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Solar Water Heating Technical Support

**Technical Report for
November 1997 through April 1998
and
Final Report**

Jim Huggins

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Solar Water Heating Technical Support
Contract # DE-FC36-86SF16305 Amendment A019

Florida Solar Energy Center

Technical Progress Report and Final Report
May 1, 1997

Introduction

This progress report covers the time period November 1, 1997 through April 30, 1998, and also summarizes the project as the final report.

Activity This Reporting Period

New Applications: (Task 1)

Thirteen applications were received for OG-300 certification. Eleven of these were certified. The other two are still in process.

One application for OG-100 certification was received and it was certified.

The total number of collectors certified by SRCC is now 58 from 10 Suppliers. The total number of systems certified by SRCC is now 133 from 10 Suppliers.

Modeling and Testing: (Task 2)

We now have the system testing laboratory functional. This laboratory is capable of conducting the series of tests prescribed by SRCC for passive solar water heating systems and heat exchangers.

We refined our model for an auxiliary gas water heater for use as a standard SRCC backup tank.

We examined the correlations used in F-Chart and RSPEC for determining the heat loss from swimming pools. These correlations are suspected as being the reason we get different results from these two programs.

We worked on customized ratings for specific climates. These ratings, perhaps better called performance estimates, are desired by utility and state organizations to determine the energy savings to be expected in their specific situations. We participated in discussions regarding whether SRCC should offer these annual performance estimates in the future as a free or paid service.

We refit some of our models based on updated TRNSYS models and to correct minor errors we found. The new models were then used to rerun some of the site-specific performance estimates.

We continue to work with the California Energy Commission to refine their requirements for solar water heating systems.

We updated our list of problems we have experienced with the TRNSYS models. We have occasional conversations with the Solar Energy Laboratory at the University of Wisconsin about these problems.

We converted and upgraded the software we use for calculating OG-100 ratings.

We made a few more runs for SMUD.

Certification Issues: (Task 2)

We continued to work with the Standards Committee and the pool collector industry to rewrite paragraph 6.1 of OG-400. This paragraph deals with the sizing of solar pool heating systems.

We redesigned the certification award certificate which is given to certified products so that we can print it directly from the database.

We worked on the 1998 directory. Part of this edition will be a new summary section which will also be published as a separate booklet.

We redesigned the application packages we send to prospective Suppliers.

We assisted HECO with information to be used in their rebate program.

A Manual of Rating Practices is attached. This manual describes policy decisions, made by the SRCC Board of Directors, which augment and explain the requirements given in document OG-300.

Technical Brief: (Task 4)

We wrote several technical articles for the SRCC Newsletter. Copies of the newsletters are attached.

Design Review Team: (Task 1)

The Design Review Team reviewed one application for OG-300 certification.

Misc.:

We participated in the SRCC Board meetings on November 19, December 17, January 21, February 18, March 18, and the annual meeting on April 25, as well as the Standards Committee meetings on November 5, December 5, January 14, March 4, and April 8.

We attended SOLTECH 1997 in Orlando, Florida.

Next Reporting Period

This report ends the support FSEC has been receiving directly from the U.S. Department of Energy for this work. Future FSEC work for SRCC will be done under a contract directly from SRCC to FSEC.

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Issue No. 6

May 1997

Application Processing at SRCC

SRCC currently operates three certification programs: solar collectors, solar water heating systems, and swimming pool heating systems. This article is the first in a series to acquaint readers with the SRCC certification process. In this article, we will discuss the process by which a collector or system becomes certified. The application process involves three major activities: preparation of the application by the Supplier, review of the submittal by SRCC, and execution of agreements by both parties.

When certification is requested, an application package for the appropriate program is mailed to the requester. The application package for each program includes a descriptive overview of SRCC, a summary of the particular certification program, a step-by-step description of the application process, a set of application forms which request information about the collector or system, a fee schedule, a copy of the agreement to be entered into by SRCC and the collector or system supplier, and a copy of the appropriate SRCC documents. In addition to the specific information requested on the application form, the Supplier must submit a diagram of the collector or system, manuals describing installation, operation, and maintenance, a copy of the warranty, and copies of the required labels. For pool heating system certification, a copy of the system sizing guide is also required.

When the application forms and associated documents are submitted to SRCC, the technical staff

reviews the information and begins the specific certification process.

Collector Certification

Prior to application for collector certification, the collector manufacturer must have the collector tested at an SRCC accredited laboratory. This test is conducted on a randomly selected sample in accordance with SRCC procedures using ASHRAE Standard 93 or 96.

The test sequence includes evaluation of both the durability and the thermal performance of the collector. One result of this test is an equation describing the thermal performance of the collector as a function of operating conditions.

The SRCC technical staff begins their review by evaluating the materials used in the collector based on known properties and the results of the durability test. SRCC documents OG-100 and Standard 100 describe the requirements of the collector certification program. Any problems which are identified are referred back to the collector manufacturer for resolution prior to certification.

The results of the thermal performance test are used to calculate a performance rating. This rating estimates the thermal output of the collector under several sets of pre-defined conditions (designed to approximate installation sites in the United States).

The application processing fee for certifying a solar collector is \$100 for each basic collector model. Similar models (same construction and materials, but different size) are \$50 each. When a certification is issued under a second name (private label) the fees are \$50 for a basic model and \$35 each for similar model.

Water Heating System Certification

The "Supplier" of a solar water heating system is the entity responsible for the assembly and installation of the system. SRCC document OG-300 describes the certification and lists all of the requirements.

There are two path-ways through the system certification process: component tests and system tests. In the component test path, the system is evaluated based on tests and information submitted on the individual components in the system. For example, in an active system, the results of the collector test are used to evaluate the suitability and performance of that component. In the system test path, the whole system is tested as a unit. For example, an integral collector storage (ICS) or thermosiphon system would be tested as an assembled system rather than testing the collector and tank individually. With either path, the test sequence includes evaluation of both durability and thermal performance.

A comprehensive review of the application is conducted by the SRCC Design Review Team. This team is composed of individuals with a great deal of experience with solar water heating systems as well as no current business ties to the solar water heating industry. All of the components in the system are evaluated both for their individual suitability for the intended application as well as their interaction with other system components. This review verifies conformance with all requirements of the OG-300 document. The manuals and the proposed labels are reviewed to verify that they contain all of the required information.

While the Design Review Team is reviewing the application materials, the technical staff prepares a computer model of the system. This model is used to calculate the thermal performance rating to be published in the SRCC Directory. A preliminary set of input parameters is sent to the Supplier to insure that there has been no misunderstanding of the system components and how they are connected.

The review process is usually an iterative one. The Design Review Team notes the deficiencies in the application and corresponds with the Supplier, who then makes changes and submits additional information.

The certification application fee for a solar water heating system is \$1,500 for the first system from each supplier and \$500 for additional systems requiring full design review. If full design review is not required (for example, changing the tank size or collector area would not require full design review), the application fee is \$100. If the solar collector portion of the system has not received certification under the OG-100 program, the maintenance fee of \$0.02 per square foot is applied to the aperture area of the system.

Pool Heating System Certification

The application process for swimming pool heating system certification is similar to that for water heating systems except that no performance ratings are calculated. The evaluation of the system is conducted by the Design Review Team using the OG-400 document. The solar collector must have been certified under OG-100.

Since there is no system test requirement, the Design Review Team must evaluate all materials, components, and system designs based on field experience and any additional information submitted by the Supplier. This is often difficult, especially for new materials and components with which there is little experience. The Design Review Team may specify additional specific tests if needed to establish the performance or durability of a particular component.

The certification application processing fee for a pool heating system is \$750 for the first system from each Supplier. Additional systems are \$500 each if full design review is required and \$100 for changes not requiring full review.

Agreement

In all three certification programs, SRCC and the manufacturer or Supplier sign a legal agreement which governs the use of the certification, defines the responsibilities of each party, and establishes renewal dates. The term of this agreement is for five years but it must be renewed annually.

Annual Fees

To maintain SRCC certification there is an annual program fee and a maintenance fee based on production. The annual program fee of \$500 is paid by each participant. If a participant receives certification in more than one program, there is an additional annual fee of \$250. The maintenance fee, which is based on aperture area, is \$0.02 per square foot of glazed collector and \$0.0067 per square foot of unglazed collector which is shipped by the manufacturer.

When SRCC and the Participant are satisfied that all of the requirements have been met, and all fees paid, the final rating is calculated (except for pool heating systems), a new page is prepared for the directory, and the agreement is finalized.

In the next newsletter, we will discuss in more detail the process used to calculate the SRCC ratings for solar collectors and water heating systems.

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August 1997

The Solar Rating

Have you ever wondered how the SRCC ratings are determined? The process is quite different for collectors than it is for systems. This article will outline the procedures used to determine these ratings and how the process has been developed to assure fairness to all applicants.

Collector Ratings

The SRCC collector rating is based on the results of the ASHRAE thermal performance test. This test, a nationally accepted consensus standard, gives an equation relating thermal efficiency to operating conditions. SRCC has defined fifteen sets of operating conditions under which ratings are given. There are three levels of solar radiation (clear, mildly cloudy, and cloudy) and five different operating temperatures (specified as a difference between collector operating temperature and outdoor air temperature of -9, 9, 36, 90 and 140° F). The thermal performance equation is applied to each combination of solar radiation and operating temperatures to get the thermal output of the collector over an eleven hour day. The rating published in the directory is simply this daily energy output.

System Ratings

After the receipt of an OG-300 application, the application is examined to determine what

information is required to assess the performance of the system using test data and a computer model. One important part of this process is the determination of what evaluation method is to be used to model the system. The rating process has been set up so that there are two evaluation methods: Component Test and System Test methods. The purpose for these two methods is so that all types of systems can be evaluated at the same level of uncertainty using the same type of computer models.

The Component Test method is used when an adequate computer model and sufficient component data for this model exists. If there is insufficient component data or there is not a computer model that matches the system to be modeled, then the System Test method is used. If the Component Test method is used, the Supplier needs to provide performance data for each of the major components used in their system (e.g. collectors, pumps, heat exchanger).

If the System Test method is used, the supplier needs to provide data from a system test (which includes more than one component: for example an ICS which contains combined tank and collector unit). In the past, most active systems have been evaluated via Component Test method and most passive systems have been evaluated via the System Test method. As the diversity of systems grows, the use of the System Test method will increase. All of the required tests are specified in the "Simplified

SDHW System and Component Test Protocols" (a future article) and OG-300.

After receiving the required information from the Supplier and the data from the test laboratory, the modeling process begins. All of the simulations are performed using a modified version of TRNSYS 14.1, a transient computer simulation program, developed at the University of Wisconsin-Madison. If a system is to be modeled using Component Test method, then the "Core" model can be created directly from the given component data and models.

A standard template is used to model all of the systems. This template contains all of the standard configurations which have been modeled for OG-300 certified systems, assuring that the system models are generated consistently. Each Core model consists of three sections: input parameters, model mapping and output. The input section consists of prompts or references for information regarding the various components (e.g. collector area, pump flow rate). The model mapping section indicates which model subroutines are to be used and how they are attached to one another (e.g. a collector's flows and temperatures are output to the inlet of a heat exchanger). The output section indicates how the various energy flows and temperatures are to be printed.

If the system is modeled from the System Test method, then the closest matching TRNSYS model is fitted to the test data. As with the Component Test method, a Core model is first created. However, these first models (calibration models) are made to replicate the system tests performed. The model is then run using the system test data and a pair of calibration values. These values are then adjusted, using software, to minimize the difference in predicted energy use between the model and the experimental data. Once the fit

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has been made, the calibration values become a parameter used in creating the final core model. Using these values, a Core model is created in the same manner as for the Component Test method. Because the system tests have been run under a specified range of conditions, the fit will be valid for all normal operating conditions.

After the core model is created, a TRNSYS model is created using the specified weather and load data for OG-300 (see the SRCC directory for details) using software developed by SRCC. This software allows the same Core deck to be used to estimate performance for a variety of loads and climates, eliminating the need to re-create multiple TRNSYS decks manually for these runs. This TRNSYS model is then run and the results are then generated by another program developed by SRCC. This program not only calculates the Solar Energy Factor shown in the directory, but it also summarizes the total energy flows and maximum and minimum projected temperature for various parts of the system. This output is useful for the debugging process and for evaluating where energy losses occur in the system.

A final program is used to summarize the results for inclusion in the directory. The automation of the process has eliminated many potential errors in the rating process and has allowed for the rapid updates of the models. It also adds consistency to the rating process.

In the next newsletter, we will describe how the test procedures for obtaining the data used to calculate the system ratings were developed.

BIOGRAPHICAL SKETCHES OF NEW 1997- 1998 BOARD MEMBERS

STEPHEN C. STILL

Stephen Still has 16 years' direct involvement in the solar energy field: Three (3) as a solar business owner, and 13 in his current position as a solar energy specialist for Eugene Water & Electric Board (EWEB), a 100,000 customer electric utility in Eugene, Oregon. His experience includes solar energy system design and performance analysis, and, in his role as project manager for EWEB, he is responsible for the development, administration, and evaluation of EWEB's solar energy programs and activities. These include customer education, solar energy analysis services for homes & businesses, solar radiation data monitoring, and EWEB's successful *THE BRIGHT WAY TO HEAT WATER™* solar water heater program.

Mr. Still is a charter member of the USDOE "USH20" initiative to promote solar water heating programs for utilities, a member of the solar energy advisory committee to the Northwest Power Planning Council, and is outspoken for marketplace innovation to promote more wide-spread consumer adoption of solar energy applications.

TOM BOHNER

Tom Bohner has been active in the solar industry for 17 years. Tom is President of Sun Systems, Inc. located in Scottsdale, AZ. Sun Systems is the largest Solar Service company in the United States. In October of 1996, Sun Systems opened their new 18,000 sq. foot manufacturing facility. Sun Systems has begun production of the CopperSun, a passive integral

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collector storage (ICS) solar appliance for the new home building market.

He served as ARESIEA's President for 3 1/2 years and continues to remain very active with industry issues.

MICHAEL D. NEWMAN

Currently the General Manager of Energy Laboratories, Inc. (ELI), Michael D. Newman is a former founder and director of AET. He has twenty years of experience in the solar industry and has strong skills in manufacturing management of solar devices as well as design and product development. His flat plate collector designs have sold more square footage in America than any others. ELI has been retained by AET to help in modernization of the plant and equipment, the implementation of management systems, and to deliver new product designs. Mr. Newman will also lend expertise in the establishment of a new company to provide fin tube with a selective surface coating.

As the founder of Morning Star Manufacturing, Inc., formerly the largest flat plate collector manufacturer in America, Mr. Newman served as President, Vice President, and Director of the company. During this time he was also a member of the Florida Solar Energy Center's Policy Advisory Board and participated in efforts in Washington to further the solar cause. He has also worked in top management (General Manager) of High Tech companies producing electronic components and developing new manufacturing methods. His experience extends into the financial management of manufacturing operations as well.

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ADDRESS CORRECTION REQUESTED

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Issue 8

July 1998

SRCC Board Selects New Chairman

At its annual meeting in Orlando, Florida, SRCC selected Marc Roper from the Colorado Office of Energy Conservation as new chair of the SRCC board.

After twelve years as the chair of SRCC, John Dunlop declined nomination for a new one-year term. Instead, he nominated Roper to succeed himself to head up the organization. Dunlop first agreed to accept nomination for SRCC chair in 1986 at a time when the solar industry and SRCC was in turmoil after the expiration of the investment tax credits. As a representative of the Interstate Renewable Energy Council from Minnesota at the time, he believed it was the proper time for the "public sector" to shoulder more responsibility for the quality assurance programs that had been so valuable to state energy offices.

During the time when sales in the solar industry were plummeting, Dunlop strongly supported efforts by Dr. Byard Wood and Jim Huggins, the current administrators of SRCC, to pursue significant changes in the SRCC certification programs. After all, he reasoned, what better time to change a service than when demand for the service was at an all time low?

SRCC embarked on a vigorous -- and ultimately successful -- effort to dramatically reduce the cost of testing and certifying solar water heating systems while increasing the flexibility of the SRCC program. SRCC developed procedures to

use computer modeling to determine the projected performance of systems and the impact

of substituting components in certified systems, rather than requiring testing of each system and subsystem. The result was the certification program now known as OG-300. These new procedures saved solar businesses (and ultimately their customers) thousands of dollars in testing fees. OG-300 has been accepted by national programs such as the

qualification program of the U.S. Housing and Urban Development home financing program and President Clinton's Million Solar Roofs program. SRCC is gaining recognition and acceptance in a number of states and local jurisdictions.

SRCC has recently moved its administrative office to Cocoa, Florida from its former location in the renewable energy suite of offices in Washington, DC. SRCC's programs continue to be supported by the U.S. Department of Energy. With renewed focus on the environmental -- and global warming -- benefits of renewable energy, demand for solar thermal products is again on the increase.

While Dunlop continues to strongly support solar applications (and continues to serve on the SRCC board), he felt the reduced market turmoil and the stability of SRCC programs and administration represented a good time to provide new leadership opportunities to members of the board.

Marc Roper not only brings many years of experience on the SRCC board, he is a vocal

champion of increased solar energy use in Colorado and an advocate for the use of SRCC's quality assurance programs.

With the transition in the chairmanship of SRCC, the corporation is gifted with fresh leadership to meet the pleasurable challenges of a robust solar energy market and demand for quality assurance programs.

Development of A Test Protocol for the Evaluation of SDHW Systems and Components

This article answers some of the questions regarding how SRCC specifies the testing requirements used in the generation of ratings for OG-300 certified systems. In an effort to increase the versatility of the tests so that they can be used for the OG-300 program, SRCC has developed a protocol that will be used as the basis for the testing of any component. This was accomplished with support of the Universities and NREL, while still trying to minimize testing costs.

In the past, the OG-200 program, based on the ASHRAE-95 test, was used as the method for evaluating SDHW systems. The advantage of this test was that all systems tested this way were rated on the same basis. However, because the test was performed under a solar simulator, it was expensive to perform and the results could only be used for one set of operating conditions.

Both of these disadvantages have been addressed in OG-300, while still maintaining the inter-comparability with other system ratings. The OG-300 program is set up so that the operating conditions can be varied and common sources of data can be used for system modeling. The assumption in the OG-300 models (system and component) is that the data used for them is valid for all normal operating conditions. This

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has required the need to refine the acquisition of data used for driving these models.

In an effort to satisfy these goals, SRCC developed a protocol which will yield both component level and system level data which will be useful for OG-300, yet is reasonably cost effective and obtainable in a short period of time. The International Standards Organization (ISO) is in the process of developing and evaluating a similar type of testing/rating protocol (in fact certain features of the current SRCC protocol are adapted from ISO); however, that protocol is substantially more complicated to implement and will likely require longer term testing to achieve a final result. SRCC will evaluate the usefulness of the ISO protocol when it has been finalized.

The component tests specified in the new SRCC protocol are not a large departure from current practice. However, in the past, SRCC has not specified a protocol for component testing and evaluation (except for collectors certified under OG-100). The SRCC test protocol is designed to ensure standardization of these tests and that the proper data are collected for use with the OG-300 TRNSYS models. The protocol is being updated to accommodate those tests which are either new (e.g. natural convection loops), or where new testing/analysis techniques have been developed.

The development of the System Test Methods is the primary focus of the test protocol. The goal of the test methods is to expose the system to a sufficient variety of operating temperature differences (system to ambient) and solar radiation levels so that the range of representative operating conditions is included in the data set. This will allow the TRNSYS model to be calibrated such that the model is valid in various climates.

To accomplish these goals, while still keeping the testing process relatively simple, a series of

warm-up tests have been designed. The warm up tests are performed by heating the storage portion of the system to a specified temperature and then exposing the collector portion of the system to the sun for several hours. The collected energy is then measured by purging the system. This same method is used for two extreme inlet temperatures and radiation levels. Other tests are specified as needed to evaluate other effects (stratification, dual axis incidence angle modifiers, etc.). Conducting the tests in this manner evaluates the performance at extreme conditions and allows a net energy gain to be calculated easily.

In the next newsletter, we will give examples of how the test procedures are applied to collectors and systems.

Structural Certification of Solar Collectors

Solar collectors are usually installed on the roof of a building where exposure to wind is inevitable. The ability of a collector to withstand the forces imposed on it by the wind is a concern of the owner and is sometimes regulated by local building codes. SRCC's OG-100 and OG-300 certification programs require submittal of a structural certification for each solar collector. This has historically been a statement signed and sealed by a registered professional engineer. This engineer has based his statement on either analytical calculations of the strengths of the frame, glazing, etc. or on the results of a test. The certification stated the wind load that may be sustained by the solar collector without damage to the cover plate material or the cover plate mounting. SRCC then simply passed this load on to users via the certification rating page. The intent of this structural certification was to provide consumers, in areas of the country where high wind loads could be expected, an indication of the

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suitability of each collector for a particular installation.

SRCC did not attempt to verify the structural certification submitted by the engineer since this was outside the scope of SRCC's certification. Additionally, the statement requested from the professional engineer did not require a specific approach be used to determine the wind load which was stated. As a result, some engineers used a wind load on the front of the collector, some on the back, and some did not even submit supporting documentation indicating the method which was used. This has lead to some confusion when comparing collectors with each other.

To clarify the collector structural certification requirements and to attempt to address specific requirements in various parts of the country, SRCC has begun investigating the collector structural certification process. The goal of this investigation is to review the consensus standards and tests already available for determining the structural properties of solar collectors and then to develop a standardized wind loading rating which could be adopted by local jurisdictions as part of the SRCC rating and certification. The SRCC structural certification will be clarified to specify which test method(s) and/or calculation method(s) are to be used to determine each collector's load rating.

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MANUAL OF PRACTICE
Solar Rating and Certification Corporation
OG-300
October 23, 1998

The purpose of this document is to present the philosophy and practice of implementing SRCC's OG-300 program for certification of solar water heating systems. The document is organized by OG-300 paragraph number where applicable. The comments for each paragraph are the result of discussions held at Board, Standards Committee, or Design Review Team meetings. Paragraphs for which there are no comments have generally been interpreted without need for additional discussion. For additional information on the history of OG-300, see the document "OG-300 Modifications", which lists all changes to OG-300 since the June 1990 version.

Included at the end of this document are copies of more lengthy documents describing specific policies or procedures.

6.1.1.2

We do not require isolation valves between the heat exchanger and the tank based on the argument that the heat exchanger is just soldered copper pipe and is not likely to fail.

6.1.1.3

Expansion tank volume is checked with the ASHRAE equations.

6.1.1.4

UL listing of tanks. Victor Eyal proposed that UL listing be required on only the electrical components installed in a tank used in a solar water heating system. The Standards Committee rejected this proposal on August 27, 1997, because of the requirement in the Uniform Plumbing Code, the Standard Plumbing Code, and Federal Standards for UL 174. This UL standard considers the whole tank.

6.1.5.2

From a Standards Committee discussion on October 9, 1996:
A switch is required in the PV line to turn the pump off for servicing.

6.1.5.6

A tempering valve is required on ICS systems. The mixing of solar heated water with auxiliary heated water does not eliminate the need for this valve.

6.1.6.3

The SRCC Board voted (February 1994) to allow paint as an insulation protection option with instructions in the owner's manual to repaint periodically.

6.3.8

NSF standard 61-1991 covers components in contact with drinking water

6.5.1

This paragraph requires that a system be assembled such that fire stopping be possible. Since, in most system, this is possible, no specific mention of fire stopping is required in the installation manual. An installation without fire stopping would fail under the requirement of paragraph 3.0 to meet local code.

6.6.3

Drain-back and drain-down/out systems do not have to use the second part of the FTL statement

6.6.4

From a Design Review Team discussion on May 18, 1995:

There was disagreement as to the need for component life expectancy in the manual. The argument against it centered around the fact that other consumer systems (refrigerators, automobiles, etc.) do not list the expected replacement time for components of the system. The argument for it was based on the consumer's need to evaluate the system during the purchasing process and to know when to expect the expense of replacing of major components.

The compromise reached here is to require that the expected lifetime of the collector and any "nonstandard" components be stated in the manual. Definition of what exactly constitutes a nonstandard component will evolve as applications are evaluated.

Projections for replacement must include a lifetime for all system components. (Standards Committee October 9, 1996)

6.6.5

From a Design Review Team discussion on October 16, 1996:

Even if the Supplier doesn't provide the fluid, the safety sheet must be in the manual.

6.6.8

We have allowed the warranty to be given to the customer in a separate packet rather than being fully stated in the manual.

Labeling

The Standards Committee considered and rejected (summer 1998) a request to combine all required labels into one label and place it an easily visible place near the solar water heating system. They felt that the warning labels and isolation valve labels had to be at the site of the hazard/valve.

Labeling requirements are given in the following paragraphs:

- 6.1.1.2 Isolation valves
- 6.3.17 Hot components
- 6.2.5 Freeze protection
- 6.4.3 Tank limits
- 6.6.7 Ungrounded piping
- 6.3.7 Fill and drain valves

Release of Information on Pending Certifications

"SRCC will not release any information concerning the status of any certification which is pending to anyone except SRCC staff and the participant submitting the application.

SRCC will send a letter to the applicant upon receipt of the application stating that the application has been received. This letter will also state that certification is not guaranteed and the applicant is to make no representation that certification will be or has been awarded unless and until written authorization has been received from SRCC.

No performance ratings will be released to anyone until the certification is complete and all fees have been paid."

Effective date: October 22, 1997

Changes in TRNSYS models:

We have established a policy of not changing the TRNSYS models and issuing new ratings between publication of the rating directory. When ratings change frequently, there is confusion among the industry and the entity requiring the rating. Once systems are being accepted (or not accepted) in a rebate or loan program, changes to the ratings can cause particular systems to gain or lose qualification. This is most disruptive to business, for both sides. Therefore, implementing changes (improvements, error patches, etc.) will take place only with the publication of a new directory. The directory is usually published approximately annually. Whenever possible, program participants should be advised of any changes to their ratings as far in advance of publication as possible to give them time to adjust their literature, sizing techniques, sales practices, etc.

Electric element thermostat deadbands:

In the TRNSYS model we have decided to use the following deadbands:

Rheem wrap-around tank	4.5°C
Standard tank:	
upper element	12.0°C
lower element	2.77°C
Thermosiphon tank	3.0°C

Overheating of PV pumped systems:

From a Standards Committee discussion on October 9, 1996:

"Proper design" and orienting the PV panel 15° east of south is not sufficient to prevent overheating. A snap switch is required.

From a Design Review Team discussion on October 16, 1996:

We cannot deny certification since other systems are approved without high limit protection to prevent glycol degradation.

When a system is changed from one tank to two tanks, check the following:

- solar tank bypass valves (6.1.1.2)
- add second tank to parts list, include make, model, R-value, and volume of the new tank (6.6.6)
- instructions for bypassing the solar tank (6.6.2 and 6.6.3)
- new diagram in manuals, including second tank and bypass valves (6.6.3)
- bypass valve labels (6.1.1.2)
- new model number for the new system
- calculate new rating

The following paragraphs address overheating. SRCC has not established a clear guideline with regard to systems with the potential to overheat. Since overheating is so dependent on system sizing, climate, and hot water usage, a given system can work properly for one installation can overheat in another.

6.1.1.1 Maintain within limits

6.1.1.9 Power failure

6.2.1 Stagnation

6.2.3 Operating conditions, environmental extremes

6.2.8 Suitable fluids

6.3.4 System failure prevention

6.3.5 Tank temperature limit

6.4.3 Fiberglass tanks within temperature limit

6.5.2 Solar system output cannot exceed auxiliary's temperature limit

6.5.11 Building material temperature limits

SRCC Policy Statement
Acceptance of New Materials, Components & Design Concepts

December 11, 1996

Approved by the SRCC Board on January 22, 1997

Introduction

HUD and others have expressed concern over the years about the need for testing new materials, components and designs for acceptability in order to assure reliability and durability of solar water heating systems. Additionally, economic analyses of solar systems based on life cycle costing is typically needed to qualify for system financing through Energy Efficient Mortgages (EEM's) and Home Energy Rating Systems and component replacement and system maintenance information is required. In order to maintain SRCC certification as a means to help assure these entities that our certified systems meet criteria required for financing or other program qualification, the SRCC standards Committee has been working on a Draft Policy Statement to address these needs. Increasing the penetration of solar technologies in the marketplace through new programs, currently in place or on "the drawing board," will depend on SRCC's ability to continue to assure certification is synonymous with a quality system, as well as to help suppliers provide the credible information needed to benefit from marketing and financing programs.

The SRCC Standards Committee recognizes the current status of the industry and the need to strike a careful balance between reliability/durability "quality assurance" and its potential (prohibitive) cost in time and dollars. In order to accomplish this balance of goals, the Committee recommends adoption of a moderate path, as embodied in the attached Draft Policy Statement (DPS). There are no "absolute" reliability/lifetime requirements in OG300/400. Rather, SRCC requires that all available information is "consistent with" the manufacturer's component lifetime claims, a "consistency principle". Consistency can be established by two methods, field experience or reliability data. Reliability data is a combination of established tests, informal tests, reliability/durability information, and analytical/computational tools.

It is the responsibility of the DRT to evaluate each system's compliance with the requirements of OG-300 or OG-400. Each application is considered independently so that the unique properties of each system can be considered. While it will not be possible for the DRT to anticipate all possible failures, the intent of the application review process is to identify potential problems and have the Supplier correct them before certification is issued/renewed. In addition to new system certification, component substitution for currently certified systems is a related issue. HUD has advocated the use of various ASTM tests as an approach to assure these needs are met. Technical staff has concluded that current ASTM/ANSI or ISO test standards are either not yet completed or do not provide adequately meaningful results, but will continue to monitor progress. Because the ISO tests are seen to be key to future solar standards and programs, both in the U.S. and abroad, staff is very interested in adopting these tests as soon as they are available.

In order to most effectively deal with these issues, the SRCC Board directed the Standards Committee to develop a Draft Policy Statement (DPS), expressing what must be developed.

Several proposals were made and discussed at length over a series of SRCC Board and Standards Committee meetings, and a number of related issues were discussed. What was needed was a policy accepted by the industry and subsequently approved by the SRCC Board to address this situation. The Standards Committee's DPS, as adopted by the SRCC Board of Directors on January 22, 1997, follows on the next two pages and outlines this policy.

SRCC Policy Statement

Acceptance of Materials, Components & Design Concepts for Certification Under OG-300 & OG-400

December 11, 1996

Approved by the SRCC Board on January 22, 1997

SRCC has appointed a Design Review Team (DRT) to review applications for system certification under the OG-300 and OG-400 programs. The purpose of this document is to provide some guidelines and underlying principles under which the DRT is to operate.

When an application for certification is received by SRCC, the Supplier must document that all materials and components are suitable for the use being specified. There are no "absolute" reliability/lifetime requirements in OG-300/400. Rather, SRCC requires that all available evidence relating to component and system durability and reliability must be consistent with the manufacturer's component lifetime claims (a "consistency principle"). The basis for this principle and its application is laid out in Sections 6.6.4 and 6.6.6 in OG-300, and in Sections 5.5.2 and 5.5.3 of OG-400.

The Supplier shall have the burden of demonstrating, to the satisfaction of the DRT, the validity of the information provided to assure consistency with this policy statement. The two approaches to applying the consistency principle are either field experience or reliability data as described below:

I. Field experience. If the material or component has been in use for at least as long as the lifetime claimed, in an equivalent manner as proposed in the certification application, and reliability/durability is consistent with statements in the Manual, the material or component is acceptable.

OR

II. Reliability Data If the material or component has not been used extensively in the same manner as it will be used in the certification being applied for, or the DRT has grounds to question the reliability/durability or performance of components, materials, or system design, the supplier must submit documentation in accordance with the DRT Guidelines below.

All data shall be forwarded to the SRCC DRT along with a signed Transmittal Form from the Supplier. A copy of the Transmittal Form is attached. One copy of this form is required to accompany each separate submittal of test data and/or information provided subsequent to the original application.

Reliability Data Requirements

Test Data:

The Supplier shall provide information regarding any reliability/durability tests which have been completed. Such tests shall include data from an SRCC accredited or listed laboratory following established test methods or a specific "informal" test protocol specified by the DRT and approved by the Technical Director.

OEM letter:

The supplier shall provide a statement from the manufacturer regarding suitability of the material or component for the application(s) described in the Manual submitted. This statement must include language that states that the material, component or system concept is suitable for, and consistent with statements in the Manual regarding component lifetime claims, for the application(s) described in the solar system's Manual. The DRT may request more specific information, such as specification of maximum continuous and exposure temperatures or pressures.

In addition, the SRCC DRT may require, at its discretion, information in the following areas:

Reliability/Durability information

The supplier shall provide the DRT with any reliability/durability information regarding the system or similar systems for certification. These data may come from various reliable sources including, but not limited to, field or test facility inspection reports, state, utility, local jurisdiction and other solar system installation or service related programs as well as national lab or industry group data. Consideration shall be given to the source of the data, the geographic location of the system(s), the quantity of incidents reported, the level of corroboration, and the level of detail provided in the report. SRCC may also pro-actively search for and obtain relevant data independent of what the supplier provides.

Analytical/Computational Tools:

The DRT may apply analytical/computational tools, such as computer simulations, to assist in the evaluation of materials/component suitability. The level of the DRT's reliance on the results from the application of analytical/computational tools will be a function of the level of validation and confidence in the specific tool(s) relative to the results required. For example, if the DRT considers an existing TRNSYS model to be accurate in the estimation of stagnation temperatures, the DRT can obtain estimates of stagnation temperatures in order to evaluate the potential impact on materials used

System Installation for DRT inspection

A complete system containing the material or component in question may be required to be installed at a location approved by the DRT and the Supplier. The material or component in question will be inspected periodically to determine its reliability, durability, and performance. The performance of the material or component in the test system, as well as any reports received from other installations of the system, will be used to determine whether certification will be approved.

SOLAR RATING & CERTIFICATION CORPORATION

**TRANSMITTAL OF TEST DATA AND/OR INFORMATION FOR
ACCEPTANCE OF MATERIALS AND COMPONENTS FOR
CERTIFICATION UNDER OG-300 AND OG-400**

INSTRUCTIONS: The original of this completed form must be included with any test data and/or third party information submitted by the applicant to support the applicant's application for certification.

NAME OF COMPANY: _____

ADDRESS: _____

CITY: _____ **STATE:** _____ **ZIP:** _____

TELEPHONE NUMBER: (____) _____ **CONTACT PERSON:** _____

SOURCE OF TEST DATA AND/OR INFORMATION:

DESCRIPTION OF DATA AND/OR INFORMATION:

"The information submitted with this transmittal has been reviewed by me and is true and correct to the best of my knowledge and belief. I hereby agree that no representation will be made by the above named company and/or its representatives that the transmitted data and/or information has been sanctioned by SRCC unless and until written authorization has been received from SRCC."

AUTHORIZED SIGNATURE: _____

NAME (printed): _____

SIGNATURE: _____ **TITLE:** _____

DATE: _____

Dielectric Unions

November 1, 1995

MEMORANDUM

To: Design Review Team

From: Jim Huggins

Subject: Policy on dielectric unions

Your responses concerning the question raised during our review of the SunEarth SunSaver open loop systems were mixed. Byard recommended following the lead of the UPC which states "The Administrative Authority may require the use of an approved dielectric insulator on the water piping connections of water heaters and related water heating equipment.". Jeff has looked into the question and doesn't think we should force the Supplier to require dielectric unions, but instead have the Supplier recommend dielectric "connections". Gary reports that Oregon requires dielectric unions or flex connections which incorporate unions.

I also talked with David Meakin who consulted a metallurgist (his father). His response was that the tank is pretty well protected by the anode rod, the glass lining, and the teflon tape usually used to seal the threads. Therefore, dielectric unions are not required.

A call to the plumbing section of my local building department produced an uninformed response. I explained what dielectric unions were and then he said "Oh, those are never used."

The relevant paragraphs in OG-300 are the following:

6.1.1.10 Different Metallic Materials

This paragraph requires compliance with HUD Minimum Property Standard 4930.2 which states "All materials which are joined directly to or in contact with other materials shall have sufficient chemical compatibility with those materials to prevent deterioration that will significantly impair their function during their intended design life."

6.2.4 Incompatible Materials

This paragraph requires isolation or treatment of incompatible materials to prevent degradation which would significantly impair function under in-service conditions.

Paragraph 6.2.4 does not seem to directly require or not require dielectric unions. This paragraph seem to deal more with short term performance (function) than lifetime. The key phrase in paragraph 6.1.1.10 is "intended design life". The protection provided by the anode rod, glass lining, and Teflon tape (plumbing paste, etc.) may be all that is taken into account when the design life of a water heater is defined. In addition, galvanized nipples are often

used at the tank. The nipples provide some protection in that they supply zinc to the galvanic process which apparently helps protect dissimilar metals (info from the metallurgist). Of the plumbing codes I looked at (UPC, NSPC, BOCA, and Southern Standard Plumbing Code) only the UPC even mentions dielectric unions and then only to pass the responsibility to the local official as noted above.

Given all of the above, I propose that we not require dielectric unions. Some code jurisdictions will require them, but that is covered by the OG-300 requirement to comply with local code. There may be some areas where they are routinely used because of the water quality. There will be areas where they will not be used because local practice has determined that they are either unnecessary or disliked. There does not seem to be consistent enough evidence on which to base a blanket requirement for them to meet compliance with OG-300.

I will proceed with this position and with SunEarth's certification unless I hear otherwise from you by November 6.

Thank you all for your input on this question.

RATING PROCEDURES

July 1996

A standardized set of procedures is used in the rating of all certified SRCC OG-300 systems. This document summarizes these procedures and provides a framework for the rating of non-standard systems and components. Many of the procedures are based upon specifics indicated in other documents. These procedures are referenced by their name and the document title. Items in { } indicate practices which deviate from the stated goals.

The rating conditions for the systems are described in OG-300. The load variables have been derived to be consistent with the DOE's Energy Factor. The radiation conditions were derived from SRCC RM-1. In 1994, the average daily radiation value was re-affirmed with a study at FSEC of average radiation for each major city in each of the 50 states. As the DOE procedure does not describe ambient temperature, a sinusoidal profile with the average equal to the mains water temperature was established in 1994. The addition of the factors has yielded a Solar Energy Factor which is comparable to the DOE Energy Factor. A modified version of the TRNSYS V13.1 (to be 14.1) simulation program is used for the simulations. Unlike the DOE procedure, the SRCC rating method uses a computer simulation (based on experimental and nominal data) to determine the average daily energy withdrawn from the system. The DOE method uses experimental data based upon an adjusted volume draw.

For rating purposes, all systems are classified as either "system test-path" or "component test-path." All systems are considered to be component test-path if the following conditions are satisfied. Otherwise, they are considered to be system test-path:

1. There is a one-to-one relationship between the model and the system to be modeled. {Some minor components have been eliminated or simplified.}
2. A validated generic TRNSYS model exists for the system. {Generally, any system using electrical energy to transport energy from the collector to the solar storage tank has been assumed to be validated using the 1992 generic system tests at CSU.}
3. There is adequate data available to use the validated model. {Many ad-hoc parameters have been used for "typical" components, in lieu of testing.}

As indicated below, the determination of the system classification, has a large impact on the rating process.

All data other than the collector or system test is provided as specified in The *Simplified SDHW System And Component Test Protocols* document. This test data is required for all other major components of the system: tanks {most storage tanks are based upon nominal dimensions with the R factor halved to account for fittings, voids, and assembly errors. This is based upon a study at ASU.} heat exchangers {most heat exchangers have been modeled using an ad-hoc effectiveness, based upon the CSU generic systems test}, pumps, controllers, etc.) The auxiliary storage tank is assumed to be the same for all systems. {The existing tank data is based on, but is not consistent with, tests run at DSET in 1985} Data for pipes is based upon nominal specifications with the R factor halved. Data for thermostat deadbands is based upon a study done by FSEC and CSU during 1993.

COMPONENT TEST PATH

All systems modeled in this manner are assumed to be fully modeled using the SRCC implementation of TRNSYS. As such, these systems are candidates for component substitution (allowing the use of different sized collectors, storage, pipes, and {controls}). {The use of different controls includes snap switch, PV, differential}.

The input to the TRNSYS model is based upon component test data {or manufacturer's nominal specifications, or best educated guesses}. All these systems require OG-100 collector test data.

The process for a system using a PV driven pump requires the use of the external DATAPLOT program and an excel spreadsheet, *SYSPDROP.XLS*, to generate a flow vs. Irradiance curve as specified in the test PROTOCOL {No part of this process has been validated}. The spreadsheet uses the Darcy-Weisbach equation for fluid flow, and Hooper's correlations for fitting losses. In addition to the relevant fittings indicated in the system diagram, the SRCC standard pipe length and an additional 10 welded 90 degree elbows are used for determining a head versus flow curve. Experimental pressure drop data is used for such components as collectors, pumps, and heat exchangers. {Most heat exchanger and collector data have been extrapolated, or estimated due to a lack of data.} The output from the spreadsheet is used as input into the DATAPLOT routines. These routines use empirical fits to match the pump, system and PV panel data together.

The process for systems using NCL (other than thermosyphon), makes use of test data {If available, otherwise estimates are used} and physical placement of components. This process is not fully defined at this point. The use of heat exchanger data with these systems has been modified to account for the large variances at low flow rates. {No part of this process has been validated}.

After the appropriate data are obtained, the following procedure is used for all component test data systems. For each new system, a generic, validated TRNSYS model is selected that matches the system to be modeled. {Any combination of TRNSYS components is selected which provides a reasonable match between the system and the available components. Strict adherence to the validated models has never been enforced for "active" systems because it has been impractical to validate the wide variety of generic systems and there have always been systems which cannot be literally modeled with the existing TRNSYS program.}

SYSTEM TEST PATH

All systems modeled in this manner are assumed to NOT be fully modeled using the SRCC implementation of TRNSYS. Instead of being thought of as a literal model, the TRNSYS model is used as a calibrated model, which accounts for factors that cannot or have not been presently modeled.

As these are not literal models, these systems are NOT candidates for component substitution. {Component substitution has been used when the primary unknown (the collector) is not affected by the swap. Scaling of the collectors and storage tanks has been used when the components are alike and the collector to tank volume ratio is relatively constant. Fitting for one type of ICS at FSEC in 1996, verified very good agreement for this scaling approach on one system.}

The input to the TRNSYS model is based upon system test data {or manufacturer's nominal specifications, or best educated guesses}. All these systems require system test data. {As noted, scaling, component substitution, and adjustment of the system test results has been done to limit the quantity of testing required. Presently only the most "best seller" is required to be tested.}

The system test data is obtained from a series of warm-up tests detailed in The *Simplified SDHW System and Component Test Protocols* document. Upon completion of the tests, a test report and data file is generated for each trial. The experimental data should be examined to ensure that the proper amount of diversity in radiation and tank temperature is maintained. If any of the criteria are not met, the data should be marked as thus, and possibly discarded. This report indicates testing conditions as well as energy withdrawn (or auxiliary energy used) during the test. For each new test, a TRNSYS deck is created that matches the system that was tested. The model used for testing is similar to the one used for the final rating model. The only difference is that this model uses an experimentally specific load and weather rather than the specified rating conditions. This data is fed into the model via the data file generated during the test, driving the model for inputs (radiation, ambient and mains temperature, and mains flow rate). Because this model is to be fit, it is not required that the model be a literal representation of the system. Hence, the test decks are derived from the "CORE" decks used for rating the systems.

The MODULAR program is used for the initial assembly of the first testing deck. The document, *DOCUMENT.TXT*, included with the program outlines the instructions for using the program. The first test deck is edited to include the correct data files and starting conditions. This deck is de-bugged and compared with the experimentally calculated energy flows. It is expected that these values will not match (otherwise, this would probably be a validated system). The comparison is only meant to catch obvious modeling or experimental errors. The initial test deck is then copied and modified for each of the system warm-up tests. A separate file (KNOB.DAT) is used to specify the delivered energy and experimental uncertainty for each trial of the test as well as some initial starting values.

Using the parametric run option (fit to data), MODULAR will iteratively fit the test decks (via multiple TRNSYS runs) to the data using the Simplex method. The fitting process adjusts two factors, the collector Frta and FrUl. An initial guess or best data is used for the Frta and FrUl. The multipliers and consequent fitting is based upon this initial value and the derived multiplier. MODULAR will re-run the data until the χ^2 is minimized, producing the best fit model. A series of fits are usually required to evaluate any experimental problems and to ascertain which decks should be used for the final fit. Any experimental errors not caught earlier should be noted at this point. Consideration of the relative weighting of the various sets of data also needs to be acknowledged. {At this point, the relative weighting has not been clarified.} {Also note that some of the Data has been grandfathered from the OG-200 data, which only allowed for a 1 parameter (Frta) fit.} Further fits are usually required to eliminate bad data and balance the tests used for the final fit. Once the fit has been made, the two fit parameters, FrUl and Frta modifiers are the two fit parameters used in the creation of the CORE decks. Note that the parameters are multipliers for the standard FrUl and Frta. This provides a means to check the quality of the fit. {This also provides a means to scale the systems since the adjustments are decoupled from the collector performance curves.} For ICS systems, the product of FrUl and the modifier is the effective UA. This will usually be higher than the decay test UA.

ALL SYSTEMS

The MODULAR program is used for the assembly of the decks and the creation of the ratings numbers. The document, *DOCUMENT.TXT*, included with the program outlines the instructions for using the program. The system deck (a "CORE" deck) is used as the basis for ratings generation. The previously defined rating conditions are amended to the model at run-time. The simulation is performed for a total of 4 days, to allow the system to reach a pseudo-steady state operating condition.

Upon completion of the simulation, a separate program OUTPUT (included with MODULAR), displays all of the energy flows and calculates the SEF. The SEF is calculated in accordance with OG-300. This value is final rating for the system. The simulations are automatically scanned to check for simulation and energy imbalance errors (above 5% imbalance indicates an error), and temperature extremes in the collector, solar storage tank, and hot water delivery. Presently the indications of high and low temperatures are used only for de-bugging the model, and as feedback for the system supplier. They are not used in the rating or QA process. The TRNSYS models used do not simulate pressures (except to drive NCL) or adjust energy delivery for freezing/over-heat conditions.