

SOLAR ENERGY SYSTEMS MAINTENANCE MANUAL



Barefoot College, Tilonia

PREFACE

*"Greetings, O Sun God!
We have known you as the source of energy
and worshipped you as a God!"*

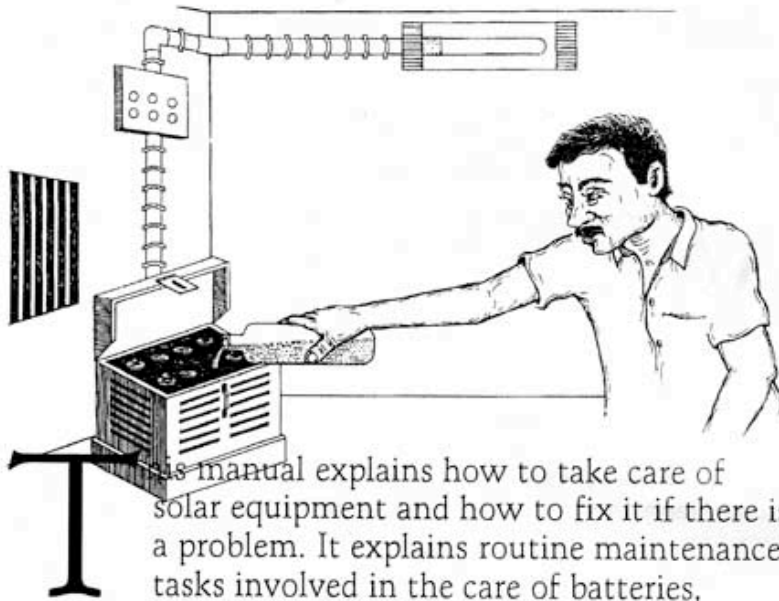
We and our forefathers have used the energy of the sun in so many ways. The collection and use of this energy has always been a challenge to people. Human beings have to a great extent learnt to use this boundless energy and maximized its practical use. The Barefoot College also has taken the initiative to make its own contribution to the use of this energy.

The first effort of the Barefoot College was the experimental use of solar energy for its Health Centre in 1984. The workers of the organisation took the responsibility of maintenance after its installation. And from this was born the concept of the barefoot solar engineer.

On the basis of this experiment a seven kilowatt solar unit was installed. It was further extended to thirteen kilowatts. This gave the necessary encouragement to optimize the use of this capacity and to spread it further. In 1989 the Solar Workshop was set up. Then came the establishment in Jammu and Kashmir, Sikkim, Bihar, Uttaranchal, Madhya Pradesh, Rajasthan and Himachal Pradesh, of the 4,200 home lighting systems and 3000 lanterns. PCBs were designed, components assembled and the training of barefoot solar engineers began. This long experience with maintenance of solar units brought home the need and importance of the use of this energy. The result was the evolution of the system of maintenance and its methodology.

The Barefoot College had these experimental and demonstration units in the sub-Himalayan region and the plains of northern, eastern, western and central India. The results proved both the necessity as well as the need for the use of solar energy in these areas. Research potential has been established, as well as the need to collect and collate information to enrich this study. Solar units and other methods of use of solar energy should have long-term feasibility. In the future, we hope to bring together the results of our research and explore the possibilities of expansion of the use of this energy.

Bunker Roy
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This manual explains how to take care of solar equipment and how to fix it if there is a problem. It explains routine maintenance tasks involved in the care of batteries, modules, wiring, controls and loads. The section on troubleshooting explains how to identify the causes of problems and how to solve them when the system fails to work.

ROUTINE MAINTENANCE

A solar electric system, which is properly installed, requires very little maintenance. In fact the work involved in maintaining a solar electric system is much less than that required to maintain a diesel or petrol powered generator. The best maintenance practice is to make regular inspections of the equipment (especially the batteries and modules), to make sure that things are kept clean and all electrical contacts are tight.

BATTERY MAINTENANCE

Batteries require regular and careful maintenance. For a longer life batteries should

- be cleaned monthly
- have their electrolyte level checked
- be kept in a high state of charge

Cleaning

(Do this once a month)

Carry the battery outside when cleaning to avoid spilling acid. Keep plenty of water nearby to rinse spills.

1. TURN OFF or disconnect the solar charge
2. Disconnect the battery from the leads and remove the terminals from the posts.
3. Clean the top and outside of the battery with water (do not allow water to enter the cells).
4. Clean the terminals and the posts until they are shiny. If the terminals are corroded (i.e. they are covered with a white powder) clean them carefully with a solution of baking powder and water. If the terminals are badly corroded then replace them.
5. Replace the cleaned terminals and tighten the bolts. Apply petroleum jelly or grease to the connected terminals.
6. If unable to open the tight bolts, place a wet cloth over it for 2-3 hours and then open it.

Checking and Topping up Electrolyte Level

(Do this once a month)

1. Remove the caps of each cell one at a time and check the level of electrolyte. Acid level should be within two centimetres of the top of the battery. If you can look inside the battery, check the plates to see their condition.
2. If the electrolyte level is down, add ionized distilled water till it is about two centimetres below the top of the battery. Distilled water can be made using glass beakers; or rain water collected in plastic or glass containers can also be used in place of distilled water.

DO NOT USE RAIN WATER COLLECTED IN METAL CONTAINERS.

DO NOT ADD ACID, TAP WATER OR TONICS TO THE BATTERIES.

Checking the State of Charge

(Do this once a month, or as required)

BE CAREFUL : DO NOT USE LOW CHARGED BATTERIES

- If the battery is in a state of low charge reduce the use of load, allow the battery to be charged by the module, or have it charged at a petrol station.
- With large systems (i.e. Schools, Hospitals etc,) keep records of the battery, state of charge, age and performance. This allows users to judge more easily whether a battery needs replacement, and enables them to budget for new batteries.

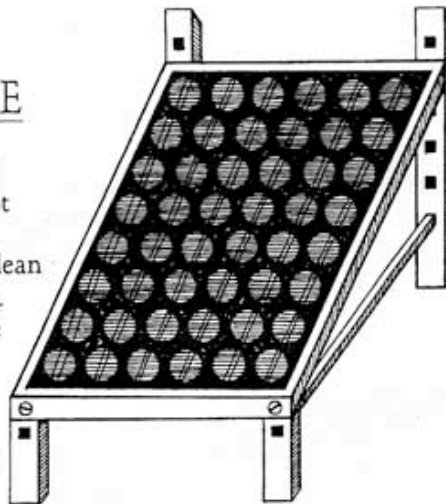
Equalizing Charge

(Do this once every four months)

An equalizing charge is a hard charge from a grid or generator powered battery charger that takes a battery a bit above its normal full state. It causes bubbling which mixes up the acid inside the battery, it also helps remove accumulated sulphate from the battery on equalizing battery during the cloudiest month of the year.

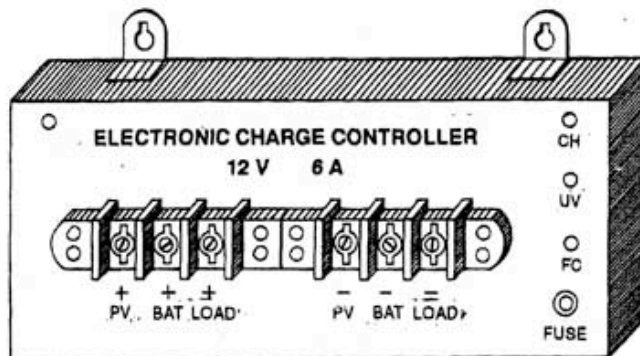
MODULE MAINTENANCE

Modules require minimum maintenance as they do not have any moving parts. Keeping the glass surface clean is the most important task. Dust and shade will reduce the electric output. Clean the module with water and if necessary a mild soap. Do not allow a plant or a tree to shade the panel.



CHECKING CONNECTONS

(Do this every few months)



Inspect the junction box on the back of each panel to make sure that the wiring is tight. Make sure that wires have not been chewed by rats and that there are no insects etc, living in the junction boxes.

Wiring and Control

If the wiring is installed properly, there should be no wiring problems for the life of the system. However, it is useful to check the wiring of the system at least once a year, especially in places where it might be damaged by rats, tampered with or accidentally pulled.

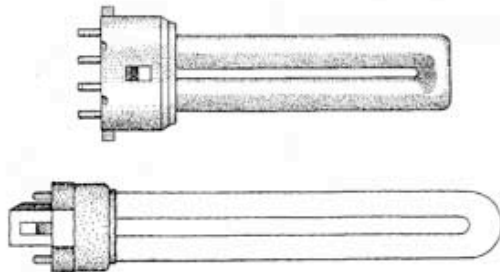
Inspecting Wiring, Fuses, Indicator Lamps and Switches

(Do this once a year)

1. Check the tightness of all connector strips. Make sure that no bare naked wire is visible.
2. Inspect system wire runs for breaks, cracks in the insulation or places it has been chewed up. This is especially important for old or exposed wire.
3. Inspect junction boxes to make sure that they have not become homes for insects. If they are in an exposed location then make sure they are still watertight.
4. Check the switch. It should not spark while turning ON or OFF.
5. Check the indicator lamps on the control. The solar charge comes ON, when the sun is up. If it is not ON, check to see if the batteries are being charged. Check whether the other LED indicators are working.
6. Check the grounding wires to make sure they are all intact.

LAMPS AND OTHER LOADS

On a daily basis one should operate the loads as efficiently as possible. Maintenance of loads includes turning lights and appliances OFF when not in use.



1. Clean lamps, reflectors and fixtures once every few months. Dust and dirt will reduce lamp output by as much as 20%.
2. Check for blackening tubes in fluorescent fixtures, and replace them immediately.
3. Replace burnt out bulbs.

SYSTEM RECORDS AND MANUALS

Keep all information about the system in a safe place. This information includes

- Circuit diagrams and map of the location of the batteries.
- Manuals, warranties and manufacturer's specifications of system components.
- Record of battery state of charge and history, installation dates, repairs, equipment replacement and system maintenance.

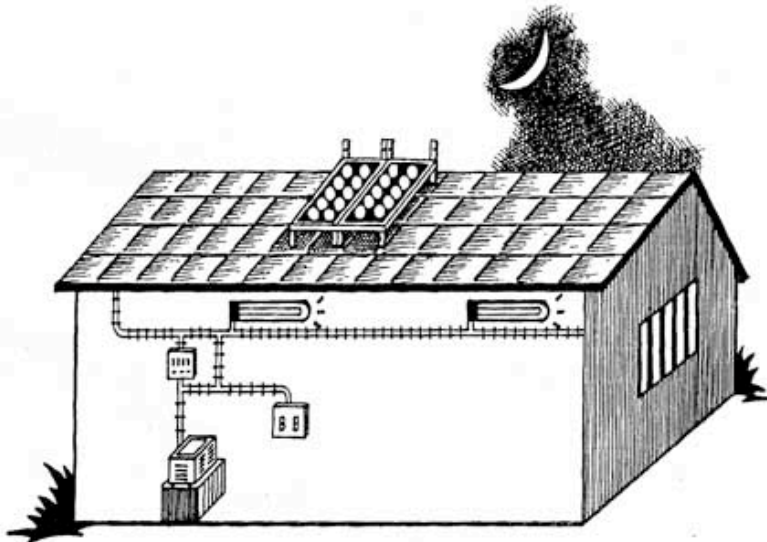
TROUBLESHOOTING

Troubleshooting means facing problems as they occur. Although if the equipment is properly installed systems are unlikely to fail, some problems that need attending to may arise.

The first thing to do is not to panic if a problem arises. Most problems have very simple causes, and can be discovered just by running checks in a few key places. The battery is the most likely source of problems in a small solar electric system. Contact a trained barefoot solar engineer in such circumstances. But check yourself first.

Check for Basic Problems First

- What was the weather like in the days/weeks before the problem? Has the weather been cloudy? Is it likely that the load has been using more energy than the modules generate? If the latter is the case then the problem may be due to misuse of the system, or due to the failure of a component.
- Is the system new? Do the users know how to maintain it properly? Contact a solar electrician if a new system has any minor faults; or users do not know how to use the system.
- What is the type, condition and age of the battery? Can it still hold a charge? If it is too old or corroded, change it.
- Locate all fuses in the system and see if they have blown. Check and see what caused the fuse to blow (i.e., overload, short circuit) before replacing it.
- Are all wires connected securely? Are any corroded? Is there any place where a wire is likely to be have broken?
- Are the modules shaded or dusty?



Problem	Cause	Remedy
<p>Battery charge is low</p> <ul style="list-style-type: none"> • "Battery Low" indicator comes on • Low voltage disconnect turns OFF load • Battery state of charge is constantly below 11.5 volts. 	<ul style="list-style-type: none"> • There is no solar charge • Battery acid low • Bad connection to control terminal • Defective battery or cell • Loose or corroded battery terminal • Dusty modules • Blown fuse • Overuse of system • Battery will not accept charge • Voltage drop between module and battery too high • Defective controller 	<ul style="list-style-type: none"> • Check and fix connection to module. • Add distilled water to cells. • Check for broken wire or loose connection. • Clean and tighten battery terminals. • Clean modules. • See 'Blown Fuse' section below. • Leave appliances OFF for a week to allow recharging or recharge by other means. • Find out age and history of battery. Replace if old or spoilt. • Check voltage drop. Replace cable with larger diameter if required. • Check operation of charge controller with dealer. Replace or repair if necessary.
<p>No solar charge</p> <ul style="list-style-type: none"> • Solar charge indicator does not light up during the day • There is no current in wires from the module 	<ul style="list-style-type: none"> • Short circuit along wires to module • Loose connection in wires connecting battery to control • Blown fuse • Soot or dust on module or damaged module 	<ul style="list-style-type: none"> • Locate and repair short circuit • Repair loose connection • See 'Blown Fuse' section below • Clean module with water and soft cloth • Check for broken cells or glass or poor connection inside module

<p>Lamps or appliances do not work One or more lamp or appliance fails to come ON when connected.</p>	<p>Lamps</p> <ul style="list-style-type: none"> • Switch is OFF • Bad tube or globe • Bad ballast inverter • Bad connection in wire • Tubes or globes have very short lifetimes <p>Appliances</p> <ul style="list-style-type: none"> • Switch is OFF • Bad connection in wire • Bad socket • Broken appliance 	<p>Lamps</p> <ul style="list-style-type: none"> • Turn switch ON • Replace with new tube or globe • Replace ballast inverter • Repair connection • Check system voltage : too low or high <p>Appliances</p> <ul style="list-style-type: none"> • Turn switch ON • Repair connection in wire • Replace socket • Try appliance where there is good power supply. Repair or replace.
<p>Blown Fuse When the fuse is removed the wire inside is broken</p>	<ul style="list-style-type: none"> • Short circuit along wire to module • Fuse too small • Lightning/power surge 	<ul style="list-style-type: none"> • Repair short circuit • Use fuse 20% larger than combined power of loads • Replace fuse

TROUBLESHOOTING GUIDE



NOTES

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