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CERTIFICATION OF SOLAR PRODUCTS - THE FLORIDA EXPERIENCE

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ABSTRACT

Florida legislation enacted in 1976 directed the Florida Solar Energy Center (FSEC) to develop standards for solar energy systems manufactured or sold in the state, establish criteria for testing the performance of solar energy systems, and provide a means to display compliance with approved performance tests for these systems. This mandate has been effectively implemented for both solar domestic water heating and solar pool heating systems. With growing interest and markets for photovoltaic systems, plans are presently being developed to expand the scope of the mandate to include photovoltaic technology.

This paper discusses four complementary facets of a photovoltaic (PV) system certification program. They include PV module performance characterization and rating; PV system design review and approval; examination and authorization of photovoltaic system installers; and inspection and acceptance testing of PV system installation. The suggested photovoltaic system process builds on lessons learned from over 20 years of testing, certifying and labeling of solar thermal collectors, and the certification of solar thermal systems.

INTRODUCTION

Market expansion for the solar industry is closely tied to solar products that meet customer expectations. The question of how best to assure solar customers that the products they're buying are satisfactory and do in fact represent a high level of quality and workmanship has yet to be fully resolved (Ref. 1). Some have argued that extended warranties and long-term service maintenance contracts are the preferred approach to meeting customer expectations. This approach puts the burden of quality control and performance on the system supplier. Past experience, however, indicates that this approach for solar thermal products is undermined by high industry turnover. Performance certification is yet another approach to overcome the customer familiarization gap. Arguably, complete system design and installation certification, endorsed by the solar industry as well as the buyer community, would avoid issues associated with performance ratings, installation procedures, safety concerns, and the like. Testing of solar components and perhaps systems to consensus standards and procedures is an integral part of this proposed certification process. As the market for all solar products continues to grow, customers as well as industry and government representatives will be pressed for a solution to this question.

A state-mandated solar collector certification program in Florida, unique in the US, offers a glimpse into the content, operation, and impact of a full-scale product certification activity. The program has been in place for the past 23 years, certifying minimum standards for every piece of solar domestic hot water and pool heating equipment manufactured or sold in Florida. With estimated annual sales of 1000 to 2000 solar water heaters and an additional 9000 to 10,000 pool heaters representing a $40,000,000 annual market, Florida's certification program is an active component of the solar marketplace.

The purpose of this paper is to examine certification paths for PV in the context of the Florida experience with domestic hot water and pool heating systems. Although PV is covered by the Florida state mandate, the market to date hasn't warranted a dedicated certification process. Efforts within the Florida PV Buildings Program identify elements of a full-scale certification process for PV that closely parallels the solar thermal certification already in place. These efforts are the focus of this paper.

BACKGROUND

Concerned with the oil supply crises of the early 1970s and continued increases in energy consumption, the Florida Legislature enacted the Solar Energy Standards Act of 1976 (Section 377.705 of the Florida Statutes) to encourage the development of alternative energy capability, specifically solar energy. This legislation directed the Florida Solar Energy Center (FSEC) to develop standards for solar energy systems manufactured or sold in the state, establish criteria for testing the performance of solar energy systems, and provide a means to display compliance with approved performance tests for these systems. The FSEC reaction to this mandate was to establish standards and testing procedures whereby solar collectors, specifically for domestic hot water and pool heating, could be examined for compliance to minimum standards, tested and rated for performance, and labeled for approved certification by FSEC. In 1978, the Solar Energy Standards Act was amended to require that all solar energy systems be certified to FSEC standards after January 1, 1980.

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DISCLAIMER

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SOLAR THERMAL COLLECTOR CERTIFICATION

The collector certification program (Ref. 1) includes a test sequence that exposes one collector (See Fig. 1), randomly selected by FSEC and supplied by the manufacturer, to the following tests:

1. Receiving inspection
2. Static pressure test
3. Thirty-day exposure test
   a) Thermal shock/water spray tests
   b) Thermal shock/cold fill tests
4. Repeat static pressure test
5. Collector time constant determination test
6. Post-exposure thermal performance
7. Incident angle modifier test
8. Disassembly and final inspection

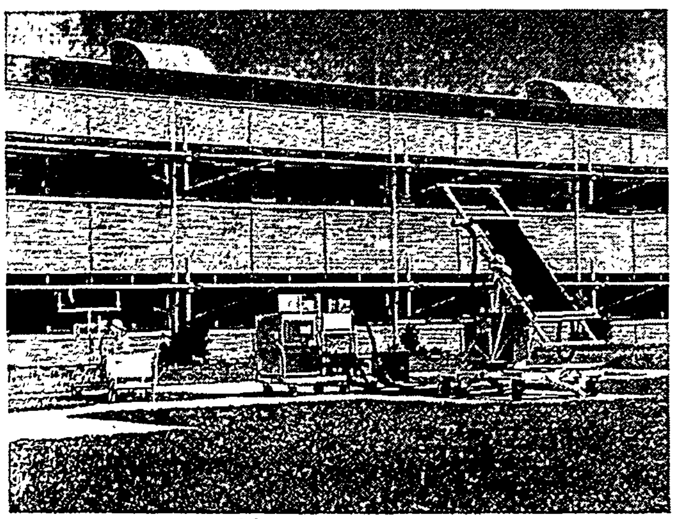

Figure 1. Solar thermal collector under test at FSEC.

The minimum standards, test methods, and criteria used for evaluating collector durability and thermal performance are prescribed by FSEC (Ref. 3). The thermal performance testing is adopted from consensus American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) standards (Refs. 4, 5). In addition to the test sequence, glazed collectors must also satisfy a structural integrity requirement that can be satisfied with either a written statement signed and sealed by a professional engineer or load testing results from an independent testing laboratory. The submitter stipulates the minimum wind loading that the collector can withstand without damage. Upon successful completion of the required tests, every collector of the type tested must be labeled with a sticker certifying compliance with minimum FSEC standards and a thermal rating based on a prescribed test. The FSEC certification fee to the manufacturer for collector compliance with the minimum standards is $1800. Based on FSEC experience, the time required for the full testing process on one collector is typically six months.

SOLAR THERMAL SYSTEM CERTIFICATION

SPACE

The system certification process is conducted through a design review whereby the system is judged for conformance to code requirements for materials and use of components as well as minimum standards of performance. In this case, performance is computed using hourly weather data and standard assumptions. System testing is not involved in this process. The review follows standard practices for design and installation of solar thermal systems developed by FSEC (Ref. 6, 7). These standards include criteria for system design, plumbing, control, fluid quality and safety, system rating, durability, operation and servicing, and installation. Upon successful completion of the system certification review, FSEC issues an approval certificate which should be made available by the seller to prospective buyers and building officials. The fee for system certification is a very nominal $50 per system. It should be noted that compliance with many requirements of systems standards can only be verified by on-site inspection after system installation. This is the responsibility of local building officials. Most building departments require that a permit be issued for the installation of a solar water heating or pool heating system. The building inspector is tasked to verify compliance with not only FSEC system certification (they just look for the label) but also other aspects of the installation covered by local code requirements.

STATUS

The solar certification program has widespread support throughout the Florida solar community. The Florida Solar Energy Industries Association (FlaSEIA) has endorsed the process and has benefited from the increased customer acceptance of solar thermal systems (Ref. 8). Through July 1998, 116 domestic hot water heater collectors (Ref. 9) and 80 pool heater collectors (Ref. 10) have active FSEC certification. Additionally, 245 hot water systems and 35 pool heating systems are currently certified (Ref. 11).

The Solar Energy Standards Act of 1976 established that FSEC should maintain the necessary capability for testing and evaluating the performance of solar energy systems and that FSEC is entitled to charge a testing fee as part of the certification process. It is estimated that the annual cost to the state of Florida to maintain and operate the certification activity is approximately $200,000. The testing fees do not appear to displace much of this annual cost.

IMPLICATIONS FOR PV CERTIFICATION

The Florida PV Buildings Program (Ref. 11) has developed processes for PV module ratings, installer training and system design reviews for grid-tied systems that could serve as a model for a full-scale PV certification activity. These processes are very similar to the collector certification and system approval review in place for solar thermal systems. One notable addition is the provision for installer authorization. An authorized installer must install all PV systems that are installed through the Florida PV Buildings Program. Authorization is gained by successfully passing an examination administered by FSEC.

Although most PV modules currently used in systems across the U.S. have been tested for compliance with safety and durability standards developed by IEEE, Underwriters Laboratory and others, module performance ratings are much more problematic. The PV Buildings Program provides for the performance characterization of a sample of four PV modules to develop an accurate performance rating for that module. The testing (see Figs. 2-4) is conducted by FSEC via consensus test procedures. The program does not currently certify the performance rating for PV modules.

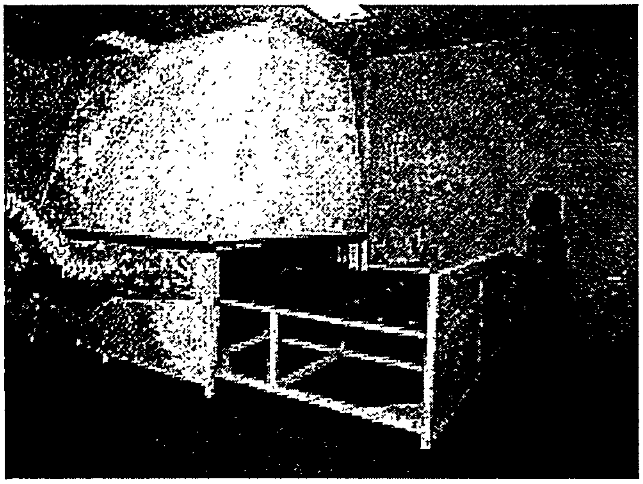

Figure 2. Spire SPI-SUN 660 flash simulator used for indoor testing at FSEC.

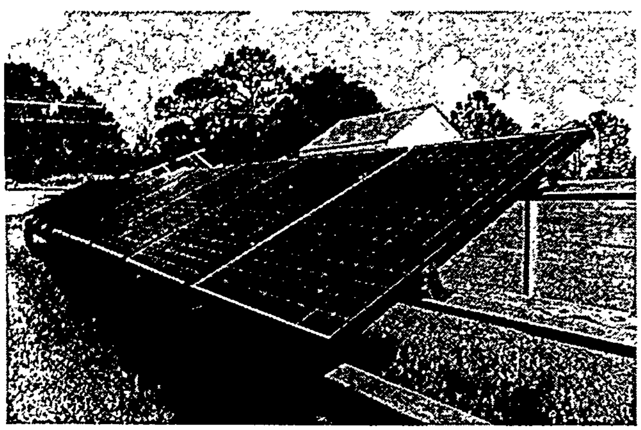

Figure 3. Outdoor testing of PV modules at FSEC's field test site.

The PV system design review and approval process is a rigorous activity to verify that the PV system meets all applicable codes and standards and uses accepted design practices. No testing is involved. The PV design review is very similar in content and application to the system certification process already in place for solar thermal systems, although no approval certificate is currently issued for the PV system.

A PV certification activity, while similar in content to that for solar thermal collectors and systems, may differ substantially in the area of inspection compliance. Experience with the Florida certification program for solar thermal installations indicates that some owners do apply for a building permit triggering an inspection by a local building official to verify compliance. However, this same experience says that most owners do not file for permits and no inspection ever takes place. Grid-tied PV systems (see Fig. 5) must be interconnected to the local utility service. Interconnection requirements for safety and performance are rigorously enforced by the utility. Because of this visibility, it is expected that all inter-tied PV systems will be inspected for compliance with state certification and local building codes. In fact, the Florida PV Buildings Program requires acceptance testing of the installed system using FSEC-approved procedures. Acceptance testing is performed to: a) ensure that the installed system meets design specifications; b) ensure that the system and components are operating properly; c) compare output with predictions; and d) check the installation for code compliance. This testing is aimed at providing early assistance to both code officials and utility personnel in ensuring code-compliant installations. In no way is it intended to usurp code official jurisdiction.

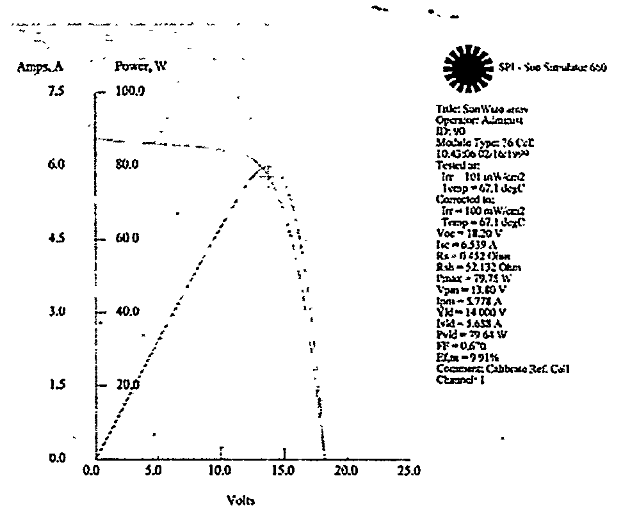

Figure 4. IV curve from Spire simulator.

Figure 5. A super-energy efficient, utility-interactive photovoltaic residence in Lakeland, Florida.

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