

<b>Title</b>	<b>Design wind energy conversion systems</b>		
<b>Level</b>	<b>4</b>	<b>Credits</b>	<b>20</b>

<b>Purpose</b>	<p>This unit standard is for people who work with renewable energy systems and covers the design process of wind energy conversion systems (WECS) including design requirements and wind and site analysis.</p> <p>People credited with this unit standard are able to:</p> <ul style="list-style-type: none"> <li>– determine design requirements for a WECS;</li> <li>– determine characteristics of the major local winds;</li> <li>– analyse wind speed and direction data;</li> <li>– use data to select a suitable site for a WECS; and</li> <li>– specify the size, characteristics, and system configuration of a WECS to provide a given WECS fraction to a load at a site with specified wind speed data in accordance with Standards.</li> </ul>
----------------	---

<b>Classification</b>	Renewable Energy Systems > Renewable Energy Systems - Installation and Maintenance
-----------------------	--

<b>Available grade</b>	Achieved
------------------------	----------

---

### 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 <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 1170.2:2011, *Structural design actions - Part 2: Wind actions*;  
 AS/NZS 1768:2007, *Lightning protection*;  
 AS/NZS 3000:2007, *Electrical Installations (known as the Australian/New Zealand Wiring Rules)*;  
 AS/NZS 3008.1.2:2017, *Electrical installations - Selection of cables - Part 2: Cables for alternating voltages up to and including 0.6/1 kV - Typical New Zealand conditions*;  
 AS/NZS 4509.1:2009, *Stand-alone power systems - Part 1: Safety and installation*;

AS/NZS 4509.2:2010, *Stand-alone power systems - Part 2: System design*;  
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.

*RFI* – radio frequency interference.

*WECS* – wind energy conversion system.

### 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 All activities must comply with any policies, procedures, and requirements of the organisations involved.

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 27439, *Demonstrate knowledge of photovoltaic technology*; and Unit 27443, *Demonstrate knowledge of wind energy conversion systems* prior to assessment to this unit standard.

---

## Outcomes and performance criteria

### Outcome 1

Determine design requirements for a WECS.

**Performance criteria**

- 1.1 Describe environmental, cultural, and social factors that impact on the implementation of a WECS.
- Range may include but not limited to – external costs, WECS manufacturing processes and embodied energy, energy payback time, noise levels, visual amenity, RFI.
- 1.2 Establish system design criteria in consultation with client.
- 1.3 Assess end-use services and energy demand for each service.
- 1.4 Perform a detailed load assessment in accordance with AS/NZS 4509.2.
- Range assessment of total daily energy, maximum demand, surge demand, load management requirements.
- 1.5 Produce daily load profiles to establish average demand, maximum demand, and likely variations in usage patterns based on time of use data for all electrical loads.
- 1.6 Use load profile analysis to determine load management strategies and/or energy source switching options to reduce the maximum and surge demand.

**Outcome 2**

Determine characteristics of the major local winds.

**Performance criteria**

- 2.1 Identify major local winds.
- Range trade winds, sea and land breezes, katabatic winds, anabatic winds.
- 2.2 Examine likely effects on the major local winds from local topography, surface roughness, isolated barriers, and temperature inversions.
- 2.3 Determine typical diurnal, monthly, and seasonal patterns of winds over the local area.
- 2.4 Determine the formation and likely effects of extreme winds and wind shear

**Outcome 3**

Analyse wind speed and direction data.

**Performance criteria**

- 3.1 Obtain and interpret local and regional wind speed and direction data.  
Range ecological indicators, wind speed/energy maps.
- 3.2 Measure sets of data for wind speed and direction using data logging anemometers.  
Range three sets of data.
- 3.3 Apply manufacturer's calibration curves to correct anemometer recorded data.
- 3.4 Use software to calculate monthly and yearly average wind speed and wind power density at a site based on existing nearby data or on-site measurements.
- 3.5 Estimate nominal wind speed for a WECS tower at required height and location taking into account readings from different elevations.  
Range surface roughness, temperature inversion, and speed-up factors at the site;  
two or more elevations.

**Outcome 4**

Use data to select a suitable site for a WECS.

Range data obtained in Outcomes 1, 2, and 3.

**Performance criteria**

- 4.1 Determine likely effects of local topography, surface roughness, isolated barriers, and temperature inversions on a WECS at a given site.
- 4.2 Select the best location for a WECS tower in terms of local factors.  
Range topography, accessibility, surface roughness, shielding from wind barriers, turbulence, temperature inversions, power transmission distance, environmental and heritage impacts including noise, visual, bird life, national parks, indigenous sites.

**Outcome 5**

Specify the size, characteristics, and system configuration of a WECS to provide a given WECS fraction to a load at a site with a specified wind speed data in accordance with Standards.

**Performance criteria**

- 5.1 Prepare WECS specifications in terms of the site, load, and wind speed.
- Range cut-in, rated and furling wind speeds, blade diameter, rated power to wind speed, construction materials, system configuration; equipment reliability, manufacturer/supplier back-up service, availability of spare parts and service personnel.
- 5.2 Calculate installed capital and life cycle costs of various system configurations in accordance with Standards.
- 5.3 Assess and optimise tower requirements for the site and size of the WECS.
- Range tower height, site access, soil type, foundations, structural certification, planning approvals.
- 5.4 Select a commercially available WECS that most closely fits the specifications.
- 5.5 Select system components in accordance with the specification.
- Range storage battery, inverter, regulator, transmission cable, back-up battery charger, generator.

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 2020
Review	2	24 October 2019	N/A

<b>Consent and Moderation Requirements (CMR) reference</b>	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](mailto:reviewcomments@skills.org.nz) if you wish to suggest changes to the content of this unit standard.