STANDALONE/OFF-GRID SOLAR POWER SYSTEM USER MANUAL

Contents

Important Safety Information

A solar PV (photovoltaic) system that is correctly installed can operate safely for many years, however, the DC and AC currents and associated voltage

present in the system can be extremely dangerous and even deadly.

Do not attempt to carry out electrical maintenance or repairs on the system. Only trained and approved personnel should undertake any electrical or

repair work. In addition, any section of the system that is an LV (low voltage) circuit, that is above 50V AC or 120V DC ripple-free, must be undertaken by

a suitably licensed electrical worker.

This manual will set out maintenance procedures and a schedule of maintenance. It is strongly recommended that maintenance or any changes to the system are carried out by Solar Power Ballarat or, if unavailable, another qualified installation company.

Your system includes signage such as the system shutdown procedure. Familiarise yourself with the signage, the shutdown procedure, and

components referred to in the shutdown procedure.

Note: this manual provides important information related to the energy storage system including safety guidelines.

How a standalone power system works

Your installed solar photovoltaic (PV) power system is not connected to the electricity grid so is a closed, independent system. Power is produced when

your solar panels convert solar radiation. Photons from the sun excite electrons in the solar cell causing an electrical current to ow. This process is not

related to whether it is hot or cold. In fact, PV systems generally perform better in cooler temperatures.

An inverter (or other power conversion equipment) converts the electrical ow from direct current (DC) to alternating current (AC) so that it is the same

as the 230-240V supply used in domestic electrical appliances.

Power produced from the solar PV supply will rst be used by loads at your premises and any extra produced will be directed to charging the battery

bank maximum charge that the battery is set to accept. .

When you are drawing power from the battery bank and it reaches its set maximum 'depth of discharge' (DoD), that is the battery energy is deleted to

the maximum level it is programmed to discharge to, it will shut down or fall back on an external petrol or diesel generator.

A generator may have an automatic switching mechanism to start and stop it electronically, or this may be a manual process. This will be explained

during your system induction training.

What can you do to help extend your battery life?

The lifetime of a battery is affected by the demands that are put on it, the degree to which it is recharged regularly and environmental factors such as

temperature. We provide advice below on maintenance procedures and suggest a maintenance schedule to help extend the battery lifetime. Good

battery health is best supported by:

regular charging up to a high state-of-charge level;

consistent temperatures in the battery enclosure;

About a battery back-up system

Some, but not all, battery inverters provide continuous power when there is a grid outage. Without an alert of some kind, you may not notice that

there has been a grid outage.

When the grid supply is present but outside of the voltage or frequency parameters set by the battery inverter, (i.e. high or low voltage or

frequency) power to the household is momentarily lost.

The solar power system recommences operating in standalone mode, until the grid supply returns to within those parameters. This brief break in

supply is to prevent the injection of energy into the point of supply and is a requirement of safety standards.

When in this mode of operation, avoid appliances that put a high demand on the system for any extended period.

Components and their function

Solar PV Module

PV modules are commonly installed in one or more rows and fixed securely on a rooftop or other surface using mounting hardware that is engineered to national standards. The collection of modules on a surface is known as an array or PV array.

Note that the voltage of this array is generally over 120 volts and therefore electrically rated as LV (low voltage), i.e. potentially

deadly and can only be maintained by quali_ed personnel.

Rooftop Junction Box

A junction box is an electrical combiner box commonly installed adjacent to the PV array, in which cabling from the modules may be marshalled into a

common supply to be fed to the inverter.

The junction box may also contain fuses and an isolator but is not serviceable and not to be opened by anyone other than trained and

qualified personnel.

Cabling

Cabling is routed from the PV array to the inverter and then to the switchboard. Cabling should be well insulated or installed in conduit

but should always be treated with great care as any movement may cause stress on connections. All cables in a PV system should be

treated as live and only quali□ed personnel should be allowed to perform any work or maintenance on these cables.

Inverter

The inverter has a variety of electrical functions including safety functions. The primary role of the inverter is to convert the DC supply from the solar

PV array to AC current matching that of common applicances.

The battery inverter controls the □ow of energy throughout the entire system. It manages the solar PV supply from the AC coupled inverters and charge

controllers, generally supplying household loads □rst. It controls the charging of and energy use from the battery.

The inverter may shut down automatically in certain situations to protect equipment or as a safety precaution.

An inverter operates e□ciently when it has appropriate air circulation. Do not place any objects around an inverter that may impede the □ow of air.

Charge Controller

The charge controller is dedicated to battery charging using only DC current. It is therefore highly e□cient. Excess power produced will contribute to

loads via the battery inverter.

Battery

The battery stores energy to be used at night time and is designed to cycle to a set depth of discharge (DoD). When the battery state of charge reaches

its set discharge level, the system will shutdown to protect the batteries. It is therefore important to take steps to conserve energy use.

Generator

In a standalone power system, the generator works in place of the electricity grid. It is drawn upon at times when the PV array is producing insu□cient

power and the battery bank is low on charge, i.e. in winter. It can be controlled by the battery inverter, and is able to supply loads and charge the

battery at the same time.

AC and DC Isolators

Isolators, also known as 'switch disconnectors', are switches to stop the electrical signal from □owing through to certain parts of the circuit. When a

switch is operated, the electrical current may remain on one or other side of the switch so all parts of the system must be treated as electrically live.

The **Solar PV AC Isolator** is generally located adjacent to the inverter (between the inverter and the electrical switchboard). This interrupts the supply

from the inverter to the a.c. switchboard and is the □rst switch to be turned o□ in the event of a system shutdown.
The **Solar PV Main DC Isolator** is generally located adjacent to the inverter. This interrupts the supply from the PV array and is the second switch to be
turned o□ in the event of a system shutdown.
The battery isolator is located close to the battery bank. This isolates the battery bank from the system to ensure that potentially dangerous DC
currents cannot continue to circulate. The battery isolator is the last switch to be turned o□.
Another DC isolator is generally installed on the roof (or other mounting surface) adjacent to the solar PV array. In the event of a □re or
emergency, emergency personnel may wish to be informed of the location of this switch. Only trained personnel should operate this
switch.

Shutdown and Alarm Procedure

Shutdown Procedure

The shutdown procedure that follows enables you to turn o□ the solar power system.
WARNING: Even when a system has been shut down, parts of the system may be electrically live. Solar PV modules can produce an
electrical current even when the system isn't operating and all electrical components should be treated as live.

Shutdown procedure

1. Switch o□ the **Solar Supply Main Switch** located within the electricity switchboard

2. Switch o□ each **PV Array DC Isolator** next to the inverter or mounted on the inverter

3. Switch o□ the power switch on the solar inverter (if it has a separate power switch)

4. Switch o□ the power switch on the battery inverter (if it has a separate power switch)

5. For the battery inverter, switch o the Main Switch (Inverter Supply) and UPS Supply isolator

to loads, located in the switchboard

6. Switch the Battery DC Isolator to the 'OFF' position. Do not hesitate when operating this

switch as an electrical arc may occur.

7. Switch o the battery sense isolator if available

What to do in the event of an Earth Fault Alarm

Your system is tted with an alarm to alert you to a situation requiring your immediate attention.

An Earth Fault Alarm is a safety mechanism to warn of a fault in the system that may result in a hazardous situation or damage to system

components.

Respond immediately to the alarm with the following actions:

1. **Do not touch any conductive (eg. metal) parts of the system as there may be an electrically live hazard present.**

2. Follow the Shutdown procedure (above).

3. Contact Solar Power Ballarat or, if unavailable, another accredited installer to seek further advice.

System Start-up Procedure

To restart the system, complete the above procedure in reverse.

During start up procedure, for the Battery System Isolator, push the handle in _rmly to ensure that fuses are reconnected.]

Recommended Maintenance

FOR QUALIFIED PERSONNEL ONLY

Solar PV systems have no moving parts and are designed to operate with minimal maintenance.

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repair work is conducted by your system installer or, if unavailable, another CEC-accredited installer. It is recommended that all maintenance

and repair work is conducted by your system installer or, if unavailable, another CEC accredited installer. It is strongly recommended that a

maintenance check of the entire power system be carried out annually.

At all times workplace safety regulations and state and federal solar PV installation codes and regulations must be followed. The following information

is provided only as a reminder of some important facets of workplace safety and is not a substitute for proper training.

Working at Heights

Safe work at heights is a subject requiring careful planning and execution. Consider the pitch of the surface when assessing the risks.

Training courses in working safely at heights are available in most locations and are highly recommended before carrying out roof work.

Ladders: Ensure ladders are set at the correct angle and with secure footing. Make sure the top of a ladder extends 1 metre above the gutter or

façade it is leaning against. Always secure a ladder at the top before stepping o a ladder onto a roof.

Personal Protective Equipment (PPE): Ensure suitable personal protective equipment is used including at a minimum:

Safety harness – training is required for proper use of harness

Footwear designed for high grip

Working at Heights on a Wet Area

Extra caution must be applied if using water while working at heights, for example when cleaning modules. Appropriate footwear and a safety harness

are essential equipment on any sloping surface. The need for edge barriers or other protective equipment must be assessed.

Electrical Risks

Solar PV modules are electrically connected to form an array that has a potentially deadly voltage. Only qualified persons should work on

these systems and extreme caution should be applied. It is not recommended to conduct maintenance on an array on a sunny day

unless modules are completely covered with an opaque material. Do not touch cabling and connections and do not pull on or cause pressure to

be applied to cabling or connections.

Battery Risk Information

Battery systems can have a work safety risks requiring specific training, qualifications and experience. Risks may include:

Dangerously high voltage or current ratings

Risk of re due to vapours, o gassing, or from crushing of battery materials

Risk of fire where configuration is not suitable for the components used.

All manufacturer installation and configuration instructions should be read and understood before undertaking installation or maintenance work on a

battery system.

The installed battery type is **Lithium Iron Phosphate(LiFePO4)**

Maintenance Procedures

FOR QUALIFIED PERSONNEL ONLY

The following pages detail recommended maintenance and associated hazards for each component of the power system. This information is provided

as a guide to visual inspections, which may identify issues before they become a safety concern, and the detailed maintenance inspections that you

should expect from an accredited professional.

Solar PV modules and array maintenance

Note that even when the system has been shutdown, solar PV arrays can continue to produce potentially deadly voltages. If any electrical
maintenance is required it is recommended to cover PV modules with an opaque material and test with a meter for any remaining
voltage before conducting such maintenance.
Solar PV modules require little maintenance, however they are commonly installed on rooftops and areas where severe weather can have adverse
e□ects on the mounting or electrical cabling, and UV radiation can damage components over time. A visual inspection can be conducted periodically to
check for any environmental impacts. Periodic cleaning of the modules is advisable, particularly in long periods of dry weather when the build-up of
dirt and dust may reduce the output of the system.
What to look for:
shading, dirt and dust
obstructions, such as leaf litter preventing air□ow beneath the modules
modules are securely fastened to mounting rails
cabling is not exposed to direct sunlight, secured in place and not dangling loosely
fauna or high winds can cause damage when cables are left with long loops
check that mounting systems and cable entries are not causing any leaks, for example, into roof cavities.
Contact your PV installer or another CEC accredited installer if you notice any potential problems. Additional accredited installer checks:
check that connections between modules and isolators are tight, sealed, secure and not su□ering damage
- tests including string open circuit voltage and current, output voltage and current, and earth resistance

Inverter and Regulator Maintenance

Ensure that no objects are located around the inverter that may impede the □ow of air for cooling. Check that indicator lights are operating as
expected.
Trained personnel only may inspect and service inverters and regulators in accordance with the manufacturer's speci□cations. Trained personnel may
clean behind the inverter, check the mounting and quali□ed personnel only may open the inverter to carry out routine or required maintenance as
specified in the inverter operating manuals, including:
check voltage and current on DC and AC sides of the inverter
check indicators are working as expected and check for error codes
check programmed configuration is meeting customer requirements check for adequate ventilation

Maintenance Schedule

This maintenance information is intended for qualified personnel.
Correct and thorough electrical safety procedures must be following when carrying out any of these tasks. These tasks are not complete procedures
and maintenance sta□ should be fully trained in each aspect of maintenance that are conducting.
6 or 12 Monthly Maintenance (ask your installer for recommended
maintenance cycle)
Check voltage and current on the d.c. side of the inverter, then voltage and current on the a.c. side of the inverter.
Follow safe work at heights procedures in the following tasks. Visual inspection of the array including: module degradation, module mounting,
mechanical and UV protection of cables, connectors and conduit secure, frame earth connections, roofing sealants and penetrations, dirt and
dust, shading changes. If any modules are found to be sub-standard, replace where necessary.
Junction box tests including: string open circuit voltage and current, output voltage and current
Earth resistance: test earth resistance with d.c. and a.c. isolators in 'OFF' position
At each inverter check for ventilation, check for any error codes in accordance with manufacturer's documentation.
Bi-annual Maintenance
As above
Service inverter in accordance with the inverter manufacturer's documentation.
Further maintenance procedures may be advisable according to the component manufacturer's documentation.