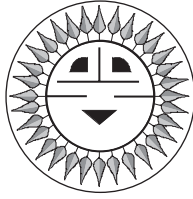


# Perspectives on the National Electrical Code®



John Wiles

Sponsored by the Photovoltaic Systems Assistance Center,  
Sandia National Laboratories

**T**he *National Electrical Code* (*NEC*®), updated and published every three years by the National Fire Protection Association (NFPA), is the most current and comprehensive electrical safety installation requirements document in the world. The 1999 *NEC* has just been published and work is already underway on the 2002 edition.

Hundreds of volunteers work on a three year cycle to review and update the *NEC* with the latest technology and methods of connecting electrical power systems. Representatives from the photovoltaic (PV) industry, academic institutions, the inspector community, Underwriters Laboratories, Inc. (UL), and the electrical utility industry meet regularly to modify and update Article 690 of the *NEC* which deals with PV systems. Although Article 690 covers only nine pages, most of the remaining 644 pages of the code also deal with aspects of PV installations.

The *NEC* has been made into law by over 40 states and by most major cities in the United States. It has been published for over 100 years. It represents the best ideas that have evolved in over a century of electrical power systems theory, design, and installation practice. There is always room for improvement and the document continues to evolve.

Paperback copies of the *NEC* are available for \$30-45 at most electrical equipment distributors. The *NEC* and the hardbound *NEC Handbook* are available from NFPA (see Access). The *NEC Handbook* provides significant amounts of explanatory detail and numerous pictures and diagrams.

## Safety Requirements

The *NEC* began as a fire safety code, but now includes personnel safety. The *NEC* requires that all equipment be examined for safety. While the local electrical inspector or authority having jurisdiction (AHJ) will

inspect the field-installed wiring, the AHJ relies on the listing or labeling mark of an acceptable testing laboratory like UL or ETL to provide an indication that all equipment, conductors, and devices have been examined for safety.

The listing mark ensures that the equipment has been tested to meet a number of appropriate safety standards relating to electrical shock and fire hazards. Many inspectors will only inspect or approve systems that have been assembled with listed components. Insurance and mortgage companies may require electrical inspections, particularly on new construction or on additions to existing policies.

The inspector will be looking for the good workmanship required by the *NEC*. PV installations that resemble other electrical power installations will be more readily accepted than those installations that have unconventional installation practices or equipment that does not resemble normal electrical supply equipment.

All listed equipment comes with labels and/or instructions that define the requirements (developed in conjunction with the requirements of the *NEC*) for installation and use of that equipment. Violations of these instructions or requirements may result in unsafe systems and equipment damage. The inspector, in many cases, will verify that these instructions have been followed.

Almost all of the material that is printed on labels attached to electrical equipment has been placed there to meet a safety requirement—either established by the *NEC* or by the listing laboratory. Much of the material found in equipment instruction and installation pamphlets and manuals is also mandated by safety requirements.

## Safety vs Performance

*NEC* requirements for PV installations and the requirements found on labels and in instructions for listed equipment, when followed, will generally result in a safe installation. While using equipment listed to UL Standards and installing that equipment to *NEC* requirements does not guarantee high levels of performance, higher performance and reliability frequently are achieved.

The required manner of sizing components, covered in past Code Corners, and the quality of listed equipment will generally result in PV systems that have higher levels of performance and reliability than systems that do not meet *NEC* requirements. Of course, it is possible to install a code compliant system using listed equipment in a poorly designed system or with misadjusted equipment, and then performance and reliability may suffer.

### The 2002 Code Cycle

Although the 1999 *National Electrical Code* has just hit the streets, complete and well-substantiated proposals for changes to the 2002 *NEC* are due to the National Fire Protection Association (NFPA) no later than 5 PM EST on Friday, November 5, 1999. This gives those individuals wishing to change the new 1999 *NEC* less than a year to write and submit proposed changes with the required substantiations. The correct form for submittal to the NFPA can be found in the back of the 1999 *NEC*. Electronic submissions may also be made. Contact NFPA for details.

Ward Bower at Sandia National Laboratories and a team of people from the PV industry will be meeting several times throughout the year to write and substantiate proposals for the 2002 Code. Contact Ward directly if you wish to participate in these meetings. You can also send your ideas to me for entry into the system if you provide, or we can develop, the necessary substantiation. For now, we have the following items under consideration:

- Figure 690-1: Label the Energy Storage
- Section 690-5: Rewording for clarity
- Section 690-6: Developing ground fault equipment requirements for AC PV modules
- Section 690-7: Consider expanding for some thin film devices
- Section 690-8(b): Possible exception for current-limited devices
- Section 690-31(b): Modifying for clarity and technical correctness
- Section 690-45: Rewording or deleting
- Section 690-54: Reword for consistency
- Section H: Adding prohibition on flooded, steel cased batteries in systems operating over 50 volts

What are your ideas? Where have you had trouble with the code or with language not clear to electrical inspectors? What can be added or changed to make your job easier?

Please keep in mind that the *NEC* is a consensus document. If you participate with an input directly to NFPA, you will get a copy of all of the 2002 *NEC* proposals. You will also have a chance to comment on any of them and will get a copy of all of the comments on all of the proposals for the 2002 *NEC*. The proposal and comments documents weigh about eight pounds each and they include the deliberation, comments, and actions taken by each of the code making panels.

Also remember that the *NEC* is not a design document. To quote a senior code making official, "The *NEC* will not contain anything that will keep stupid people from making stupid mistakes."

Jump in—the code-making water is fine!

### Access

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