

U/BM/ARM/WPSC

ORIGINAL

Decision 93681 NOV 3 1981

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Application of Ying Manufacturing)
for exemption from certain check-)
list requirements of Decision Nos.)
92251, 92501 and 92769.)

Application 60912
(Filed September 22, 1981)

O P I N I O N

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. 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 George Amaroli of the Energy Conservation Branch (ECB) of July 29, 1981, which was docketed as Application 60912 on September 22, 1981, Ying Manufacturing (Ying) requested certain exemptions from checklist requirements for its "SOLARMAGIC" solar systems.

Certain systems such as the Ying thermosyphon Freon-charged units must meet monitoring requirements established by the

ECB on a case-by-case basis as directed in D.92501, page 6, paragraph 7.

Ying's Position

Ying has modified its standard solar collector panels to accept Du Pont Freon R114 as a boiling liquid heat transfer medium. The collector is connected to an all-copper storage tank, which is factory-assembled with the collector. The storage tank consists of a copper tank with two built-in separate copper heat exchangers. The copper tank is an atmospherically vented tank with fill, vent, and drain outlets. Potable water is the heat storage liquid recommended for use for the tank.

The two heat exchangers are submerged inside the copper storage tank. The first heat exchanger serves to transfer the solar heat from the Freon to storage water. The second heat exchanger transfers the stored solar heat from the storage water to domestic hot water service.

The collector flow passage is connected to one heat exchanger of the storage tank. The flow passages of the collector and the heat exchanger are tested to 300 psig, although the normal Freon pressure will not exceed 200 psig.

Freon R114 is factory-charged into the solar hot water appliance. Whenever there is sufficient solar irradiation, the Freon boils and changes from liquid to vapor phases. This phenomenon is known as boiling liquid heat transfer by latent heat,

the heat-pipe principle. Ying states that recent test data from research institutions indicate that boiling heat transfer rates in solar collector panels as compared to liquid flow process heat transfer in the same collector is higher by up to 35%.

The saturated Freon vapor rises to the storage tank and condenses as it transfers the solar energy to the storage reservoir. The condensed and liquefied Freon returns to the bottom of the collector. The process repeats so long as there is sufficient solar irradiation. Because of the highly efficient heat exchanger design (patent pending), Ying states that less than 5% losses occur through the transfer of heat from the collector to the storage tank so that a net gain of 20% is claimed with the boiling heat transfer process over that of the conventional liquid flow heat transfer process in solar collectors.

The second heat exchanger transfers the cold, incoming city water to hot water before it flows to the conventional backup water heater. The hot water leaving the appliance is practically the same temperature as the hot water within the storage tank.

Minimum losses occur in the Ying heat exchanger when transferring heat from the solar collector to the hot water storage reservoir. The second heat exchanger experiences practically no losses. The high efficiencies of the heat exchangers result from large copper surfaces.

The Ying SOLARMAGIC hot water appliance requires no auxiliary or parasitic energy to operate. Ying claims that it transfers more solar energy than conventional liquid flow processes in either active solar or thermosyphon systems. The storage reservoir is heavily insulated (R25). It is corrosion-free because of the Freon transfer liquid and all-copper construction of the storage tank. Ying claims that it is more reliable than a refrigerator, because a SOLARMAGIC appliance has no moving parts.

APPLIANCE SPECIFICATIONS

	<u>Model 32T</u>	<u>Model 40T</u>
Collector	SP480	SP410
Weight (Lb.)		
Empty	165	205
Full	180	220
Nominal Size (In.)	4 x 48 x 96	4 x 48 x 120
(Sq.Ft.)	32	40
Storage Tank		
Capacity (Gallons)	55	70
Weight (Lb.)		
Empty	175	218
Full	631	799
Nominal Size (Ins.)	14 x 30 x 96	14 x 30 x 120
Insulation	R25	R25

Ying SP series flat plate solar collector panels have been field-tested by numerous certification testing laboratories and government agencies. Tests have been done by New Mexico State University under the Department of Energy "DOE 200" Program and under the TIPSE Program of California Energy Commission.

Ying can furnish these and other test reports upon request.

SOLARMAGIC 32T Test Under Dynamic Environment

Ying also states that it installed a SOLARMAGIC 32T unit on a pickup truck. The solar collector panel faces the passenger side of the vehicle at a tilt angle of 30°. On the morning of July 15, 1981, the truck traveled north towards Fresno. After passing the mountains the SOLARMAGIC 32T was fully filled with 55 gallons of potable water (75°F.) in the storage tank. The truck traveled at the normal highway speed while northbound. The solar panel experienced a combined wind speed of approximately 70 to 75 mph. The truck arrived at Fresno at 11 a.m. and was parked with the panel directed south for approximately one hour. The truck traveled locally in Fresno between one and three o'clock. By 3 p.m. the solar collector had been tested for collecting energy in the traveling environment at the speed range of 30 to 75 mph. By connecting the SOLARMAGIC 32T appliance to the city water, Ying demonstrated to a PG&E seminar and other interested parties by releasing 55 gallons of hot water at the temperature setting of 107°F. The storage tank hot water was at an initial temperature of 153°F. at the 3 p.m. starting time of the test. After the 55 gallons of 107°F. water was discharged, the storage tank temper-

ature dropped to 127°F. The test data indicated the solar energy harnessed during the northward trip was a total of 35,736 Btu, or 1,117 Btu/sq.ft. The discharged amount of hot water energy of 55 gallons at 107°F. is equal to approximately 12,370 Btu.

SOLARMAGIC 32T Test Under Static Conditions

The test procedure for solar equipment at Ying is to compare it with a known reference solar component or system in all-day tests. In the past two years, Ying has repeatedly tested the SOLARMAGIC 32T appliances. During a good winter sunny day in Gardena, California, the thermal energy accumulated in the 32T storage tank ranged between 29,000 to 30,000 Btu's, equal to approximately 900 Btu per sq.ft. of collector. The initial water temperature in the storage tank was 65°F. and the final temperature was 135°F. The ambient temperature averaged 65°F.

During a good summer sunny day the average ambient temperature was 80°F. Ying collected all day solar energy at the level of 32,000 to 34,000 Btu's in the 32T storage tank. The system collected more than 1,000 Btu per sq.ft. per day.

A domestic solar hot water system performance test procedure is being developed now in the United States. The factory test procedure represents a reasonable and dependable method for preliminary system performance evaluation for SOLARMAGIC appliances.

System Sizing

Based on the performance data of the SOLARMAGIC appliances, the following table is Ying's recommendation for sizing for single-family dwellings.

	<u>No. of 32T Units</u>	<u>No. of 40T Units</u>
1 - 2 Bedrooms	1	
3 Bedrooms		1
4 Bedrooms	2	

Ying claims the above sizing will satisfy 60% of the solar hot water energy load for California and Arizona residents.

Five-Year Full Warranty

Ying warrants the SOLARMAGIC 32T and 40T solar hot water appliances for a five-year period from the date the units are installed and operational. The warranty covers repair or replacement of the unit necessitated by defects in material or workmanship. The five-year full warranty, offered by Ying as its standard warranty in all states, exceeds the State of California solar tax credit regulations.

The five-year full warranty is supported by an extended service program from the Mercer Group of Marsh and McLennan Company. The first year of the warranty will be provided by the installing contractor, as required by California state law. During the remaining four years of the warranty, the Mercer Group

Insurance Company will pay for any labor costs, transportation costs, or crane costs incurred while repairing a SOLARMAGIC system.

Maintenance Requirements

If the SOLARMAGIC appliance is not being used for longer than four weeks, the solar collector panel should be covered by suitable opaque material to protect the system from over stagnation. In dusty areas, the transparent collector cover should be cleaned periodically.

Staff Position

ECB is persuaded by Ying's analyses that its systems have the potential of meeting the program performance criteria. Ying's units may, through proper sizing, save 60% of the energy required for domestic water heating needs. ECB proposes that the Ying units which are monitored serve households using 300 therms per year for water heating or the electric equivalent to best establish their practical use in California. Each installation must yield 60% net energy savings established by a rigorous monitoring program in randomly selected installations. The installations selected will be at the sole discretion of the ECB.

Discussion

Solar domestic water heating systems monitored in California which were installed prior to the sizing requirements set forth in this demonstration program have yielded solar

fractions well under 60% as installed under the former uncoordinated industry methods. In D.92501, the Commission adopted a checklist by which the installer of each system must certify that the system will deliver a net 60% solar fraction. It also specifically directed staff to evaluate under a monitoring program "the extent to which solar water heating can be relied upon to provide adequate and reliable supplies of energy." It also required staff to evaluate applications for exemptions to the rules.

A third or fourth collector panel or a larger storage tank for solar heated water would likely improve the performance of such systems. This simple solution of incrementally increasing the system's panel area or tank size does not apply in Ying's case because it markets standardized modular units.

The use of Freon instead of water as the working fluid satisfies the freeze-protection requirement since Freon will not freeze at any temperature heretofore recorded anywhere in California.

It is possible, however, for Freon under pressure to escape from the system as a gas. A thermometer well or other device must be placed in the water line between the Ying appliance and the backup water heater in such a manner and location that the

temperature may be readily determined whenever hot water is being used in the dwelling and heated water should be flowing from the Ying appliance into the backup water heater.

ECB Monitoring

ECB staff evaluations of Ying equipment will be based on the monitoring objectives set forth below:

- a. The system must be large enough to provide at least 60% of the actual usage of conventional energy for water heating.

- b. The monitoring system testing shall be carried out with households which have been determined by the ECB to have used 300 therms of natural gas or a comparable amount of electricity per year for water heating.

- c. In households where less than 300 therms per year or equivalent is used, Ying systems will be eligible for the program provided the solar contribution is at least 60% and system sales represented by Ying to qualify for PUC rebates are restricted to those markets.

The ECB has established its method for monitoring of eight systems to include choosing as a minimum four picked at random in the warm climate areas and four at random in the colder climate areas. Two systems in each climate area shall be served with natural gas and two with electric backup.

The ECB agrees to a system monitoring program lasting a minimum of nine months with interim reviews. If after six months, monitoring the installed solar system extrapolating the data over 12 months shows noncompliance with monitoring objectives, then the ECB staff will bring these deficiencies to Ying's attention and Ying will upgrade its systems in all future similarly situated installations.

On natural gas backup systems a gas flow meter will be used for measurement of natural gas backup fuel use. Other metering will be the same as for the electric backup systems.

ECB staff has met with representatives of Ying to resolve these and other technical issues and performance specification questions. ECB is satisfied that Ying has provided reasonable supporting data to proceed as a participant in the Demonstration Solar Financing Program based on the conditions set forth herein.

Ying and ECB staff agree that, based on the following provisions, Ying Models 32T and 40T qualify under the "Demonstration Solar Financing Program" established by D.92251, 92501, and 92769 issued September 16, 1980, December 5, 1980, and

March 3, 1981, respectively, in OII 42 by the California Public Utilities Commission. As used below, Ying refers to Ying Manufacturing or to installers of Ying equipment. Ying agrees to the following:

- a. Ying reserves the right to ask for modifications of the above requirements pending system monitoring results.
- b. Ying will not remove functioning backup water heaters.
- c. Ying will instruct customers to turn off pilot lights on gas water heaters during summer months.
- d. Ying will recommend installation of time clocks on all systems that use electricity as auxiliary backup.
- e. ~~Ying and its installers will provide a five-year free parts and labor warranty as described on page 7.~~

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l. f. Should the Commission as outlined in OII 42 require extended pro rata warranties limited to serious deterioration of glazing and absorber plate fluid passageways and storage tank corrosion, Ying will extend the warranties to include these requirements. The warranties exclude accidental or intentional damage to the system by acts of the customer or other persons.

f. g. To evaluate on-site hot water heating conventional performance, Ying reserves the right to request monitoring results of base energy use when the solar system is monitored not to exceed one month at a time, including the option to do this in different seasons.

- g* ~~h~~ If the accumulation of hard water deposits in the system causes a serious loss of system efficiency, Ying agrees to assist customers in flushing and removing hard water deposits from the system. No charge will be made for such service during the first five years.
- h* ~~f~~ Ying reserves the right to request that performance results be adjusted if needed to account for deviations from:
- 1) Expected insolation levels (unusual climate), and
 - 2) Expected water consumption during the monitoring period.
- i* ~~h~~ Ying systems shall have external means to determine the water level in the heat exchanger tank and the minimum level shall be indicated.
- j* ~~k~~ A device must be installed to permit the user to determine whether the appliance is heating water.
- k* ~~l~~ ~~As a part of the five-year warranty,~~ Ying agrees to refill at no charge the Freon loop and the heat exchanger tank if the levels drop below the minimum levels.
- l* ~~m~~ The freeze protection requirement is satisfied by the use of Freon.

Ying will meet the minimum quality and sizing criteria as contained in Decision Nos. 92251, 92501, and 92769 except as specified in the following paragraph.

Ying will not install as part of this program any systems serving one bedroom single-family homes with less than 32 square feet of panel surface (one 32T unit).

Ying will not install as part of this program any systems serving two or three bedroom single-family homes with less than 70 gallons of solar heated storage and less than 40 square feet of panel surface (one 40T unit). Four and five bedroom single-family homes will receive not less than 64 square feet of panel surface and the equivalent of 110 gallons of solar heated storage (two 32T units). For single-family households in northern California such as coastal areas like San Francisco and north or inland areas like Sacramento and north and other similar climate areas, Ying installations for three, four and five bedrooms should be no less than 64 square feet of panel surface area (two 32T units).

It is further agreed that any reference to this decision in correspondence, marketing literature, or media advertising shall also 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, reliability, or the short- or long-term energy savings performance of this or any other brand system or component for domestic water heating or any other application."

While this disclaimer is applicable to any system under our demonstration program, it is important to set it out here because of the exemption being requested by Ying, to remove any

doubts on whether or not this order would constitute an implied endorsement. We agree with ECB's position and the agreement it has reached with Ying as set out above.

ECB recommends the application be granted ex parte. We believe that public hearings would serve no useful purpose.

Finding of Fact

Ying systems may reasonably be expected to supply 60% net energy savings over nonsolar domestic water heating systems as previously discussed.

Conclusions of Law

1. The exemptions requested by Ying are reasonable and should be granted subject to the agreements reached between ECB and Ying as previously discussed.

2. The following order should be effective on the date of signature in order to allow Ying to participate in the solar financing program at the earliest time.

O R D E R

IT IS ORDERED that:

1. Ying Manufacturing (Ying) is granted the requested eligibility to participate in the Demonstration Solar Financing Program.

2. The eligibility requested is granted subject to Ying's full acceptance and compliance with the requirements specified by ECB and its agreement with ECB as specified herein, including the Disclaimer of Product Endorsement.

3. Except as granted and provided herein, Ying and its contractors shall adhere to all other currently effective sizing and installation requirements set forth in D.92251, 92501, and 92769; and as may be further ordered by this Commission for continued eligibility for participation in the Demonstration Solar Financing Program.

This order is effective today.

Dated NOV 3 1981, at San Francisco, California.

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

I certify that this decision was approved by the above Commissioners today.

John E. Bryson