

Grid connected PV systems with battery storage

1. System configurations

1.1 Purpose of each component in a grid connected PV system with energy storage

1.2 Functional block diagrams for typical configurations of grid connected PV system with battery storage including:

- One interactive inverter for connecting to renewable energy, grid, specified loads and energy storage
- One interactive inverter for connecting to grid and energy storage and renewable energy connects to energy storage using d.c. coupled controller
- Two inverters comprising one renewable energy grid interactive inverter and one inverter/charger (could be interactive) and the switch box is used to interconnect the two inverters to the grids and load
- Two separate inverter systems one is grid connected inverter connecting renewable energy to grid. The other acts like a UPS and is connected to the grid, loads and energy storage. The renewable energy does not charge the energy storage
- Two inverters where the grid connect inverter connects to loads and load terminal of other inverter (a.c. coupled). The other inverter connects to grid and energy storage.

2. Energy storage

2.1 Methods of energy storage:

- batteries
- flywheel
- thermal
- pumped hydro

3. Batteries

3.1 Meaning of the terms that define aspects of batteries 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)

3.2 Methods for determining state of charge of a lead-acid battery through measurement of specific gravity or battery voltage using safe working practices

3.3 Factors with respect to installation practices that affect the life of commercially available types of batteries suitable for grid connected PV system with battery storage.

3.4 Sulphation and stratification in lead acid batteries including:

- the cause
- the effects
- methods of prevention or reduction

3.5 Relationship between the depth of discharge and temperature on the capacity and life of commercially available types of batteries

3.6 Charging regimes suitable for commercially available types of batteries used in grid connected PV system with battery storage batteries, using real examples.

3.7 Hazards associated with the handling, installing or maintaining commercially available types of batteries and in particular lead-acid batteries and the risk control measures

3.8 Procedures for safe disposal of commercially available types of batteries in accordance with AS 4509.

4. Inverters

4.1 Relationship between the commercially available inverters suitable for use in grid connected PV system with energy storage and the various system configurations including:

- connection to the grid
- connection to the loads at the site
- connection to the PV array

4.2 Specifications of an inverter used in a grid connected PV system with energy storage, including:

- output rating
- maximum energy storage charging current

4.3 Programming a grid connected inverter with energy storage through its front panel interface and/or via a computer interface

5 Solar controllers

5.1 Types and applications of solar controllers within the various system configuration.

5.2 Specifications of a solar controller used in a grid connected PV system with energy storage, including:

- output rating
- d.c. current rating in and out

5.3 Programming a grid connected inverter with energy storage through its front panel interface and/or via a computer interface

6 Installation requirements

6.1 Installing energy storage devices in accordance with standards and guidelines

6.2 Installing inverters suitable for connecting to energy storage in accordance with standards and guidelines

6.3 Installing solar controllers in accordance with standards and guidelines

6.4 Installing all balance of system equipment in accordance with standards and guidelines

7 Electrical diagrams

7.1 Circuit schematic of typical grid connected PV system with battery storage including:

- (if applicable) the a.c. loads being supplied during periods when grid is unavailable
- all major components
- protection devices
- earthing
- isolation
- switching
- metering

7.2 Site diagrams to show the locations of equipment, fittings and cabling

8 Testing and Commissioning

8.1 How to safely test each piece of equipment

8.2 How to safely test a whole system operation

9 Maintenance Procedures

9.1 Preparation of Maintenance Checklists

9.2 Documentation of maintenance activities

10 Fault Finding Procedures

10.1 Preparation of Fault Finding Checklists

10.2 Documentation of fault finding activities