The 1993 National Electrical Code and The Inspector

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The 1993 National Electrical Code® has been published and is now available from the National Fire Protection Association (see access), local electrical supply houses, and some bookstores. There have been some changes to Article 690, which discusses photovoltaic systems. They will be discussed below and a large number of changes in other sections of the code too numerous to discuss. As always, working with the local inspector requires a degree of creativity, some patience, and hard work. Tried-and-true methods of working with the inspectors are outlined below.

The 1993 Code

Section 690-4 now requires that inverters used in photovoltaic (PV) systems be identified for such use. This means that when the inverter goes through the testing and listing process by a Nationally Recognized Testing Laboratory, like Underwriters Laboratories, the process must use procedures that relate the product use to PV systems. The PV industry now has three manufacturers selling listed products (Heart, Trace, and Dimensions Unlimited), but not all are identified for use in PV systems.

Section 690-8 was modified slightly to ensure that short-circuit currents are used to calculate conductor sizes and overcurrent device ratings when PV circuits are involved. This section also has an addition (paragraph c) to alert those who are tapping a 24 Volt battery at 12 Volts that the common return conductor (usually negative) must be sized to handle the total current flowing in both of the positive conductors.

The grounding and disconnect requirements have been clarified in Section 690-13. Ungrounded current carrying conductors to the PV array must have switched disconnects or circuit breakers. Grounded conductors shall not have switched disconnects and should only use bolted disconnects. A bolted disconnect is where two conductors are spliced or connected together with a compression connector, wire terminals and bolts, terminal strip or other device which allows the conductors to be easily disconnected by a qualified person.

Section 690-31 now allows USE (Underground Service Entrance) and SE (Service Entrance) single-conductor cables to be used for module interconnect wiring in addition to the previously allowed UF (Underground Feeder) cable. Note that UF cable is falling into disfavor. Reports are surfacing which indicate that PVC insulation softens when UF single conductor cable carrying direct currents is used in moist environments.

Working with the Inspector

In areas where either the NEC or a local electrical code is in effect, the electrical inspector plays a key role in ensuring that any electrical power system is safely installed. Early involvement of the inspector will benefit all concerned for a number of reasons.

While the local inspector may not be familiar with direct current or PV electrical power systems, he or she is very closely acquainted with the code and the interpretation of the codes in that location. The inspector is also familiar with the electricians and electrical contractors in the region and whether or not they are up to an installation using a relatively new technology.

A team composed of a PV dealer/installer and a local electrician has the best chance of getting a PV system installed in a safe manner that will pass inspection. Most electricians know how to obtain the proper permits, where to get the proper equipment, how to do power wiring that meets the code, and how to work with the inspector. The PV dealer/installer brings the knowledge of PV design and equipment to the team. Both of these parties working together with the inspector can synergistically achieve a safe, durable, high performance PV system.

Because of the scarcity of PV systems and residential DC power systems, the PV dealer/installer frequently has to educate the inspector in these areas. This usually requires that the PV expert meet the inspector early in the process to discuss the basics of PV systems and to solicit any advice that the inspector might have. Having a written description of the system that can be left with the inspector is usually a good idea.

The system write-up should start with a very basic description of PV systems. A one line diagram of the system should be presented and a more detailed full system schematic included in an appendix. Literature on all of the equipment that is to be used should also appear in an appendix and that literature should show the UL listing information where possible. The main body of the system description should address how the system will meet the code requirements in each major area. These areas include grounding (both system and equipment), disconnects, overcurrent protection, and wiring methods. Ways of meeting the intent of the code with unlisted equipment should also be discussed. The more detail that can be provided to the inspector, the more educational information he or she will have, and the more likely the installation and inspection process will go smoothly.

Rough-in inspections are frequently required when the wiring is installed in the walls or conduit, but the outlets, switches, and breakers as well as other equipment is not installed and no power is connected to the system. In a PV system, the modules would be installed, and the batteries, charge controller, and inverter would be in place. The wiring and cabling would be installed, but should not be connected.

If the PV system is being used to provide temporary power for construction, then the temporary installation must also meet all of the NEC requirements. If the inspector sees a messy, jury-rigged temporary PV system, he or she is liable to walk away and not come back! The NEC requires workman-like installations of all power systems — even a temporary one. The inspector is used to seeing contractors using a temporary power pole in a safe manner. Jumbled batteries, loose cables, no fuses or disconnects, and unmounted modules will not only turn the inspector off, but are very unsafe.

The safest, most efficient, and most durable PV systems are the result of a team effort between the user, the PV dealer/installer, an electrician, and the electrical inspector.

For those who would like a detailed example, a 120-page PV system description prepared by the author describing his own home system is available for $28.00 from the Southwest Technology Development Institute.

Access

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