Doing the Best We Can

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Decisions, decisions, decisions—every day, we make decisions. The decisions each of us makes affect our lives and the lives of others.

Some of us wear helmets when we ride bicycles and motorcycles, and some don't. Many of us choose not to eat meat, while others enjoy a good steak. Some people have life insurance, and others don't. Most wear seat belts in cars, but many do not. Many of us exceed the speed limit, while others adhere to it. Some drive while intoxicated.

The decisions that we make on a daily basis may or may not have consequences—either immediately or at some time in the future. No one can force us to make a particular decision, but we are responsible for the consequences of those decisions. We may be held accountable for them. The same applies to decisions we make when designing, installing, and maintaining a renewable energy system.

In designing and installing a PV system, the longevity of the PV module must be kept in mind. Few engine-driven generators will last more than a few years under continuous use. But PV modules that are being installed today will be producing energy for the next 30 years or more. The first PV cells made in the 1950s are still working, and there is good evidence that the PV module purchased today will still be an energy source in 2050.

With PV systems lasting 30 plus years and generating voltages from about 20 volts to nearly 600 volts, there are consequences of not designing and installing them as well as we can. In residential PV systems, we have to deal with circuits containing high currents at low voltages and high voltages at low currents. On systems above 10 KW, we are dealing with both high voltages and high currents. If these voltages and currents are loosed upon the unsuspecting, they have the very real ability to damage property and harm people, as has been reported in *Home Power* and elsewhere.

Numerous decisions need to be made in designing and installing a PV system. In areas where codes are in effect, the decisions may be spelled out by those requirements. Again, no one is forced to act on those requirements, even when they are the law. Whether in code areas, or in areas where there are no codes, the decisions you make will affect the safety, reliability, durability, and performance of the PV system.

When an individual installs a PV system on his or her own home, the consequences of any decisions might be limited to the home and immediate family members. On the other hand, negative consequences of such an installation where shortcuts have been taken may not be very limited—remember Mrs. O'Leary's cow? (It reportedly kicked over an oil lamp in a barn on October 8, 1871, and the resulting fire burned down a good portion of Chicago.)

When an installation is made for others, the consequences of all decisions may be far reaching. While many *Home Power* readers are technically competent, we cannot assume the same about all "green-minded" people who might buy PV systems.

Doing It Right

For those willing to look and study, the information required to install a safe, reliable, and durable PV system is available. If you are reading *Home Power,* you have the basic sources that you need to get this information.

All previous *Code Corner* columns are available on the Southwest Technology Development Institute (SWTDI) Web site. The *PV Power Systems and the National Electrical Code: Suggested Practices* manual in PDF format is also there. Hard copies are available from Sandia National Labs.

The Sandia Web site also has numerous PV design, installation, and maintenance documents available at no cost. Both the SWTDI and Sandia sites have links to other Web sites with substantial amounts of good information, including U.S. Department of Energy sites. The PV module and equipment manufacturers advertising in *Home Power* have brochures and manuals available for the asking. All of the above materials are free.

The *National Electrical Code (NEC)* and the *NEC Handbook* are available from the National Fire Protection Association and many local electrical supply houses. A Web search will uncover numerous electrical equipment manufacturers that will be glad to provide information on their products. And, if you are unsure about your ability to absorb all of this PV design and installation information, you might want to rely on one of

the experienced PV designers or installers who advertises in *Home Power.*

The *National Electrical Code*

The *NEC* is not legislated into law throughout the entire country. Even in areas where it is in effect, there may be no electrical inspections. However, the *NEC* does present a good set of guidelines for electrical installations, including PV installations.

The code is updated regularly. The requirements that it specifies are, for the most part, based on good common sense and hard facts—hard facts that have been demonstrated by previous property damage or loss of life. Considering the longevity of PV modules as electrical generators, some people consider the *NEC* requirements to be a minimum set of installation guidelines.

You can choose to use listed (tested to the appropriate UL Standard) or unlisted electrical equipment. The *NEC* requires the use of listed equipment that has been examined for safety by an independent, nationally recognized laboratory. The use of listed equipment helps to ensure that the equipment can be installed according to the requirements established by the *NEC.* It also means that the equipment will be compatible with other listed equipment in the system.

Other Decisions

While the *NEC* may assist you in the design and installation of a PV system, many other requirements bear on the design and installation. Building codes may affect both the electrical and mechanical design. Fire codes may impact the location of components.

In nearly every instance where a decision is required in a PV system, there are codes to guide you with additional information to support your decisions. Making the right decisions may not result in the lowest cost system. But it may result in a safer system, a more durable system, a more reliable system, and a system that could yield increased performance over many years.

If you are installing a utility-interactive PV system (grid-connected), any failures in the design or installation (intentional or unintentional) may have far reaching consequences. For example, an improper connection to your household wiring may result in the failure of GFCI devices (ground-fault circuit interrupters). Such failures might not allow these devices to function to prevent electrical shock and death. Following both the code requirements (proper point and method of connection) and using listed equipment will help ensure that unfortunate consequences do not arise when installing a utility-interactive PV system.

The Choice Is Yours

As in all areas of life, you must make decisions when designing and installing a PV system. The consequences of those decisions can be either positive or negative. Only you, the system designer and installer, can make those decisions, and only you may be held accountable for those consequences—both positive and negative. The choice is yours. Study and follow the best guidance available to achieve a safe, reliable PV system. Or don't, and be prepared to accept the consequences if tomorrow or 30 years from now, things don't work out as planned.

An Update

Does the main PV disconnect have to be grouped with the main utility disconnect on a utility-interactive (UI) or combined battery/UI system? Some inspectors, after reviewing *NEC* sections 690.14, 230.2, and 230.70 in the 2002 code, may allow the PV disconnect to be mounted in a location that is not near the main utility disconnect. Of course, appropriate placards must be installed indicating the presence and location of both disconnects. Other inspectors have voiced the opinion that for fire and personnel safety, the two disconnects must be grouped together.

Questions or Comments? If you have questions about the *NEC,* or the implementation of PV systems that follow the requirements of the *NEC,* feel free to call, fax, e-mail, or write me. Sandia National Laboratories sponsors my activities in this area as a support function to the PV industry. This work was supported by the United States Department of Energy under Contract DE-FC04-00AL66794. Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy.

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The 2002 *NEC* and the *NEC Handbook* are available from the National Fire Protection Association (NFPA), 11 Tracy Drive, Avon, MA 02322 • 800-344-3555 or 508-895-8300 • Fax: 800-593-6372 or 508-895-8301
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