Australian Government

UEE Electrotechnology Training Package

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Links

Companion Volume implementation guides are found in VETNet - - https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b8a8f136-5421-4ce1-92e0-2b50341431b6

UEERE4001 Install, maintain and fault find battery storage systems for grid-connected photovoltaic systems

Modification History

Release 1. New unit of competency.

Application

This unit involves the skills and knowledge required to safely and effectively install, maintain and fault find battery storage systems for grid-connected photovoltaic (PV) systems.

A person competent in this unit will hold an unrestricted electrical licence issued in an Australian State or Territory and be able to install, maintain and fault find battery storage systems for grid-connected PV in accordance to relevant industry standards and regulations.

This unit is subject to the following requirements:

- Legislation, regulations, relevant industry standards and codes of practice for electrical work including specific work health and safety (WHS)/occupational health and safety (OHS) legislation and regulatory requirements
- Electrical licencing requirements – unrestricted electrical work
- Legislation, regulations, relevant industry standards and codes of practice for renewable energy.

There may be variations in these requirements across jurisdictions.

Pre-requisite Unit

UEENEEK148A Install, configure and commission LV grid connected photovoltaic power systems

Competency Field

Renewable and Sustainable Energy

Unit Sector

Electrotechnology

Elements and Performance Criteria

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

1 Plan for the installation, maintenance or fault finding of battery storage systems for grid-connected PV systems	**1.1** Installation design requirements, components and how they interconnect with the different system configurations are identified
	1.2 Hazards associated with battery storage systems for grid-connected PV systems are identified and the risk control measures are listed in safe work method statements/job safety analysis
	1.3 Designer recommendations, relevant industry standards, regulations and manufacturer specifications are identified and applied to planning the system installation, maintenance or fault finding
	1.4 Tools and safety equipment are selected and checked for safe performance of required tasks
	1.5 Maintenance is planned in accordance with system designer's requirements
	1.6 PV system and reported faults are identified and fault finding techniques applied
2 Carry out the installation, maintenance and fault finding of battery storage systems for grid-connected PV systems	**2.1** Job safety analysis is undertaken or safe work method statement is prepared and used to inform work processes in accordance with regulations and workplace procedures
	2.2 Battery storage components are installed in accordance with system design documentation, relevant industry standards, regulations and manufacturer specifications
	2.3 Inverters are installed in accordance with system design documentation, relevant industry standards, regulations and manufacturer specifications
	2.4 System charge controllers are installed in accordance with system design documentation, relevant industry standards, regulations and manufacturer specifications
	2.5 Storage system equipment including, cables, protection and isolation equipment, and signs are installed in accordance with system design documentation, relevant industry standards, regulations and manufacturer specifications

	2.6 System charge controllers and inverters are programmed in accordance with design documentation, relevant industry standards, regulations and manufacturer specifications
	2.7 Required modification to the electrical installation is carried out in accordance with design documentation, regulations and relevant industry standards
	2.8 Maintenance checklists are used to identify items needing servicing or replacement
	2.9 Required maintenance is performed by servicing or replacing items
	2.10 Fault finding techniques are applied to correctly diagnose and rectify system faults
	2.11 Testing, commissioning or reinstatement of the system is conducted in accordance with design documentation, regulations, relevant industry standards and manufacturer specifications
3 Document the installation, maintenance or fault finding of battery storage systems for grid-connected PV systems	**3.1** Testing, commissioning and required compliance documents are completed
	3.2 As installed, electrical system drawings and equipment location plans are produced
	3.3 Client system documentation, from designer, is completed
	3.4 Client is briefed on safe and correct system operation and recommended maintenance
	3.5 Maintenance checklists are finalised correctly and added to client system documentation
	3.6 Fault report/record is completed and added to client system documentation

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 can be found in the Companion Volume Implementation Guide.

Unit Mapping Information

This is a new unit – no equivalent unit

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 UEERE4001 Install, maintain and fault find battery storage systems for grid-connected photovoltaic systems

Modification History

Not applicable.

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:

- documenting the battery storage system installation for the client:
  - plan and enact scheduled maintenance of a system
  - document/record maintenance activities
- finding faults in battery storage systems for grid-connected photovoltaic (PV) system:
  - plan and enact identified fault finding procedures for the installed system
  - document/record fault finding activities
- installing battery storage systems for grid-connected PV systems:
  - install battery storage components
  - install inverter/s
  - install charge controller/s
  - install the balance of system equipment including cables, protection and isolating devices, and signage
  - program inverter/s and charge controller/s
  - modify electrical installation as required
- maintaining battery storage systems for grid-connected PV systems
- preparing for the installation of a battery storage system:
  - interpret system design documentation that specifies the quantity and location of all equipment in compliance with relevant industry standards, building codes and regulations
- testing and commissioning PV system:
  - test operation of each piece of equipment
  - test operation of complete system
  - commission the system
  - brief client on safe and correct system operation and recommended maintenance
- undertaking site assessment:

- interpret system design documentation that specifies the quantity and location of all equipment in compliance with relevant industry standards, building codes and regulations.

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:

- battery storage systems:
  - battery storage systems for grid-connected PV systems including:
    - applications for battery storage including:
      - electrical energy supply during grid outages
      - electrical energy supply direct to loads during periods of high tariffs
  - purpose of each component in battery storage systems for grid-connected PV systems
  - functional block diagrams for typical configurations of battery storage systems for grid-connected PV systems including:
    - multimode inverter/s for connecting to renewable energy, grid, loads and battery storage; these inverter/s provide backup to dedicated loads on grid failure and may:
      - have a built in charge controller for direct connection of a PV array or
      - require a separate charge controller to direct current (DC) couple the PV array and battery
    - two types of inverters comprising, PV grid-connected inverter/s and multimode inverter/s where:
      - both inverter types are connected to the grid and loads via a switching device that may provide backup to dedicated loads during grid failure
      - both inverter types are connected to the grid and only the multimode inverter/s may provide backup to dedicated loads on grid failure
      - only the multimode inverter/s are connected to the grid. The grid-connected inverter/s are alternate current (AC) coupled to the multimode inverter/s and both types can provide backup to dedicated loads on grid failure
- charge controllers including:
  - types and applications of charge controllers for different system configuration
  - specifications of a charge controller, including:
    - output rating DC voltage operating window and/or rating

        - DC current rating in and out
        - efficiency
- grid-connected batteries:
    - battery terms including:
        - nominal voltage
        - cell
        - primary and secondary cells
        - battery
        - charge and discharge rate
        - amp hour capacity
        - watt hour capacity
        - state of charge (SOC)
        - depth of discharge (DOD)
    - battery types including:
        - major features of commercially available types of batteries suitable for battery storage systems for grid-connected PV systems
        - factors affecting the life of commercially available types of batteries including the estimation of battery life
        - charging regimes suitable for commercially available types of batteries
    - battery safety including:
        - hazards associated with handling, installing or maintaining commercially available types of batteries and risk control measures
        - procedures for safe disposal of commercially available types of batteries
    - common processes leading to battery failure in commercially available batteries including sulphation and stratification in lead acid batteries
- grid-connected inverters:
    - inverters including:
        - differences between multimode and grid connect inverters
        - output rating of a multimode inverter/s in relation to:
            - required maximum demand
            - capacity for battery charging
        - program parameters for a multimode inverter, for the correct operation of the system
- grid-connected storage systems fault finding:
    - fault finding procedures including:
        - fault finding procedures for individual equipment
        - fault finding procedures for interconnected systems
- grid-connected storage systems installations:
    - installation requirements including:

        - installing battery storage devices in accordance with system design documentation, relevant industry standards, regulations and manufacturer requirements
        - installing inverters suitable for connecting to battery storage in accordance with system design documentation, relevant industry standards, regulations and manufacturer requirements
        - installing charge controllers in accordance with system design documentation, relevant industry standards, regulations and manufacturer requirements
        - installing all balance of system equipment in accordance with system design documentation, relevant industry standards, regulations and manufacturer requirements
    - electrical drawings including:
        - electrical systems circuit diagrams of typical battery storage systems for grid-connected PV systems including:
            - AC loads being supplied during periods when grid is unavailable
            - all major components
            - protection devices
            - earthing
            - isolation
            - switching
            - metering
        - equipment location plan/s to show the locations of equipment, fittings and cabling
- grid-connected storage systems maintenance procedures including:
    - maintenance requirements for individual equipment
    - maintenance requirements for interconnected systems
- grid-connected storage systems testing and commissioning procedures including:
    - safe testing of equipment
    - safe testing of system operation
    - commissioning of battery storage system.

Assessment Conditions

As a minimum, assessors must satisfy applicable regulatory requirements, which include requirements in the Standards for Registered Training Organisations, current at the time of assessment.

As a minimum, assessment must satisfy applicable regulatory requirements, which include requirements in 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:

Industry Standards

- relevant industry standards
- relevant industry product standards
- AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)

Documentation including reporting formats

- manufacturer technical data site plans
- system designer documentation relevant to installing the system
- maintenance checklists and/or testing and commissioning sheet

Measuring and testing equipment

- multimeter insulation resistance tester clamp tester (DC and AC)

Plant

- an existing installed PV array along with the equipment to facilitate the installation of a battery storage system for grid-connected PV systems. This equipment shall comprise:
    - battery storage
    - multi-mode inverter/s
    - devices for interconnecting solar to system either including charge controller or an appropriate inverter and all required balance of system equipment including:
        - cables
        - protection and isolating devices
        - isolators and signage in accordance with relevant industry standards, regulations and industry guidelines
- appropriate switchboard (or similar) to simulate interconnection of the system with an existing electrical installation

Safety systems and personal protective equipment (PPE)

- example of a job safety analysis or safe work method statement form relevant for the practical installation; PPE related to the types of battery storage included in the system

Software/Systems

- programming software for the inverter/s and charge controller/s

Specialist requirements

- specific manufacturer specifications for the equipment included in the battery storage system for grid-connected PV systems including:

    - installation manuals and user guides for typical components and those provided for the practical installation
- special tools as required for installing specific equipment
- special testing tools or equipment required for testing and commissioning, maintenance and fault finding of specific equipment

Tools and equipment

- hand tools and power tools.

Links

Companion Volume implementation guides are found in VETNet - https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b8a8f136-5421-4ce1-92e0-2b50341431b6

UEERE5001 Design battery storage systems for grid-connected photovoltaic systems

Modification History

Release 1. New unit of competency.

Application

This unit involves the skills and knowledge required to design battery storage systems for grid-connected photovoltaic (PV) systems.

This unit applies to a person with a sound knowledge of the components and different system configurations of battery storage systems for grid-connected PV systems and suitable energy management strategies that can be applied to the site where a system can be installed.

A person competent in this unit will be able to design a system, which includes calculating and selecting the correct sized equipment so the system output performance meets the client specific requirements within the guidelines of relevant industry standards, regulations and manufacturer requirements.

The unit involves designing a system taking into consideration all necessary work health and safety requirements relevant for the selected system and documenting the design including all calculations, equipment specifications and layouts.

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

Pre-requisite Unit

UEENEEK135A Design grid connected photovoltaic power supply systems

Competency Field

Renewable and Sustainable Energy

Unit Sector

Electrotechnology

Elements and Performance Criteria

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

1	**Plan the design of battery storage systems for grid-connected photovoltaic systems**	**1.1** Available components are identified and the different system configurations are applied to system design planning
		1.2 Hazards associated with battery storage systems for grid-connected PV systems are determined and appropriate risk control measures are developed
		1.3 Electrical load/s to be supplied from the battery storage system are identified
		1.4 Energy assessments are undertaken using appropriate tools including data logging tools and/or energy assessment forms
		1.5 Site is assessed to determine feasibility, equipment location and any required switchboard modification
		1.6 Energy management strategies are applied to produce an energy management plan
		1.7 Relevant industry standards, building codes, regulations and manufacturer requirements are applied to system design planning
		1.8 Relevant electricity tariffs are incorporated in the system design
		1.9 Solar resource data is applied in the system design
		1.10 Client situation, budget and desired outcomes are incorporated in the system design
2	**Design battery storage systems for grid-connected photovoltaic systems**	**2.1** Suitable system configurations are selected to meet client requirements
		2.2 System efficiencies are applied to system designs and overall system yield for different system configurations is determined
		2.3 Type and capacity of inverter/s to meet performance requirements are determined
		2.4 Type and capacity of battery storage to meet performance requirements are determined
		2.5 Type and capacity of charge controller/s to meet performance requirements are determined

	2.6	Capacity of PV array to meet performance requirements is determined
	2.7	Merits of alternate configurations including maintenance requirements are analysed and the most appropriate system design is selected
	2.8	Location of each item of equipment is determined
	2.9	Size of cables and ratings of protection and isolations devices are determined
3 Document the design of battery storage systems for grid-connected photovoltaic systems	**3.1**	Identified hazards are listed and appropriate risk control methods are specified
	3.2	Required items of equipment and system components are identified and listed
	3.3	System operating parameters are specified
	3.4	Electrical systems schematic/s and equipment location plan/s, inclusive of signage, are produced
	3.5	System cost and performance are documented
	3.6	Maintenance, client and installer documentation are produced

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 can be found in the Companion Volume Implementation Guide.

Unit Mapping Information

This is a new unit – no equivalent unit.

Links

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Assessment Requirements for UEERE5001 Design battery storage systems for grid-connected photovoltaic systems

Modification History

Not applicable.

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 two separate occasions and include:

- applying work health and safety (WHS)/occupational health and safety (OHS) policy, work procedures and instructions
- ascertaining and documenting system requirements including:
  - client objectives for the proposed system
  - client budget
  - energy profile of the site where the system will be connected and producing an energy management report
  - energy management strategies
  - hazards related to the system and the site
  - relevant electricity tariffs and utility requirements
  - site inspection including existing electrical installation to meet client objectives
- designing the system including:
  - analysing, reviewing and selecting configuration to meet performance requirements
  - assessing the photovoltaic (PV) array capacity to meet performance requirements
  - determining location of equipment
  - determining sub-system efficiencies
  - determining suitable configuration/s
  - drawing the suitable configuration/s
  - selecting and sizing cables, protection and isolation devices
  - selecting type and capacity of inverter/s, including programming of parameters to meet performance requirements
  - selecting type and capacity of battery storage to meet performance requirements
  - selecting type and capacity of charge controller, including programming of parameters to meet performance requirements
- documenting the system design including:

- compiling client documentation
- compiling installer documentation
- preparing electrical system schematic and equipment location plan
- specifying equipment including signage
- specifying system budget and performance including battery storage capacity and PV yield
- specifying maintenance requirements.

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:

- batteries including:
  - meaning of the terms that define aspects of batteries including:
    - amp hour capacity
    - battery
    - cell
    - charge and discharge rate
    - depth of discharge (DOD)
    - nominal voltage
    - primary and secondary cells
    - state of charge (SOC)
    - watt hour capacity
  - major features of commercially available types of batteries suitable for battery storage systems for grid-connected PV systems
  - factors affecting the life of commercially available types of batteries including the estimation of battery life
  - common processes leading to battery failure in commercially available batteries including sulphation and stratification in lead acid batteries
  - charging regimes suitable for commercially available types of batteries
  - hazards associated with handling, installing or maintaining commercially available types of batteries and risk control measures
  - procedures for safe disposal of commercially available types of batteries
- battery storage energy demand including:
  - load profiles illustrating average demand and maximum demand, based on appliances required during grid outages or during periods of high tariffs
  - total energy demand including:
    - energy required during periods of high tariffs
    - length of time of typical or expected grid outage

- battery storage systems for grid-connected PV systems including:
  - applications for battery storage including:
    - electrical energy supply direct to loads during periods of high tariffs
    - electrical energy supply during grid outages
  - drivers of grid-connected battery storage
  - purpose of each component in a battery storage system for grid-connected PV system
  - functional block diagrams for typical configurations of battery storage systems for grid-connected PV systems including:
    - multimode inverter/s for connecting to renewable energy, grid, loads and battery storage; this inverter/s provide backup to dedicated loads on grid failure and may:
      - have a built in charge controller for direct connection of a PV array or
      - require a separate charge controller to direct current (DC) couple the PV array and battery
  - two types of inverters comprising, photovoltaic grid-connected inverters and multimode inverters where:
    - both inverter types are connected to the grid and loads via a switching device that provides backup to dedicated loads during grid failure
    - both inverter types are connected to the grid and only the multimode inverter/s provide backup to dedicated loads on grid failure
    - only the multimode inverter/s are connected to the grid; the grid-connected inverter/s are alternating current (AC) coupled to the multimode inverter/s and both types can provide backup to dedicated loads on grid failure
- charge controllers including:
  - types and applications of charge controllers within the various system configurations
  - specifications of a charge controller including:
    - DC current rating in and out
    - DC voltage operating window and/or rating
    - efficiency
    - output rating
- diagrams including:
  - electrical schematics of battery storage systems for grid-connected PV systems including modifications to switchboard to cater for specified loads
  - site diagrams to show the locations of equipment, fittings and cabling
- energy management strategies and/or energy source switching options to reduce the maximum and surge demand, based on load profile analysis
- inverters including:

  - differences between multimode and grid-connected inverters
  - output rating of a multimode inverter in relation to:
    - capacity for battery charging
    - required maximum demand
  - program parameters for a multimode inverter, for the correct operation of the system
- maintenance and installation requirements including:
  - maintenance schedule for battery storage systems for grid-connected PV systems
  - specification of the installation and maintenance requirements for battery storage systems for grid-connected PV systems taking into consideration safety and relevant industry standards, regulations and manufacturer requirements
- system design including:
  - determining the system yield/performance, equipment costs, maintenance requirements, budget and overall life-cycle costs
  - relationship between the system components:
    - PV array, battery storage and inverters/controllers and the system design criteria
  - size and selection of the battery storage to meet the system performance requirements
  - selecting and sizing the balance of system components including:
    - earthing
    - isolation and switching devices
    - protection devices
- WHS/OHS policy, workplace procedures and instructions.

Assessment Conditions

As a minimum, assessors must satisfy applicable regulatory requirements, which include requirements in the Standards for Registered Training Organisations, current at the time of assessment.

As a minimum, assessment must satisfy applicable regulatory requirements, which include requirements in 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:

- relevant industry standards
- relevant industry product standards
- AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)
- applicable documentation including:
  - energy assessment forms
  - examples of typical client requirements and site specific details
  - manufacturer technical information including:
    - data sheets, installation manuals and user guides
    - block of systems configurations and circuit diagrams
  - relevant industry standards and regulations
  - solar resource data and electricity tariffs.

Assessment must include the design of battery storage systems for grid-connected PV systems that meet the specific requirements of the client within the guidelines of relevant Australian Standards, including designs for new and retrofit installations.

Links

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UEE Electrotechnology Training Package

Modification History

Not applicable.

Credit Arrangements

At the time of endorsement of this Training Package no national credit arrangements exist.

Links

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