Heat pump water heaters are modeled based on their rated EF. In addition to recognizing the performance impact of loads on annual efficiency, the heat pump water heater model also includes a climate zone adjustment to reflect changes to heat pump efficiency with the ambient temperatures in that climate zone.

3. Instantaneous Gas Water Heaters

A PIER-sponsored evaluation of instantaneous (or tankless) gas water heaters was completed to assess whether the rated Energy Factor for these units accurately describes real world system performance. Results of the study indicate that the Energy Factor test procedure underestimates the impact of small volume hot water draws and heat exchanger cycling on annual system performance. Based on these findings, the 2008 Standards applied a 0.92 derating factor on the nominal EF of all gas instantaneous water heaters. This derating was validated by further PIER field research completed in 2011.

Instantaneous water heaters are occasionally installed with small electric storage buffer tanks downstream of the tankless unit to mitigate the potential for cold water sandwich effects. If one of these units is installed, both the buffer tank and the instantaneous water heater must be modeled. The buffer tank must be listed in the CEC Appliance Directory and the listed standby wattage is used to model the buffer tank as a separate electric point of use water heater. In cases where the buffer tank in built into the instantaneous gas water heater the wattage of heating coil in the buffer tank must be modeled in the same manner as if the buffer tank where separate.

4. Solar Water Heating Systems

Solar water heating can be used in compliance with single family or multi-family buildings. For treatment of solar water heating systems, please refer to Section 5.6.2.

5.5.2 Compliance Issues

Water heating is becoming more and more important to overall compliance as building envelope performance and mechanical efficiency improved. When the performance approach is used, a high efficiency water heater can significantly impact the overall performance margin of a building especially in the milder climates like climate zones 4 through 9, where water heating typically represents a larger fraction of the overall house energy budget.

Asking for a cut sheet on the installed equipment to verify efficiency is a simple shortcut to checking compliance. Also note that when used in a combined hydronic system it is important to check the capacity of the system to verify that both space and water heating loads can both be met

5.6 Solar Water Heating

The Water Heating Calculation Method allows water heating credits for solar water heaters. Solar systems save energy by using non-delectable resources to offset the use of conventional energy sources.

For single-family solar systems, All systems must be Solar Rating and Certification Corporation (SRCC) approved. Accepted testing procedures include either fully approved system with OG-300 test results or built up system that use the collector (OG-100) rating. For

multi-family, only systems with OG-100 collectors can be installed. For more detailed instructions on installation of solar water heaters refer to RA4.4. The sort able database of SRCC-certified is located on the SRCC website[1].

Figure 5-13 summarizes the process flow for demonstrating compliance via both the prescriptive and performance compliances.

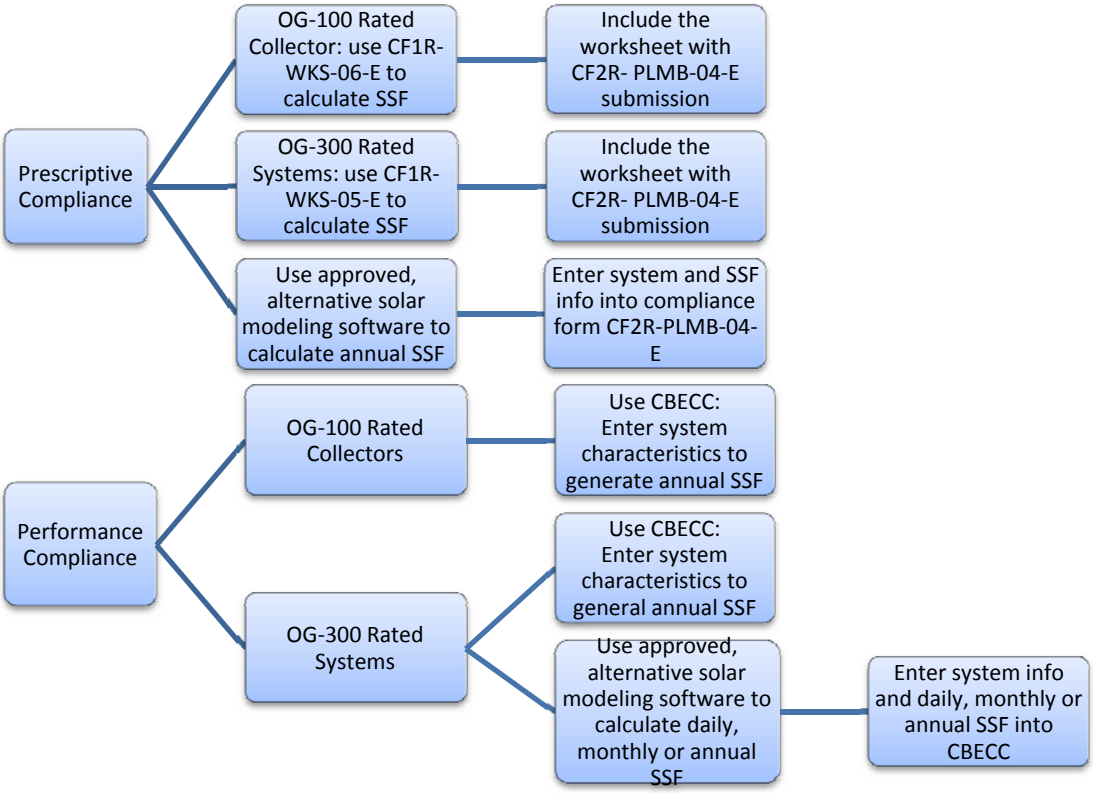

Figure 5-13 – Compliance Process for Solar Water Heating System

Under the prescriptive compliance path, to calculate SFF for OG-300 systems go to the following link.

http://www.gosolarcalifornia.org/solarwater/nshp/swh_calc_systems.php

and complete the use the compliance worksheet. To do this you will need the Solar Energy Factor (SEF) value from the SRCC website listed previoulsy. To calculate SSF for OG-100 collectors under the prescriptive compliance use the compliance tool at the following link:

http://www.gosolarcalifornia.org/solarwater/nshp/swh_calc_collectors.php

and complete the worksheet.

Regardless of the system type installed and compliance method chosen, mandatory requirements for pipe insulation and storage tank insulation apply as described in Section 0.

Mandatory Requirements

[1] https://secure.solar-rating.org/Certification/Ratings/RatingsSummaryPage.aspx

1. Solar or Recovered Energy in State Buildings

§110.3(c)6

Low-rise residential buildings constructed by the State of California shall have solar water heating systems. The solar system shall be sized and designed to provide at least 60 percent of the energy needed for service water heating from site solar energy or recovered energy. There is an exception when buildings for which the state architect determines that service water heating is economically or physical infeasible. See the Compliance Options section below for more information about solar water heating systems.

2. Solar Ready Buildings Requirements

150.0(r),110.1

There are new mandatory requirements for all buildings to be "solar ready." The motivation behind having solar ready requirements is to encourage more future installations of both photovoltaic and solar water heating systems, even if these systems are not installed during the time of new construction. Details on these solar ready requirements are in the "Solar Ready Requirements" chapter of the compliance manual. In summary, the elements to being solar ready include:

- Designated solar zone
- Designated conduit and plumbing paths
- Documentation for solar zone and paths on construction plans, and
- Adequate electric busbar and panel capacity

5.6.1 Prescriptive Requirements

This section discusses when solar water heating is required prescriptively for systems serving single and multiple-dwelling units.

1. Single Family

Solar water heating is prescriptively required for systems serving single family dwelling units with electric water heaters. Where no natural gas is available the standards allow the use of either electric-resistance storage or instantaneous water heater systems to serve single family dwelling units but only with the use of solar water heating. To use this prescriptive option all of the following requirements and conditions must be met:

a. If natural gas is unavailable to the home; and

b. The water heater is located within the building envelope; and

c. Recirculation pumps are not used; and

d. The water heating system includes a solar water-heating system with a minimum SSF of 0.50.

In meeting the solar thermal system criteria the system or collectors must be certified by Solar Rating and Certification Corporation (SRCC) as described above in the introduction to 5.5. Either OG-100 or OG-300 systems can be installed. Installation of a solar water heating system exempts single family homes from needing to set aside solar zone for future solar PV or solar water heating installation (§110.10(b)1A).

The collector installation must also meet the installation requirements detailed in RA-4.4. These requirements specify that systems complying with the OG-300 system must be installed to the following guidelines:

a. Face within 35 degrees of due south; and

b. Have a tilt slope of at least 3:12; and,

c. Be un-shaded by buildings or trees. See the residential appendix RA4.4 for details.

For built up systems using components and the OG-100 collector rating the collectors must be installed to match the specification entered when the solar thermal system was modeled.

For compliance with either option, you will need to print out the results and submit along with the completed compliance form.

2. Multi-family, Motel/Hotels and High-Rise Nonresidential

150.1(c)8Ciii

Solar water heating is prescriptively required for water heating systems serving multiple dwelling units, whether they are multi-family, motel/hotels or high-rise nonresidential buildings. The minimum SSF is dependent on the climate zone: 0.20 for CZ 1 through 9, and 0.35 for CZ 10 through 16. The regulations do not limit the solar water heating equipment or system type, as long as they are SRCC certified and meet the orientation, tilt and shading requirement specified in RA4.4. Installation of a solar water heating system exempts multifamily buildings from needing to set aside solar zone for future solar PV and solar water heating installation (§110.10(b)1B). The following paragraphs offer some high-level design considerations for multifamily building solar water heating systems.

A high-priority factor for solar water heating system design is component sizing. Proper sizing of the solar collectors and solar tank ensures that the system take full advantage of the sun's energy while avoiding the problem of overheating. While the issue of freeze protection has been widely explored (development of various solar water heating system types is a reflection of this evolution), the issue of overheating is often not considered as seriously as it should be, especially for climate conditions with relatively high solar insolation level such as California. This is especially critical for multifamily-sized systems, due to load variability.

The solar water heating sizing requirements for the Standards are conservative, the highest SSF requirement called for by the 2013 Title 24 at 50%. Stakeholders further suggested that industry standard sizing for an active system is 1.5 ft^2 collector area per gallon capacity for solar tank. For more detailed guidance and best practices, there are many publicly available industry design guidelines. Two such resources developed by/in association with government agencies are *Building America Best Practices Series: Solar Thermal and Photovoltaic Systems*[2] , and *California Solar Initiative – Thermal: Program Handbook*[3].Because of the new solar water heating requirement and prevalence of recirculation hot water systems in multifamily buildings, it is essential to re-iterate the importance of proper integration between the hot water recirculation system and the solar water heating system. Industry stakeholders recommended the recirculation hot water return to be connected back to the system *downstream* of the solar storage tank. This eliminates the unnecessary wasted energy used to heat up water routed back from the recirculation loop that may have been sitting in the solar water tank if no draw has occurred over a prolonged period of time.

[2] http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/41085.pdf

[3] http://www.cpuc.ca.gov/NR/rdonlyres/CB11B92E-DFFF-477B-BFA9-F1F04906F9F9/0/CSIThermal_Handbook201209.pdf

Another design consideration is the layout and placement of collectors and solar tank. The idea here, similar to the discussions on recirculation system design in Section 5.3.3, is to minimize the length of plumbing, thus reducing pipe surface areas susceptible to heat loss and piping materials needed. This calls for the shortest feasible distance between the collectors themselves; furthermore, since solar tanks are typically plumbed in series with, just upstream of the conventional/auxiliary water heating equipment, the distance between collectors and solar tank should also be as short as practically possible.

5.6.2 Performance Compliance

Solar water heating systems with SSF higher than the specified prescriptive minimum or required mandatory level can be used as a tradeoff under the performance approach. Figure 5-13 shows the compliance process needed for demonstrating compliance with solar water heating modeling. The new CEC compliance software integrates the capability of calculating an annual SSF. Users now input collector and system component specifications to calculate a corresponding SSF for the proposed system. The SSF along with other system parameters should be entered into compliance form which will be used to populate the certificate of compliance.

5.7 Swimming Pool and Spa Heating

5.7.1 Swimming Pool and Spa Types

The Standards now include many additional requirements for residential swimming pool filtration equipment which affect pump selection and flow rate, piping and fittings, and filter selection. These new Standards are designed to reduce the energy used to filter and maintain the clarity and sanitation of pool water.

5.7.2 Mandatory Requirements

Before any pool or spa heating system or equipment may be installed, the manufacturer must certify to the Energy Commission that the system or equipment complies with §110.4 and §110.5. The requirements include minimum heating efficiency according to Appliance Efficiency Regulations, an on-off switch outside the heater, permanent and weatherproof operating instructions, no continuous pilot light, and no electric resistance heating (see exceptions below).

§110.5

Pool and spa heaters may not have continuously burning pilot lights.

§110.4

Outdoor pools and spas with gas or electric heaters shall have a cover installed. The cover should be fitted and installed during the final inspection.

There are two exceptions for electric heaters, which may be installed for: