SunWize
Power & Battery

PV System Design and Loss of Load Probability (LOLP)

How does LOLP affect system reliability?

Photovoltaic (PV) systems power a wide variety of loads, including many that represent critical applications where reliable power is paramount. Examples include security equipment, monitoring of critical assets and vital telecommunication links. Since PV is typically the sole source of power at these sites, the PV system design engineer is faced with the important challenge of designing the PV system for continuous, reliable power under all anticipated environmental conditions.

There are two primary areas of focus for a PV system designer: high reliability component selection (high mean-time-between-failure [MTBF]) and high annual system availability (also known as low loss-of-load-probability [LOLP]). For this discussion let us assume that the highest quality components have been selected. That leaves the trickier challenge of high annual availability, or low LOLP.

Some years ago an MIT professor developed a series of statistical algorithms modeled on thousands of observed weather patterns. These algorithms utilize available data on monthly solar radiation levels at a given site to model the likely weather patterns at that site. A PV array's performance is dependent on the weather, specifically on the daily levels of available solar radiation. When the algorithms are introduced to a load requirement, which is powered by a PV array and a battery bank, the result is a statistical prediction of the PV system's monthly performance.

This probability program considers the solar radiation levels and the size of the load, the PV array and the battery bank, and predicts the likelihood that the load will be "lost" in a given month (loss of load probability). The load is defined as lost if the battery drops

below the 20% state-of-charge point. At this point the system controller will intentionally disconnect the load from the battery, thereby avoiding a severe discharge that could damage the battery's positive and negative plates.

The program looks at 12 months worth of LOLP data and sums up the data for an annual total. The inverse of that total is called the annual availability of the system. The design engineer must put this program to work to produce monthly LOLP levels and an annual availability that are consistent with the requirements of the application. Typical levels of monthly LOLP are 0.01% or less, with annual availabilities of 99.97%. In more common terms, this equates to a potential loss of load 3 times in 27.4 years.

If this level of annual availability turns out to be insufficient, the designer has the option of increasing the PV array and/or the battery size. Either or both of those actions will decrease the LOLP for every month, which in turn will increase the annual availability.

Referring to figure 1 you can see how increasing the battery size from B1 to B2 moves you from an LOLP of 0.006% to 0.003%. You can also achieve better results by keeping the battery as is, but increasing the PV array, or by increasing both.

When used properly, the above program becomes an important tool for the design engineer to insure the proper level of PV system availability. The program allows the engineer to vary either the PV array or battery bank size (or both) until the proper monthly LOLP levels are produced. When combined with the reliability that comes from the selection of top-quality components, the result is a PV system engineered to provide many years of faithful service to a critical load.

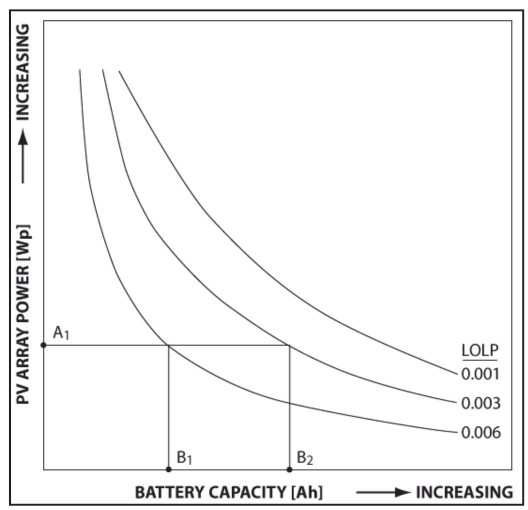

Figure 1

Corporate Headquarters
1337 Main Street, P.O. Box 895, Philomath, OR 97370
1.800.827.6527 | power@sunwize.com | www.sunwizepower.com