

Thrust Area 4: Solar (Thermal)

Enhanced and Expanded Solar Thermal Test Capabilities

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Description: FSEC believes that independent, third-party testing and certification has extensive value in the marketplace, especially for products that are not widely “proven” with consumers such as solar water heating systems and solar electrical (photovoltaic) systems. In addition, due to the resurgence of the solar industry, FSEC has received a significant increase in demand for solar collector and solar system testing and certification. This occurrence has resulted in requiring the Center to correspondingly amplify its capabilities to respond to the increased demand. This project has the objective of increasing FSEC’s solar thermal testing and certification activities by the following actions: test and analysis equipment and software upgrades and expansion, integration of the solar collector and system laboratories, enhancing documentation and reporting methods and streamlining and devising more comprehensive client test and certification application documents. Additional test facilities have come on-line internationally in the last two years and the increased testing capacity resulting from the additional tests labs has reduced the industry demand for FSEC’s thermal test services. FSEC however, remains the only test facility in the U.S. capable of testing certain types of solar thermal energy equipment and the current testing demand at FSEC still significantly exceeds the demand prior to 2008.

Budget: \$809,295

Universities: UCF/FSE

External Collaborators: US Department of Energy, SRCC

Progress Summary

The enhanced and expanded solar thermal test capabilities have shown significant progress. The following is summary of the key aspects of the project.

Measurable Results:

<u>Year</u>	<u>Test Rate</u>	<u>Report Rate</u>	<u>Certification Rate</u>
2008 (before project)	4 collectors/year	4 reports/year	4 per year
2009	14 collectors/year*	22 reports/year*	-
2010	27 collectors/year*	20 reports/year*	195 per year †
2011	15 collectors/year ^a	12 collectors/year ^a	180

* These rates include the interim test and report category which allows collectors to get to market prior to performance testing while still protecting the consumer from poor quality product.

† The certification rate was actually the number of certification for FY2010. Thus the absence of data in year 2009. The rate is expected to increase as the information control system is implemented.

^a About 15 test facilities have come on-line in the last two years. The increased capacity has significantly reduced the industry demand for FSEC’s thermal test services.

Key Elements: Following is a brief project summary of achievements and activities for 2011 with an indicator of % complete.

1. Information Control System – 70%
 - Create application for storage and retrieval of test data in a database. The Test Application Data Analysis (Ta Da) system provides a more efficient method for data review and generation of summary data related to the tests.
 - Provide an information control system that allows customer and user access to determine material status and report on material testing with the ultimate goal of automatically generating the test reports and certifications.
2. MTP Unit 2 – capacity increase – 100 %
 - Update test platform with all the improvements to date with respect to sensors, automation, and wind systems.
 - Modify test platform to add capability to test both glazed and unglazed collectors with only minor adjustments needed based on collector type.
3. Systems Test Lab – 90%
 - A new test facility used to test thermal system components and thermal collectors with integral storage (i.e. thermo-siphon systems) was completed at FSEC. The previous facility was decommissioned and removed providing lab space for other research.
 - Final system validation and start-up procedures are currently underway.
 - The new facility will allow FSEC to be one of only 2 labs in the country capable of performing tests on certain types of solar thermal systems and components, and FSEC will be the only lab capable of conducting a few specific tests related to solar thermal systems.
4. Fixed Stand Configuration - 0%
 - Project cancelled. 15 test facilities have come on-line internationally in the last year. The increased capacity has significantly reduced the industry demand for FSEC's thermal test services.

2011 Annual Report

Project Impact:

The Florida Solar Energy Center (FSEC) believes that independent, third-party testing and certification has extensive value in the marketplace, especially for products that are not widely “proven” with consumers such as solar water heating systems and solar electrical (photovoltaic) systems. Independent, third-party certification provides not only protection for consumers, but also much needed consumer confidence. Even more important, third-party certification provides protection to reputable manufacturers, ensuring that lower quality products, often from foreign markets, do not compete head-to-head with Florida and U.S. products unless they meet the same standards.

In addition, to be eligible for the 2005 EPAct federal tax credits for solar thermal systems, the consumer must purchase a solar thermal system certified by the Solar Rating and Certification Corporation (SRCC) or FSEC. Since this federal tax credit has been extended through 2016, solar thermal testing and certification will continue to be required. While SRCC or FSEC may accept test results from other testing laboratories for certification, it has only been since July 2009 that other accredited test facilities have been available. Prior to 2010 FSEC was the only accredited thermal test facility in the US. Additional tests labs have significantly reduced the industry demand for FSEC's thermal test services. FSEC however, remains the only test facility in the U.S. capable of testing

certain types of solar thermal energy equipment and the current testing demand at FSEC still significantly exceeds the demand prior to 2005.

Solar thermal systems for residential domestic water heating are subject to much variability in quality and performance. An important function of FSEC is consumer protection from poorly designed and manufactured thermal collectors and systems. For many years, the solar water heating industry has experienced very slow and steady growth. FSEC's test capabilities were quite adequate to test and certify the 3-5 new collectors introduced each year. However, in 2005, the demand for testing jumped dramatically, and is now projected at 20-40 new collectors annually, at least for the next 5 years. This increase is driven both by the recent "boom" in green energy awareness and the globalization of the solar industry, resulting in many requests from overseas manufacturers wanting to enter the US market. This project will allow FSEC to meet the new demand for testing and certification of solar thermal collectors and systems.

Project Description:

This project has the objective of increasing FSEC's solar thermal testing and certification activities by the following actions:

- Implement the Interim Certification category to speed product to market
- Upgrade and Expand the Test and Analysis Equipment and Software
- Implement an information control system which encompasses on-line application and payment all the way through to the test report and the certification.

Interim Certification

The interim certification category was introduced in June 2009 to allow quality products to market quickly. Collectors are exposed to outdoor conditions as required by the standard to determine general quality. If they pass these tests they are allowed to market for a limited time until the performance testing is completed. The addition of additional test labs worldwide has resulted in essentially no backlog for collector testing at FSEC in 2011. As a result, very few manufactures of solar energy equipment requiring testing are opting for interim certification. The interim certification program served the purpose it was designed to serve, and will be maintained as an option for FSEC certification.

Testing Instrumentation

Over the years, the instrumentation used in testing solar thermal collectors at FSEC has aged to the extent that an unacceptable level of failures occur that causes negative impacts in the time period required to complete a performance test. For example, problems with sensors, connectors, computers, data cabling and the like often corrupt the test data. These events, the troubleshooting and the repair activity extend the time required to complete the test. Thus, FSEC implemented a modern instrumentation and testing system using advanced but proven hardware and software. Specifically, powerful Compact Field Point (CFP) data loggers, processors and controllers were applied in these instrumentation upgrades.

The advanced hardware and software configuration has been completed and released to production for three test stands as of the time of this writing. A fourth platform, used primarily for equipment calibrations may be updated as well, but that activity is not currently scheduled as part of this project.

The collector test software application created in LabVIEW® offers more flexibility and autonomy in running the performance tests. Features such as automatically adjusting the inlet temperature to compensate for changing air temperature and automatically deciding the orientation of the tracking platform when testing off-angle were introduced to maximize the data collection rate while minimizing user intervention. A Test Application Data Analysis (Ta Da) application was written and released which allows more flexibility and efficiency in reviewing the data and developing the tables and graphs required for the test report.

In addition to performance testing the same automation principles were applied to the temperature sensor calibrations, flow calibrations and pressure tests. These improvements have reduced the test time significantly while improving the data capture integrity.

A parallel equipment and software upgrade has been underway for thermal system component testing at FSEC. System component testing includes testing of solar thermal collector “systems” that include hot water storage in the design. Examples of these collectors include integral collector storage (ICS) and thermosiphon systems. Other components such as heat exchangers, storage tanks, and certain pumps can also be tested in the FSEC thermal system components lab. These tests are also required for equipment certification, but cannot be performed with the same equipment used for typical collector performance testing. In 2011, significant progress was made in the systems component test lab. New equipment was purchased and installed in an on-site lab building, and the old, existing component test facility was decommissioned and dismantled. The new facility is approximately 90% complete with some final assembly and testing needed prior to formal commissioning.

Information Control System

Prior to the recent high demand for thermal collector and system test and certification the document control system at FSEC was sufficient. However, changes in circumstance require a more efficient, traceable information control system. The requirements for an accredited test facility along with the increased work volume demanded a more efficient document control process. Work has been ongoing on a system that encompasses all the aspects required to be a competent provider of testing and certification services.

A system is envisioned where the customer can readily apply and pay on-line for services requested. Additionally they will be able to track the progress of their test from beginning to end. The personnel in the test facility will use it to enter data as the unit progresses through the facility. It will seamlessly communicate with the data collection and analysis software. The test report will be automatically generated and much of the certification process will be automated. Additionally the system will meet the requirements that an ISO 17025 accredited test facility must meet with respect to document control.

Work has begun on the system. The conceptual design is complete with the database design is nearly complete. A separate contract has been entered into between FSEC and the National Renewable Energy Laboratory (NREL), which leverages work already accomplished to pursue information control upgrades further.

Key Results:

The following major projects were identified to attain the project's goals. The following is a summary of key elements up to and including activities in 2011 with an indicator of % complete.

1. Interim Test and Report for Certification – 100%
 - Provide a process that allows collectors to get to market quickly while maintaining consumer protection for quality.
2. Mobile Tracking Platform (MTP) Unit 2 Wind System – 100 %
 - Provide wind source for collector testing to meet wind requirement on demand.
3. MTP Unit 1 Wind System – 100%
 - Provide wind source for collector testing to meet wind requirement on demand.
4. MTP Unit 1 Conversion to Dual Flow – 100 %
 - Provide this test platform the capability to process the predominant collector type like the other platforms.
5. LabVIEW® based Collector Testing – 100%
 - Provide updated data logging automation for improved reliability and data transfer.
6. Sensor Improvement – 100 %
 - Research and implement new sensors and applications of sensors for more reliable and precise data measurement.
7. MTP Unit 4 – capacity increase – 100%
 - Bring into production a new test platform that has all the improvements to date with respect to sensors, automation, and wind systems.
8. Information Control System – 70%
 - Create application for storage and retrieval of test data in a database. The Test Application Data Analysis (Ta Da) system provides a more efficient method for data review and generation of summary data related to the tests.
 - Provide an information control system that allows customer and user access to determine material status and report on material testing with the ultimate goal of automatically generating the test reports and certifications.
9. MTP Unit 2 – capacity increase – 100 %
 - Update test platform with all the improvements to date with respect to sensors, automation, and wind systems.
 - Modify test platform to add capability to test both glazed and unglazed collectors with only minor adjustments needed based on collector type.
10. Systems Test Lab – 90%
 - A new test facility used to test thermal system components and thermal collectors with integral storage (i.e. thermo-siphon systems) was completed at FSEC. The previous facility was decommissioned and removed providing lab space for other research.
 - Final system validation and start-up procedures are currently underway.
 - The new facility will allow FSEC to be one of only 2 labs in the country capable of performing tests on certain types of solar thermal systems and components, and FSEC will be the only lab capable of conducting a few specific tests related to solar thermal systems.
11. Fixed Stand Configuration - 0%
 - Project cancelled. 15 test facilities have come on-line internationally in the last year. The increased capacity has significantly reduced the industry demand for FSEC's thermal test services.

Deliverables:

Expanded solar thermal testing facilities for domestic hot water collectors and systems, with proven capabilities:

- Pursue with all deliberate speed another collector certification mechanism that ensures collector durability and quality, but allows time-limited provisional collector performance ratings such that new collectors and systems can enter the marketplace within three months of application.
- Increase FSEC's collector testing capacity to handle the current and potential future demand for solar thermal hot water systems. Capacity will exceed 15 full performance collector tests per year and 15 - 20 system component tests per year.
- Develop information control system to drastically improve efficiency and accuracy.

Industry Support:

This task will be strongly supported by the solar thermal manufacturers, who must have certification (FSEC within Florida, and FSEC-contracted SRCC nationwide) to effectively sell their products and qualify those products for various state and federal incentives and rebates. The Solar Rating and Certification Corporation (SRCC) has traditionally been operated from the FSEC campus and the SRCC contracted with FSEC for \$500,000 of annual work in test and certification. In July of 2011, SRCC moved into a separate independent facility, and now has only limited contracts with FSEC for database and related IT support. Further, the US Department of Energy has funded work at an annual rate of \$500,000 to FSEC and SRCC through December of 2011. However, this support is directed to labor and other operating expenses, and will not provide for the capital expansion and enhancements proposed under this task.