Australian Government

Office of the Renewable Energy Regulator

Renewable Energy (Electricity) Regulations

Regulation 19B

LEGISLATIVE INSTRUMENT

Determination of the method to be used to determine the number of certificates that may be created for a particular model of solar water heater

Version 1 – March 2011

I, Andrew Livingston, Renewable Energy Regulator, make this determination for the purposes of regulation 19B of the Renewable Energy (Electricity) Regulations.

In making this determination, I had regard to:

(1) the method set out in the Australian Standards listed in Schedule 4 of the Renewable Energy (Electricity) Regulations, as in force at the date of this determination; and

(2) the guidelines known as *REC calculation methodology for solar water heaters and heat pump water heaters with a volumetric capacity up to and including 700 litres*, as in force at the date of this determination; and

(3) the guidelines known as *REC calculation methodology for solar water heaters and heat pump water heaters with a volumetric capacity over 700 litres*, as in force at the date of this determination.

Andrew Livingston
Date: 23 March 2011

Federal Register of Legislative Instruments F2011L00486

Contents:

Part 1: Definitions used in this instrument

In this Legislative Instrument, unless the contrary intention appears:

AS/NZS 2535.1: 2007 means Australian and New Zealand Standard *AS/NZS 2535.1: 2007 Test methods for solar collectors — Part1: Thermal performance of glazed liquid heating collectors including pressure drop*

AS/NZS 2712: 2007 means Australian and New Zealand Standard *AS/NZS 2712: 2007 Solar and heat pump water heaters – Design and construction*

AS/NZS 3498: 2009 means Australian and New Zealand Standard *AS/NZ 3498: 2009 Authorization requirements for plumbing products—Water heaters and hot-water storage tanks*

AS/NZS 4234: 2008 means Australian and New Zealand Standard *AS/NZS 4234: 2008 Heated water systems – Calculation of energy consumption*

AS/NZS 4552: 2005 means Australian and New Zealand Standard *AS/NZS 4552: 2005 Gas Water Heaters for hot water supply and/or central heating*

AS/NZS 4692.1: 2005 means Australian and New Zealand Standard *AS/NZS 4692.1: 2005 Electric water heaters. Part 1: Energy consumption performance and general requirements*

AS/NZS 5125.1: 2010 means Australian and New Zealand Standard *AS/NZS 5125: 2010 Heat pump water heaters – performance assessment*.

COP means coefficient of performance

extension package TRNAUS means the TRNSYS extension package for Australian Solar Products, see TRNAUS, *TRNSYS Extensions for Australian Solar Products*. Solar Thermal Energy Laboratory, School of Mechanical & Manufacturing Engineering, University of NSW. (http://www.solar1.mech.unsw.edu.au/glm/trnaus/trnaus.pdf)

HPWH means an air source heat pump water heater, or a solar water heater with an air sourced heat pump booster.

large SWH means a SWHs with a volumetric capacity over 700 litres which is not a HPWH

Morrison et al (2004) means Morrison G.L., Anderson T and Behnia M. (2004) Seasonal performance rating of heat pump water heaters, ISES Solar World Congress conference 2002, also *Solar Energy* V76, 147-152, (2004)

ORER means the Office of the Renewable Energy Regulator

PV means Photovoltaic

STC means small scale technology certificate

SWH means solar water heater

small SWH means a SWHs with a volumetric capacity up to and including 700 litres which is not a HPWH

TRNSYS computer modelling package means the Transient Energy System Simulation Tool computer modelling package produced by the Solar Energy Laboratory at the University of Wisconsin-Madison, The Centre Scientifique et Technique du Batiment in Sophia Antipolis, France, Transsolar Energietechnik GmBH in Stuttgart, Germany and Thermal Energy Systems Specialists in Madison, Wisconsin. See *TRNSYS User Manual*, Klein, S.A. et al., The University of Wisconsin Solar Energy Laboratory

Part 2: STC Calculation Methodology for Solar Water Heaters with a volumetric capacity up to and including 700 Litres and Air Source Heat Pump Water Heaters with a volumetric capacity up to and including 425 Litres

A. Introduction

Part 2 contains the methodology for determining the number of STCs that may be created for SWHs with a volumetric water storage capacity up to and including 700 litres ('small SWHs') and HPWHs with a volumetric water storage capacity up to and including 425 litres.

B. Methodology

The methodology for determining the number of STCs that may be created for a small SWH or HPWH is as follows:

1. Using Versions 15 to 16 of the TRNSYS computer modelling package, format the TRNSYS deck files as set out in the TRNSYS Modelling Guidelines in Part 4 of this Instrument.

2. Calculate the **total annual auxiliary energy** (MWh/y) for the small SHW or HPWH using the TRNSYS computer modelling package, using the following TRNSYS input parameters:

    a. Solar collector slope = 20°.

    b. Solar collector azimuth = 45°.

    c. For the climatic zones, use the weather data provided on the CD that is part of AS/NZS 4234: 2008.

    d. Select the hot water load (small, medium or large) such that a minimum energy savings of 60% is achieved in zone 3 for medium or large loads (heat pump water heaters and solar assisted heat pump water heaters achieving less than 50% solar energy savings in zone 3 may only be assessed at small or medium load). A minimum delivery temperature of 45°C must be achieved for each zone for which STCs are to be claimed.

    e. The modelling of product shall show compliance with the legionella control requirements specified in AS 3498: 2009.

f. To rate thermosiphon solar water heaters and thermosiphon sidearm heat exchangers, use the extension package TRNAUS for TRNSYS.

g. HPWH COP and power consumption performance shall be determined from full system tests in a calorimeter chamber. The performance shall be correlated using either:

   (i) the method described in AS/NZS 5125: 2010 or,

   (ii) only up to and including 23 December 2011, the method described in Morrison et al (2004).

h. All other input parameters and control strategies must be those used in the actual system, except where outlined in the Special Circumstances in Division C of Part 2 of this Instrument.

3. (a) For small SWHs (other than gas boosted SHWs) and HPWHs, subtract the **total annual auxiliary energy** used by the small SHW or HPWH from the energy use of the reference electric water heater in AS/NZS 4234:2008 supplying the same load (Table A10 AS/NZS 4234:2008) to determine the **displaced energy**.

   (b)For gas boosted SWHs use Appendix G of Amendment 1 to AS/NZS 4234:2008 to determine the **displaced energy**.

4. Convert the displaced energy to MWh/y.

5. Multiply the displaced energy in MWh/y by 10 to determine the **10 year MWh savings**.

6. Round down the ten year MWh savings to the nearest lower integer.

7. That number is the number of STCs that may be created for the small SWH or HPWH in the relevant zone.

C. Special Circumstances

The parameters used to calculate the total auxiliary energy for step 2 in the Methodology in Part 2 Division B are subject to modification in the following special circumstances.

(1) Dual Element Tanks

For systems where a bottom element is, or can be, fitted in the tank (e.g. a dual element tank) the bottom element is to be used. The minimum boost time for a bottom element shall be nominal off-peak times of 11 pm to 6 am.

Some tank designs may be modified by the installer to insert an element at the bottom of the tank even if this element has been blanked off. If a model uses a tank that can have the bottom element connected at the time of installation or at any later time, the bottom element is to be used.

(2) One-Shot Boosting

One-shot boosting is a manual control that allows a default boost mode (such as off-peak boosting) to be overridden so that the user can satisfy a short term high demand for hot water.

Where the system automatically resets to the default boosting mode within 24 hours of the user changing the boost mode, the one-shot boosting can be ignored.

Where the system does not automatically reset to the default boosting mode within 24 hours of the user changing the boost mode, the boosting mode activated by the manual control must be considered to be active at all times.

(3) Combined photovoltaic (PV) and water heating collectors

Combined PV and water heating collectors that do not incorporate a concentrator may obtain STCs for the water heating aspect of the mechanism if the following testing regime is documented.

(a) PV output

The PV output shall be assessed using a collector with the water heating part of the collector empty.

(b) Water heating output

The thermal efficiency of the collector shall be assessed to AS/NZS 2535: 2007 with the PV output set to maximum power conditions. The electrical output of the collector shall not be included in the thermal efficiency assessment.

Part 3: STC Calculation Methodology for Solar Water Heaters with a volumetric capacity greater than 700 Litres

A. Introduction

Part 3 contains the methodology for determining the number of STCs that may be created for SWHs with a volumetric water storage capacity over 700 litres ('large SWHs').

B. Methodology

The methodology for determining the number of STCs that may be created for a large SWH is as follows:

1. Using Versions 15 to 16 of the TRNSYS computer modelling package, format the TRNSYS deck files as set out in the TRNSYS Modelling Guidelines in Part 4 of this Instrument.

2. Calculate the **total annual auxiliary energy** (MWh) for the large SWH using the TRNSYS computer modelling package, using the following TRNSYS input parameters:

   a. Solar collector slope = 20°.

   b. Solar collector azimuth = 45°.

   c. For the climatic zones use the weather data provided on the CD that is part of AS/NZS 4234: 2008.

   d. The modelling of the product shall show compliance with the legionella control requirements specified in AS 3498:2009.

   e. To rate thermosiphon solar water heaters and thermosiphon sidearm heat exchangers, use the extension package TRNAUS for TRNSYS.

   f. To determine tank heat loss:

      i. For SWHs with a tank which is 630 Litres or larger is to be determined in accordance with the document titled *ORER Heat Loss Test Procedure for Solar Water Heaters with a Hot Water Storage Tank Greater than 630 Litres,* 2003 (see http://www.orer.gov.au/publications/heatloss.html).

ii. For sub-element tanks smaller than 630 Litres the applicable tank heat loss assessment method specified in AS/NZS 4692: 2008 is to be used.

g. The modelled lengths of piping shall be based on the following:

i. For a pumped circulation system, the length of pipe between the storage tank and the closest corner of the solar collector array for shall be the manufacturer's specification or 25 m (each way), whichever is larger.

ii. For all systems the lengths of the supply and return pipes shall account for additional piping length associated with reverse return plumbing.

iii. For a pumped circulation solar preheat tank, the length of piping between the tank and the series auxiliary booster shall be the manufacturers specification or 10 m whichever is larger.

iv. For a thermosiphon solar preheater, the length of piping between the preheater and the series auxiliary booster shall be the manufacturer's specification or 25 m whichever is larger.

v. The diameter of all connecting piping shall be equal to the manufacturer's specifications.

h. All other input parameters and control strategies must be those used in the actual system, except where outlined in the Special Circumstances in Division C of Part 3 of this instrument.

3. Select the **peak daily winter load** to suit the scale of the installation. The load shall be the same for all zones and set such that the solar water heater achieves at least 60% annual energy savings in zone 3. A minimum delivery temperature of 45°C must be achieved for each zone for which STCs are to be claimed.

4. Determine the **annual energy use** of an electric water heater ('the reference system') supplying the same hot water load, as follows:

i. The heat loss from the reference system shall be 15% of the hot water load, therefore use a factor of 1.15.

ii. The time weighted average seasonal load multiplier to be used is 0.905, see AS/NZS 4234:2008.

iii. Multiply 365 by 0.905, by 1.15 by the **peak daily winter load**.

5. Determine the displaced energy as follows:

   i. For non-gas boosted systems subtract the **total annual auxiliary energy** used by the SWH, calculated in Step 2, from the **annual energy use,** calculated in Step 4, to determine the **displaced energy**.
   ii. For gas boosted systems, the equivalent displaced electric energy shall be determined using Appendix G of AS/NZS 4234:2008 except the annual electrical energy use of reference electric heater shall be as calculated in Step 4.

6. Convert the displaced energy to MWh/y.

7. Multiply the displaced energy (MWh/y) by 10 to determine the **10 year MWh savings**.

8. Round down the ten year MWh savings to the nearest lower integer.

9. That number is the number of STCs that may be created for the large SWH in the relevant zone.

C. Special Circumstances

The parameters used to calculate the total auxiliary energy for step 2 in the Methodology in Part 3 Division B are subject to modification in the following special circumstances.

(1) Dual Element Tanks

For systems where a bottom element is, or can be, fitted in the tank (e.g. a dual element tank) the bottom element is to be used. The minimum boost time for a bottom element shall be nominal off-peak times of 11 pm to 6 am.

Some tank designs may be modified by the installer to insert an element at the bottom of the tank even if this element has been blanked off. If a model uses a tank that can have the bottom element connected at the time of installation or at any later time, the bottom element be used.

(2) One-Shot Boosting

One-shot boosting is a manual control that allows a default boost mode (such as off-peak boosting) to be overridden so that the user can satisfy a short term high demand for hot water.

Where the system automatically resets to the default boosting mode within 24 hours of the user changing the boost mode, the one-shot boosting can be ignored..

Where the system does not automatically reset to the default boosting mode within 24 hours of the user changing the boost mode, the boosting mode activated by the manual control must be considered to be active at all times.

(3) Combined photovoltaic (PV) and water heating collectors

Combined PV and water heating collectors that do not incorporate a concentrator may obtain STCs for the water heating aspect of the mechanism if the following testing regime is documented.

(a) PV output

The PV output shall be assessed using a collector with the water heating part of the collector empty.

(b) Water heating output

The thermal efficiency of the collector shall be assessed to AS/NZS 2535: 2007 with the PV output set to maximum power conditions. . The electrical output of the collector shall not be included in the thermal efficiency assessment.

(4) Family of Products

A 'family of products' is where a combination of tanks and collectors are used in a modular fashion to create a product range of different sizes.

Where a range of solar collector array sizes are used on the same storage tank the performance of the family of products may be determined from detailed simulation of the performance of the largest, smallest and midpoint array sizes. The performance of other members of the family may be determined by interpolation.

For a solar system consisting of parallel sub-units, each having an identical solar collector array and storage tank configuration, the total annual auxiliary energy of the system may be calculated by multiplying the total annual auxiliary energy of one sub-system by the number of sub-systems. Note the volume of the sub-systems tanks can be less than 700 L, but the combined physical inner volume of the sub-systems tanks must add to more than 700 L to if this approach is to be used.

Part 4: TRNSYS Modelling Guidelines

A. Introduction

The TRNSYS modelling guidelines set out below describe the format and structure required for the TRNSYS deck files and the default values to be used in certain circumstances. These guidelines must be adhered to.

B . TRNSYS MODELLING GUIDELINES

TRNSYS DECKS

Deck layout

- All include files shall be at the top of the deck immediately after the SIMULATION statement.
- Use the deck structure provided by ORER, *ORER template deck*, 2011(see http://www.orer.gov.au/manufacturers/index.html) or another deck structure approved by the Regulator.
- The include files shall be as provided by ORER and shall not be modified.
- All constants shall be towards the top of the deck.
- The output, list and other output file names shall be the same as the deck name except for the file type.

Simulation display

- **Simulation output**: A TYPE 25 printer unit shall be included in the deck. This shall output the following results: the zone, load size, percent energy savings, STC rating and annual energy delivered below 45°C.

- **Energy balance:** A monthly energy balance in a TYPE 28 output unit shall be included in the deck. This shall include a full system energy balance i.e. collector input + boosting + pump input – load – pipe losses – tank losses – energy dumped

- **Runtime graph:** A runtime graph (TYPE65) shall be included in each deck showing at least

  Hot water delivery temperature
  Solar collector flow rate
  Solar collector inlet temperature
  Solar collector outlet temperature
  Load
  Similar variables shall be plotted for heat pump water heaters.

Controller default settings

- If the maximum tank temperature setting of the pump controller used for no-load system operation test (clause 7.4.3.2 in AS/NZS 2712: 2007) is not specified in the AS/NZS 2712: 2007 test report, then a maximum value of 65°C shall be used.
- For a simple temperature difference pump controller the minimum turn off temperature difference shall be 1 K.

Piping models

- All piping shall be modelled using the TYPE 31 pipe routine.

Gas heater defaults

- If an instantaneous gas booster has not been assessed for electrical power consumption during standby under AS 4552: 2005, then a value of 10 W shall be used. If the electrical power consumption during burner operation is not available, then a value of 50 W shall be used.

Storage tank stratification

- The default stratification specification for a pumped circulation solar preheat storage tank shall be "Uncontrolled flow pumped circulation" (AS/NZS 4234: 2008 clause 3.7.4) unless the collector flow return to the solar preheat tank is in the top 2/3rds of the tank.

Effective air temperature

- The effective air temperature used to determine solar collector and piping heat loss during night time (horizontal irradiation < 1 kJ/h m2) shall be Taeff = Ta – (Ta –Tsky)/5, where Ta denotes the ground level air temperature and Tsky the sky temperature as defined by AS/NZS 4234: 2008.
- The effective air temperature used to determine solar collector and piping heat loss during day time (horizontal irradiation ≥ 1 kJ/h m2) shall be Taeff = Ta.

Units

- The units system used in TRNSYS is metre, kg, h and kJ. All energy transfer rate parameters must be converted from W to kJ/h (multiply Watts by 3.6 to get kJ/h).