

1. Module details

Module name

Photovoltaic Installations

Module duration

It is expected that students with the appropriate entry knowledge and skills will successfully complete this module in 20 hours.

Module code

NUER15

Discipline code

1105

2. Module purpose

This module provides knowledge and skills in the installation, commissioning and maintenance of photovoltaic (PV) power systems, both stand-alone and grid connected, for work under the supervision of a person with relevant system design and installation qualifications.

3. Prerequisites

NUER16 – Fundamentals of Renewable Energy Systems *or*
NUER01 – Introduction to Renewable Energy Technologies

4. Relationship to competency standards

This module provides part of the underpinning knowledge and skills identified in the ‘Evidence Guide’ of specific units in the National Electrotechnology Competency Standards, namely NES201, NES202, NES401.

5. Content

Array installation requirements

OH&S requirements for roof work
Types of roofing methods and construction; rafters and tile battens; weatherproofing;
Frames & frame construction; methods for tilt adjustment; fixing methods for different roof types;
aspect and roofing angles; orientation to north; mounting on non-north facing roof surfaces
aesthetic considerations;
building integrated PV products

Electrical Installation

Common methods for wiring and connecting; PV module connector systems;
Wiring to minimise power loss in series strings
PV module blocking and bypass diode installation;
location of regulators, inverters, d.c. control board and battery
minimising cable route length;
Hazards and OH&S requirements when handling and installing batteries

System installation and Maintenance

- Safe work practices
- Installing batteries
- isolation and shutdown procedures
- battery maintenance tasks – flooded and VRLA
- PV array maintenance including vegetation control

6. Assessment strategy

Assessment methods

Assessment should encompass both progressive and holistic elements in recognition of the interdependence between learning outcomes and to ensure the module purpose is met. To assist in ensuring validity, reliability and fairness, assessment instruments should include both practical exercises and written exercises consisting of a number of item types, such as multiple choice, short answer and problem solving.

Conditions of assessment

Normally learning and assessment will take place in a classroom/ laboratory environment, or in simulated or actual workplace conditions during installation, commissioning and maintenance work.

7. Learning outcome details

Learning outcome 1

Describe the requirements for installation of a PV array, in accordance with AS 4509 and OH&S guidelines.

Assessment criteria

- 1.1 State OH&S requirements and methods for working on roofs.
- 1.2 Describe common methods of roof construction and methods to ensure integrity of waterproofing.
- 1.3 Describe common types of roof mounted and free-standing PV array frame construction and methods of tilt angle adjustment.
- 1.4 Describe fixing methods for different roof types.
- 1.5 Describe array mounting methods for non-north facing roof sections.
- 1.6 Outline aesthetic considerations in choosing an appropriate array location and type of mounting.
- 1.7 Outline the mounting and fixing methods for at least one type of commercially available building integrated PV product.

Learning outcome 2

Outline the electrical installation requirements for a PV system in accordance with AS 4509.

- 2.1 Describe methods used in wiring and connecting PV arrays.
- 2.2 Outline the considerations involved in wiring of series connected PV modules in order to minimise power losses due to shading.
- 2.3 Sketch a PV array wiring diagram including the placement of blocking and bypass diodes.
- 2.4 Outline the considerations involved in choosing the location of regulators, d.c. control board and batteries.
- 2.5 Choose a cable route from array to battery so as to minimise the route length.

Learning outcome 3

Perform installation and maintenance tasks on a PV power system in accordance with relevant standards and OH&S guidelines.

Assessment Criteria

- 3.1 Perform installation work on a PV power system in accordance with relevant standards and OH&S guidelines.
- 3.2 Carry out correct isolation and shutdown procedures prior to carrying out maintenance tasks.
- 3.3 Outline the hazards present and OH&S requirements when handling and installing batteries.
- 3.4 Perform basic maintenance tasks on flooded lead acid and VRLA batteries.
- 3.5 Perform routine maintenance tasks on PV arrays.
- 3.6 Determine required vegetation control to remove or reduce shading or soiling on a PV array.

8. Delivery of the module

Delivery strategy

Delivery strategies must be suitable for learning both theoretical and practical aspects described in the module purpose. It is considered that the most effective way to achieve this is by the integration of theory and practice where students learn through practical experience in working with real systems.

It is recommended that learning and assessment be facilitated in a holistic manner. The learning outcome sequence may be other than that indicated in the module.

Resource requirements

Resources should be sufficient for students to perform practical work in pairs. This will require a range of commercially available system components, tools and measuring instruments, as well as access to sites or training facilities for system installation and maintenance. Copies of all relevant standards are required.

Occupational health and safety requirements

A safe and healthy environment will be provided for students and teachers as well as safety procedures with regard to learning / teaching activity according to local OH&S regulations.

The following OH&S issues are to be addressed in the appropriate learning outcome(s):

General:

- lifting and carrying
- eye/skin/ear protection
- use of power tools
- working on roofs
- keeping work areas tidy

Electrical:

- use of measuring meters
- isolation procedures
- use of ladders
- work with battery installations (Eg. hydrogen explosion, acid spillage, ventilation, short circuits)

Minimum physical resources

PV modules and frame sufficient for array of at least 300 W rating

Recommended References

AS 4086.2:1997 *Secondary Batteries for use with stand-alone power systems. Part 2: Installation and Maintenance*

AS/NZS 3000:2000 *Wiring Rules*

AS 4509.1:1999 *Stand Alone Power Systems. Part 1: Safety Requirements*

AS 4509.2:2002 *Stand Alone Power Systems. Part 2: Design Guidelines*

AS4509.3:1999 *Stand Alone Power Systems. Part 3: Installation and Maintenance*

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Derrick, A. Francis, C. & Bokalders, V. (1991). *Solar Photovoltaic Products - A Guide for Development Worker*. Intermediate Technology Publications Ltd. London.

Hankins, M. et al (1995). *Solar Electric Systems for Africa*. Commonwealth Science Council, London.

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NUER15 - Photovoltaics Installations v 2.DOC 6/02/02