U/BS/FS/WPSC

ORIGINAL

Decision 82 08 071 AUG 18 1982

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Application of Entropy Limited for exemption from certain checklist requirements of Decision Nos. 92251, 92501 and 92769.	Application 82-01-03 (Filed January 5, 1982)

OPINION ON SOLAR WATER HEATER ELIGIBILITY

Entropy Limited (Entropy) is a manufacturer of domestic solar water heating systems which it markets under the names Sunpump and Suncycle. The system is an atypical system which is not currently eligible for rebates under the Commission's OII 42 program. Entropy requests that the Commission find the Sunpump system eligible. Entropy also requests exemption from items 5, 6, 13, 17, 20, 23, and 29 of the Commission's checklist requirements, arguing that such requirements are unnecessary or inappropriate for its particular system. Entropy also proposes methods to determine minimum sizing for its system to be eligible for rebates or loans.

In this decision, the Commission finds Entropy's Sunpump systems eligible under specified circumstances. The Commission grants Entropy exemption from checklist items 5, 17, 20, and 23, and partial exemption from item 13. The Commission denies Entropy

exemption from items 6 and 29 and establishes an additional requirement regarding insulation. Finally, this decision sets forth sizing criteria for Entropy's systems.

Applicant's Background

Entropy has manufactured essentially the same solar water heater in Boulder, Colorado since the mid-1970's. Although most Entropy systems have been sold in Colorado, some have been installed in the New England states since Entropy participated in a U.S. Department of Energy solar water heater demonstration there. Others are located in the Southwestern states and most recently in Southern California.

Entropy systems use two or more of its one-square meter (11 sq. ft.), slightly concentrating collectors. Only about seven gallons per day of water is needed per collector for normal heat transfer. Little water is needed not because the collector is small but because the water is actually boiled, concentrating the collected energy into steam (at atmospheric pressure).

The steam expands by its own pressure, through the piping, to the heat exchanger provided with these collectors. The steam's heat is transferred through this heat exchanger to the potable water being heated. The condensed steam water is usually

recycled by a pump from the heat exchanger back to the collectors. Any heat transfer water evaporating from the system is automatically made up with water from the city mains inlet line.

This design has features of both open loop and closed loop systems. City mains water is used in the collectors, yet the water recirculates. At the same time, the recirculation loop is open to the atmosphere. This unique combination has caused some misunderstandings about the applicability of several items on the OII 42 Installation Checklist. An Entropy system that would be eligible for the OII 42 programs is shown in Appendix A.

Program Background

On September 16, 1980, we issued Decision (D.) 92251 establishing demonstration solar financing programs for Pacific Gas and Electric Company, San Diego Gas & Electric Company, Southern California Edison Company, and Southern California Gas Company. We subsequently modified this decision by D.92501, December 5, 1980, and D.92769, March 3, 1981. In these decisions, we specified a checklist of requirements for domestic solar-water heaters. Solar water heaters must meet all sizing and checklist requirements to be eligible for the solar financing program effective March 1, 1981.

By its letter to the Executive Director on December 17, 1981, and its application which was docketed as Application 82-01-03 on January 5, 1982, Entropy Limited (Entropy) requested eligibility and certain exemptions from the checklist requirements established by D.92251, 92501, and 92769.

Entropy requests eligibility for systems sized by its own method, believing that no recognized method appeared applicable. The following exemptions are also requested from the current Post-Installation Inspection Checklist which became effective June 22, 1981. In the following sections, each Checklist Item is listed along with Entropy's argument for an exemption and the Energy Conservation Branch (ECB) position. Discussion of sizing and other issues starts on Page 13.

Closed Loop Fluid Sampling Valve

Item 5. "On a closed loop system, has a sampling or drain valve been provided in the collector loop?"

The intent of this item is to allow routine monitoring of the quality of recirculating ("closed loop") heat transfer fluid, and to allow it to be changed if necessary. The means of draining the system is actually covered by Item 4.

Entropy's rationale for exemption:

> "A drain valve is not required in the collector loop of an electric powered system. The water bypass line provides that function: any excess water supplied to the collector is automatically drained back to the holding tank."

Entropy's rationale does not address the the intent of Item 5. The holding tank lid in Entropy systems provides the necessary access for sampling fluid quality using a small cup or scoop. Therefore no sampling valve is needed. Assuming such a valve is not supplied, utility inspectors should make certain that Item 4 is satisfied so that draining can be accomplished whenever desired. Item 4 is discussed on Page 12.

Valving for Independent Operation

Item 6. "Has provision been made to permit independent operation of conventional back-up systems; and in the case of single family gas back-up systems, has valving been provided to enable both solar and conventional systems to operate independently?"

The intent of this item is to improve reliability and to separate water stored at different temperature levels to improve system collection efficiency.

Entropy's rationale for exemption:

> The Sunpump domestic hot water systems may be attached directly to electric, oil, or gas back-up tanks, and no valving is required. In all cases the solar and conventional systems may operate together, or independently, with no manual or controller valving required."

Entropy's rationale does not address the intent of Item 6. Separate solar storage tanks, or properly designed single tanks combining both solar and auxiliary heated storage, have been widely used in the utility programs to improve collection efficiency.

In Entropy systems, separate storage would not improve efficiency, because all steam condenses, even when the water is already hot. But there are still two reasons why valving is needed.

A bypass valve (one 4-port or three 2-port) is required at the auxiliary (backup) tank for gas backup single family systems to improve standby efficiency, because such tanks are poorly insulated internally. During summertime solar-only operation, solar heat would be lost via convection up the central flue of the gas backup tank if solar heated water were to flow through the tank, on its way from the solar storage tank to the fixtures.

A bypass valve for efficiency is not required at an electric backup tank, because such tanks have no internal flue and are generally well-insulated.

Bypass valving at the solar storage tank is also required for reliability in both gas and electric backup two-tank (solar plus backup) systems. On electric one-tank systems, or stratified solar-plus-backup one-tank systems, simple shutoff valves at the solar piping connections are adequate. In case of a pressure

leak in the retrofit solar system, the system may be completely isolated for repairs while the backup provides all hot water for the dwelling, through the original plumbing as it did before the solar system was added.

Multi-family systems have a variety of backup methods. Bypass valving to satisfy the reliability criterion above must always be provided.

Thus, while we recognize that Entropy collectors do not improve in collection efficiency due to this requirement, we believe that overall system efficiency, as well as reliability, are improved by the valving arrangements described and no exception appears justified.

Piping Diameter

Item 13. "Is plumbing 3/4 inch type M copper or better?"

The intent of this item is to prevent the flow restrictions which develop after a few years in hot water piping, especially at connections, due to hard water deposits or corrosion inside the pipe.

Entropy's rationale for exemption:

> "The Sunpump system water supply and water bypass lines require only 1/2" lines, with a 1/4" section for flow meter connections. Typical flow rates through these lines are on the order of 1 to 2 G.P.H.; maximum flow rate for very large systems would be 9 G.P.H."

Entropy's rationale is appropriate. Typical heat transfer liquid flow rates for conventional systems with circulating pumps are about 100 gallons per hour (G.P.H.). Entropy offers an optional trickle flow pump (an intermittent "jet" pump) which reduces the flow rate to less than 10% of this amount per collector. But reducing pipe diameter from 3/4 inch to 1/2 inch only reduces the area for fluid flow to 44% of the 3/4 inch pipe area. Therefore use of 1/2 inch pipe is justified, but on the collector supply water and bypass piping only. This pipe size reduction is not justified at all in systems using a conventional, high-flow rate circulating pump. All other piping must be 3/4 inch copper, except the makeup water line and flow meter connections.

Temperature and Pressure Relief Valves

Item 17. "Are temperature and pressure relief valves installed on the system in the proper places?
(On pressurized systems, this is on the tank. On closed loop systems, it is on the tank and on the collector loop.)"

The intent of this item is to prevent an explosion hazard from developing between closed valves due to overheating of any fluid that might be contained.

Entropy's rationale for exemption:

> "The Sunpump closed loop systems (gravity and electric powered) require no pressure relief valves in the collector loop since the collectors are always directly vented to the atmosphere through the atmospheric vent at the system heat exchanger."

Entropy's rationale is appropriate. Entropy "closed loop" systems actually contain a short vertical section of 1/2-inch pipe as a vent which is open to atmosphere. It is located in the collector bypass line and is needed to accommodate the large daily temperature variation in the heat transfer circuit. That is, the "closed" loop is not really closed at all, and cannot be, by intent or accidently, when the system is installed according to the manufacturer's directions. Therefore, utility inspectors need only check for the presence of the open 1/2 inch pipe vent, in place of a conventional pressure relief valve. A pressure and temperature relief valve is unnecessary, and the requested exemption from Item 17 is justified.

Vacuum Relief Valves

Item 20. "In drain-down systems, has a vacuum relief valve been installed in the system? (Not applicable to closed loop systems with expansion tanks.)"

The intent of this item is to assure reliable freeze protection. In most drain-down systems, a vacuum will hold water in the lines unless air (atmospheric pressure) can reach the uppermost part of the piping when the pump is turned off. The vacuum relief valve lets air into the piping. (Entropy must address this item because its systems are not "closed loop with expansion tank".)

Entropy's rationale:

"The Sunpump closed loop systems require no vacuum relief valves since the water feed and bypass lines are directly vented to the atmospheric vent (same vent as #17)."

Entropy's rationale is appropriate. The 1/2 inch open pipe vent for pressure relief also serves to relieve vacuum and to permit immediate drain down when the pump stops. No vacuum relief valve is necessary.

Expansion Tank

Item 23. "Has the expansion tank been located on the suction side of the pump?"

This item applies to true closed loop systems, which may build up internal pressure when hot. It does not apply to Entropy systems, because the recirculation loop is vented to atmosphere. Entropy referred to another type of tank in its rationale.

Entropy's rationale for exemption:

> "The jet pumps sometimes used with the Sunpump electric powered systems use an expansion tank on the pressure side of the pump. In this application the expansion tank is used as a pressure ballast tank in the same manner that it is typically used to provide a pressurized water supply to a residence using water supplied from a well. In the solar system application it is used to provide the small quantity of water required by the Sunpump collectors with minimum use of electrical power and minimum running time on the pump."

Entropy's rationale does not address the intent of Item 23. The "expansion tank" in Entropy's system is functionally an accumulator or fluid spring to lift water to the collectors. Relocating it for any reason would defeat its purpose in the Entropy system. Item 23 is not applicable to Entropy.

System Operation Indicator

Item 29. "Is a device which indicates that the system is operating installed?"

The intent of this item is to indicate whether water is being heated.

Entropy's rationale for exemption:

"Sunpump systems are frequently installed to operate in a passive mode requiring no electrical power, or, in the case of electrically powered systems, to operate with an absolute minimum of parasitic power. For that reason and because there are typically no moving parts in the system, operating indicators or pump power indicators are available as options or to meet any special system requirements."

System operation means heating water. That may be indicated by a thermometer in a solar hot water pipe before the backup tank. In the case of a one-tank system, two thermometers should be provided - one each on the inlet and outlet water lines connecting the heat exchanger to the conventional water heater tank - to permit comparison of temperatures. Lights or flow meters would show only that something is moving. No exemption from Item 29 is justified.

Flushing and Draining

Item 4. "Has a method for flushing and draining the system been installed, unless prohibited by manufacturer's specifications?"

This item is related to Item 5 discussed on page 4. The intent of this item is to simplify the restoration of the system's original performance, after the passage of time has degraded the heat

transfer fluid and inner surfaces. It is especially important to be able to do so in Entropy's systems, because they use untreated tap water as a boiling heat transfer fluid.

Entropy recommends silicone caulk be used to re-seal the pinned plugs in the ends of its collectors each time they are removed for cleaning. Caulking must be used, and no other type is said to be suitable because of the high collector temperature. The ECB believes this feature is impractical for a 20-year service life, and recommends that standard brass 2-inch threaded pipe plug fittings with screw plugs be used for this purpose instead of the pinned and caulked plugs now used.

Similar fittings, or hose bibs, should be installed in the recirculation loop piping or holding tank, to permit the water to be completely changed periodically, in compliance with Item 4.

Because system performance is degraded only indirectly by non-compliance with this item, it need not be retroactive to systems already installed.

Sizing and Other Issues

The process of solar energy transfer from the collectors to the storage tank in the Entropy system differs in two important respects from most of the systems eligible under the OII 42 program.

Heat Transfer Water Quality

The heat transfer fluid in Entropy systems changes from a liquid to a vapor and back again during operation. That is, the water in the collector first absorbs enough energy to raise its temperature to the boiling point. It continues absorbing solar energy in the collector, while changing to steam, until about seven times as much energy has been absorbed as was needed to raise the water to the boiling point in the first place. The steam with this highly concentrated energy flows of its own pressure (only about 0.5 psi), either up or down, to the heat exchanger, which is normally mounted on the side of the solar storage tank. There the solar energy is given up by the steam as it condenses back to water, thus transferring the heat at this point into the potable water.

Any particulates, dissolved minerals or other impurities in a boiling heat transfer fluid will gradually be deposited in the collectors, and scale does form in Entropy collectors at normal operating temperatures of around 200 degrees F. In most parts of the country the small amount of scale that forms from the initial charge of tap water does not noticeably degrade performance. The scale is soft, like that in a household teakettle, and Entropy states that it may be flushed with a garden hose. Further, Entropy

notes that only about one pint of water per collector per year is lost to evaporation through the 1/2 inch vent, and is replaced with more tap water, through the automatic make-up device. Therefore, Entropy believes that flushing at short intervals is not normally necessary.

Enough scale may accumulate to reduce system efficiency, however, if the local water is hard (containing significant amounts of dissolved minerals), and especially if leaks develop in the system causing excessive amounts of make-up water to be introduced. Also, maintenance by flushing would be more difficult if stagnation conditions were to cause the soft scale to harden.

Entropy reports that its systems have been in place for up to six years in Colorado, the New England states and the Southwest. No water quality problems are unresolved. The method used in Southern California, to remove the clay particulates commonly found, is the use of a water filter, now supplied with Entropy systems sold there.

Considering again the OII 42 program assumption of 20 years of energy savings from each installed solar water heater, the ECB staff recommends that one of the conditions for OII 42 eligibility be that Entropy dealers and do-it-yourself installers must certify that only distilled or deionized water was used for the initial charge in the heat transfer loop.

Moreover, if the accumulation of water impurities in the system causes a measurable loss of system efficiency, we interpret Entropy's standard 5-year warranty to specifically cover restoration of performance by servicing for removal of these deposits at no charge to the customer. Entropy should also modify the system at the same time to permit the owner to avoid similar problems during the remainder of the 20-year life, under the local water conditions which degraded the initial performance during the first five years.

Water-Powered Solar System

A "water powered" version of Entropy's system is available as well as the electric-powered and gravity-powered versions. In the water-powered version, the condensed steam drains away and is not recycled. All of the water used comes under pressure directly from the city water line, thereby eliminating the need for a pump.

The ECB notes that the water-powered version would need frequent cleaning of scale in California. The water-powered version also would use over 10,000 gallons of water per year in addition to the heated potable water consumed, because of the need for a small but constant flow of water to flush impurities. Under California water conditions including occasional shortages and of high particulates and dissolved minerals, the ECB believes the

water-powered version of Entropy systems would on average probably not conserve enough resources, net, over its assumed 20-year life, to justify eligibility for utility rebates or loans.

Steam Line Insulation

The second significant issue is piping insulation. Heat losses from piping are considerable in typical systems where the temperature of the heat transfer fluid (water) is in the range 100-140° F. The fluid (steam) in Entropy's system is usually hotter than 200° F, between the collector and the heat exchanger.

The insulation specified in Entropy's installation instructions specify one-inch thick High Density Fiberglass Tube Wrap. The steam line insulation, if increased from the standard one-inch thickness to a two-inch thickness, would save about 10,000 Btus per year per foot of steam line, or about $4 per foot over the 20-year system life. No foamed materials or organics should be used for this insulation, if high temperature and ultraviolet degradation would result. Therefore, the ECB believes that two-inch thick insulation, as used in Colorado, is cost-effective and should be required in Entropy installations, since the piping losses can waste 20% or more of the collectors' daily output.

Aluminum Absorbers

Early models of Entropy collectors labeled SCM-200 used a coated aluminum absorber tube. Entropy has used copper absorbers since observing corrosion of the aluminum absorber after installation. Only these later models, labeled SCM-201, should be eligible for the OII 42 program.

Excessive Solar Heated Water Temperatures

Since Entropy's system operates at the boiling point of water, the water being heated can approach this temperature if hot water demand is low. The hazard of accidential scalding of the user is minimized by the OII 42 Installation Checklist requirement for a cold water mixing or tempering valve on the hot water service line.

Still, the Entropy system should not be connected directly to a conventional water heater tank because high water temperature safety devices in those tanks may be triggered. Such gas valves or thermostatic circuit breakers, when exposed to water temperatures above some limit (which may be only 160°F), will prevent any further backup energy from heating the water. The one-time safety device once triggered must often be replaced by a serviceman.

In two-tank configurations, the solar heated water is physically separated from the conventional water heater. Entropy's heat exchanger should instead be connected not to the conventional water heater, but to such solar-only solar storage tanks (or to the lower portion of a one-tank configuration designed for solar applications). The tempering valve should be installed near the solar storage tank outlet, (or the one-tank outlet), preceding any other tank, fixture or component which might receive very hot water.

Freeze Protection and Pipe Slope

Entropy collectors have a single fluid passage about two inches in diameter, which it states is maintained only about 20% full of water. Entropy states that no collector damage can result from collector freezing due to this large air gap.

All piping to and from the collectors, however, must be uniformly sloped to completely drain into adequately freeze-protected areas. Freeze protection of any drainback system would be jeopardized without such slope. Moreover, in the Entropy system, steam condensation collecting in possible low sections of the piping would restrict steam flow and lower system performance. In contrast, the collectors must be absolutely level (within 1/8 inch), as described in the installation procedures, in order to produce their designed solar energy output.

Sizing

Three components of Entropy systems could be subject to sizing requirements. The first of these is storage tank size. The total volume of solar-heated plus auxiliary-heated water has been set for all systems under the OII 42 program depending on the number of tanks and the number of bedrooms served. In a two-tank system, the solar-only tank must hold 25 gallons per bedroom served. In a single tank system (combination solar tank with integral auxiliary tank above) the tank volume must be 34 (33.6) gallons per bedroom.

The second component of Entropy's system which might be subject to OII 42 sizing is the heat exchanger. There currently are no guidelines in the OII 42 program for heat exchanger sizing. Entropy states that one of its heat exchangers will serve up to 12 collectors, and that a 3/4 inch pipe will carry the resulting steam flow.

The third component is the total collector area. A solar water heater performance test known as SRCC-OG200 was recently adopted as a national standard for testing collectors and other components as a system. But California conditions may be more favorable to solar than are the national average test conditions. Moreover, since SRCC-OG200 is an expensive test, the ECB has not required it for estimating performance unless no other

test results were available. (The ECB has required SRCC-OG200 results in those cases of passive systems where it is already required for the California solar tax credit. The California Energy Commission has exempted Entropy from this requirement.)

Rather than using SRCC test results, the ECB has instead accepted other tests and made reasonable assumptions as needed to evaluate the performance of Entropy's system.

Entropy initially submitted two proposed sizing methods for its collectors. The first was based on an extreme modification of a simple manual sizing method proposed early in OII 42 by ECB staff and never actually implemented. The second method was Entropy's own complex manual calculation procedure.

The ECB preferred and requested actual test data. Entropy then provided the results from a relatively simple test method based on the constant temperature of steam. Measuring the weight of several gallons of condensed steam is simpler than measuring variable fluid flow rates and temperatures, and in Entropy's case is no less accurate. Entropy believes that its system should be sized using these test results.

The results of an independent, more conventional, test by DSET Laboratories, Inc. generally support Entropy's test results. They show that Entropy's collector/heat exchanger systems

perform much better at noon on a clear day (direct radiation), than they do early or late in the day, or under a hazy sky (off-altitude and off-azimuth radiation). Entropy's own advertising brochure shows that on a "typical clear August day" in Colorado, the collector delivers solar energy for less than seven hours, and almost none before 11 a.m. One of the reasons for this is the constant, relatively high, loss from the steam line which must be raised to temperature each day, and kept there even when the available radiation is low.

Based on available test data, the ECB recommends that an average annual output per day of 5,900 Btu be assumed for SCM-201 collectors (with the selective black chrome copper absorbers) which are installed in California under the OII 42 program. This output corresponds to 21.5 therms per year. Therefore, five collectors would be needed to meet the annual load of a 3-bedroom home under OII 42. Table 1 summarizes the minimum eligible sizing for single family homes.

Ideally, the minimum sizing shown in Table 1 would depend on many factors such as the exact location within California. But we recognize that solar water heaters increasingly are marketed as modular appliances independent of small differences in climate, orientation, tilt, and so on. Less obvious or

controllable factors such as the daily hot water use profile, installation quality, and weather variations affect solar system performance so strongly that actual savings from a given system can only be predicted within a broad range. For these reasons, and the fact that ratepayer benefits from the OII 42 program will stem from the average effect of all of the systems installed, we believe that all Entropy systems installed under OII 42 should be sized according to Table 1.

Monitoring

Entropy solar systems should be evaluated as set forth below:

a. Determine whether the systems are large enough to save at least 60% of the annual metered usage of conventional energy for water heating including adjustments for amount of hot water consumed.

b. Implement the monitoring program in households which the ECB considers likely to use 300 therms of natural gas per year (or a comparable amount of electricity) for water heating.

Eight systems should be randomly selected, four in warm climate areas and four in cold climate areas. Two systems in each climate area will be served with natural gas backup and two with electric backup.

TABLE 1

Performance of Entropy Limited Solar Water Heater Systems
Using Model SCM-201 Collector Units

Number of Bedrooms	OII 42 Minimum Output Therms/Yr.	Number of Collectors (Sq. Ft.)
1	33	2 (22)
2	68	3 (32)
3	101*	5 (54)
4	135	6 (65)

Conditions:

Daily radiation is 1,700 Btu per sq. ft.
Daily load is 20 gallons of hot water per bedroom.
Temperature rise is 70 degrees F.
Net output of one collector unit is 5,900 Btu per day or 21.5 therms per year.
Steam line is 10 feet long and insulated with 2 inches of fiberglass.
Orientation is within 45 degrees of due South at tilt equal to latitude.

*See Appendix B for derivations.

The system-monitoring program will last a minimum of nine months with interim reviews. After six months of monitoring, if any of the eight solar systems is not displacing 60% of conventional energy use (according to data extrapolated over 12 months), Entropy may meet with the ECB to discuss these results and develop a recommendation to upgrade all future installations in similar locations to avoid disqualification from the program.

Systems with electrical backup will be monitored with a water meter to determine the volume of hot water used, and an electric meter to measure water heating electricity consumption. (On natural gas backup systems, a gas flow meter will be used to measure conventional energy use.) Both will use an electric meter to measure controller parasitics and any pumping energy. The solar bypass valve will be used initially to estimate the energy consumption of the conventional water heater before the solar retrofit, so as to later determine whether the solar system is displacing 60% of that energy.

The ECB staff has discussed with Entropy these technical issues in depth. ECB recommends that Entropy be allowed to participate in the Demonstration Solar Financing Program based on the following conditions (as used below, Entropy refers to Entropy Limited and/or its installers):

a. Entropy's warranty will cover system repair or replacement due to damage by freezing wherever installed.

b. Entropy will assure that in no case is a residence converted from gas water heating to electric water heating.

c. Entropy will instruct customers to turn off pilot lights on gas backup water heaters during summer months.

d. Entropy will instruct customers to turn off electric backup water heaters during summer months.

e. Entropy will recommend installation of time clocks on all electric backup water heaters.

f. A water filter will be used in the system. The water filter available from Entropy should be installed according to Entropy between the electric pump and the flow meter.

Entropy and its installers will meet the minimum quality and sizing criteria as contained in D.92251, 92501, and 92769 and all subsequent decisions and will meet the current standards of the California Energy Commission's Solar Energy Tax Credit Guidelines when installing Entropy systems. Entropy and its installers will size systems according to the Table on Page 24.

Any reference by Entropy to this order in its correspondence, marketing literature, or media advertising must contain the following full text of this Disclaimer of Product Endorsement:

> "The California Public Utilities Commission in no way endorses, recommends, or warrants the durability, suitability, or the reliability, or the short- or long-term energy savings performance of this or any other brand of system or component for domestic water heating or any other application".

While this disclaimer is applicable to any system under our demonstration program, we must be certain that this order is not viewed by the public as an implied endorsement.

We believe that public hearings would serve no useful purpose. This application should be granted ex parte to the extent provided in the following order.

Findings of Fact

1. The heat transfer fluid in all Entropy systems may be sampled through the holding tank lid.

2. Entropy systems require the same isolation and bypass valves for reliability and efficiency as do other solar water heaters.

3. Flow in the collector supply and bypass lines in an Entropy system is less than five gallons per hour, and in the makeup water line is less than one gallon per month.

4. A high temperature relief valve would provide redundant safety against steam pressure build-up in the collector loop.

5. The vent in Entropy bypass lines also serves as a vacuum relief valve.

6. The "expansion" tank used in Entropy systems is not intended to accommodate thermal expansion of fluid.

7. Entropy systems do not include any indicators that water is being heated.

8. Entropy systems use untreated tap water as a boiling heat transfer fluid.

9. Entropy's standard warranty covers loss of performance due to scaling for five years.

10. Entropy collectors have removable pinned plugs which require sealing by caulking after each cleaning of the collector.

11. Entropy systems which are water-powered use a once-through cycle of water to steam which consumes over 10,000 gallons of tap water per year and increases the amounts of impurities entering the recirculation loop.

12. Steam line insulation if increased from the standard one-inch thickness to a two inch thickness would save about 10,000 Btu's per year per foot of steam line, or about $4 per foot over the 20-year system life.

13. Entropy collectors containing an aluminum absorber and labelled SCM-200 corrode prematurely. The Model SCM-201 contains a copper absorber.

14. Entropy systems can raise the temperature of solar heated storage close to the boiling point.

15. Conventional water heater tanks often have over-temperature safety devices which do not re-set if activated.

16. Drainback freeze protection is provided for exposed piping and collectors are not subject to damage by freezing.

17. Steam line piping condensate can accumulate and restrict steam flow at low points so as to jeopardize system safety and performance.

18. The maximum recommended number of 11-square foot collectors to be accommodated by the heat exchanger and standard 3/4" steam output line is 12.

19. Entropy's test system of one collector with heat exchanger delivered about one-third of the incident clear-day, solar energy in the test results provided.

20. A public hearing is not justified.

Conclusions of Law

1. No exemption from the requirement of Checklist Item 5 to provide for sampling of the heat transfer fluid is justified or necessary for Entropy solar water heaters assuming that they also comply with the drain requirement of Item 4.

2. Entropy systems should comply with the isolation and bypass valving requirements of Checklist Item 6.

3. Exemption from the 3/4-inch piping requirement of Checklist Item 13 is justified only for water piping between the collectors and a low flow "jet" pump and/or the holding tank, and for the make-up water line from the cold water inlet pipe to the holding tank.

4. Exemption from the pressure relief and vacuum relief valve requirements of Checklist Items 17 and 20 are justified.

5. Relocation of the "expansion" tank referred to in Checklist Item 23 would defeat its purpose in Entropy systems.

6. Entropy systems should comply with the operation indicators requirement of Checklist Item 29.

7. Entropy collectors should be fitted with threaded pipe plugs to comply with Checklist Item 4 requiring a method for flushing and draining the system without disassembly.

8. Entropy's "water-powered" system should not be eligible for the OII 42 program.

9. Entropy's customers should certify that only distilled or de-ionized water was used for the initial charge in the heat transfer loop.

10. At least a two-inch-thickness of fiberglass piping insulation should be provided on Entropy steam lines.

11. Model SCM-200 collectors containing an aluminum absorber should not be eligible.

12. Entropy heat exchangers should not be directly connected to conventional backup water heaters.

13. All collector piping should be uniformly sloped to prevent steam condensate water from accumulating.

14. Entropy systems should be sized in accordance with Table 1.

15. This application should be processed ex parte.

16. The following order should be effective the date of signature in order to allow participation in the solar financing program and competition with other solar manufacturers at the earliest time.

O R D E R

IT IS ORDERED that:

1. Entropy's Sunpump/Suncycle electrically-powered and thermosyphon solar hot water heaters using SCM-201 collectors are eligible for utility financing in the OII 42 program subject to the conditions set forth below.

2. Entropy is granted exemption from demonstrating compliance with Checklist Items 5, 13, 17, 20 and 23 per Conclusions 1, 3, 4, and 5.

3. The exemptions requested by Entropy to Checklist Items 6 and 29 are denied per Conclusions 2 and 6.

4. Entropy eligibility for utility financing under the OII 42 program is conditional on full acceptance and compliance with all other conditions and Conclusions contained in this Decision including Table 1 and the Disclaimer of Product Endorsement, as well as the current storage volume requirements.

5. Except as granted and provided, Entropy and its contractors shall adhere to all other currently effective requirements set forth in D.92251, 92501, and 92769 or subsequent orders in this proceeding.

This order is effective today.

Dated AUG 18 1982, at San Francisco, California.

JOHN E. BRYSON
President
RICHARD D. GRAVELLE
LEONARD M. GRIMES, JR.
VICTOR CALVO
Commissioners

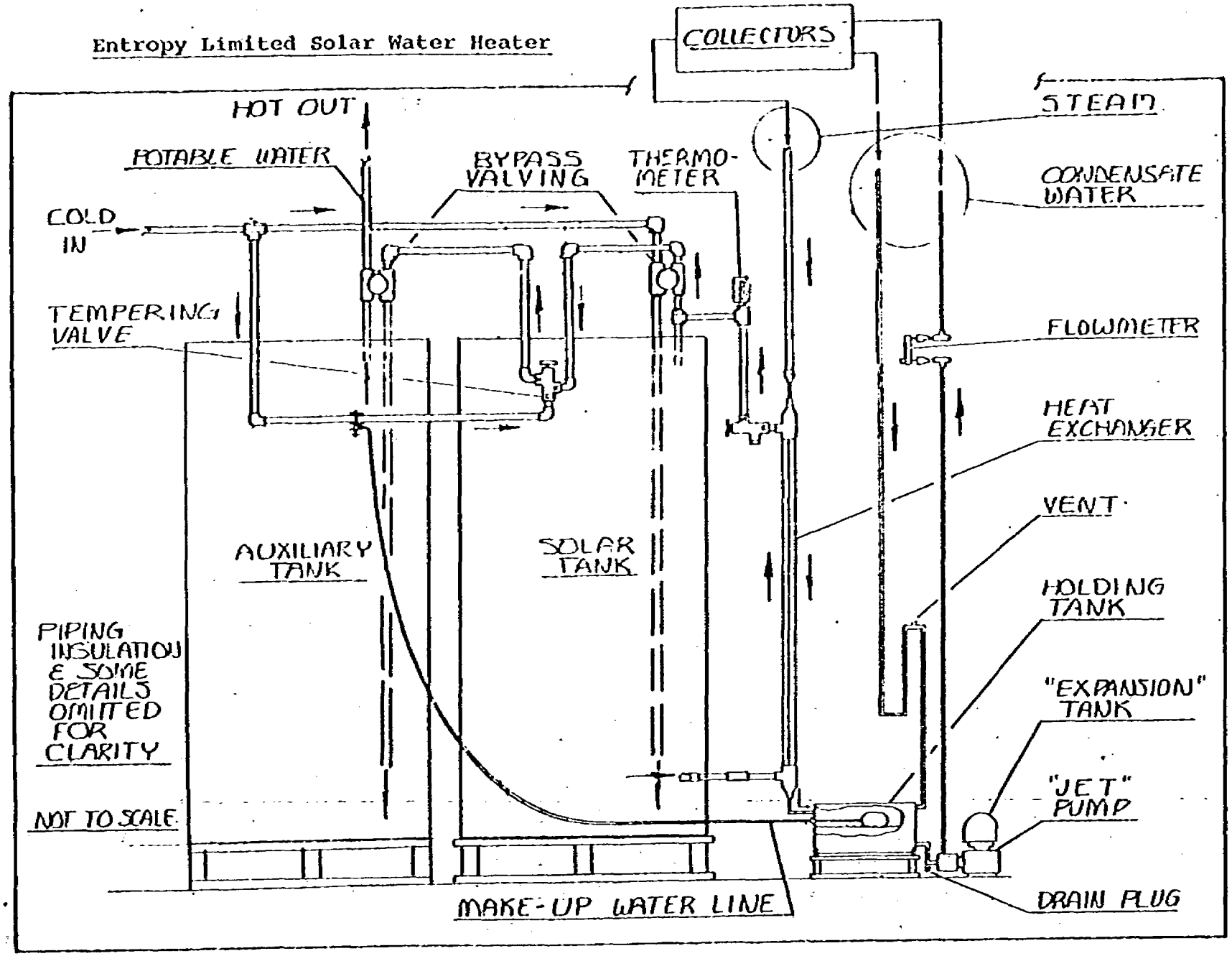
Commissioner Priscilla C. Grew, being necessarily absent, did not participate

I CERTIFY THAT THIS DECISION WAS APPROVED BY THE ABOVE COMMISSIONERS TODAY.

Joseph E. Bodovitz, Executive Director

APPENDIX A

Entropy Limited Solar Water Heater



OII 42 Program Assumptions

Solar Water Preheater Systems With Gas Auxiliary Energy

Line	Item	Amount
1	Single Family Daily Hot Water Usage	20 Gallons per Bedroom
2	Three Bedroom Dwelling Usage	60 Gallons per Day
3	Energy to Raise Water 70 degrees F	128 Th/yr
	Conventional Water Heater Efficiencies	
4	After Combustion and Flue Losses	53%
5	After Jacket Losses	80%
6	Net Efficiency (4 times 5)	42%
	Before-Solar Conventional Energy Usage	
7	(3 over 6)	300 Th/yr
	60% Savings of Conventional Energy	
8	(7 times 60%)	180 Th/yr
	Maximum Metered Usage With Solar	
9	(7 less 8)	120 Th/yr
10	Energy From Auxiliary With Solar (9 times 6)	51 Th/yr
11	Minimum Net Energy From Solar (3 less 10)	77 Th/yr
12	Solar System Piping Efficiency	95%
13	Net Solar Plumbing Efficiency (12 times 5)	76%
	Gross Solar Energy Output Required	
14	(11 over 13)	101 Th/yr

OII 42 Program Assumptions

Solar Water Preheater Systems With Gas Auxiliary Energy

Line	Item	Amount
1	Single Family Daily Hot Water Usage	20 Gallons per Bedroom
2	Three Bedroom Dwelling Usage	60 Gallons per Day
3	Energy to Raise Water 70 degrees F	128 Th/yr
	Conventional Water Heater Efficiencies	
4	After Combustion and Flue Losses	75%
5	After Jacket Losses	80%
6	Net Efficiency (4 times 5)	60%
	Before Solar Conventional Energy Usage	
7	(3 over 6)	213 Th/yr
	60% Savings of Conventional Energy	
8	(7 times 60%)	128 Th/yr
	Maximum Metered Usage With Solar	
9	(7 less 8)	85 Th/yr
10	Energy From Auxiliary With Solar (9 times 6)	51 Th/yr
11	Minimum Net Energy From Solar (3 less 10)	77 Th/yr
12	Solar System Piping Efficiency	95%
13	Net Solar Plumbing Efficiency (12 times 5)	76%
	Gross Solar Energy Output Required	
14	(11 over 13)	101 Th/yr

OII 42 Program Assumptions

Solar Water Preheater Systems With Electric Auxiliary Energy

Line	Item	Amount
1	Single Family Daily Hot Water Usage	20 Gallons per Bedroom
2	Three Bedroom Dwelling Usage	60 Gallons per Day
3	Energy to Raise Water 70 degrees F	3750 Kwh/yr = 128 th/yr
	Conventional Water Heater Efficiencies	
4	After Combustion and Flue Losses	100%
5	After Jacket Losses	80%
6	Net Efficiency (4 times 5)	80%
	Before Solar Conventional Energy Usage	
7	(3 over 6)	4687 Kwh/yr = 160 th/yr
	60% Savings of Conventional Energy	
8	(7 times 60%)	2813 Kwh/yr = 96 th/yr
	Maximum Metered Usage With Solar	
9	(7 less 8)	1874 Kwh/yr = 64 th/yr
10	Energy From Auxiliary With Solar (9 times 6)	1499 Kwh/yr = 51 th/yr
11	Minimum Net Energy From Solar (3 less 10)	2251 Kwh/yr = 77 th/yr
12	Solar System Piping Efficiency	95%
13	Net Solar Plumbing Efficiency (12 times 5)	76%
	Gross Solar Energy Output Required	
14	(11 over 13)	2962 Kwh/yr = 101 th/yr