

Title	Design photovoltaic power systems		
Level	4	Credits	20

Purpose	<p>This unit standard is for people who work with renewable energy systems and covers the design process of photovoltaic (PV) systems and sun and site analysis.</p> <p>People credited with this unit standard are able to:</p> <ul style="list-style-type: none"> – determine design requirements for a PV system; – perform a site survey for a PV system and record findings; – specify and design a stand-alone PV power system for residential or commercial premises; – specify and design a residential grid connected PV system without battery storage; and – specify and design a residential grid connected PV system with battery storage.
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Classification	Renewable Energy Systems > Renewable Energy Systems - Installation and Maintenance
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Available grade	Achieved
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Guidance information

- 1 This unit standard has been developed for learning and assessment on-job.
- 2 References

All Australian Standards (AS) may be found at www.standards.org.au;
 All Australian/New Zealand Standards (AS/NZS) may be found at <http://www.standards.org.nz/>;

AS 4086.2:1997, *Secondary batteries for use with stand-alone power systems - Installation and maintenance*;
 AS/NZS 1170.2:2011 Rec: 2016, *Structural design actions - Part 2: Wind actions*
 AS/NZS 1170.3:2003 A2: 2017, *Structural design actions - Part 3: Snow and ice actions*;
 AS/NZS 3000:2007, *Electrical Installations (known as the Australian/New Zealand Wiring Rules)*;
 AS/NZS 3010:2005, *Electrical installations – Generating sets*;
 AS/NZS 4509.1:2009 Rec:2016, *Stand-alone power systems - Part 1: Safety and installation*;
 AS/NZS 4509.2:2010 Rec:2016, *Stand-alone power systems - Part 2: System design*;
 AS/NZS 5033:2012: *Installation and safety requirements for photovoltaic (PV) arrays*;
 Electricity (Safety) Regulations 2010;
 Electricity Act 1992;

Health and Safety at Work Act 2015, and associated regulations; and all subsequent amendments and replacements.

3 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.

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.

Industry practice – those practices that competent practitioners within the industry recognise as current industry best practice.

OSH – occupational safety and health.

PV – photovoltaic.

RFI – radio frequency interference.

4 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 OSH policies and procedures may include but are not limited to work permits and clearances, hazard monitoring, evacuation procedures, plant and electrical isolation.

d Computer based tools can be used to aid calculations.

e 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.

- 5 It is recommended that candidates have been assessed against Unit 27432, *Demonstrate knowledge of photovoltaic arrays mounting requirements*; Unit 27433, *Demonstrate knowledge of renewable energy concepts and technologies*; and Unit 27439, *Demonstrate knowledge of photovoltaic technology*; prior to assessment to this unit standard.

Outcomes and performance criteria

Outcome 1

Determine design requirements for a PV system.

Performance criteria

1.1 Describe factors that impact on the implementation of a PV system.

Range external costs, PV manufacturing processes and embodied energy, energy payback time, noise levels, visual amenity, RFI, environmental, cultural, and social.

1.2 Determine system design requirements in consultation with client.

- 1.3 Assess end-user services and energy demand for each service.
- 1.4 Perform a detailed load assessment in accordance with Standards.
- Range assessment of total daily energy, maximum demand, surge demand.
- 1.5 Establish load management and logging equipment requirements.
- 1.6 Produce load profiles from usage data for all electrical loads including expected variations to establish average and maximum demands.
- 1.7 Determine load management strategies and/or energy source switching options to reduce maximum and surge demand based on load profile analysis.

Outcome 2

Perform a site survey for a PV system and record findings.

Performance criteria

- 2.1 Estimate solar availability for the site.
- Range declination angle, orientation, reflectance, sunshine hours, insolation, shading, seasonal variance.
- 2.2 Determine locations for monitoring panels or screens in accordance with the site owner's specification.
- 2.3 Determine suitability of the roof or other selected platform for mounting the array.
- 2.4 Determine the method for mounting PV modules.
- 2.5 Determine location of ancillary components.
- Range switchboard or distribution board, inverter or charge controller, array junction box, backup battery, backup generator.
- 2.6 Determine cabling routes and estimate cable lengths.

Outcome 3

Specify and design a stand-alone PV power system for residential or commercial premises.

Performance criteria

- 3.1 Describe the operation of a stand-alone PV power system for residential or commercial premises.
- Range safety features, power requirements, control.

- 3.2 Compare costs of a stand-alone PV system with other power supply options.
Range capital cost, simple payback time.
- 3.3 Perform a detailed load assessment consistent with Standards.
Range assessment of total daily energy, maximum demand, surge demand, load management requirements.
- 3.4 Calculate system voltage and main component sizes.
- 3.5 Develop a system specification based on site and customer requirements.
- 3.6 Select a PV array that meets the design requirements in accordance with the specification and Standards.
Range physical sized, load, solar radiation data, mounting requirements.
- 3.7 Select ancillary components in accordance with the specification and Standards.
Range regulator, inverter, battery, battery charger, backup generator, metering, switches, cabling, cabling hardware, protection and isolation devices, electrical enclosures.
- 3.8 Select PV array mounting frame design and materials in accordance with the specification and Standards.
- 3.9 Design battery accommodation in accordance with the specification and Standards.
- 3.10 Produce a schematic diagram of the inverter circuit configuration including isolation and connection with respect to RCDs.
- 3.11 Perform energy calculations for the system.
Range energy yield, specific energy yield, performance ratio.
- 3.12 Produce a design for the PV power system in accordance with the specification and Standards.
- 3.13 Estimate the capital cost and running costs for the PV system.
- 3.14 Produce a manual for the PV system in accordance with Standards.
- 3.15 Produce an installation specification for the stand-alone PV power system for residential or commercial premises.

Outcome 4

Specify and design a residential grid connected PV system without battery storage.

Performance criteria

- 4.1 Describe the operation of grid connected PV systems without energy storage.
- Range synchronisation, safety features, power flow, control, metered energy for systems.
- 4.2 Compare costs of the grid connected PV system without battery storage with other power supply options.
- Range costs include – capital cost, simple payback time; three other power supply options.
- 4.3 Perform a detailed load assessment consistent with Standards.
- Range assessment of total daily energy, maximum demand, surge demand, load management requirements.
- 4.4 Calculate system voltage and main component sizes including minimum and maximum number of PV modules in a string for the specified voltage.
- 4.5 Determine the operating window of the inverter for the expected minimum and maximum effective cell temperatures.
- 4.6 Select and size an inverter rating with respect to the output power of the array.
- 4.7 Develop a system specification based on site and customer requirements.
- 4.8 Select a PV array that meets the design requirements in accordance with the specification and Standards.
- Range physical size, load, solar radiation data, mounting requirements.
- 4.9 Select ancillary components in accordance with the specification and Standards.
- Range regulators, inverter, battery, battery charger, backup generator, metering, switches, cabling, cabling hardware, protection and isolation devices, electrical enclosures.
- 4.10 Select PV array mounting frame design and materials in accordance with the specification and Standards.
- 4.11 Design battery accommodation in accordance with the specification and Standards.
- 4.12 Produce a schematic diagram of the grid-connected inverter circuit configuration including metering arrangements, isolation and connection with respect to RCDs.

- 4.13 Perform energy calculations for the system.
Range energy yield, specific energy yield, performance ratio.
- 4.14 Produce a design for the PV power system that uses a series or switched configuration in accordance with the specification and Standards.
- 4.15 Estimate the capital cost and running costs for the PV system.
- 4.16 Produce a manual for the PV system in accordance with Standards.
- 4.17 Produce an installation specification for the residential grid connected PV system.

Outcome 5

Specify and design a residential grid connected PV system with battery storage.

Performance criteria

- 5.1 Describe the operation of grid connected PV systems with energy storage.
Range synchronisation, safety features, power flow, control, metered energy for systems.
- 5.2 Compare costs of the grid connected PV system with battery storage with other power supply options.
Range capital cost, simple payback time.
- 5.3 Perform a detailed load assessment consistent with Standards.
Range total daily energy, maximum demand, surge demand, load management requirements.
- 5.4 Calculate system voltage and main component sizes including minimum and maximum number of PV modules in a string for the specified voltage.
- 5.5 Determine the operating window of the inverter for the expected minimum and maximum effective cell temperatures.
- 5.6 Select and size an inverter rating with respect to the output power of the array.
- 5.7 Develop a system specification based on site and customer requirements.
- 5.8 Select a PV array that meets the design requirements in accordance with the specification and Standards.
Range physical sized, load, solar radiation data, mounting requirements.

- 5.9 Select ancillary components in accordance with the specification and Standards.
- Range regulators, inverter, battery, battery charger, backup generator, metering, switches, cabling, cabling hardware, protection and isolation devices, electrical enclosures.
- 5.10 Select PV array mounting frame design and materials in accordance with the specification and Standards.
- 5.11 Design battery accommodation in accordance with the specification and Standards.
- 5.12 Produce a schematic diagram of the grid-connected inverter circuit configuration including metering arrangements, isolation and connection with respect to RCDs.
- 5.13 Perform energy calculations for the system.
- Range energy yield, specific energy yield, performance ratio.
- 5.14 Produce a design for the PV power system in accordance with the specification and Standards.
- 5.15 Estimate the capital cost and running costs for the PV system.
- 5.16 Produce a manual for the PV system in accordance with Standards.
- 5.17 Produce an installation specification for the residential grid connected PV system with battery storage.

Planned review date	31 December 2024
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Status information and last date for assessment for superseded versions

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

Consent and Moderation Requirements (CMR) reference	0003
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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.