



Australian Government

UEERE0011 Design grid-connected photovoltaic power supply systems

Release: 1

UEERE0011 Design grid-connected photovoltaic power supply systems

Modification History

Release 1. This is the first release of this unit of competency in the UEE Electrotechnology Training Package.

Application

This unit involves the skills and knowledge required to design grid-connected photovoltaic (PV) power supply systems.

It includes preparing to design, and developing and obtaining approval for grid connected power supply systems. It also includes designing grid-connected PV power supply system installation, following design briefs, incorporating schemes for protection of persons and property from dangers of system malfunctions, ensuring safety and performance standards and functional requirements are met, and documenting design calculations and criteria.

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Pre-requisite Unit

UEERE0022 Solve basic problems in photovoltaic energy apparatus and systems

Competency Field

Renewable Energy

Unit Sector

Electrotechnology

Elements and Performance Criteria

ELEMENTS

Elements describe the essential outcomes.

1 Prepare to design a grid-connected PV power supply system

PERFORMANCE CRITERIA

Performance criteria describe the performance needed to demonstrate achievement of the element.

1.1 Work health and safety (WHS)/occupational health and safety (OHS) requirements and workplace procedures are identified and applied

- | | | |
|----------|---|--|
| | 1.2 | Grid system is determined from design brief |
| | 1.3 | Industry regulations and job requirements are identified and applied to work in accordance with workplace procedures |
| | 1.4 | Design development work is planned to meet scheduled timelines in consultation with relevant person/s |
| 2 | Develop a grid-connected PV power supply system design | |
| | 2.1 | Grid-connected power supply systems, performance standards and compliance methods are applied to the design |
| | 2.2 | Alternative arrangements for hybrid power systems design is considered based on the requirements outlined in the design brief |
| | 2.3 | Safety, functional and budgetary considerations are incorporated in design |
| | 2.4 | Grid-connected power supply system design draft is checked for compliance with the design brief, industry regulations, job requirements and workplace procedures |
| | 2.5 | Grid-connected power supply system design is documented and submitted to relevant person/s for authorisation |
| | 2.6 | Unplanned situations are responded to in accordance with workplace procedures |
| 3 | Obtain approval for grid-connected PV power supply system design | |
| | 3.1 | Grid-connected power supply system design is presented and explained to client and/or relevant person/s |
| | 3.2 | Requests for alterations to design are negotiated with relevant person/s in accordance with workplace procedures |
| | 3.3 | Final design is documented and authorisation obtained from relevant person/s |
| | 3.4 | Quality of work is monitored against workplace procedures |

Foundation Skills

Foundation skills essential to performance are explicit in the performance criteria of this unit of

competency.

Range of Conditions

Range is restricted to essential operating conditions and any other variables essential to the work environment.

Non-essential conditions may be found in the UEE Electrotechnology Training Package Companion Volume Implementation Guide.

Unit Mapping Information

This unit replaces and is equivalent to UEENEEK135A Design grid-connected photovoltaic power supply systems.

Links

Companion Volume implementation guides are found in VETNet - -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b8a8f136-5421-4ce1-92e0-2b50341431b6>

Assessment Requirements for UEERE0011 Design grid-connected photovoltaic power supply systems

Modification History

Release 1. This is the first release of this unit of competency in the UEE Electrotechnology Training Package.

Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements and performance criteria on at least one occasion and include:

- developing outlines of alternative designs
- developing the design within the safety and functional requirements and budget limitations
- documenting and presenting design effectively
- successfully negotiating design alteration requests
- obtaining approval for final design
- dealing with unplanned events
- applying relevant work health and safety (WHS)/occupational health and safety (OHS) requirements
- designing grid-connected photovoltaic (PV) power supply system
- identifying and applying industry regulations
- meeting scheduled timelines
- working with relevant person/s.

Knowledge Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements and performance criteria and include knowledge of:

- PV power systems design principles, including:
 - site survey encompassing:
 - declination angle, reflectance, sunshine hours, extra-terrestrial irradiation
 - energy efficiency techniques relevant for domestic dwelling and commercial premises to reduce the electrical energy demand
 - energy efficient initiatives that could be implemented by the site owner
 - assessing WHS/OHS risks when working on a particular site
 - solar access for the site
 - shading and estimates of its effect on the system
 - solar resource for the site
 - available area for the solar array

- roof is suitable for mounting the array
- modules mounted on the roof
- switchboard or distribution board is located for connecting the output of inverter
- array junction box (if required) and location of inverter
- cabling route and estimates of the lengths of the cable runs
- monitoring panels or screens and determining a suitable location with the site owner
- PV arrays selection encompassing:
 - selection and sizing of PV array for a grid-connected inverter system, based on annual energy demand, budget constraints, architectural constraints or limitations on available inverter sizes
 - determining the minimum and maximum number of PV modules in a string for the specified voltage
- system components selection encompassing:
 - balance of the system components, including cabling, circuit protection and isolation equipment for a grid-connected PV system
 - energy yield, specific energy yield and performance ratio for system
 - schematic diagrams of common grid-connected inverter circuit configurations, including metering arrangements, isolation and connection with respect to residual circuit devices (RCDs)
 - major installation details for a proposed grid-connected inverter system, based on the requirements set out in AS/NZS 4777 Grid connection of energy systems via inverters and AS/NZS 5033 Installation and safety requirements for photovoltaic (PV) arrays
- other design considerations encompassing:
 - major non-technical considerations impacting on the design, installation and operation of grid-connected PV systems, including economic, financial, contractual, institutional, legislative and regulatory
 - calculation of the annual reduction in greenhouse gas emissions achieved by a given PV power system at a given location
- inverters encompassing:
 - types of inverters used in grid connected systems
 - Australian Standard symbol for a low voltage (LV) inverter
 - the basic function of an inverter
 - simple block diagram of a typical inverter used in grid-connected system
- inverter operation encompassing:
 - the basic principle of operation of a single phase inverter (using switch analogue)
 - the operation of an inverter bridge and half-bridge configuration
 - operation of a FET inverter
 - connection of a grid inverter and measurement of the inverter parameters for various loads
- inverter characteristics encompassing:
 - the characteristics which distinguish inverters suitable for grid-connected PV array application from standard inverters

- using waveform diagrams, the function of PWM techniques in square wave, modified square wave and synthesised sine wave inverters
- output voltage waveforms for square wave, modified square wave and synthesized sine wave inverters showing typical voltages and periodic times
- the six (6) essential inverter specifications
- PV grid-connected system operation encompassing:
 - block diagram of a PV grid-connected system
 - operation of grid interactive PV systems, including synchronisation, safety feature, power flow control, passive and active anti-islanding, and metered energy for systems
 - schematic diagrams of common grid-connected inverter circuit configurations, including metering arrangements, isolation and connection with respect to RCDs in accordance with AS/NZS 4777.1 Grid connection of energy systems via inverters - Installation requirements
- grid-connected inverter selection encompassing:
 - operating window of the inverter for the expected minimum and maximum effective cell temperatures
 - selection of an inverter rating with respect to the output power of the array/s
 - major installation requirements for all system components which will ensure correct operation, long life, safety and ease of maintenance consistent with AS/NZS 4509 Stand-alone power systems, AS 4086.2 Secondary batteries for use with stand-alone power systems - Installation and maintenance, AS/NZS 3000 and relevant WHS/OHS guidelines
 - selection of a suitable location for the PV array, inverter and other components, at a given installation site in accordance with AS 2676.2 Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings - Sealed cells and AS 3011.2 Electrical installations - Secondary batteries installed in buildings Sealed cells, and the considerations given in AS/NZS4509 Stand-alone power systems and AS 4086.2 Secondary batteries for use with stand-alone power systems - Installation and maintenance
 - typical installation configurations for grid connection of energy systems via inverters
 - function and operation of a grid protection device as specified in AS/NZS 4777 Grid connection of energy systems via inverters
 - draft array wiring plan for series connected modules to minimise power loss due to shading at a particular site
 - installation requirements for a grid connected system
 - labelling and signage requirements for switchboards supplied with power from grid connected inverters, as set out in AS/NZS 4777.1 Grid connection of energy systems via inverters Installation requirements
 - the additional requirements for UPS systems as specified in AS/NZS 4777.1 Grid connection of energy systems via inverters - Installation requirements
- relevant manufacturer specifications
- relevant risk mitigation processes
- relevant WHS/OHS legislated requirements

- relevant workplace documentation
- relevant workplace policies and procedures
- budgeting methods
- design briefs
- grid systems
- hybrid power systems
- quality assurance requirements.

Assessment Conditions

Assessors must hold credentials specified within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must satisfy the Principles of Assessment and Rules of Evidence and all regulatory requirements included within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must occur in workplace operational situations where it is appropriate to do so; where this is not appropriate, assessment must occur in simulated workplace operational situations that replicate workplace conditions.

Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.

Resources for assessment must include access to:

- a range of relevant exercises, case studies and/or other simulations
- relevant and appropriate materials, tools, equipment and personal protective equipment (PPE) currently used in industry
- applicable documentation, including workplace procedures, equipment specifications, regulations, codes of practice and operation manuals.

Links

Companion Volume implementation guides are found in VETNet - -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b8a8f136-5421-4ce1-92e0-2b50341431b6>