How to Keep Batteries Alive for Years

Lead-acid batteries are often considered to be the "weak link" in renewable energy systems. However, today's renewable energy batteries are better than ever, and so are the controllers that regulate and protect them. Battery problems are rarely the fault of the batteries themselves! The following tips will be detailed in this guide and will help to prevent these mistakes.

1. Size a battery bank and PV array properly
2. Avoid multiple parallel strings
3. Prevent corrosion
4. Sell only high-quality batteries, selected for the job
5. Moderate the temperature
6. Use temperature compensation devices
7. Use low battery disconnect
8. Bring batteries to a full state-of-charge at least every 3 weeks
9. Knowing when your battery is 100% charged
10. Install System Monitors
11. "Just add water"
12. Install a Backup Charging System

1. Size the battery bank and PV array properly

According to Sandia National Laboratory's PV Lab, a battery bank should be sized (as a minimum) to the capacity of 5 days of load. Energy use in most home power systems increases over time, so consider sizing larger than that.

Why?
After 1 year of service, it is NOT advisable to enlarge a battery bank by adding new batteries to it, because batteries' voltage response changes with age. Stray currents flow, causing losses and failure to equalize. A PV array, if it is the primary energy source, should be sized to produce (on average) 30% more energy than the load requires. This compensates for battery losses and for less-than-average charging conditions. Luckily, a PV array can be expanded at any time.

2. Avoid Multiple Parallel Strings

The ideal battery bank is the simplest, consisting of a single series of cells that are sized for the job. Higher capacity batteries tend to have thicker plates, and therefore greater longevity. Having fewer cells will reduce the chance of randomly occurring defects, and reduces maintenance. Suppose for example, a job requires a 700 Amp-Hour bank. We can approximate that by using 3 parallel strings of golf-cart batteries (220 AH), or 2 strings of the larger L-16 style batteries (350 AH) or a single string of larger, industrial batteries.

It is not advisable to install more than three parallel battery strings. The resulting bank will tend to lose its equalization, resulting in accelerated failure of any weak cells. Weak cells will be difficult to detect because they will "steal" from the surrounding cells, and the system will suffer as a whole and will cost your customer more.

3. Prevent Corrosion

In flooded battery installations, corrosion of terminals and cables is an ugly nuisance that causes resistance and potential hazards. Once corrosion gets hold, it is hard to stop. The good news -- it is easy to prevent! Apply a non-hardening sealant to all of the metal parts of the terminals BEFORE ASSEMBLY. Completely coat the battery terminals, the wire lugs, and the nuts and bolts individually. A sealant applied after assembly will not reach all around every junction. Voids will remain, acid spatter will enter, and corrosion will begin as soon as your installation is finished.

Special compounds are sold to protect terminals, but you can get perfectly good results using common petroleum jelly (Vaseline). It will not inhibit electrical contact. Apply a thin coating with your fingers, and it won't look sloppy. If wire is exposed at a terminal lug, it should be sealed airtight, using either adhesive-lined heat-shrink tubing or submersible rubber splice tape. You can also seal an end of stranded wire by warming it gently, and dipping it in the petroleum jelly. It will liquefy and wick it into the wire. It also helps to put the batteries over a floor drain, or in a space without a floor, so that they can be rinsed with water easily. Washing the battery tops (about twice per year) will remove accumulated moisture (acid spatter) and dust. This will further reduce corrosion and will prevent stray currents from stealing energy. Batteries that we have protected by these measures show very little corrosion, even after 10 years without terminal cleaning.

4. Sell only High-Quality Batteries selected specifically for the job

Dankoff Solar Products distributes premium quality batteries of two types, flooded (wet cell) and sealed (valve regulated absorbed glass mat). Give your customer the confidence that comes from owning a premium quality battery bank that will last for many years. Rolls Batteries by Surrette represent the finest in deep-cycle flooded batteries. Their unique dual container protects them during transportation, keeps the tops clean, and adds a valuable safety factor. Concorde Batteries are sealed and maintenance free. Concorde builds batteries for aerospace and the military and recently expanded into renewable energy.

5. Moderate the Temperature

Batteries lose approximately 25% of their capacity at a temperature of 30°F (compared to a baseline of 77°F). At higher temperatures, they deteriorate faster. Thus, it is desirable to protect them from temperature extremes. If no thermally stable structure is available, consider a partially buried utility box or other earth-sheltered enclosure. Where low temperature cannot be avoided, specify a larger battery bank to make up for the loss of capacity in the winter. Avoid direct radiant heat sources that will cause some batteries to get warmer than others.

6. Use Temperature Compensation Devices

When batteries are cold, they require an increase in the charge voltage limit in order to reach full charge. When they are warm, they require a reduction in the voltage limit in order to prevent overcharge. Temperature compensation is a feature in many of our charge controllers and power centers, as well as in the back-up chargers in Trace inverters. To use this feature, order the accessory temperature probe for each charging device, and attach it to any one of the batteries.

7. Use Low Battery Disconnect

Discharging a battery to exhaustion will cause immediate, irreversible loss of capacity and life expectancy. All systems should employ low battery disconnect in the load circuits. Trace inverters have this feature in their charging circuit, and so do many of our charge controllers, power centers, pump controllers. Sandia National Laboratory's PV Lab recommends a cut-off voltage of 11.4V (under a relatively light load, relative to a 12V battery).

8. Bring Batteries to Full 'State of Charge" Every 3 Weeks

Instruct the system owner (or responsible party) to bring the batteries to a full state-of-charge (SOC) at least every 3 weeks. This reduces internal corrosion and degradation, and helps to ensure equalization, so that any weaker cells do not fall continually further behind. A full SOC may occur naturally during most of the year, but the operator should not hesitate to run a generator when necessary to bring the batteries up. This recommendation should be given to your customer in writing or posted at the power center. For more details, refer to the instructions for the inverter/charger and for the batteries

9. Knowing When Your Battery is 100% Charged

The "charged" indicator on most PV charge controllers means only that battery voltage is relatively high. The SOC may be approaching full but is not necessarily near 100%. A voltmeter reading gets you closer, but it is not a certain indicator. It varies too much with current flow, temperature, and time, to give a clear indication.

For flooded batteries, a hydrometer is the definitive indicating device, although not a convenient one. With it, you can measure every cell individually. You should have one in your field kit for system checks and troubleshooting. Obtain one from a battery or automotive supplier. Even the cheapest hydrometer is fine. Rinse it after use and keep it clean. An amp-hour meter is the most informative and user-friendly way to monitor SOC. For sealed batteries, it is the ONLY definitive method. *See next paragraph.*

10. Install System Monitors

Would you sell your customer a car with no dashboard? Metering is not just "bells and whistles". It is necessary to help both you and your customer to read the status of the system. Our new Pulse Energy controllers have a good range of indicator lights and readouts, built in. For a more critical system or for a remote home, we recommend the addition of a digital monitor. It monitors voltage and current, records amp-hours, and accurately displays the state-of-charge of the battery bank. Any system user can understand its display of "Battery Level %". It will also show amps +/-, volts, historical highs and lows, days since full charge, and more. It may be mounted in another room or building for handy viewing. In addition, it will turn a Trace inverter (if present) on or off remotely.

11. Just Add Water

Note: This applies only to "flooded batteries", not to "sealed batteries". The plates of every cell in your battery bank must be submerged at all times. Never add any fluid to a battery except distilled water, deionized water, or very clean rainwater collected in plastic containers. Most batteries require addition of water every 6 to 12 months. There is no need to fill them more frequently than needed to submerge the plates. Fill them only to the level recommended by the manufacturer, generally about an inch below the top, otherwise they may overflow during finish-charging.

12. Install a Backup Charging System

Most full-featured inverters have a built-in backup charger. However, it won't work if it isn't connected! If your client does not own a generator, then install a cable that will reach to the designated generator location. If they obtain a generator, all they need to do is plug the cable into the generator's outlet.

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