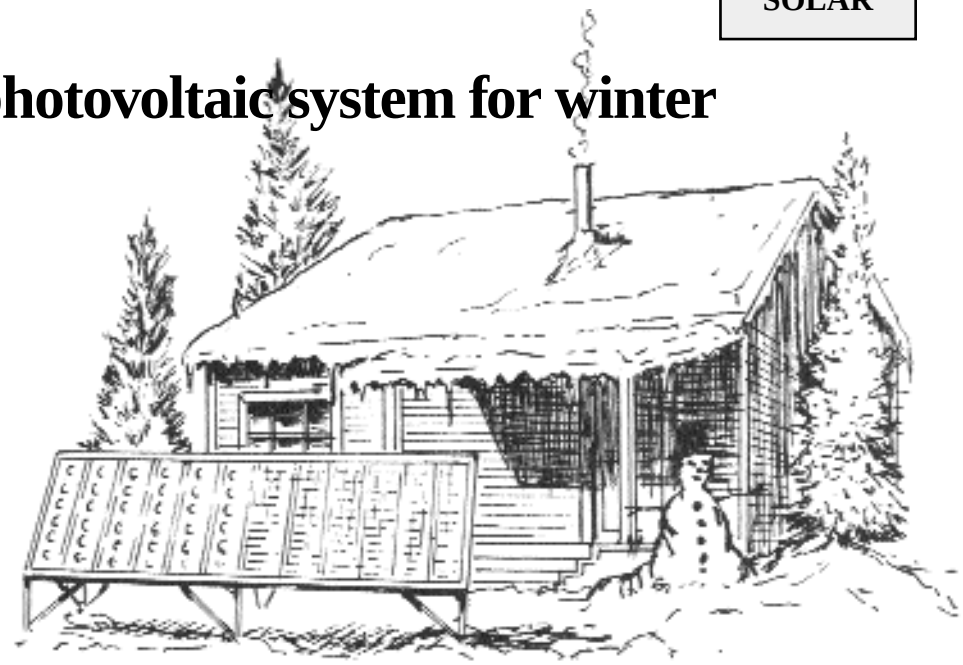
Preparing your photovoltaic system for winter



By Windy Dankoff

The winter season puts a solar power system to the test. You need the most energy for lighting, but have the least amount of solar power available. Fall is the time to inspect your system and make adjustments and improvements to prepare for winter's challenge.

The following items should be checked, where appropriate:

Photovoltaic array: Inspect/tighten mounting bolts & wiring, test output, tilt for winter angle. *Trackers:* oil bearings, check mounting and shock absorbers.

Gas generators, wind generators, hydro-electric: Consult your dealer, manufacturers, instruction manuals, etc.

Charge controller: Check regulator voltage settings; check voltmeter accuracy with digital meter. If batteries may reach a temperature below 55 degrees F, they should be allowed to rise to a higher voltage (14.8V min. on a 12V system). If your charge control has a "temperature compensation" feature, the temperature sensor should be attached to one battery so this can happen automatically. If it does not have this but is adjustable, you may raise the voltage by hand, then lower it again in the spring (to 14.3V). If your controller is not adjustable, then keep your batteries warm.

Batteries (lead-acid types): Test each cell/each battery with digital voltmeter or hydrometer to spot potential failures and check need for equalization. Set up equalization charge if necessary. Ask your system supplier how to do this if you don't know how. Wash away accumulated moisture and dust from battery tops. (Use baking soda solution to neutralize acid deposits.) Clean or replace corroded terminals and coat them with petroleum jelly. Check water levels & refill with distilled or deionized water. Inspect venting. (Check for insect nests in vent pipes.) Check insulation/shelter from cold.

Wiring: Check for proper wire sizing, tight connections, fusing, safety.

Grounding/lightning protection: Install/inspect ground rods and connections, ground wiring. (See *BHM* #17)

Loads/appliances: Check for "phantom loads" and inefficient usages. Examples: Wall cube transformers and TVs with remote control that use power all the time they are plugged in. Does your furnace thermostat hold your inverter on 24 hrs/day?—See below!

Lights: Look for blackening incandescent bulbs; consider more efficient Quartz-Halogen or fluorescent replacements. Clean the dust from light bulbs and fixtures.

Inverters: Check adjustments, settings, connections. Note: Inverters with Battery Charge Option should have charge voltage set around 14.5 (or 29) volts if a generator is to be used for charging. See your manual.

Water supply: Check freeze-protection, pump maintenance, pressure tank pre-charge.

Battery temperature

Lead-Acid storage batteries lose about 25% of their storage capacity at 30 degrees F. If fully discharged, they can freeze at 20 degrees and be destroyed. Summer heat is also destructive. For these reasons batteries should be protected from outdoor temperature extremes. Batteries are safe indoors, if installed properly. See *The Solar-Electric Independent Home Book* by Jeff Fowler, *The New Solar Electric Home* by Joel Davidson (*BHM* sells them on page 97), or other installation manuals, and the National Electric Code.

Freeze protection and heat tapes

Electric heat tapes are a popular way to prevent water pipes from freezing under mobile homes, on solar water heaters, in well sheds, and other places where they may be exposed to cold. Where heat tapes are a necessary evil, here are some tips to minimize their energy usage:

Insulate!!! Use foam pipe jacketing, Fiberglass, anything that insulates, and plenty of it. Be sure cold air and moisture are sealed out. **Use less heat tape** than recommended with fewer, wider-spaced coils. With extra insulation, you won't need much heat.

"Frostex" round heat tape is most efficient, but you may wish to add a Line Voltage Thermostat to disconnect it in warm weather. If you use a conventional flat tape, be sure it has a thermostat on it. The thermostat may be tucked into the insulation closer to the pipe so it won't turn on until cold penetrates into the insulation.

Also, **use an inverter** that is efficient for running **small** loads like your heat tape, or **convert heat tapes to 12 or 24 volts!** If you're not afraid to cut and splice, here's how to make a low voltage heat tape:

1. Buy a conventional **flat** heat tape **with thermostat**.
2. For 12V, measure 1/10 of its length from the thermostat end and **cut**. For 24V, use 1/5 of its length.
3. Strip the cut end and connect the two inner wires together using the barrel of a crimp terminal. Be careful; the wires are thin and delicate. Protect the end with silicone sealant and/or tape.

You now have a low voltage tape with thermostat. It will draw the same wattage **per foot** as the original. The neon indicator light won't work, but an ammeter will indicate current flow. The remaining tape may be cut into more low voltage tapes by splicing lamp cord to one end and tying the other end together (using crimp connectors). You will need to add a thermostat if desired. One Line Voltage Thermostat can switch many tapes on and off.

Install heat tapes, even where you don't expect a freeze. They make it easy to thaw surprise freezes without digging, ripping out insulation, etc. Thermostats are optional on these "back-up" tapes.

Furnace and controls

Thermostat circuits and **power usage:** Most central heating systems use a low voltage circuit through a wall thermostat to tell the furnace when to turn on and off. The low voltage is derived from a small transformer which is powered constantly. It consumes only a few watts, but in an alternative energy system that may be a significant load—if it is the only AC device that's running, it is adding constant additional draw just to keep the inverter "up." That amounts to the wintertime energy output of 1 to 3 PV panels, costing over $300 each, plus battery capacity to match!

If yours is a system where the inverter spends most of its time turned off (relatively little AC power usage), it is worth the small modification of adding a Line Voltage Thermostat to your furnace circuit. You may order one from a heating or electric supplier. Have it installed **in the AC line** to the furnace controls. (Also bypass the original thermostat.) This way when heat is not needed, all power is cut to the furnace transformer. A small "limit switch" thermostat may also be added to sense heat in the furnace and keep the blower on until "left-over" heat is exhausted. Material cost of these modifications is under $40, and wiring is simple.

Low temperature setting: When nobody's home you may need your furnace only to prevent your home from reaching freezing temperature (so that water pipes, fixtures, and bottles won't freeze). Most heating thermostats stop at 50 degrees F, but a lot of fuel may be saved if the temperature can be lowered to 40 degrees or less. Electric power is saved too, since the furnace blower will run much less. I suggest replacing common thermostats with a Line Voltage Thermostat listed below.

A "line voltage thermostat" is one that is designed to handle power directly from 120 VAC. A recommended one is Dayton 2E158, available from W.W. Grainger or from any electric or heating supplier. Like most other switches, it will also handle its rated amperage (22A) at 12 or 24 VDC. Its 35 to 90-degree range makes it appropriate for use with heat tapes and furnaces, and coolers and fans as well. The Dayton 2E158 allows switching power on or off with temperature rise, so it also works for switching **fans** on at high temperature for circulation of solar or wood heat.

Being your own power company has its rewards and its responsibilities. Extra attention paid in preparation for winter time will reward you with greater energy independence for years to come. If you are uncertain about working on your system, contact your dealer or a qualified electrician. Δ