U/JM/FS/WPSC

ORIGINAL

Decision 83 05 064 MAY 18 1983

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Application of Gulf Thermal Corp. for exemption from certain check-list requirements of Decision Nos. 92251, 92501, and 92769.	Application 82-11-58 (Filed November 30, 1982)

OPINION ON SOLAR WATER HEATER ELIGIBILITY

Gulf Thermal Corporation (Gulf) manufactures domestic solar water heating systems composed of one or more of its PT-40 Integrated Collector-Storage (ICS) devices. These systems have not been previously eligible for the Commission's OII 42 Demonstration Solar Financing Program because no method was available until recently to estimate their energy-saving potential. These systems are marketed and distributed in California by Solar Harvest, Inc. (Solar Harvest). Solar Harvest requests that the Commission find the Gulf PT-40 systems eligible to participate in the program.

By this decision, the Commission finds the Gulf PT-40 eligible under the sizing and other conditions specified.

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. Since March 1, 1981, all solar water heaters have been required to meet OII 42 sizing and checklist requirements to be eligible for the solar financing program. For ICS systems, to which some program assumptions do not apply, eligibility has been granted only after application on a case-by-case basis by the manufacturer or by its representative.

Applicant's Background

Solar Harvest, the sole authorized west coast distributor for Gulf, began marketing solar systems in October 1982 consisting of one or more of Gulf's PT-40 ICS units shown in Appendix D. Each unit actually consists of four 9.5 gallon stainless-steel absorber tanks connected in series with small cross-section connectors beneath a triple glazing of translucent teflon and tempered solar glass. The connectors, measuring less than 1 inch by 2 inches are subject to freezing. The inside of the aluminum box housing the tanks is insulated to R-12 with polyisocyanurate foam, and each tank is surrounded on three sides by borosilicate fiberglass and polyisocyanurate foam. The remainder of each tank is open to the glazing to absorb insolation.

Solar Harvest applied November 30, 1982 for eligibility of systems using the PT-40 ICS units to participate in the Demonstration Solar Financing Program. The application includes requests for exemption from five items contained in the current Post-Installation Inspection Checklist, which became effective on June 22, 1981. In the following sections, each checklist item is given along with Solar Harvest's argument for an exemption, and ECB staff's position and recommendation. Discussion of the sizing and ICS freeze protection issues begins on Page 7.

Exposed Components Freeze Protection:

Item 11: "Are exposed components other than the collector protected from freeze damage?"

a) Air vent
b) Vacuum breaker
c) Temperature and pressure relief valve
d) Expansion tanks
e) Other"

The intent of Item 11 is to protect external components from freeze damage. Sub-items a), b), d) and e) are not relevant to the PT-40 because its ICS design does not include an air vent, vacuum breaker or expansion tank. It does, however, include a temperature and pressure ("t/p")relief valve. Solar Harvest gives the following rationale for exemption:

"a) Our installation policy ... would ensure that the units would not be installed in areas where the t/p valves would be threatened by freezing.

b) The inherent thermal mass of the PT-40 will protect the t/p valve under mild freezing conditions.

We disagree. These guidelines do not guarantee effective protection because it is difficult for contractors to know with certainty whether freezing might occasionally occur in areas having normally favorable degree-day conditions. For example, much of California's Central Valley, which is normally temperate, experienced prolonged freezing and near-freezing conditions this past winter because of continuous fog. Similar conditions would lower the temperature of the ICS unit itself, reducing thermal protection to the t/p valve. Exemption from Item 11 is not justified.

Item 21: "Are the collectors manifolded in a reverse return, parallel manner, or are other flow balancing techniques employed?"

This item is intended to prevent large differences in the flow rate or temperature of water supplied to each unit in a system. Such differences can readily occur and reduce system performance.

In seeking an exemption to this item, Solar Harvest explains that:

"In ICS units optimal delivery can often be achieved using a series rather than a parallel flow path."

We agree that a system of three or fewer units in series can perform effectively. Although the tests submitted were conducted on a system of only two units connected in series, we believe that three units in series produce slightly higher water temperatures which permit a longer summer season of operation without the back-up heater. For this reason, plumbing arrangements of the minimum required number of units may be made with a maximum of three PT-40 ICS units connected in series.

In contrast, a system with four units connected in series would reject heat from the last (hottest) unit, and thus not perform as well as parallel banks each of two units in series. Thus, we require that large systems contain no more than three units in series, with parallel connections as needed to comply with the requirement in Item 21 regarding an equal flow path length through all collectors.

Item 22: "Has the circulator pump been installed according to manufacturer's specifications?"

The intent of this item is to ensure the proper direction of circulation in active solar systems. Solar Harvest explains that "This unit does not employ a pump." We accept Solar Harvest's rationale; ICS units do not contain a circulation pump because supply water pressure is all that is needed to move water through the system.

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

The intent of this item is for the owner to be able to judge whether or not the system is operating - i.e. heating water to the proper temperature. Solar Harvest gives the following explanation of why it should be exempt from this item:

> "There are no electronic or mechanical 'moving parts' to monitor in this system. The customer can verify that the system is producing hot water by opening a valve and determining if the water is hot."

Solar Harvest's rationale does not address the intent of Item 29, which was to monitor not individual mechanisms, but the performance of the system as a whole. Installing a thermometer in the piping between the solar water heater and the back-up tank would satisfy this item, although the user would need to open a hot water faucet to read an accurate temperature. The valve or other provision for flushing cannot also serve for this Item because it may not be readily accessible, may require tools, would require a drain or container for up to several gallons of sampled water, and would require the individual to provide a thermometer each time or risk a hot water burn. Thus, no exemption from Item 29 is justified.

Item 30: "Does the storage tank have a minimum insulation of R-12?"

The intent of this item is to minimize heat loss. Solar Harvest gives the following rationale as to why it should be exempt from Item 30:

> "The storage tank(s) are an integral part of the PT-40. To the extent possible, the tanks have been insulated to better than R-12, but a portion of each tank functions as absorber and as such cannot be directly insulated."

Item 30 is intended to apply to systems having the storage capacity separate from the collector itself. This is not the case in ICS units, which combine the functions of heating and storing water. We accept Solar Harvest's reasoning that although each of the four tanks in the PT-40 is surrounded over most its area by R-12 polyisocyanurate and fiberglass insulation, a portion must remain exposed to absorb solar energy. Exemption from Item 30 is justified.

Sizing

Solar Harvest submitted the results of an SRCC-OG200 test conducted on two PT-40 units connected in series. A certification letter from SRCC (Solar Rating and Certification Corporation) accompanied the test results. The test was developed as a national standard, and the SRCC certification is required by the California Energy Commission for eligibility for the California Solar Tax credit for solar systems installed during 1982.

The sizing requirement is calculated by correcting the system output in BTU's per day from the SRCC test to account for California conditions. Based on the test data, and on correcting calculations using the method outlined in Appendix A, ECB recommends that an annualized average daily output of 23,500 BTU be adopted for the series pair of PT-40 units. This corresponds to an output of 11,750 BTU per day or 42.9 therms per year for each individual ICS unit. Since 101 therms per year has been adopted as the required annual output for systems serving a three-bedroom house in the Solar Rebate Program, we find that two units are needed to meet the load of a three-bedroom home. Table 1 summarizes the minimum sizing requirement for PT-40 solar systems.

Systems containing more than three units must be plumbed in compliance with Item 21 of the Checklist, as discussed on page 5. A third unit may be installed in series, even though the test was conducted on only two units in series, because the added heat losses can be offset by the savings from a longer summer season of operation with the back-up water heater turned off, because the solar water temperature will be higher.

TABLE 1

Minimum Sizing of Gulf Thermal Solar Water Heater Systems Using Model PT-40 Units

Number of Bedrooms	OII 42 Minimum Output Therms/Yr.	Number of PT-40 Units
1	34	1
2	67	2
3	101	2
4	135	3
5	168	4
n greater than 5	33.7 n	.78n

Note: No more than three (3) units may be installed in series.

Collector Freeze Protection

Gulf offers a 20-year warranty covering freeze damage when the system is installed according to its installation manual. That manual states:

> "In areas where periodic freezing conditions exist, the system must have a manual drain down capability to protect the piping. As an option, an automatic freeze protection device, such as the Eaton Dole FP-45 valve or H&H Precision Productions' V243 valve can be installed between the collector and the roof."

The Solar Harvest unit is an integral collector-storage unit, but it is not a typical ICS unit consisting of a single tank. Instead four 9-1/2-gallon tanks under the glazing are connected in series with semi-circular tubes formed from sheet metal.

The convection currents which make all of the solar heated water available to prevent freezing in single-tank ICS units are not as effective in the smaller volumes of the Solar Harvest tanks. The small semi-circular tank connectors, especially, are not well protected. Their small isolated water volumes, though larger, are comparable to sections of flat-plate collectors, which have no inherent freeze protection.

Flat-plate collectors are well-insulated on the sides and back, as is the Solar Harvest unit. Yet they are prone to freezing, largely because of their small cross-section waterways which have little heat content to prevent freezing. For these

reasons, the ECB recommends limiting the eligibility of Solar Harvest units to the 2,300-foot maximum elevation granted to other passive systems under OII 42. While we acknowledge the protection offered to customers by the applicant's warranty, it is not as reliable protection of our ratepayers rebate investment over the 20-year horizon of OII 42, as would be the mitigation of exposure to freezing conditions provided by our 2,300 foot maximum elevation.

It may be argued that some ICS units eligible up to 2,300 feet or more are not required to provide a thermostatic drain valve as Solar Harvest does when it warrants its unit against freeze damage for OII 42 eligibility. We find, however, that the greater risk of freeze damage with Solar Harvest's unit justifies the additional protection offered by the thermostatic valve, even when we are not permitting the greater exposure to freeze damage that would be found above 2,300 feet. The reasons for the choice of 2,300 feet are given in Appendix C.

Piping and valving are normally more vulnerable to freezing than an ICS unit itself. Therefore, insulation to comply with the Checklist must completely cover all outdoor piping, fittings, and valve bodies. Even small gaps in insulation can greatly increase nighttime heat loss, reducing both system efficiency and protection against frozen pipes.

Monitoring

PT-40 solar systems should be evaluated in the monitoring program now underway for all other solar water heaters installed under the OII 42 program, provided the sample can accommodate additional systems at this time.

Disclaimer

Any reference by manufacturers, distributors, wholesellers, retailers, or installers including Gulf Thermal and Solar Harvest to this order in their 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. Gulf Thermal Corporation (Gulf) manufactures the PT-40 integral collector-storage (ICS) solar water heating unit.

2. The PT-40 consists of a glazed, insulated, aluminum box containing four absorber tanks in series with small diameter connectors subject to freezing.

3. Solar Harvest is Gulf's agent in California.

4. Solar Harvest applied for OII 42 program eligibility because ICS systems are not eligible without a demonstration of quantifiable energy savings and because it sought exemptions to the Inspection Checklist.

5. Exposed valves and components may freeze unless protected.

6. Systems having more than three units in series may not deliver the rated output per unit.

7. Solar Harvest's unit has no pump.

8. A means to verify system operation should be accessible without tools.

9. Excess insulation can reduce the solar gain of an ICS system.

10. Solar Harvest submitted the results of an SRCC-OG200 test of two Gulf PT-40 units installed in series, along with SRCC certification of the results.

11. SRCC-OG200 results may be converted to estimate system performance under California conditions.

12. Conventional water heater losses may be eliminated by appropriate valves and switches

13. Gulf offers a 20-year warranty covering ICS damage due to freezing when the system is installed with nonelectric intermittent drain valves, and which meets state solar tax credit requirements.

14. A maximum installation elevation of 2,300 feet has been adopted to minimize the likelihood of freeze damage to solar water heaters not emptied of water under freezing conditions.

15. ECB staff estimates that one Gulf PT-40 unit will deliver 11,750 BTUs per day on an average annual basis, or 42.9 therms per year under California conditions.

16. Little increase in delivered solar energy is gained by connecting more than three (3) units in series.

17. The expense of a public hearing is not justified for this application.

Conclusions of Law

1. Gulf PT-40 solar water heater systems should be eligible to participate in the OII 42 Demonstration Solar Financing Program under the following conditions.

2. Installation Checklist Items 22 and 30 are not applicable to Solar Harvest units.

3. Installation Checklist Items 11, 21 and 29 must be answered Yes for eligibility.

4. Gulf PT-40 systems should be found eligible for rebates when sized according to Table 1.

5. Gulf PT-40 systems installed below 2,300 feet with a nonelectric thermostatic drain valve as shown in Appendix D should be assumed to be adequately protected against freeze damage for purposes of the OII 42 program.

6. Solar Harvest should assure that no water heaters are converted from gas to electric back-up water heating.

7. Solar Harvest should instruct customers to turn off pilot lights on gas back-up water heaters during summer months.

8. Solar Harvest should instruct customers to turn off electric back-up water heaters during summer months.

9. Solar Harvest should recommend installation of time clocks on all electric back-up water heaters.

10. Gulf PT-40 systems must comply with all other Commission decisions in the OII 42 program, and with all other requirements set forth in this decision.

11. PT-40 solar water heaters should be installed in strict accordance with Gulf's and Solar Harvest's instructions.

12. This application should be processed ex parte.

O R D E R

1. Solar Harvest solar water heating systems of multiple Gulf PT-40 integral collector-storage units are eligible to participate in the OII 42 Demonstration Solar Financing Program under the sizing criteria set forth in Table 1 hereof, and under the freeze protection, and all other conditions summarized in the Conclusions of Law 1 through 12.

This order is effective today for systems installed after January 29, 1980 in retrofit applications of dwellings occupied before January 29, 1980.

Dated MAY 18 1983, at San Francisco, California.

LEONARD M. GRIMES, JR.
President
VICTOR CALVO
PRISCILLA C. GREW
DONALD VIAL
Commissioners

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

Joseph E. Bodovitz, Executive Director

APPENDIX A

Method Used to Process the Gulf PT-40 Solar Water Heater Test Results

The minimum number of Gulf PT-40 units to be installed per bedroom follows from the results of the SRCC-OG200 test by comparing the results against the 101-therm minimum criterion for a three-bedroom dwelling (Appendix B). The SRCC-OG200 test conditions reflect national average values, not California values, for available solar radiation and other variables. Therefore, the annual solar output under California conditions was determined by modifying the results as follows:

The method used to estimate performance under conditions which differ from the test conditions ideally should have national consensus. Such a consensus is now in its early stages. Since a usable method may not be available before the OII 42 program is over, the ECB staff, with informal review from the solar community, is applying its own approach uniformly to all applicants.

Of the many conditions chosen for the SRCC-OG200 test, three vary significantly for systems installed in California. These are the incident solar energy, the volume of hot water drawn per day, and the effect of overnight heat losses on the net solar energy delivered by the system.

Incident Solar Energy

An increase in incident solar energy will increase the solar energy delivered by the system. The increase can reasonably be estimated to be in the ratio of the California annual average value to the test value, or (1700/1500), in Btus per sq. ft. per day. Theoretically it is less than this ratio.

Hot Water Usage

The effect of varying the second factor, the amount and timing of hot water drawn per day, is more difficult to quantify; however, the direction of this effect is clear. Reducing the volume from approximately 95 gallons per day during the test, to 60 gallons per day (for a three-bedroom dwelling under OII 42).

will reduce the net solar energy delivered.a/ (Shifting the timing of usage from evening towards morning also reduces the energy delivered, but we do not differ with the test assumption of equal draws at morning, noon and late afternoon.)

If we quantify this reduction factor for lower water use at a value of (1500/1700), it would simplify the analysis by just offsetting the increase due to greater solar insolation. The necessary accuracy depends on the number of other factors considered and on the quality of related data used. In the absence of a recognized method to calculate this factor, ECB staff believes that (1500/1700) is a reasonable value. Therefore, the output under OII 42 conditions of radiation and water usage is unchanged from the SRCC-OG200 value.

Overnight Heat Losses

All solar systems having outdoor storage tanks lose heat overnight. This group of principally passive (nonpumped) systems includes thermosyphon systems (tank with flat-plate collectors) and ICS systems (integral collector-storage units having only a tank). The importance of this factor in the net solar energy delivered by a solar system is recognized in the SRCC-OG200 test process by a separate 16-hour temperature decay test conducted to determine the rate of heat loss under known test conditions. The amount of energy actually lost in any given location depends on the annual average nighttime temperature. Therefore no night heat losses are deducted from the SRCC-OG200 energy output as reported.

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a/ For persons familiar with the development of the OII 42 eligibility criteria, this "net solar energy delivered" (in Btus for example) should be distinguished from the "solar fraction" (in %). While net solar Btus would fall in this case, the solar fraction would likely increase because it is the ratio of net usable Btus to total Btus. (The total Btus fall nearly 50% from 100 gal./day to 60 gal./day, while net Btus might only fall 20%.)

The overnight temperature decay measured in the SRCC test, must be distinguished from the specific freeze protection energy consumed by a system. Freeze protection energy consumption is not measured by the SRCC test. Some freeze protection features actively consume significant amounts of energy, depending on climate. Freeze protection is discussed separately in Appendix C of this decision.

The method of determining the amount of energy lost due to overnight temperature decay, using local temperatures and SRCC heat loss rate data, will eventually be part of a consensus standard to modify the SRCC test result. An engineering estimate of that loss is described here.

Two items of test data are used. One is the temperature of the solar heated water remaining in the solar system after the standard test day. The difference between this temperature and the annual average overnight temperature in California population centers, is used as the factor driving the overnight heat loss.

The second item is the rate of heat loss. The two rates used in this analysis reflect overnight conditions of zero wind during the three days of solar simulation and a known wind during the separate heat loss test.

These two data items are combined with an exponential heat loss model to produce an overnight heat loss which we then deduct from the SRCC rating as reported.

APPENDIX B
Page 1 of 3

OII 42 Program Assumptions

Solar Water Preheater Systems with Gas Auxiliary Energy
Conventional Gas Water Heater

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

APPENDIX B
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OII 42 Program Assumptions

Solar Water Preheater Systems with Gas Auxiliary Energy
High-Efficiency Gas Water Heater

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

APPENDIX B
Page 3 of 3

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

Use of Heat to Prevent Freezing in Solar Systems

Water confined in an exposed solar collector may cause damage to it by freezing and expanding if the air temperature falls much below 45 deg. F. (depending on wind and cloud cover). Water will freeze occasionally in all parts of California.

Typically the flat-plate components of active and of thermosyphon systems require freeze protection because they contain little heat when solar radiation is not available. ICS systems typically do not require freeze protection because of their large thermal mass.

Freeze protection for piping leading to and from solar systems is not discussed in individual solar decisions for two reasons. Piping is relatively inexpensive in comparison to the collector components of a solar system, and secondly, because good plumbing practice for all water piping calls for insulation as heavy as the local climate warrants.

The water in solar collectors should be drained to prevent damage, but for practical or economic reasons, the user may only try to prevent freezing. In that case, antifreeze may be added, to so-called closed loop systems, where the potable water supply does not flow directly through the collectors.

Another method is to provide heat to the collectors. It is used in those designs where potable water is always present throughout the system. In mild climates, the long-term performance of these systems will not be greatly reduced. There are now at least three methods to heat collectors.

A common one is to simply start the system electric pump, in an active system, to circulate warm water from the indoor storage tank. Another is to turn on electric heaters in the collectors themselves. The Commission has limited use of both of these in OII 42 to climates defined by a maximum elevation for installation. A third method is now being used, chiefly in thermosyphon systems.

In that method a valve is activated by thermal contraction when the temperature drops into the freezing range of water. It opens to permit water to move through the system under line pressure, as if a hot water tap were opened in the dwelling. The coldest water is forced out first, over the valve actuator followed by water which warms the coldest parts of the system, including the valve. The valve actuator expands and closes, and when the heat provided by the water has dissipated, the cycle repeats itself. In very cold weather, the valve may remain open.

While this method relies only on water pressure for reliability, it is from an energy standpoint, no different from the recirculation method used in active systems, or the electric anti-freeze used in thermosyphon systems.

All three methods rely on heat to keep ice from forming. Therefore, their use of resources and effect on net energy production is the same on a statewide average. The conditions of exposure are the same, because all three methods are equally eligible regardless of insolation, water supply temperature, climate, or dwelling size.

A maximum elevation of 2,300 feet has been chosen and used in all eligibility decisions for solar water heaters having protection comparable to the Solar Harvest unit. The energy needs for active freeze protection of a nonpumped system at 2,300 feet are about the same as for a circulator pump in a system which is drained for freeze protection. (The recirculation method actually is limited to 1,000 feet elevation, not 2,300 feet, but only because it is less efficient. Electricity is used both to collect heat and to recirculate some of it, before dissipating that heat, but ice forms no more easily because the recirculation method is used.)

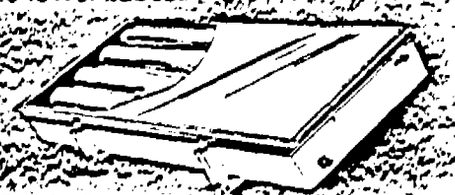
NEW!

GULF THERMAL CORPORATION

ANNOUNCING THE GULF THERMAL PT-40

A PROGRESSIVE-TUBE SELF-CONTAINED SOLAR WATER HEATER

The PT-40 combines efficiency, moderate cost, and an unobtrusive appearance with excellent behavior. The series flow pattern of the Progressive-Tube® ensures availability of the hottest water for each usage, containing the colder replacement water in the lower tubes.

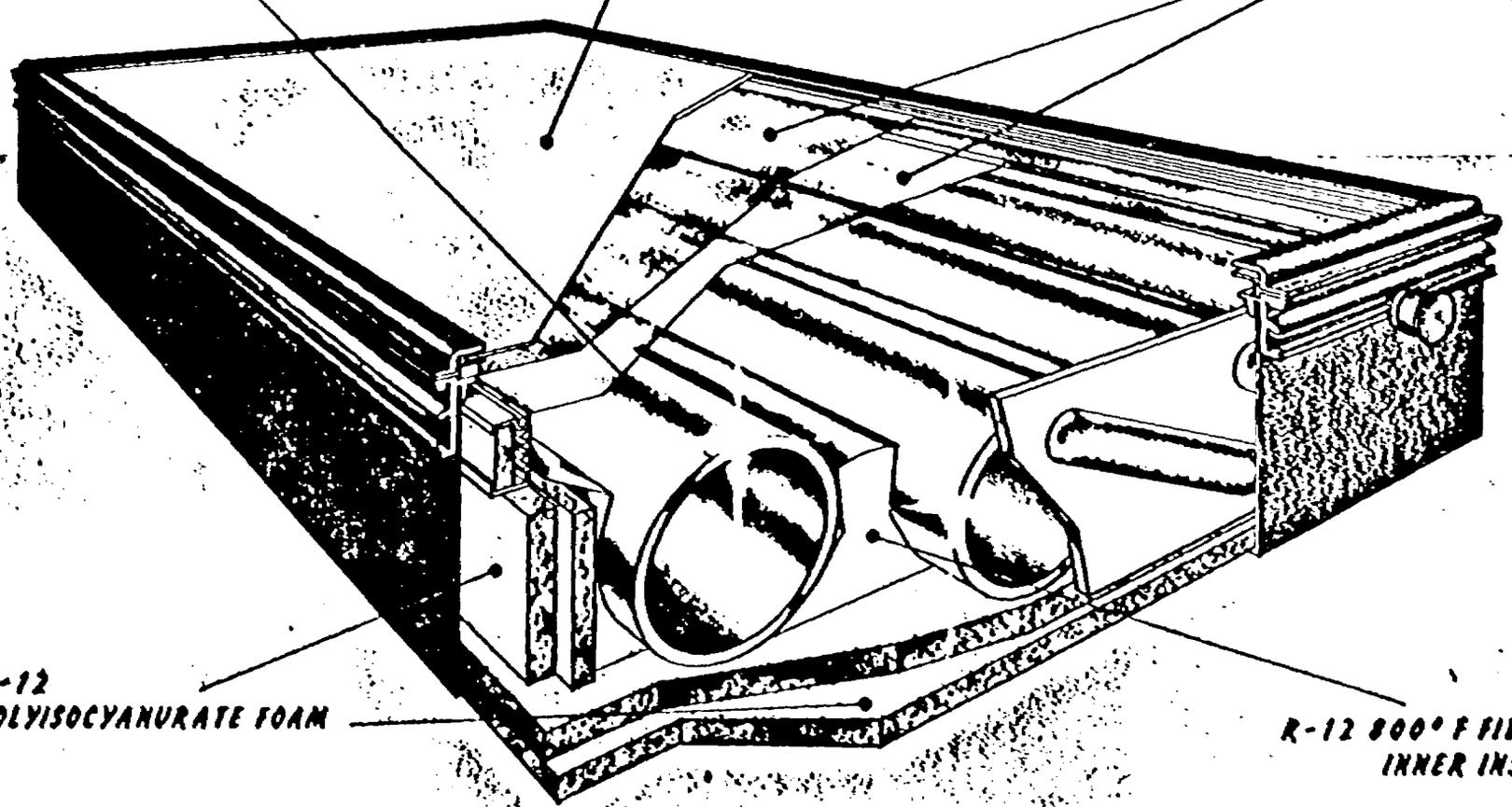


THE PT-40 FEATURES:

- Low profile — 31¼" X 85" X 9¼ deep.
- Flashing channel incorporated in frame.
- Roof retrofit, roof drop-in, or ground mount.
- All stainless steel tank. Threaded stainless fittings welded to the header.
- Bronze acrylic aluminum outer case, upper frame, and mounting hardware.
- Simple installation, only two threaded connections. No pumps, no controls, no maintenance.
- Triple glazed for heat retention. Back, sides,
isocyanurate and borosilicate insulation (R-12 minimum).
- Sufficient manual drain down for freeze protection. Unit is not
recommended for use during prolonged freezing conditions.
- Dry weight: 240 lbs. Wet weight:
368 lbs. Capacity: 36.25 gallons.
- Each unit tested to 225 psi, prior to shipment.
- Now undergoing SRCC test sequence.
- 20 year warranty.

ORATION

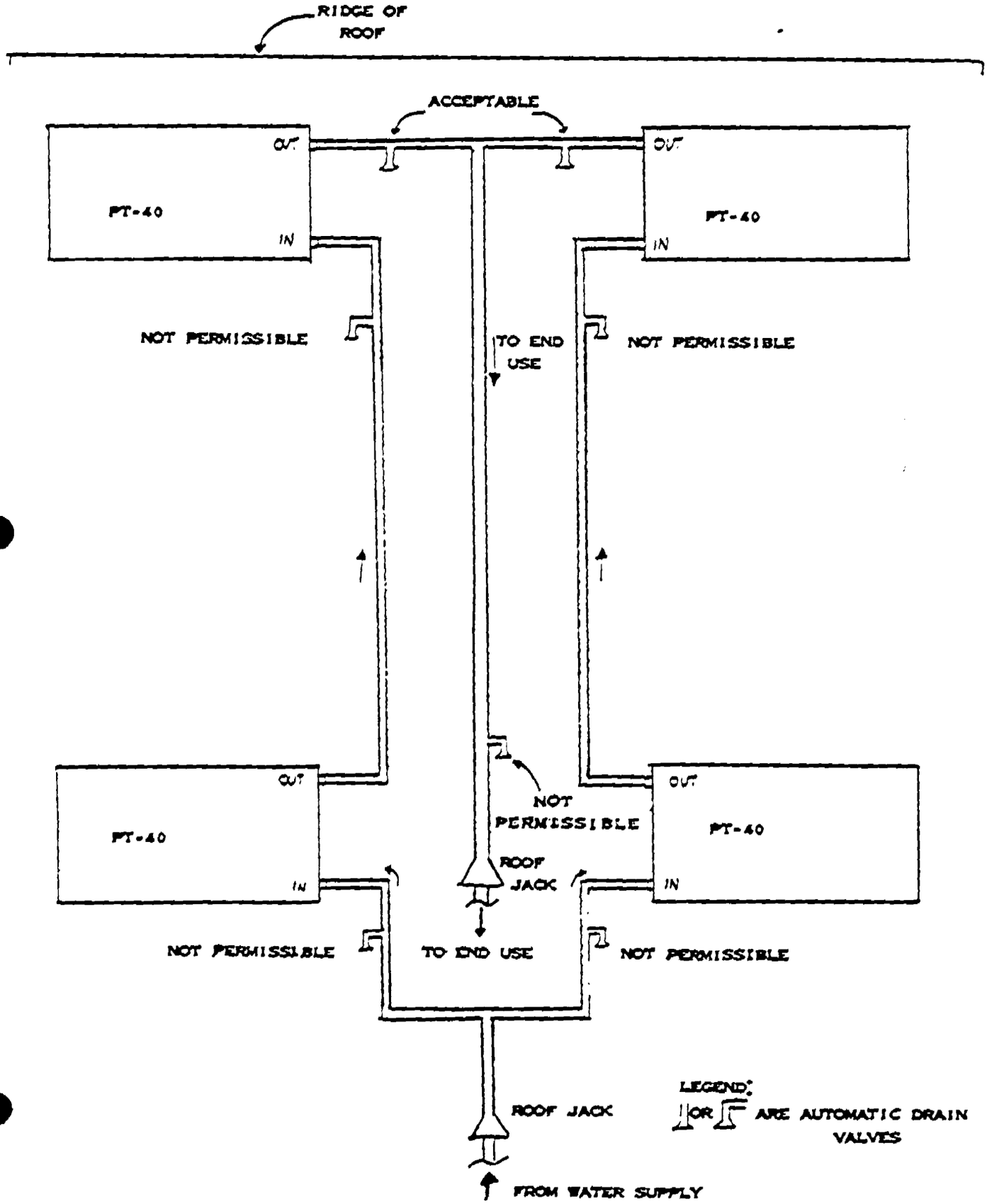
P.O. Box 1273 ● Sarasota, Florida 33578 ● 813/957-0106



SOLAR HARVEST

GULF THERMAL CORPORATION PT-A8

EXAMPLES OF PERMITTED AND NOT PERMITTED INSTALLATIONS OF FREEZE PROTECTION DRAIN VALVES IN A SYSTEM OF TWO PARALLEL-CONNECTED SERIES PAIRS.



TWENTY YEAR WARRANTY

GULF THERMAL CORPORATION
P.O. BOX 1273, 1645 12TH STREET, SARASOTA, FL 33578
813 957-0106

Gulf Thermal Corporation warrants its ProgressivTube T.M. Solar Water Heaters to be manufactured to high standards with first commercial grades of materials, from reliable sources, used throughout. Each unit is pressure tested prior to shipment.

For a period of twenty (20) years from the date of installation, Gulf Thermal will repair or replace any defective parts, including the absorber coating, where such defect is the result of manufacturing error or defective material. This includes cost of labor (as per Warranty Repair Labor Schedule), materials, and shipment to installation site within the Continental U.S., port embarkation for overseas sites.

Gulf Thermal ProgressivTube TM Solar Water Heaters are warranted against freeze damage within the conditions outlined in the Installation, Maintenance, Owner's Manual. The company's liability under this warranty shall be ended in the event of breakdown of the unit due to improper installation, use, reglazing, failure to replace broken glazings promptly, or other breach of the enclosure allowing the intrusion of excessive moisture or other foreign material.

This warranty goes with the unit and is unaffected by change of ownership. Consequential damages as result of failure of this unit are not warranted.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state. In order to obtain performance on any of the above warranty obligations, contact your local Gulf Thermal Dealer/Distributor, or should you have an unsolved problem concerning any Gulf Thermal product, please write or call the marketing department or the undersigned.

Dudley Slocum

DUDLEY SLOCUM, PRESIDENT