**User manual for operation, management, and troubleshooting –Solar mini-grid • Template**

**User manual**

**Solar mini-grid**

[Site name]

[Location]

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# INTRODUCTION

This document introduces the operation and maintenance of your solar mini-grid system. Your system is designed to meet all of Nepal’s conditions and regulations. Although it is maintenance, it must always be remembered that the system generates electricity and we recommend that you do not attempt to service it unless you are suitably qualified. Your safety is our primary concern.

# EQUIPMENT SUPPLIER

***[Please mention the equipment suppliers’ details such as name, address, etc.]***

# EQUIPMENT INSTALLER & COMMISSIONER

|  |
| --- |
| Name: ……………………………………..  Address: ……………………………………..  Emergency phone no.: ……………………………………..  Telephone no.: ……………………………………..  Mobile no.: …………………………………….. |

# ABOUT THIS DOCUMENT

No liability is accepted for incorrect use, unauthorized changes to the assembly components, or the resulting consequences. All information and instructions in this manual refer to the current state of development.

# OWNER MAINTENANCE

For your safety, we recommend that you do not attempt any servicing yourself unless recommended by a professional technician.

The solar panels work best when clean. Regular rainfall or washing with a hose will maintain their cleanliness. If they do become excessively soiled they can be cleaned with cold water. It is strongly recommended that you avoid climbing and use the services of a qualified professional who is trained in occupational health and safety procedures.

Shading of the solar panels will affect efficiency and performance. Plant and tree growth that may cause shading at various times of the year, should be monitored and dealt with as required. Likewise leaves, bird droppings, and other debris coming to rest either on or around the solar modules should be carefully removed.

If you notice your system is not operating correctly, please check the **Troubleshooting** section of this document.

If you need to shut down the system, please follow these steps in order.

* Switch off the **DC Isolator/breaker** adjacent to the Inverter
* Switch off the **AC isolator/breaker** adjacent to the Inverter

Following these steps will safely isolate the solar array. To switch it back on, you simply reverse the procedure. Always remember that your system will be generating electricity during daylight hours and care should always be taken to eliminate the risk of electric shock. Refer to the ***OPERATING INSTRUCTIONS*** in this document for more information.

# HOW YOUR SOLAR MINI-GRID WORKS?

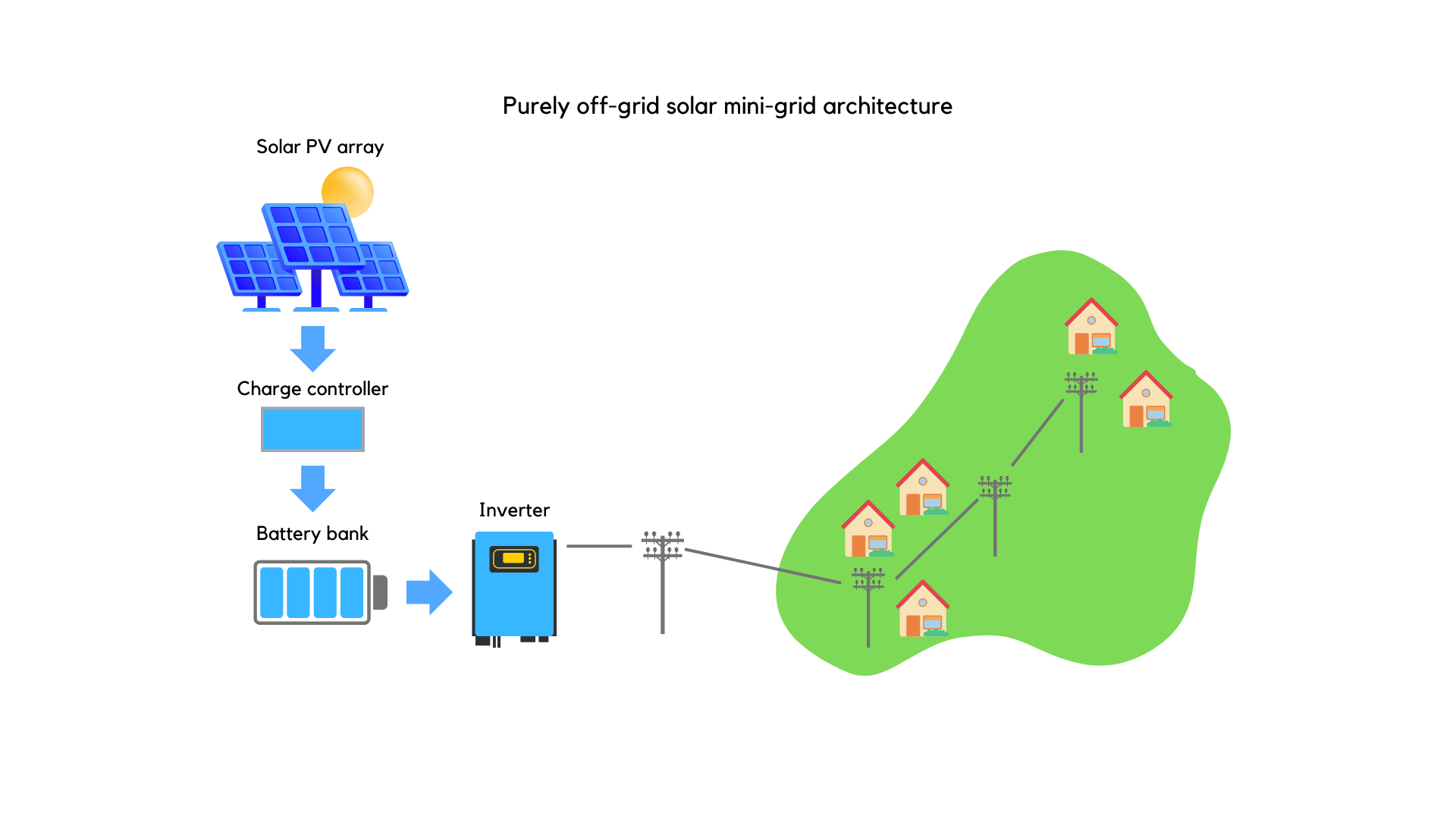
This section briefly describes the general architectures of solar mini-grid systems.

*Note: The architectures shown in this section may not exactly translate to the system installed. The information given in this section is to provide only a general overview of solar mini-grid architectures.*

Figure 1 shows the architecture of a pure off-grid solar mini-grid. The term ‘pure’ here means that solar PV is the only source of energy generation in these systems with no means of diesel generator back or grid-interactive option. This is equivalent to a community-scale off-grid solar PV system.

In general practice, this architecture is adopted in the following site conditions,

1. Where the grid access is not foreseen for the duration of the design life of the solar mini-grid.
2. Critical loads having significant economic loss are not foreseen for the design life of the solar mini-grid.



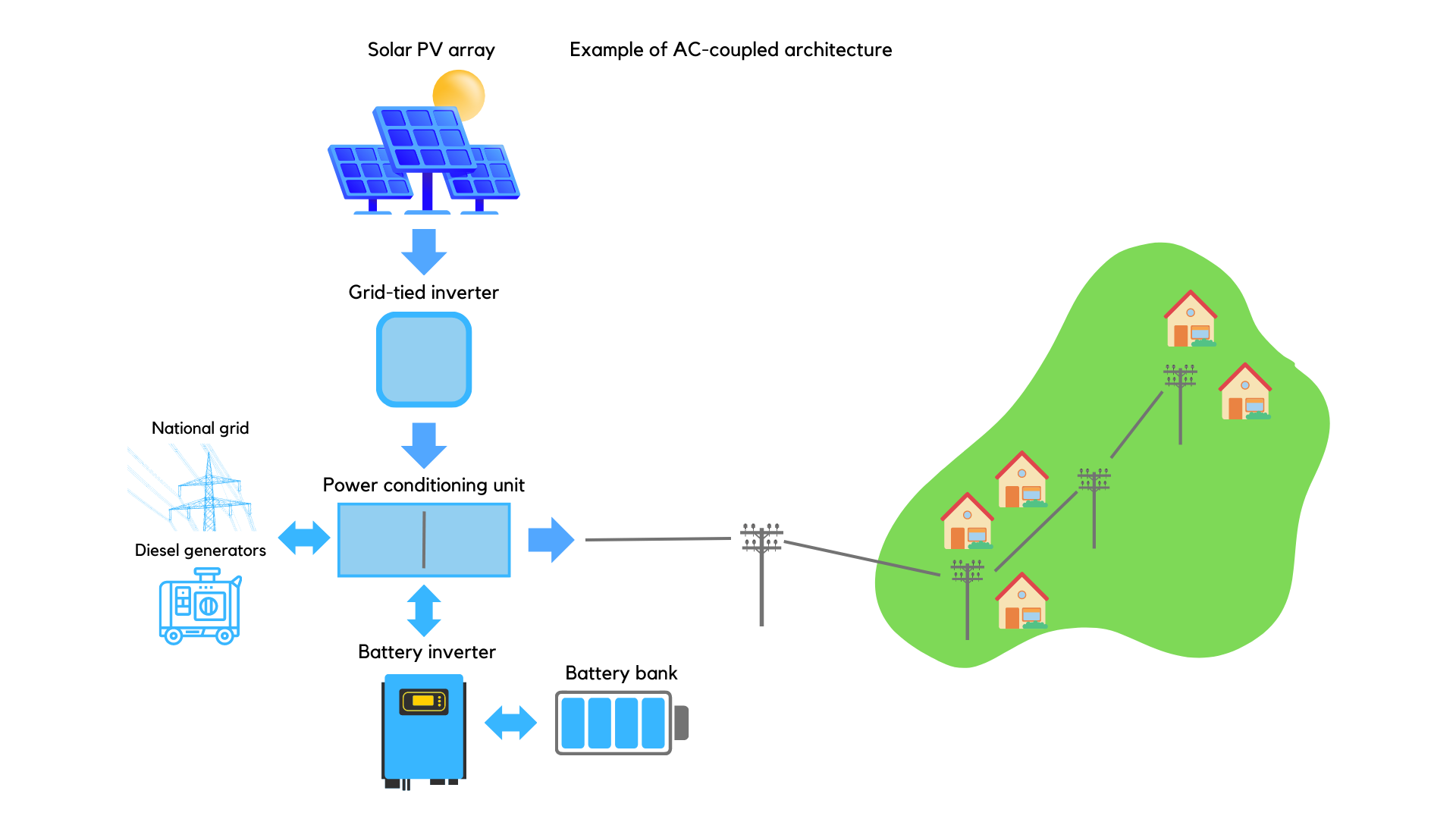
**Figure 1: Purely off-grid solar mini-grid architecture**

An example of a more advanced[[1]](#footnote-1) solar mini-grid architecture is shown in Figure 2. A major differentiating aspect of this architecture compared to the purely off-grid architecture is that it allows for the connection of other sources of electricity such as diesel generators[[2]](#footnote-2) and the national grid[[3]](#footnote-3). This gives the mini-grid more flexibility in its management of electricity sources. For example, when the national grid reaches the community several years after the installation of the solar mini-grid system, it can interconnect with the mini-grid system utilizing the existing transmission and distribution infrastructure. Solar mini-grid can then prioritize solar PV energy generation and utilize the national grid when energy generation from solar PV is inadequate.

The example architecture shown in Figure 2 is for an AC-coupled solar mini-grid system. In this architecture, the main bus carries alternating current (AC) to which different components of the system are synchronised. Similarly, DC-coupled solar mini-grid systems are also available, where the main bus carries direct current (DC).

In general practice, this architecture is adopted in the following site conditions,

1. Where the grid access is foreseen within the duration of the design life of the solar mini-grid.
2. Critical loads having significant economic loss are foreseen during the operation of the solar mini-grid.



**Figure 2: Advanced solar mini-grid architecture**

The solar modules are usually installed in the ground. The number of modules will depend on the nominal size of your system and, collectively, they are known as the solar array. The solar array converts daylight into direct current (DC) electricity.

The DC electricity is then fed to the inverter. The inverter converts the DC electricity to alternating current (AC) electricity which is compatible with the electricity supplied to your house from the isolated grid. The inverters have a digital readout so you can monitor information such as the amount of solar electricity produced, etc. Refer to the separate inverter owner’s manual for more information.

The power produced by the PV system is now consumed by the electric loads in the households.

# SYSTEM PERFORMANCE

During daylight hours, your system will be generating electricity at varying rates depending on the amount of sunshine. The more sunlight falling on the solar array the more electricity is generated. Variable factors such as cloud cover, seasonal solar angle variations, shading or soiling of the solar array will affect the electricity output.

Note that you do not need to change your energy usage lifestyle to correspond with your solar system. Your energy consumption will be supplied by both solar and batteries.

# ENERGY CONSERVATION

Your solar mini-grid system represents an investment in your future energy needs as well as a benefit to the environment. Unlike conventional generators of electricity that have been causing major environmental problems such as smog, acid rain and global warming, your solar mini-grid system does not produce any air or water pollution while it is generating electricity.

Considering that it generates free electricity from daylight, it makes sense to consider the other side of the energy equation – your electricity consumption.

# OPERATING INSTRUCTIONS

Your solar electricity system is designed for automatic operation without the need for user intervention. There are no moving parts or need for the owner to interact during its normal operation.

# OPERATING SAFETY INSTRUCTIONS

* Do not attempt to service the system unless you are *fully qualified* to do so. To service any electrical connection, you have experience as an electrical technician with training provided by the operating company. You must also be guided by a qualified professional from the operating company.
* All service work must be carried out in strict compliance with all local and national electrical regulations and standards.
* Review and follow all safety instructions supplied with all components of your solar electricity system.
* Do not attempt to clean or come in contact with the surface of a solar module with broken glass. This could result in a dangerous electric shock.
* Be aware that power may be present at any point in electrical circuits despite the opening of circuit breakers or isolators.
* Circuit breakers can trip automatically if problems occur. If the circuit breaker is switched back to the closed or “on” position and it immediately trips back to the open or “off” position, there is a problem.

# USING YOUR INVERTER (PV AND BATTERY INVERTERS)

The inverter converts the DC power produced by the solar panels into AC power while also monitoring and displaying the energy yield.

## Front panel display

*Put a front display of your Inverter that clearly shows the LED indications if any.*

### LED status indicator lights

*Put a table in this section showing the different LEDs and what they depict, like what it means when it is solid and what it means when it is flashing.*

### Keypad

*Put a picture and a table in this section showing different keypads and what it is used for. Also, put a process to function different steps to operate and check the parameters on the LCD.*

### LCD

The liquid crystal display (LCD) is located on the front panel of the inverter which shows the following information:

* Inverter operation status and data;
* Service messages for the operator
* Alarm messages and fault indications

*Put a picture of the LCD and a table showing different LCD functions and status details, alarm details or any messages for the operator.*

## Start and stop

### Start the inverter

*Put a procedure on how to start the inverter.*

### Inverter working status

*Put a different status indication and LCD showing the inverter is working in normal or different conditions.*

### Stop the inverter

*Put steps for stopping the inverter during maintenance or emergency conditions.*

### Operation

*During normal operation, the display alternately shows the power and the operation status with each screen lasting for a few seconds. Put a flowchart or steps showing the operation status of the inverter.*

### Main menu

*This section is used to put the main menu where different functions and menus are available. Put a step on how to get to the main menu of the display and mention different options available in the main menu.*

### Lock screen

*Put a step showing the lock screen usage and the way to protect it from unauthorized interference.*

## Settings

### Set time

*Put a step on how to set a time.*

### Advanced info – technicians only

*Put a step on how to set the advanced info option. This is used for professional technicians only.*

### Alarm message

*Put a step on what different alarm codes are mentioned and what are the causes of the alarms. Check if the alarm messages are in line with the issues.*

# TROUBLESHOOTING

## Troubleshooting PV panels

* *You can mention here what you should require to check at the first step such as checking the output of the entire system or inverter.*
* Secondly, you can check the inverter input voltage from the PV array and current.
* Either you will find the entire PV array system is not producing any power or the output power is lower than expected. Mention the current and voltage as it is noted by the multimeter.
* Check physically at first if all the PV modules are ready or not, then check the combiner boxes for any fuses that may be blown.

## Troubleshooting PV inverters

* *Please mention where are the basic location that should be checked for the voltage and the standard expected parameters that need to be observed.*
* Is there any display note down as if there are any alarm signals or status that is abnormal? If there is some concern, then further inspection shall be required to be done from the product user manual or troubleshooting details.
* *You then need to describe the contact person that shall be required to contact for a detailed inspection.*

## Troubleshooting batteries

* *The battery voltage shall be required to be mentioned at different statuses.*
* *Shall need to put the physical property that shall require checking if the battery is physically in normal condition.*
* *The cable lug connections and their general properties and basic issues that may arise which need rectification shall also be mentioned.*

# WARRANTY DETAILS

*In this section please mention the warranty of the different equipment used in the solar PV system.*

**Installer details** (to be completed by the installer)

As a designer/installer of the PV system, I,

***[Name of installer]*, *[Address of installer]*****declare that this installation has been performed following all relevant standards in force at this date.**

|  |
| --- |
| Contact: ………………………………………………………………….  Phone: ……………………………………………………………………  Signature of the installer  (with name and position): ……………………………………………….  Date of installation and commissioning: ………………………………. |

|  |
| --- |
| **Inverter details**  Make: ………………………………………  Model: ………………………………………  Size: ……………………………………….. |

|  |
| --- |
| **Solar PV details**  Make: ………………………………………  Model: ………………………………………  Size: ……………………………………….. |

|  |
| --- |
| **Battery details**  Make: ………………………………………  Model: ………………………………………  Size: ………………………………………... |

|  |
| --- |
| **Other BoS details**  Make: ………………………………………  Model: ………………………………………  Size: ………………………………………... |

1. The word advanced is used to communicate higher complexity compared to purely off-grid architecture [↑](#footnote-ref-1)
2. Diesel generators can serve as backup electricity for load and battery charging when poor weather conditions result in inadequate solar PV generation and when the battery bank charge is low [↑](#footnote-ref-2)
3. National grid can be connected when it reaches the community several years after the installation of the solar mini-grid [↑](#footnote-ref-3)