN, GSM, USB, RS232, RS485, powerline, Bluetooth, SPYCE.

Outcome 5

Demonstrate knowledge of electricity distributor requirements in relation to grid-connected renewable energy systems.

Performance criteria

5.1 List general requirements for the supply of electricity.

5.2 Describe electricity distributor requirements for interconnection.

Range safety of personnel, islanding, grid stability, compliance with the Electricity Industry Participation Code – Part 6.

5.3 Describe the network connection process for each of the distributed generator classes as defined in the Code.

Outcome 6

Demonstrate knowledge of the purpose and operation of metering for grid-connected renewable energy systems.

Range connection procedures, import, export.

Performance criteria

6.1 Describe the purpose, types, and arrangements of grid-connected metering.

6.2 Describe communication methods and arrangements for remote monitoring of meter functionality.

Planned review date	31 December 2024

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	21 July 2011	31 December 2015
Review	2	17 July 2014	31 December 2020
Review	3	24 October 2019	N/A

Consent and Moderation Requirements (CMR) reference	0003

This CMR can be accessed at http://www.nzqa.govt.nz/framework/search/index.do.

Comments on this unit standard

Please contact The Skills Organisation at reviewcomments@skills.org.nz if you wish to suggest changes to the content of this unit standard.