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## 1.1 Program Background

In early 2006, the Commission, in collaboration with the California Energy Commission, established the California Solar Initiative (CSI), a \$2.5 billion incentive program to promote solar development through 2016, to be funded from the distribution rates of gas and electric ratepayers. (See Decision (D.) 06-01-024.) At that time, the Commission stated its intent to consider incentives for solar water heating (SWH) as part of the CSI program, and directed San Diego Gas & Electric Company (SDG&E) to contract with California Center for Sustainable Energy (CCSE) (formerly the San Diego Regional Energy Office) to administer a pilot program for SWH incentives in the SDG&E territory. (*Id.* at 13.)

Subsequently, with the passage of Senate Bill (SB) 1 in August of 2006, funds for CSI were limited to \$2.16 billion and could no longer be collected from gas ratepayers. At the same time, SB 1 included a provision allowing \$100.8 million of total CSI funds to be used for incentives for solar thermal technologies, such as solar water heating. (See Pub. Util.Code § 2851(b).)<sup>1</sup> With CSI funding now limited to collections from electric ratepayers, the Commission concluded in D.06-12-033 that although CSI would include as part of its total budget \$100.8 million for incentives to solar thermal technologies, CSI should only pay incentives to solar thermal technologies that displace electric usage. (D.06-12-033, Conclusion of Law 19 at 38.) The SWH pilot in the SDG&E territory, budgeted at \$3 million, was allowed to proceed to provide useful information on SWH incentives in general. (*Id.*, Conclusion of Law 20.)

In February 2007, the Commission approved the SWH pilot budget of \$2.59 million and the pilot began operation in the SDG&E territory on July 2, 2007, with a scheduled end date of December 31, 2008.<sup>2</sup> In D.08-06-029, the Commission made minor modifications to the pilot and allowed it to run until December 31, 2009 or until the budget is exhausted, whichever occurs first.

In late 2007, the Governor signed Assembly Bill (AB) 1470, authorizing the creation of a \$250 million incentive program to promote the installation of 200,000 SWH systems in homes and businesses that displace the use of natural gas by 2017. The statute requires the Commission to evaluate data from the SWH pilot and determine whether an SWH program is "cost effective for ratepayers and in the public interest" before designing and implementing an incentive program for gas customers. (Section 2863(a).)

## 1.2 Program Budget

The total incentive budget for the CSI-Thermal Program is approximately \$280,800,000. Of this total, \$180,000,000 is allocated for natural gas displacing SWH systems (not including low-income incentives), as authorized by AB1470, and up to \$100,800,000 for electric displacing systems, as authorized by SB1. Incentive dollars will be allocated between two customer classes, single family residential and commercial/multifamily, as follows:

-40% of the total incentive budget is reserved for single-family residential customer SWH systems;

-60% of funds may be used for incentives to commercial or multifamily SWH systems Funds may be moved from the commercial/multifamily budget to the single family residential budget, but not vice versa.

<sup>1</sup> All statutory references are to the Public Utilities Code, unless otherwise noted.

<sup>2</sup> See "Assigned Commissioner[s] and Administrative Law Judge's Ruling Approving Solar Water Heating Pilot Program," Rulemaking (R.) 06-03-004, February 15, 2007

### **1.3 Program Goals**

CSI-Thermal Program is designed to significantly increase the adoption rate of SWH technologies into the California marketplace. The program strategy and design principles will address the barriers to growth, namely installation costs, lack of public knowledge about SWH, permitting costs and requirements, and a potential shortage of experienced installers.

The primary goals of the CSI-Thermal Program include the following:

- Significantly increase the size of the SWH market in California by increasing the adoption rate of SWH technologies, including:

- Achieving the installation of natural gas-displacing systems that displace 585 million therms (equivalent to 200,000 single family residential systems);
- Achieving the installation of electric-displacing SWH systems that displace 275.7 million kWh (kilowatt hour) per year (equivalent to 100,800 single family residential systems); and
- Achieve an expansion of the market for other solar thermal technologies that displace natural gas and electricity use, in addition to SWH.

-Support reductions in the cost of SWH systems of at least 16% through a program that increases market size and encourages cost reductions through market efficiency and innovation;

-Engage in market facilitation activities to reduce market barriers to SWH adoption, such as high permitting costs, lack of access to information, and lack of trained installers;

-Increase consumer confidence and understanding of SWH technology and their benefits

## **2. Program Eligibility Criteria and Requirements**

The criteria and requirements listed below must be met for a project to be deemed eligible for a CSI-Thermal program incentive.

### **2.1 Participants in the CSI-Thermal Program**

#### **2.1.1 Customer Participation**

The Customer is the owner of the solar water heating system at the time the incentive is paid. For example, when a vendor sells a turnkey system to a property owner, the property owner is the Customer. In the case of a third-party-owned system, the third party (or leaser) is the Customer. See section 5.3, Incentive Reservation for Third Party Purchases, for more details. Customers have two installation options: They may hire one of the program's approved contractors to install their system or they may choose to do a self installation.

##### **2.1.1.1 Customer Class**

The CSI-Thermal customer class and incentive rate will be determined by the utility rate schedule of the Customer. In cases where the requested incentive rate differs from the classification of the Host Customer utility rate schedule, the customer must work with their utility to have that changed by the time the incentive is paid. This program consists of two customer classes: single family residential and multifamily/commercial. Each class is further broken down into natural gas water heating customers and electric water heating customers.

### **2.1.1.2 Natural Gas Displacing SWH customer**

To be eligible for gas-displacing SWH incentives, the applicant must be a gas customer of PG&E, SDG&E or SoCal Gas. The applicant must be installing SWH on a new or existing home or business to offset gas water heating. If SWH becomes mandatory for new home construction in the state of California, new homes will no longer be eligible for incentives under this program.

### **2.1.1.3 Electric Displacing SWH customer**

To be eligible for electric-displacing SWH incentives, an applicant must be an electric customer of PG&E, SCE, or SDG&E. The applicant must be installing SWH on an existing home or business to offset electric water heating. New construction projects are not eligible to receive an incentive under the electric-displacing portion of this program.

**Question for workshop:** Is eligibility defined broadly enough to allow third-party ownership?

### **2.1.1.4 Propane or other heating oil displacing SWH customer**

**Question for workshop:** Should solar water heaters that displace propane or other heating oil be eligible for CSI-Thermal Incentives?

## **2.1.2 Contractor Participation**

All contractors applying for an incentive through the program must become approved through the CSI-Thermal Program Administrators. Contractors must meet the license, warranty, and training requirements as stated in this handbook. Contractors must submit the Contractor Participation Application available online, along with the required labor warranty. Each contractor who meets these requirements will be added to our list of approved contractors. This list will be available publicly on the program website.

### **2.1.2.1 License Requirements**

Installation contractors must have an active A, B, C-4, C-36 or C-46 license, and be in accordance with rules and regulations adopted by the State of California Contractors State Licensing Board (CSLB). If a contractor's license expires or becomes suspended during the program, the PAs will inactivate their approved contractor standing until their license becomes active again. Current projects will not be paid unless the system was signed off by the city or county prior to the suspension or until expiration of the license becomes active again.

### **2.1.2.2 Training Requirements**

Contractors are required to attend a designated CSI-Thermal training workshop. Only contractors who participate in the workshop will be allowed to install and collect incentives from the program. The workshop provides an overview of the CSI-Thermal Program Handbook, application process, program requirements, technical requirements, and additional resources. In order to remain on the active list of approved contractors, contractors must maintain a minimum of three installations per year or must attend the designated workshop annually.

Although not required, installation contractors are encouraged to become certified by the North American Board of Certified Energy Practitioners (NABCEP). For additional information on NABCEP, go to [www.nabcep.org](http://www.nabcep.org).

### **2.1.3 Self Installer**

Self-installations are allowed in the CSI-Thermal Program. Homeowners or building owners who choose to install a system must attend a designated CSI-Thermal training workshop. The training workshop provides an overview of the CSI-Thermal Program Handbook, application process, program requirements, technical requirements, and additional resources. Self installers must install their SWH system within 12 months of attending the required training or they must re-attend the designated training.

Self-installers are also required to comply with all applicable laws, codes, regulations, permits and installation requirements listed in this handbook. Self-installers will receive the incentive payment directly once all program requirements have been met. Self installers must submit receipts or invoices showing 100% of the system has been purchased. XXX.

### **2.1.4 Equipment Sellers**

Equipment sellers may be the same as the contractor. If the equipment seller is not the contractor, indicate the contact information for the seller on the Program Application. Equipment sellers must be appropriately licensed by XX XX.

### **2.1.5 Site Definition**

#### **2.1.5.1 Single family project site definition**

Any eligible site must be either an existing building with an electric water heater, be a customer of SDG&E, PG&E, or SCE, and have a unique electric meter number; or be a new or existing building with a gas water heater, be a customer of SDG&E, PG&E, or SoCal Gas, and have a unique gas meter number.

#### **2.1.5.2 Multifamily/Commercial project site definition**

## **2.2 Equipment Eligibility and Requirements (Pub. Util. Code § Sections 2864 and 2865)**

### **2.2.1 Eligible Equipment**

In order to receive an incentive through the CSI-Thermal Program, installed solar water heating equipment must meet the following criteria:

- Single family residential SWH systems must have a Solar Rating and Certification Corporation (SRCC) OG-300 System Certification;
- Solar collectors used in multifamily residential, commercial, or industrial water heating shall have SRCC OG-100 Collector Certification;
- Components must be new and unused;

### **Question for Workshop: Should we allow used copper piping?**

- Systems must be installed in conformity with manufacturer's specifications and all applicable codes and standards;

- SWH systems must have meters or other kilowatt thermal (kWth) measuring devices to monitor and measure system performance and the quantity of energy generated or displaced by the system. Meters are required for systems displacing over 30 kWth;

SWH systems that meet the above criteria and that obtained the final signed off building permit by the appropriate city or county building department after July 15, 2009 will be eligible to apply for a CSI-Thermal incentive.

### **2.2.2 Ineligible Equipment and System Applications**

CSI-Thermal will only pay incentives to SWH systems that displace gas or electricity usage. The California Public Utilities Commission may consider, at a later date, allowing incentives to non-SWH solar thermal systems that displace gas usage and meet all other program requirements.

### **2.2.3 Building Permit Requirements**

Completion of a project will be proven with a final signed off building permit issued by the appropriate City or County building department. Permits signed off before July 15, 2009 are not eligible for the CSI-Thermal program.

### **2.3 Warranty Requirements**

All systems must have a minimum of a 10-year manufacturer's warranty on the solar collector(s), minimum of 1-year manufacturer's warranty on the individual balance of system components, and a minimum of 1-year warranty on installation labor and workmanship. Standard warranty information must be submitted with the Contractor Participation Application. The customer and contractor must both sign the warranty section of the project application form indicating that the above warranty documents have been provided. Contractors installing direct forced circulation systems must provide the end-user with a 5-year warranty on equipment and labor against freeze damage.

**Question for Workshop:** Should we require the warranty provisions to be written into the contract between the customer and the contractor?

### **2.4 Energy Efficiency Requirements**

An energy audit is required for all existing residential and commercial buildings in order to receive a CSI-Thermal incentive. The audit must have been performed during the past three years. Acceptable audit protocols consist of an online audit, telephone audit, or onsite audit provided by the utilities, Program Administrator, or a qualified independent vendor or consultant. A copy of the completed Energy Efficiency Audit must be submitted with the project application.

Customers may submit proof of Title 24 energy efficiency compliance issued within the last three years as an alternate to an energy efficiency audit. A Title 24 report would be required for new residential homes to satisfy energy efficiency requirements.

**Question for workshop:** Is an audit a sufficient energy efficiency requirement, or should there be some energy efficiency measures that we should mandate, such as low-flow showerheads or insulating exposed pipe?

### **2.5 Metering Requirements**

### **2.5.1 Small Systems (under 30 kWth)**

Systems displacing 30 kWth and below, the equivalent to a 14 collector system or smaller, will have metering and monitoring equipment installed for program evaluation purposes on a sample of these systems, including residential, commercial, and multifamily properties. The cost for monitoring equipment on this sample will be borne by the PAs through their measurement and evaluation (M&E) budgets.

### **2.5.2 Large Systems (over 30 kWth)**

Performance monitoring and metering equipment will be required on all solar thermal installations with a capacity of displacing over 30 kWth, which is the equivalent to a 15 collector system or larger.

## **2.6 Owner's Manual**

CSI-Thermal requires the contractor to provide a detailed operation and maintenance manual to the customer at the time of the final inspection. The owner's manual should contain details on system design and operation, including a maintenance schedule, a sequence of operations for system shutdown and restart, warranty information and contact information for follow-on service. A properly designed Owner's Manual will help the customer maintain and troubleshoot the system so that it performs better and fewer calls are made to the contractor.

## **2.7 Quality Assurance**

It is the intent of the CSI Thermal Program to provide incentives for reliable, permanent, safe systems that are professionally installed, and comply with all applicable federal, state, and local regulations. All systems must be installed in compliance with the SRCC standards and guidelines.

### **2.7.1 Inspection Requirements**

Program Administrators will conduct a system inspection visit for the first three single family systems and the first three multifamily/commercial systems installed by each approved contractor. Program Administrators will determine a random sampling process thereafter, and reserve the right to increase the inspection sample at any time. Projects that do not pass the CSI-Thermal Program inspection will not receive the incentive payment until the necessary corrections have been made. Program Administrators will inform the installing contractor of the items that need to be corrected, and contractors are expected to make every attempt to correct the failure items within 30 days. Corrections may be verified at the Program Administrators discretion via an onsite re-inspection or through acceptable photos of the correction items. Program Administrators reserve the right to revoke the contractor's approved status if contractor fails to make requested corrections.

### **2.7.2 Fraud**

The Program Administrators will exercise their judgment in assessing fraud, which can occur due to gross negligence or intentional submission of inaccurate system information in an attempt to collect more incentive dollars. Fraud may be determined at any stage of the CSI Thermal Program process. If it is determined that fraud has been committed, a reasonable sanction shall be imposed at the discretion of the Program Administrator, and may result in a suspension from the CSI Thermal Program for a minimum of one year.

### **2.7.3 Right to Audit**



The Program Administrators reserve the right to conduct spot checks to verify that project related payments were made as identified in the final invoices or agreements provided by equipment sellers and/or contractors. As part of these spot checks, the Program Administrators will require Applicants to submit copies of cancelled checks, credit card statements, or equivalent documentation to substantiate payments made to the equipment seller and/or contractor. The final amount legally incurred or paid to the equipment seller and/or the final amount paid to the contractor for the purchase and installation of the system must match the cost information identified in the project application.

To meet this requirement, the system owner must submit final invoices and/or a copy of the final agreement, and cost documentation must provide sufficient information to identify clearly the equipment purchased and the labor paid. If there is no direct proof of actual payment from the system owner to an appropriately licensed contractor or seller, the incentive will be cancelled or reduced. Applicants must explain the difference if the final amount paid by the Applicant is different from the amount of the purchase or installation shown in any agreement or invoice or in the previously submitted Reservation Request.

In addition, the final invoices or agreements should clearly indicate the extent to which the CSI Thermal incentive lowered the cost of the system to the system owner. If the system owner has entered into an agreement to pay the equipment seller over time rather than in lump sum, the final agreement must indicate the terms of payment and the amount of any deposits or payments paid by Applicant to the equipment seller to date. The system owner must pay the cost of any system installation prior to submitting a payment request to the Program Administrator.

When submitting this documentation, Applicants are encouraged to remove their personal account numbers or other sensitive information identified in the documentation.

### **3. CSI-Thermal Program Incentive Structure**

The CSI-Thermal Program incentives are available to help make solar thermal technology financially viable for the system owner; therefore the incentive must be passed down to the system owner. For single family projects, the system owner should pay the contractor the project cost minus the incentive amount and the incentive will be paid directly to the contractor as the final payment for the project. The incentive will be paid up front for both gas and electric-displacing SWH systems that meet program participation requirements. Incentives will be calculated based on estimated first year therm or kWh displacements of the SWH system. Incentive rates will decline over the life of the program in four steps to facilitate market transformation. Applicants will use the online incentive calculation tool provided by the program, as described in paragraph 4.

Incentives will decline from step to step when the amount of reserved or paid incentives is equal to the budget allocation for the customer class of natural gas displacing systems in each service territory. If a Program Administrator receives applications accounting for more dollars than what is left in the budget allocation for a given step, a lottery may determine which projects receive the higher incentive level. The electric displacing step changes will occur at the same time as natural gas step changes. Incentive step changes will move independently in each service territory and for each class of customer. Incentives will be paid on a first come, first serve basis. The most current information on incentive step status per customer class will be posted on the statewide Go Solar California website, as well as each Program Administrator's website.

Customers may not receive SWH incentives from both a utility energy efficiency program and CSI Thermal for the same SWH system. A CSI-Thermal Program incentive may not exceed the total project cost alone or when combined with other incentives.

**Note to workshop:** Some language about incentive steps and other features of the application process will change once it has been determined whether the application process will be a one-step or two-step process.

### 3.1 Natural Gas Component

Incentive rates will decline over the duration of the program in four steps. The following table displays the dollar amount per therm in each step and the total budget amount per step.

Step	Incentive per therm displaced	Funding Amount
1	\$12.82	\$50,000,000
2	\$10.26	\$45,000,000
3	\$7.69	\$45,000,000
4	\$4.70	\$40,000,000

#### 3.1.1. Single-Family

Single family residential system incentives are calculated using the SRCC OG-300 estimation of annual therm savings in the appropriate climate zone, combined with the solar orientation factor (SOF). The SOF is calculated by measuring the tilt and compass orientation, or azimuth, of the SWH collectors. The actual incentive paid to any qualified system is derived by multiplying the system's OG-300 rating by the incentive rate in the appropriate step as listed in the table below.

Step	Incentive per therm displaced	Maximum Incentive Single Family Residential Projects	Funding Amount
1	\$12.82	\$1,875	\$20,000,000
2	\$10.26	\$1,500	\$18,000,000
3	\$7.69	\$1,125	\$18,000,000
4	\$4.70	\$680	\$16,000,000

Example of the incentive formula for a project submitted in Step 1 is as follows:

SRCC OG-300 estimated annual therm savings X \$12.82 X SOF= incentive amount

#### 3.1.2. Multi-Family/Commercial

Step	Incentive per therm displaced	Maximum Incentive for Commercial/Multifamily SWH projects	Funding Amount
1	\$12.82	\$500,000	\$30,000,000
2	\$10.26	\$500,000	\$27,000,000
3	\$7.69	\$500,000	\$27,000,000
4	\$4.70	\$500,000	\$24,000,000

### 3.2 Electric Component

As incentives decline under the gas-displacing program, a corresponding reduction occurs to the electric-displacing incentive. Like the gas incentive rates, electric incentive rates will decline over the duration of the program in four steps. The following table displays the dollar amount per kWh in each step.

#### 3.2.1. Single-Family

Single family residential system incentives are calculated using the SRCC OG-300 estimation of annual kWh savings in the appropriate climate zone, combined with the solar orientation factor (SOF). The SOF is calculated by measuring the tilt and compass orientation, or azimuth, of the SWH collectors. The actual incentive paid to any qualified system is derived by multiplying the system's OG-300 rating by the incentive rate in the appropriate step as listed in the table below.

Step Level	Electric-Displacing Incentive (\$/kWh)	Maximum Incentive for Residential System
1	0.37	\$1263
2	0.30	\$1025
3	0.22	\$750
4	0.14	\$475

SRCC OG-300 estimated annual -kWh savings X \$12.82 X SOF= incentive amount

#### 3.2.1. Multi-Family/Commercial

#### 4. CSI-Thermal Program Incentive Calculator

An online calculator tool will be available to estimate natural gas or electricity displacement for SWH systems based on system location, design and expected performance.

#### 4.1 SRCC OG-300 Single Family Incentives

There are three variables to calculating the incentive for SRCC OG-300 single family projects:

- SRCC estimated annual energy savings, based on the California Energy Commission (CEC) climate zone of the project site

- Incentive Step Level at the time the application is approved

- Solar Orientation Factor (SOF), which includes the azimuth and tilt of the collectors

Incentive Calculation Formula example for Step 1: SRCC OG-300 estimated annual therm savings X \$12.82 X SOF= incentive amount

#### 4.2 SRCC OG-100 Multi-Family/Commercial

## **5. Incentive Application Process for CSI-Thermal Program**

### **5.1 Single Family Project Application Process**

Applying for a CSI-Thermal incentive for single family system installations will be a one-step process.

#### **5.1.1 Application Submittal**

#### **5.1.2 Application Approval**

#### **5.1.3 Payment Process**

### **5.2 Multifamily/Commercial Project Application Process**

Applying for a CSI-Thermal incentive for multi-family/commercial system installations will be a two-step process.

### **5.3 Requesting an Incentive Reservation**

#### **5.3.1. Incentive Reservation for Third Party Purchases**

### **5.4 Incentive Reservation Approval**

### **5.5 Changes to Reservations**

#### **5.5.1. Installed Equipment**

#### **5.5.2. Extending the Reservation Expiration Date**

### **5.6 Incentive Payment Request Process**

#### **5.6.1. Requirements for Incentive Payment**

### **5.7 Incentive Payment Approval**

## **6. Technical Requirements**

### **6.1 Design and Installation Criteria**

In all cases, systems must be installed in conformance with the manufacturers' specifications and with all applicable electrical, plumbing and building codes and standards. Permits are required for all solar thermal project installations. All systems must be installed in compliance with the SRCC standards and guidelines.

### **6.2 Freeze Protection**

All installed systems must meet freeze protection requirements set forth by SRCC. The CSI-Thermal Program relies on the California Energy Commission's (CEC) 16 climate zones to determine eligibility of appropriate freeze protection technologies. It is important to note that most collector manufacturers will not guaranty against freeze damage.

### **6.2.1. Integral Collector Storage**

Integrated Collector Storage (ICS) systems are protected by the thermal mass of the storage in the collector down to the Freeze Tolerance Level (FTL) as certified by SRCC. If the historical low temperature for the climate zone of the project site has dropped below the FTL for a period of 18 hours or greater, the ICS system should not be installed in that climate zone. ICS systems are not permitted in climate zones 14, XX, XX, XX, XX due to high overnight heat losses.

### **6.2.2. Direct Forced Circulation**

Direct Forced Circulation freeze protection will not be allowed in climate zones where the historical low temperature for the project site has dropped below the FTL for a period of 18 hours or greater. Direct Forced Circulation systems are only permitted in climate Zones 7, XX, XX (Coastal) if installed with the appropriate automatic freeze drain valve, which is properly maintained. Direct forced circulation freeze protection entails many risks:

- If the winter temperatures are cold and/or the freeze sensor is inaccurate, or improperly installed the energy losses can be high due to the frequent nighttime running of the pump
- If power is lost in near-freezing conditions, the pump will not operate and freeze damage might occur.
- Scale can block warm water flow thru the small tubes in the collector and the automatic freeze drain valve
- Thermal migration upwards from the solar tank can reduce the effectiveness of the freeze sensor or automatic freeze drain valve
- With multiple collectors the risk of localized freeze damage is magnified unless multiple freeze drain valves are used.
- Even if everything is done correctly, a risk exists that the ambient temperature depression, coupled with clear night sky radiation could draw down the heat energy stored in the solar tank.
- Microclimate variations, such as mountains and valleys, increase the risk of freeze damage.
- Another risk associated with direct forced circulation freeze protection systems is stagnation during summer or periods of low use, causing scale to block risers. This risk is discussed in Section 6.5, Stagnation.

Contractors installing direct forced circulation systems must provide the end-user with a 5-year warranty on equipment and labor against freeze damage.

### **6.2.3. Closed Loop Glycol**

Active and Passive (Thermosyphon) Closed Loop systems are protected by a mixture of propylene glycol and water in the collector loop. Most code jurisdictions require a double-walled heat exchanger if the glycol is not classified as a Class I non-toxic fluid, according to the Gosselin Toxicity Index. A two walled heat exchanger provides separation of the glycol mixture from the potable water supply, to prevent mixing of the fluids in the event of a leak and to provide visibility of the leak. Glycol systems require periodic maintenance, and are subject to breakdown if exposed to high temperature. Glycol systems should have means to limit damage from high temperature, and the glycol fluids should be tested every few years, with replacement of the glycol every five to ten years. Maintenance requirements must be clearly explained in the owner's manual, and maintenance service should be included in the contract. Clear labels must

warn against substituting toxic antifreeze fluid for propylene glycol. Closed Loop Glycol systems are acceptable in all CEC climate zones with the appropriate ratio of glycol to water for the historical low temperatures.

#### **6.2.4. Closed Loop Drainback**

Drainback systems drain the water from the collectors when the pump shuts down. This is the most reliable freeze protection method if properly installed. Piping must be continuously sloped (at least ¼ inch per foot) to drain back from the collectors. The added benefits of a drainback system include reducing the risk of scalding, scaling, and collector relief valve blowoff, which might occur during vacations or times of low use especially in the summer. In sunny conditions, drainback systems pump water through the collectors, and heat is then transferred from the collector water to the potable water supply via a heat exchanger. Drainback systems are acceptable in all CEC climate zones.

### **6.3 Shade**

It is strongly recommended that contractors use a Pathfinder, Solmetric SunEye, or similar device to conduct a shade analysis at the project site. The maximum amount of annual average shading of solar collector(s) allowed between the hours of 10 am and 3 pm is 10%. Collectors with an annual average shade greater than 10% are not eligible for an incentive through the CSI-Thermal Program.

### **6.4 Scalding**

Anti-scald valves are required in accordance with local code. Should the local code not require an anti-scald valve, then a system must still minimally meet the OG300 requirement for a mixing valve. All installed systems must have scald protection.

Acceptable anti-scald valves include ASSE 1017, 1016 or 1070 certified anti-scald valves.

The following valves are certified by the American Society of Safety Engineers and are acceptable for use in the CSI-Thermal Program.

The choice of which valve(s) to use depends on the site and customer needs. In any event, pressure drop should be a consideration. If water pressure to the valve is low, and there is a long pipe run to taps, seek a valve that has low pressure drop.

ASSE 1016 valves are for points of use (showers and taps), and are usually installed on new construction.

ASSE 1017 valves are installed just downstream from the conventional water heater. They react to pressure or temperature extremes more rapidly than traditional tempering valves. The output temperature is adjustable, and on some models can be as high as 160°F. They are intended for use where higher temperatures are needed downstream, such as for hydronic space heating, but should be locked at the lowest acceptable temperature. Some are limited to 120 degrees. If a high temperature ASSE 1017 valve is used, another, ASSE 1070 valve should be used downstream from the heating loads and before the showers and taps.

ASSE 1070 valves can be used in conjunction with ASSE 1017 valves, by providing a 110°F max set point downstream from higher temperature branches, closer to the end-use points.

If for example, the home has a long pipe run from the water heater to a shower, consider an adjustable ASSE 1017 valve, set the temperature at the water heater high enough to deliver sufficient heat to the shower, and install point of use ASSE 1016 devices on taps enroute to the shower to protect against scalding. Or, if feasible, install an ASSE 1070 anti-scald mixing valve where appropriate to limit final temperature to the other taps.

If required, or if installing a one-tank solar system, CCSE encourages the use of ASSE 1017 rated anti-scald valves which are adjustable up to 120 or 145°F and locked at a reasonable setting for the site. In those homes with pre-existing low water pressure we encourage points-of-use anti-scald devices.

Scalding is a serious risk. Over 23,000 children under age 4 were scalded by shower or bath water in 2006. This was with conventional water heaters and normal temperature set points. A solar heating system can add 10°F to 50°F to the set point temperature.

Scalding is an especially high risk for young children, senior citizens, or invalids. A person can suffer third degree burns in 3 to 5 seconds if exposed to 140°F water. The worst case is a solar system that feeds hot water to end use points with no intermediate anti-scald valves. This effect is especially a concern when a system is oversized. This can happen with either a single tank or a two-tank system. It is most dangerous in summer during a period of low hot water use and hot air temperatures. Solar temperatures can reach as high as 180°F (higher if it is an evacuated tube installation).

In the past, it was common to see Watts tempering valves installed on the hot out pipe from the auxiliary water heater. These provided some degree of scald protection, but are not true “anti-scald” valves. To be called “anti-scald”, the valve must have been certified to ASSE 1016, 1017 or 1070 standard. True anti-scald valves respond more safely to pressure or temperature changes.

Anti-scald devices have improved over the years and, in addition to anti-scald mixing valves, there are simple faucet and showerhead fittings that protect against scalding, and are easily attached. Modern mixing valves may be capable of higher temperatures before failing. Contractors are required to install a mixing valve downstream from the water heater, or at points-of-use. To reduce call-backs due to “no hot water”, it behooves the Contractor to spend a bit more for devices that can withstand higher temperatures, and have low pressure drop.

## **6.5 Stagnation/Overheat Protection**

Stagnation is also a serious risk. It may lead to equipment damage or injury from scalding. Stagnation occurs in open systems when the pump stops running in a hot condition, and the water in the collector boils off. This hot water can damage roof asphalt tiles or sealant used for roof penetration. If there is a risk of this happening, a temperature and pressure relief valve is required at the collector, with a drain to a safe area that won't cause damage to the roof or injury to persons.

Conditions conducive to stagnation are:

- Hot summer days, with little or no hot water consumption

- An efficient collector or more
- A high limit control shutting the pump off when the sun is heating the collector

A risk of scalding occurs when the collector stagnates and boils off. If the pump comes on while someone is using hot water, a plug of scalding water could be sent through the hot water line to the point of use.

The ideal protection is a drainback system. Drainback systems allow the water in the collector loop to drain back into a small storage tank whenever the solar loop pump is shut down (e.g., when the high temperature limit is reached). If there is no water in the collector loop, boil off can't occur.

Another way to reduce the risk of stagnation in an open system is to require the owner to partially drain the collector loop whenever the risk is high (e.g., going on vacation and periods of less use). If this is the only means of preventing stagnation, it must be clearly explained in the owner's manual.

## **6.6 Roof Loading**

Thermosyphon and ICS system may require roof load calculations based on the roof structural layout, due to the weight of the solar storage tank on the roof. The roof load limit is not a factor for active systems (systems with only the collector and mounting and plumbing hardware on the roof). Local code officials may require a structural engineer to sign calculations for roofs if the roof load exceeds a certain weight. Contractors should be familiar with local code requirements.

## **6.7 System Sizing**

### **6.7.1 Single Family projects**

Single-family residential system size should be based on the number of occupants in the household or based on actual hot water usage, as determined through metering prior to installation. One SRCC OG-300 system will typically be sufficient for one household. The following guidelines are required for appropriate system sizing for single family solar water heating systems:

-Determine demand: Assume 20 gallons per day (GPD) of hot water usage by the first occupant, 15 GPD by the second occupant, and 10 GPD by each additional occupant.

-Determine collector space needed: A general rule of thumb is one square foot of collector space per gallon of hot water used per day.

-Select an SRCC OG-300 system with the appropriate square footage of collector space.

### **6.7.2 Multifamily/Commercial Projects**

## **7. Acronyms**

**AB:** Assembly Bill

**CCSE:** California Center for Sustainable Energy



**CPUC:** California Public Utilities Commission

**CSI:** California Solar Initiative

**CSI TP:** California Solar Initiative Thermal Program

**CSLB:** California State Licensing Board

**CT:** Current Transformer

**DOE:** Department of Energy

**GPD:** Gallons Per Day

**kWh:** Kilowatt-hour

**NABCEP:** North American Board of Certified Energy Practitioners

**NREL:** National Renewable Energy Laboratory

**OG:** Operating Guidelines

**PE:** Professional Engineer

**PG&E:** Pacific Gas and Electric

**PRV:** Pressure Relief Valve

**SB:** Senate Bill

**SDG&E:** San Diego Gas and Electric

**SOF:** Solar Orientation Factor

**SRCC:** Solar Rating and Certification Corporation

**SWH:** Solar Water Heating

**SWHPP:** Solar Water Heating Pilot Program

**UL:** Underwriter's Laboratory

## 8. Definitions

**Customer:** An eligible customer must be the owner of the system.

**Freeze Tolerance Level (FTL):**

**Multi-Family Dwellings:** Multifamily complexes are defined as those with five (5) or more dwelling units. Duplexes, triplexes, and four-plexes will be qualified as single family homes for the purposes of determining income eligibility.”

**Question for workshop:** Are there likely to be situations where Duplexes, triplexes, and four-plexes share a single boiler, and therefore require an OG-100 rated system? Should we change this definition to be more accommodating of such situations?

**OG-100:** Operating Guidelines 100 (OG-100) is a certification and rating program for solar collector developed by the Solar Rating and Certification Corporation (SRCC). The purpose provides a means for evaluating the maintainability of solar collectors and a thermal performance rating characteristic of all-day energy output of a solar collector under prescribed rating conditions.

**OG-300:** Operating Guidelines 300 (OG-300) is the solar water heating system rating and certification program developed by the Solar Rating and Certification Corporation (SRCC). The purpose of this program is to improve performance and reliability of solar products and is based upon the determination by SRCC that the system successfully meets its minimum criteria for design, reliability and durability, safety, operation and servicing, installation, and operation and maintenance manuals.

**Site: Residential:** Any eligible site must be either an existing building with an electric water heater, be a customer of SDG&E, PG&E, or SCE, and have a unique electric meter number; or be a new or existing building with a gas water heater, be a customer of SDG&E, PG&E, or SoCal Gas, and have a unique gas meter number.

**Solar Rating and Certification Corporation (SRCC):** SRCC is a non-profit organization that operates as an independent third party certification entity. SRCC administers a certification, rating, and labeling program for solar collectors and a similar program for complete solar water heating systems.

## 9. Program Contact Information

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