

STANDARD OPERATING PROCEDURE

For CUTM 16.25 x 2 Identical Microgrids



SELCO Solar Light Private Limited
#690,15th Cross, JP Nagar 2nd Phase,
Bangalore 560078. KARNATAKA,
INDIA

Tel.: +91-80-2665 4509/ 2665 4510 Fax: +91-80-2244 0529
E-mail: selco@selco-india.com Website: www.selco-ndia.com

Customer Care Toll Free No. : 1800-419-0780

ABOUT THIS MANUAL

Welcome to the Standard Operating Procedure Manual! Please read all instructions contained within this manual to gain a full understanding of how to do maintenance and troubleshooting of the system. This manual should be placed at a safe place to ensure that it is available when needed.

SCOPE

The manual provides information about about solar technology, maintenance and troubleshooting and list of documents need to be maintained by the end user.

AUDIENCE

The manual is intended to assist technical staff for maintaining and troubleshooting the system installed in CUTM.

ORGANIZATION

This manual is organised into 5 chapters.

Chapter 1 contains information about solar technology

Chapter 2 contains information about the solar system installed in CUTM (Microgrid)

Chapter 3 contains information about how to do the maintenance of the installed system

Chapter 4 contains information about troubleshooting, LCD screen and LED indications in PCU.

Chapter 5 contains information about the documents that has to be maintained.

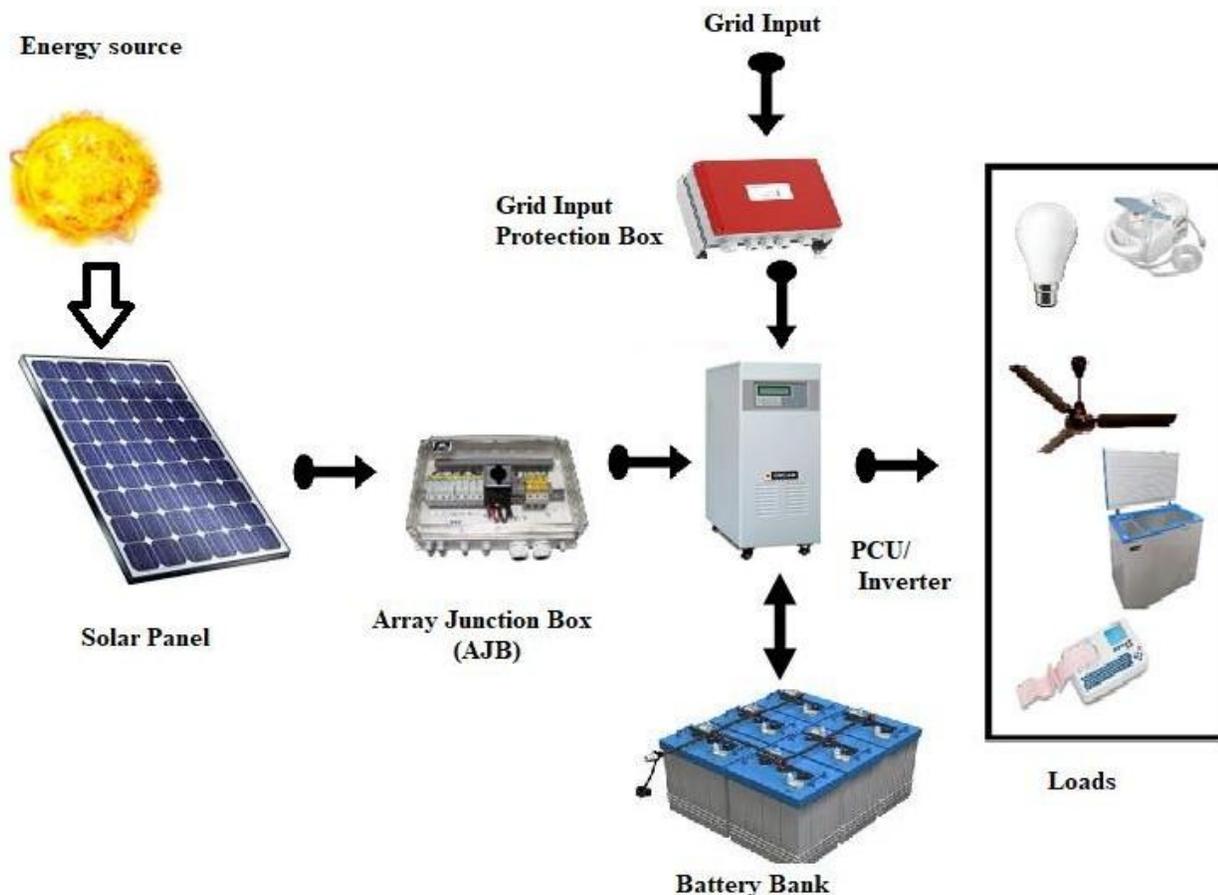
DISCLAIMER

Always read and follow user manuals and safety warnings. The instructions given in this manual are for guidance only and are not to be construed as engineering approved documents. You should consult the nearest SELCO branch for troubleshooting.

INTRODUCTION

SOLAR TECHNOLOGY

Sun is a powerful source of energy. Solar energy can be converted directly or indirectly into other forms of energy, such as heat and electricity. To convert solar energy into electricity, a solar system is required. The solar PV system uses solar panels made up of Photovoltaic (PV) material. When sunlight falls on photovoltaic material, it generates electricity. The power from solar panel is stored in the battery and the battery ensures clean power to the load at any time. The functions of the charge controller are to stop charging the battery from the solar panel when the battery is full and to stop powering the appliances when the battery is down. An inverter is used to run AC appliances from a DC source like a battery or a solar panel. It converts DC(Direct current) into AC(Alternative current).



ADVANTAGES OF USING SOLAR ENERGY

- ✓ Easy to install.
- ✓ Safe, clean and reliable
- ✓ Minimum maintenance. No fuel required.
- ✓ Can be used for free. No electricity charges.

SOLAR - ELECTRIFICATION:

SOLAR COMPONENTS

Solar Panel



- Solar panels collect energy from the sun and turn solar energy into electricity.
- It converts photons (light) into electrons of direct current ("DC")

Solar Battery



- Stores electrical energy
- Solar panels charge the battery during the day, and this power can be drawn upon in the evening

Module Mounting Structure (MMS)



Module mounting structure is used to fix solar panels on surfaces like roofs or the ground

Array Junction Box with MCB



It is used to interconnect several solar arrays.

MCB(Miniature circuit board) is used for protection

Power Conditioning



- PCU is solar charge controller + inverter+ grid charger
- Converts DC to AC
- It charge battery bank through either a Solar or a Grid

Grid Input Protection Box



- Grid protection device has inbuilt Surge Protection Device (SPD) and Miniature Circuit Breaker (MCB).
- It protects PCU from grid spikes and Voltage fluctuation

ENERGY NEEDS FOR 16.25 kWp x 2 IDENTICAL SOLAR MICROGRIDS

Energy audit is an effective tool in defining and pursuing comprehensive energy management programmes. The same approach has been taken care to understand on what to do, where to start, at what cost and for what benefits before we plan for a centralized solar based microgrid solution. Energy audit helps in energy cost optimization and suggests the methods to improve the operating and maintenance practices of the system.

Hence, a preliminary energy audit has been done & the following data was captured:

Shop 1

UMBC Shop

Timing: 9 am - 8 pm

Sl. No.	Load Details	Power Consumption (Watt)	Quantity (Nos.)	Time to Run (Hr.)	Remarks
1	Microwave Oven	2000	1	0.25	10 Sandwiches & each for 30 seconds
2	Fridge - Omfed	160	1	10	-
3	Mixer	550	1	0.5	Not working now
4	Aquaguard	20	1	6	-
5	Cellfrost	260	1	10	-
6	Ceiling Fan	75	2	6	-
7	LED Lights	14	8	3	-
8	Mosquito Repellant	40	1	4	-
9	Cadbury Fridge	90	1	10	-
10	Popcorn Machine	-	1	-	Not working now
12	Automatic Cooker-Warmer / Steamer	660	1	-	Not working now
13	French Fry Machine	-	1	-	Not working now

Shop 2

Shining Restaurant

Timing: 12 pm - 3 pm & 7 pm - 10 pm

Sl. No.	Load Details	Power Consumption (Watt)	Quantity (Nos.)	Time to Run (Hr.)	Remarks
1	Wall Mounted Fans	55	6	4	-
2	Sony Speakers (5 In 1)	420	1	4	-
3	LED Light	12	14	6	-
4	Wifi	40	1	24	-
5	Counter Fan - ALMONARD	40	1	5	-
6	Haier Refrigerator	180	1	10	-
7	Weighing Machine	5	1	3	-

8	Havells Mixer	750	1	1	-
9	Mosquito Repellant	40	1	6	-
10	Haier Long Refrigerator	320	1	10	-
12	Wall Fan - Bajaj Esteem	55	1	6	-
13	LED Light	12	4	3	-
14	CCTV	5	4	24	-
15	Outside LED	12	1	6	-
16	Haier RAC Split AC	1650	1	2	EER - 3.15
17	HITACHI RAU018GPD2009	1650	1	2	EER - 3.25
18	Exhaust Fan	746	2	3	-

Shop 3

Ambizen Medicare

Timing: 9 am - 1 pm & 3 pm - 7 pm

Sl. No.	Load Details	Power Consumption (Watt)	Quantity (Nos.)	Time to Run (Hr.)	Remarks
1	LED Bulb	7	5	4	10 Sandwiches & each for 30 seconds
2	Stand Fan - Khaitan	180	1	8	-
3	Old Refrigerator	80	1	10	-
4	Air Conditioning Machine	-	-	-	Not working now

Shop 4

Centurion Food & Variety Store

Timing: 9 am - 9 pm

Sl. No.	Load Details	Power Consumption (Watt)	Quantity (Nos.)	Time to Run (Hr.)	Remarks
1	CCTV	5	5	24	10 Sandwiches & each for 30 seconds
2	Fridge - Coca Cola	750	1	10	-
3	Fridge 2	405	1	10	-
4	Samsung Fridge RT24ADPP1 / XTL	134	1	10	-
5	Microwave Oven LG	2000	1	0.25	-
6	Ceiling Fan	75	1	12	-
7	LED Light	14	1	5	-
8	Cadbury Fridge	90	1	10	-

Shop 5

Jhilmil Foods

Timing: 9 am - 1 pm & 3 pm - 7 pm

Sl. No.	Load Details	Power Consumption (Watt)	Quantity (Nos.)	Time to Run (Hr.)	Remarks
1	LED Light	60	2	4	10 Sandwiches & each

					for 30 seconds
2	Ceiling Fan	75	1	8	-
3	Fridge - Coca Cola	750	1	10	-
4	Samsung Fridge RT24ADPP1 / XTL	134	1	10	-
5	Fridge	300	1	10	-
6	Fridge	-	-	-	Not working now

Shop 6

Fruit Juice Center

Timing: 8.30 am - 10 pm

Sl. No.	Load Details	Power Consumption (Watt)	Quantity (Nos.)	Time to Run (Hr.)	Remarks
1	Mixer	750	1	1.5	Total 200 - 300 Glasses
2	Crompton Mixer	750	1	1.5	
3	LED Tube Lights	20	3	3	-
4	Sharp Fridge - SHARP hjd19s - 180 Lt	150	1	10	-

Shop 7

Maa Durga Venture

Timing: 9 am - 10 pm

Sl. No.	Load Details	Power Consumption (Watt)	Quantity (Nos.)	Time to Run (Hr.)	Remarks
1	LED Lights	14	4	4	-
2	CCTV	5	1	24	-
3	Fridge	180	1	10	-
4	Fridge	250	1	10	-
5	Stand Fan - Khaitan	180	1	4	-
6	Ceiling Fan	75	1	4	-

Shop 8

Shining XEROX Shop

Timing: 9.30 am - 2 pm & 3 pm - 9.30 pm

Sl. No.	Load Details	Power Consumption (Watt)	Quantity (Nos.)	Time to Run (Hr.)	Remarks
1	Ceiling Fan	75	1	8	-
2	LED Bulb	40	1	4	-
3	CFL Bulb	7	2	4	-
4	LED Bulb	5	1	4	-
5	Computer	110	1	6	-
6	Lamination Machine EXCELAM XL-12	600	1	0.5	-
7	Photocopier Machine	1200	2	1	-

8	Printer with Scanner	550	1	1	-
9	CCTV	5	1	1	-
10	LED Light	14	4	2	-
11	Ceiling Fan	75	1	2	-

Shop 9

OM Sai Ram Foods

Timing: 8 am - 2 pm & 3 pm - 9 pm

Sl. No.	Load Details	Power Consumption (Watt)	Quantity (Nos.)	Time to Run (Hr.)	Remarks
1	LED Light	14	4	4	-
2	Small Fan	55	1	3	-
3	Big Stand Fan (Cinni)	110	1	6	-
4	Mixer	750	1	1	-

Shop 10

Tiffin Shop

Timing: 8 am - 8 pm

Sl. No.	Load Details	Power Consumption (Watt)	Quantity (Nos.)	Time to Run (Hr.)	Remarks
1	Stand Fan	90	1	3	-
2	LED Bulb	20	1	4	-

Shop 11

Coffee Shop

Timing: 9 am - 9 pm

Sl. No.	Load Details	Power Consumption (Watt)	Quantity (Nos.)	Time to Run (Hr.)	Remarks
1	Stand Fan	90	1	8	-
2	LED Bulb	20	2	4	-
3	Coffee Machine	2810	1	3	-

Shop 12

A.R. Snacks

Timing: 8 am - 2 pm & 4 pm - 8 pm

Sl. No.	Load Details	Power Consumption (Watt)	Quantity (Nos.)	Time to Run (Hr.)	Remarks
1	Fridge - Pepsi	260	1	10	-
2	Kwality Fridge	160	1	10	-
3	Whirlpool FF23C	191	1	10	-
4	Stand Fan	180	1	8	-
5	Microwave Oven	2000	1	0.25	-
6	LED Light	14	6	4	-

7	LED TV	30	1	3	-
8	Sound System	100	1	3	-
9	Cooler	300	1	4	-
10	Digital Clock	5	1	12	-

Push Carts (3 Nos.)

Timing: 4 pm - 8 pm

Sl. No.	Load Details	Power Consumption (Watt)	Quantity (Nos.)	Time to Run (Hr.)	Remarks
1	LED Light	30	3	4	-

New Shaded Area

Timing: Open Area & can be used for all the time

Sl. No.	Load Details	Power Consumption (Watt)	Quantity (Nos.)	Time to Run (Hr.)	Remarks
1	LED Light	10	12	6	Under Construction
2	Fans (Ceiling / Wall Mounted)	75	6	6	-
3	Outdoor Light	12	1	12	-

New Shaded Area above the Fountain (Planned)

Timing: Open Area & can be used for all the time

Sl. No.	Load Details	Power Consumption (Watt)	Quantity (Nos.)	Time to Run (Hr.)	Remarks
1	LED Light	10	4	6	-
2	Fountain	746	1	6	-

SOLUTION PROVIDED:

Microgrid 1:

Max Load that can be connected	11 kW
Max units of energy (kWh) usage per day	37.3 Units
System Voltage	240 V

Sl.No.	Products	Capacity
1	Solar Module with mounting structure	16.25 kWp
2	Solar battery with battery rack	400 Ah, 240 V
3	Solar Power Conditioning Unit – Single Phase	20 kVA, 240 V
4	Centralised Metering Solution with Data Logging Facility	1 Set.
5	Safety equipment & Protection Unit	1 Set.
6	Cables & Consumables	1 Set.

Microgrid 2:

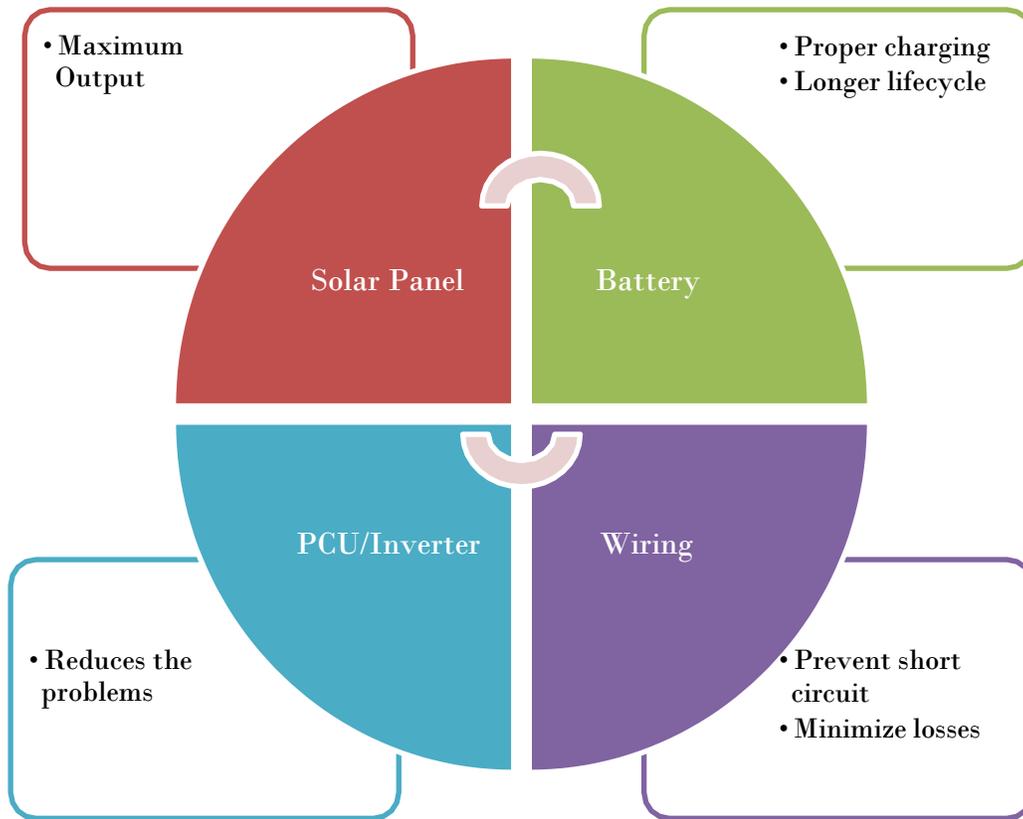
Max Load that can be connected	11 kW
Max units of energy (kWh) usage per day	37.3 Units
System Voltage	240 V

Sl.No.	Products	Capacity
1	Solar Module with mounting structure	16.25 kWp
2	Solar battery with battery rack	400 Ah, 240 V
3	Solar Power Conditioning Unit – Single Phase	20 kVA, 240 V
4	Centralised Metering Solution with Data Logging Facility	1 Set.
5	Safety equipment & Protection Unit	1 Set.
6	Cables & Consumables	1 Set.

Total System Capacity: 32.5 kWp

MAINTENANCE:

NEED FOR MAINTANENCE



SOLAR PANEL

Do's

- Clean the glass surface of the module using water and a soft sponge or cloth every 15 days.
- Check the electrical and mechanical connections periodically to verify that they are clean, secure and undamaged.
- Check for corrosion
- Check front of modules for cracking ,cut or other damage to glass
- Check modules for evidence of burning under glass.



Don't

- Do not use any detergent.
- Do not attempt to disassemble the module connection.
- Do not remove any attached nameplates or components.
- Do not apply paint or adhesive to the module.
- Do not use mirrors or other hardware to artificially concentrate sunlight on the module.
- Do not stand or step on module.
- Do not place any heavy objects on the module
- Avoid shadows falling on panels
- Do not displace the panels from the mounting structure.



SOLAR BATTERY

The Ambience:

- Makes sure that the surrounding is moisture free
- Makes sure that the battery room is properly ventilated and clean.

Do's (Weekly basis)

- Clean the top surface and terminals of the battery once a week.

Do's (During Battery Servicing Periods)

- Check the distilled water level once in 4 months and if require, Refill as per the guidelines (Battery shouldn't be overfilled. The maximum electrolyte level is approximately $\frac{1}{4}$ " to $\frac{1}{2}$ " below the vent well tube which extends down into the battery). Check for distilled water leaks due to cracks or overflow.
- Check for corrosion at terminals and connections.
- Check the battery terminal safety caps is mounted properly.
- Clean your hands thoroughly after every time you handle the battery.
- If required apply petroleum jelly to the terminals.



Don't

- Do not touch both battery terminals with your bare hands at the same time.
- Remove watches and jewelry when working with or near battery to avoid shock.
- Never keep tools or other metal items above and near a battery.
- Do not smoke in battery charging areas as the acid used in the battery is inflammable
- Prevent open flames and sparks in battery charging areas.
- Do not allow anybody, except SELCO representatives, to change any of its parts.



POWER CONDITIONING UNIT/ INVERTER

Do's

- Keep the room properly ventilated.
- Check functionality by display and indications weekly.
- Clean the inverter surface weekly.
- Check all the connections are properly tightend.



Don't

- Do not remove any attached nameplates or components.
- Do not open the PCU cover to clean or for any other purpose.
- Do not change electrical connection on your own.
- Do not allow water to drip or splash on the PCU.



SAFETY INSTRUCTIONS

1. Read the entire manual and associated product manual before using your system.
2. Use SELCO solar modules for their intended use only. Follow all manufacturer instructions. Do not disassemble the module, or remove any part installed by the manufacturer, as this will void any manufacturer warranties.
3. Solar modules have a protective glass front. Broken solar module glass is an electrical safety hazard (electric shock and fire). These modules cannot be repaired and must be replaced immediately. If you have a broken module, turn your system off or call the service personnel immediately.
4. Do not place any metallic or fire prone object close to the charge regulator, inverter or battery. A minimum of 12" space should be maintained all around for free air circulation.
5. Call the service personnel if the charge regulator or inverter indicates a fault.
6. Prevent the direct contact of the positive and negative terminals of panels and batteries.
7. Batteries store a large amount of energy. Never short circuit the external contacts of battery under any circumstances.
8. Please observe the safety recommendations of the battery manufacturer. If in doubt, consult the service personnel.
9. Never smoke or allow a spark or flame in vicinity of battery.
10. Do not use any other adapter for charging the solar home lighting system. Except the specified solar panel.
11. Do not allow water to drip or splash on the charge regulator and battery.
12. Do not heat the system components. Do not keep the system parts near the storage of inflammable gas/liquid.
13. Do not place objects on top of any component.
14. Prevent any shadow falling on the panels. Shadow causes the output of the panels to reduce.
15. Avoid children touching the panels, batteries, and other electrical components.
16. Keep the components clean and free from dust & water.



- ✓ Battery performance will decrease after 2/3 years or sooner if not maintained well.
- ✓ Don't throw away dead batteries. Keep them stored safely (away from children/fire) for collection by technical team for recycling.

TROUBLESHOOTING

GUIDELINES

PROBLEM	CAUSES	SUGGESTIONS
Some loads are working while others are not	Burnt lamps	Replace lamps
	Loose connection	Check connections
The system works but runs out of power too quickly	Check if panel is shaded	If yes, remove shades.
	Check if panels are broken/ burnt/ cut/crack	If yes, inform SELCO centre.
	Panel surface is not clean	Clean the panels with wet cloth.
	Extra appliances used or	Turn off the load while not in use.
	appliances used for longer duration than suggested. (Overuse)	Do not use extra appliance. If your requirement is more, contact SELCO centre for redesigning the system.
	Battery low (See the display in PCU)	Check grid availability. If yes and battery voltage level is low, inform SELCO centre
The system stops working entirely	The MCB trip.	Switch ON the MCB (Behind the PCU)
	Loose Connections	Check for any loose connections.
	Battery low (See the display in PCU)	Makes sure the load is not running for more hours. Check the distilled water level in the battery. Check the mains voltage display in PCU.(230 V) If both are ok, inform SELCO centre.
	Check the PCU Red indications near 'Fault'	Inform SELCO centre.
Any other problem		Inform SELCO centre.

POWER CONDITIONING UNIT (PCU) DISPLAYS

LED INDICATIONS

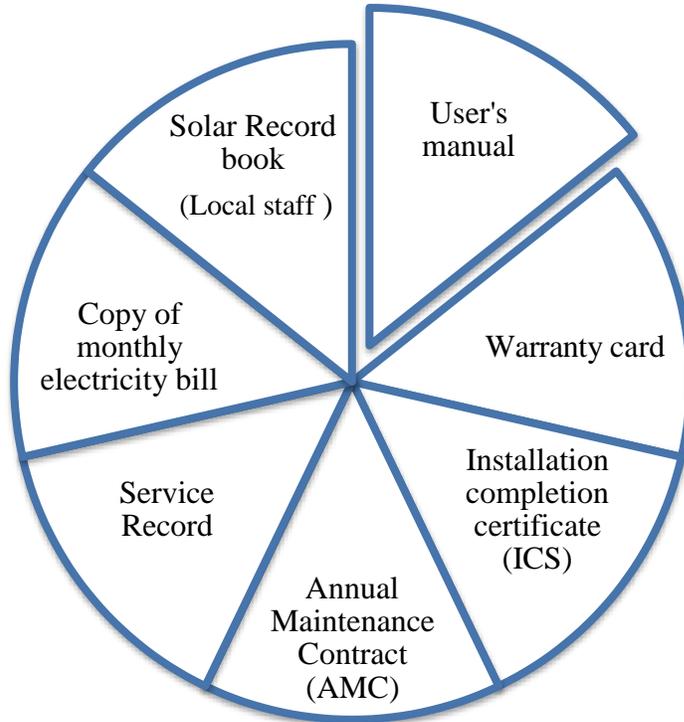
LED INDICATION	INDICATION STATUS
Red	Mains ON
Yellow	Charger ON- Mains/Solar
Red	Fault LED
Green	Output ON/ Load ON

PCU DISPLAY

DISPLAY	LCD INDICATION
Solar PCU	
Battery Voltage	Shows Battery Voltage
Mains Voltage	Shows Mains Voltage
Mains Frequency	Shows Mains Frequency
Inverter Voltage	Shows Inverter output Voltage
Inverter Frequency	Shows Inverter output Frequency
Load level %	Shows percentage of connected load
Charging Amperes	Shows Mains charging current for batteries
SPV Voltage	Shows Voltage across Solar panels
SPV Amperes	Shows Current generated by Solar panels
Total kWh	Shows total Solar energy generated , resets after 999 units or on Battery removal
Standby mode	Shows No Load condition- goes to Standby Mode
Priority	Shows priority mode- Grid or Solar
Fault	Fault will be latched upon Fault LED Indication
UPS Switch (Inverter ON/OFF)	ON/OFF

DOCUMENTATION

DOCUMENTS NEED TO MAINTAIN BY LOCAL STAFF



SOLAR RECORD BOOK

A service record book has to be maintained by the local staff to track the functioning of solar system installed. It will help to track maintenance and service and to identify any recurring issues.

Service record should include the following:

