U/BS/FS/WPSC

ORIGINAL

Decision 82 11 022 NOV 3 - 1982

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

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| Application of King Energy Systems for exemption from certain requirements of Decision Nos. 92251, 92501 and 92769. | Application 60978 (Filed October 13, 1981) |

OPINION ON ELIGIBILITY FOR THE OII 42 SOLAR FINANCING PROGRAM

King Energy Systems (King) manufactures domestic solar water heaters composed of several tank-type collector-storage devices. These systems have not been eligible under the Commission's Order Instituting Investigation (OII) 42 Demonstration Solar Financing Program (Program) because no method was available until recently to estimate the energy savings produced by them. King requests that the Commission find its two models of solar water heater units eligible for OII 42 financing assistance.

By this decision, the Commission finds solar water heaters using King's Model 600RD units to be eligible for the Program under specified sizing and other conditions. The Model 600R is denied eligibility due to inadequate energy savings.

Applicant's Background

King manufactures a tank-type solar water heater unit, typically installed as a system of several units which collects and stores solar energy without a pump. Generically such solar water heaters are known as integral collector-storage (ICS) units. Water flows in an ICS system only when hot water is being used in the dwelling. Most King units have been installed on single-family homes by Servamatic Solar Systems, Inc. They are always installed so as to preheat the water entering the customer's existing water heater.

King currently sells two models: each collector has a 20-gallon nominal storage capacity. The 600R model consists of a horizontal cylindrical tank, surrounded by two clear plastic cylinders, all three concentric. A curved stainless steel reflector is fixed beneath the assembly. The 600RD model has a similar configuration but instead of the outer clear plastic cylinder, the entire assembly is surrounded by a large black plastic box with a clear plastic dome.

On June 17, 1981, King informally sought eligibility for its 600R model, through a consulting service. Shortly after, King began marketing its 600RD (the model enclosed under a dome). The Energy Conservation Branch (ECB) then requested that King itself, as the manufacturer, formally file an application for

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eligibility in the program, for one or both models. King was requested to include a system test of the 600RD under conditions of controlled radiation and water draw, in order that minimum eligible sizing could be calculated and a decision issued on that unit.

By its letter to the ECB of September 29, 1981, which was docketed as Application 60978 on October 13, 1981, King then requested that the 600RD solar water heater it manufactures be declared eligible for participation in the solar rebate program.

King also requested eligibility for a limited number of 600R models, namely, all those installed between March 1, 1981, and the year-end date of December 31, 1981, when King expected all of the inventory of the older 600R model to have been sold. A test of the 600R was being conducted at the time King applied.

King believes that, under at least some conditions, both of these models are capable of displacing 60% of the conventional energy used in water heating. King seeks eligibility and sizing guidelines for systems using its units under the OII 42 utility financing program.

Program Background

On September 16, 1980, we issued Decision (D.) 92251 in OII 42 which established 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 technical requirements to be eligible for the demonstration solar financing program of rebates and loans beginning March 1, 1981.

The program contemplated flat-plate systems primarily. Nonflat-plate systems such as those manufactured by King must be approved for eligibility by Commission decision on a case-by-case basis.

In the remainder of this decision, we first discuss freeze protection and valving issues applicable to both the 600R and 600RD models. Following that we deal with sizing of King Model 600R systems installed from March 1 through December 31 of 1981. Following that we discuss the minimum eligible sizing for all 600RD systems.

Freeze Protection

King units have no explicit freeze protection feature. Protection of some sort is a program requirement. ICS units such as King's usually contain enough solar heat, however, to prevent freezing of the tank under conditions found throughout most of California.

Piping in ICS and other passive systems, however, is subject to freezing during cold weather even when insulated. Therefore, insulation in compliance with the Installation Checklist must completely cover all outdoor piping, fittings, and valve bodies. Even small gaps will greatly increase nighttime heat loss, reducing efficiency as well as the protection against frozen pipes.

A maximum elevation of 2,300 feet has been adopted for passive system installations under the Program except for two heavily insulated devices, and one which uses a nonfreezing fluid.1/

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1/ Solahart, A.60127, Memorandum of Understanding (MOU), February 20, 1981; Hemet, Letters, MOU, May 14, 1981; Amcor, A.60349, MOU, May 27, 1981; Burke, Letters, MOU, August 17, 1981; Ying, A.60912, D.93681, November 3, 1981; Sharpe, A.60480, D.93741, November 13, 1981; Solar Edwards, A.61086, D.82-04-020, April 6, 1982; and Cornell Energy, A.82-03-112, D.82-09-018, September 8, 1982.

Valving

Although King did not specifically request exemption from the requirements for isolation valving, or for a tempering valve, we note that some King systems may already have been installed without one or both of these valves. We reaffirm the need for these valves in all systems to be eligible for OII 42 financing assistance, for reasons of reliability of hot water service, and of safety from possible excessive water temperatures.

Warranties

King warranties on the 600R and 600RD units meet the requirements for California solar tax credit eligibility.

System Sizing for the Model 600R

Until recently all solar water heaters eligible under the OII 42 program have been subject to minimum collector area and solar-heated storage volume requirements. However, a solar water heater system performance test known as SRCC-OG200 was recently developed as a national standard. Certification following this test was recently adopted by the California Energy Commission (CEC) as an eligibility requirement for the California solar tax credit for ICS devices after 1982. The minimum solar energy output for OII 42 program eligibility is 101 therms per year for a three-bedroom dwelling. (This figure is developed in Appendix C based on adopted OII 42 criteria.)

The 600R has not been tested under SRCC-OG200, or if so, the results have not been submitted as part of this application. However, the 600R has been tested under a method agreed to by the CEC and King. That test was conducted in June 1981 by a laboratory certified by the CEC, the Solar Energy Analysis Lab (SEAL) in San Diego.

The results of the ECB's analysis of the SEAL test is given in Tables 1 and 2. The analysis method is described in Appendix A.

TABLE 1

Performance of a King Energy
Model 600R Solar Water Preheater System

Number of 600R Units: 3
Hot Water Use @ 20 Gallons per Bedroom per Day
Gallons Per Day: 60
Time of Day: As Shown
Dwelling Size: 3 Bedrooms

| Case (a) | Profile of Hot Water Use (b) | Solar Energy Production REQUIRED for OII 42 a/ (Th/Yr) (c) | Solar Energy DELIVERED (Th/Yr) (d) |
|---|---|---|---|
| A | 60 gal @ 6 a.m. | 101 | 12 |
| B | 20 gal @ 6 a.m.<br>20 gal @ 12 noon<br>20 gal @ 6 p.m. | 101 | 42 |
| C | 60 gal @ 6 p.m. | 101 | 67 |

Conditions: 1,700 Btu/ft$^2$ per day incident on system.

Statewide Average Air Temperatures: Day: 67 degrees F.
Night: 53 degrees F.

Total Water Temperature Rise after Auxiliary: 70 Degrees F.

Wind: 4 mph.

a/ Per Appendix C.

TABLE 2

Performance of Various King Energy
Model 600R Solar Water Preheater Systems

Number of 600R Units: As Shown
Hot Water Use @ 20 Gallons per Bedroom per Day
Gallons Per Day: As Shown
Time of Day: 6 p.m.
Dwelling Size: As Shown

| No. of Bedrooms | Hot Water Use (Gal/Day) | Solar Energy Production REQUIRED for OII 42 (Th/Yr) | Solar Energy DELIVERED By (No. OF 600R UNITS IN SERIES) 2 (Th/Yr) | 3 (Th/Yr) | 4 (Th/Yr) |
|---|---|---|---|---|---|
| (a) | (b) | (c) | (d) | (e) | (f) |
| 1 | 20 | 34 | 24 | 26 | 28 |
| 2 | 40 | 67 | 44 | 49 | 51 |
| 3 | 60 | 101 a/ | 59 | 67 | 71 |

Conditions: 1,700 Btu/ft$^2$ per day incident on system.

Statewide Average Air Temperatures: Day: 67 degrees F.
Night: 53 degrees F.

Total Water Temperature Rise after Auxiliary: 70 Degrees F.

Wind: 4 mph.

a/ Per Appendix C.

It appears from these tables that King 600R solar water heaters are not able to produce the minimum amount of conventional energy savings needed to justify payment of the OII 42 utility rebates. Even using all the water from three or four units at the most favorable time (6 p.m.), the 600R systems do not meet the OII 42 criteria. Normally, water use is spread throughout the day, further reducing the solar contribution in practice.

King also requested that it be permitted the "30% reduction" granted for some systems installed between March 1, 1981 and June 15, 1981. The 30% allowance did not apply to ICS systems, but only to the flat-plate collector area required by the Sizing Chart Handbook which was published by the CEC several months late. Moreover, that temporary reduction presumed that such systems, if sized without the 30% reduction, would be able to meet all criteria including adequate savings. However, as we concluded above, no King 600R system under average statewide conditions would produce the minimum OII 42 savings, even if it were two or three times as large as most systems now installed.

It might be argued that where radiation conditions are extremely high and favorable to solar, such as in desert areas, King 600R systems should be granted approvals in individual cases. We think not, because the performance of the 600R depends strongly on the time of day of water use. Even though daytime heat gain may

be significant, most of the heat gained is lost overnight. Most users of a 600R system who used most of their hot water before midday would save relatively little. The underlying program assumptions, that significant solar heat can be stored not only overnight but for several days if necessary, cannot be met in King 600R installations.

System Sizing for the Model 600RD

King submitted the results of the SRCC-OG200 system test for its 600RD model. The output of a King 600RD solar system in therms per year under OII 42 conditions can be calculated from the results of this test, as described in Appendix B of this decision.

Based on the test data and those calculations, the ECB recommends that an annual average output per day of 9,000 Btu be adopted for each King 600RD unit which is installed in California under the OII 42 program. This output corresponds to 32.9 therms per collector unit per year. Therefore, three collectors would be needed to meet the annual load of a three-bedroom home under OII 42. Table 3 summarizes the minimum eligible sizing for 600RD systems.

The ECB notes that the output of successive ICS units is reduced when they are connected in series (the outlet of one leading to the inlet of the next). Therefore, we could restrict the sizing requirements for multiple units to a maximum of two

units in series since the test results are for two units in series. Additional pairs then would need to be in parallel (the outlet of all pairs leading to the same manifold).

But three units in series produce slightly higher water temperatures. For this reason, plumbing arrangements of the minimum required number of units may be made with a maximum of three King 600RD units connected in series. The necessary parallel connections made thereafter must comply with the Installation Checklist Item No. 21 regarding an equal flow path length through all collectors. A longer summer season of solar-only operation with the backup water heater turned off will then be possible while still making suitably hot water available for use.

TABLE 3

Minimum Sizing of King Solar Water Heater Systems
Using Model 600RD Collector Units

| Number of Bedrooms | OII 42 Minimum Output Therms/Yr. | Number of Collectors (Sq. Ft.) b/ |
|---|---|---|
| 1 | 33 | 1 (23.7) |
| 2 | 68 | 2 (47.4) |
| 3 | 101 a/ | 3 (71.1) |
| 4 | 135 | 4 (94.8) |
| n over 4 | 33n | n (23.7n) |

a/ See Appendix C for derivation.

b/ A maximum of three (3) collectors to be installed in series.

Ideally, the minimum sizing shown in Table 3 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 be predicted only within a reasonably 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 King systems installed under OII 42 should be sized according to Table 3.

Monitoring

King solar systems should be evaluated in the monitoring program now beginning for all other solar water heaters which are installed under the OII 42 program.

ECB recommends that King Model 600RD units be allowed to participate in the Demonstration Solar Financing Program based on the following conditions (as used below, King refers to King and/or its installers):

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

b. Neither King installers nor any other installers working in cooperation with King shall convert from gas water heating to electric water heating; otherwise the customer will be ineligible for the utility rebate or loan.

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

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

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

King and its installers should meet the minimum criteria contained in D.92251, D.92501, and D.92769 and all subsequent decisions, and should meet the current standards of the CEC's Solar Energy Tax Credit Guidelines when installing King systems.

Any reference by manufacturers, distributors, wholesellers, retailers, or installers including King and Servamatic, 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. King manufactures a 600R model and a 600RD model of its ICS solar water heater unit.

2. King applied for OII 42 program eligibility because the program technical assumptions about solar water heater energy savings do not apply to ICS units.

3. A maximum elevation of installation of 2,300 feet above sea level has been adopted to provide adequate freeze protection for all passive water heaters of the King type which are eligible under OII 42.

4. Installation Checklist requirements for isolation valves and tempering valves apply to King systems.

5. The performance test adopted by the CEC for ICS systems is known as SRCC-OG200.

6. King submitted the results of the SRCC-OG200 test for its 600RD unit, and the results of a simpler test for its 600R unit.

7. King warranties on the 600R and 600RD units meet the California solar tax credit requirements.

8. Analysis of the results of the test of the 600R unit as given in Tables 1 and 2 indicates that 600R systems deliver less solar energy than the 60% savings of conventional energy criterion for OII 42 eligibility.

9. Little increase in delivered solar energy is gained by connecting more than three ICS units in series.

10. Analysis of the results of the SRCC-OG200 test indicates that one 600RD ICS unit will deliver 9,000 Btus per day on an annual average basis or 32.9 therms per year under California conditions.

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

Conclusions of Law

1. King solar water heaters using 600R units should not qualify for OII 42 financing assistance.

2. King solar water heaters using 600RD units should be found eligible for rebates when sized as shown in Table 3.

3. King 600RD solar water heaters installed below 2,300 feet elevation should be assumed for purposes of the OII 42 program to be adequately protected against freeze damage.

4. King 600RD solar water heaters must comply with all other Commission decisions in the OII 42 program, and with the other requirements set forth in the decision above.

5. This application should be processed ex parte.

O R D E R

IT IS ORDERED that:

1. King Energy Systems' (King) solar water heating systems of multiple Model 600RD integral collector-storage units are eligible to participate in the OII 42 Demonstration Solar Financing Program under the sizing and freeze protection conditions summarized in the Conclusions of Law.

2. King solar water heating systems of multiple Model 600R units are not eligible to participate in the OII 42 Demonstration Solar Financing Program.

3. Except as granted and provided, King and its installers shall adhere to all other currently effective requirements set forth in D.92251, D.92501 and D.92769 or subsequent orders in this proceeding including the Disclaimer of Product Endorsement.

This order is effective 30 days from today.

Dated NOV 3 1982, 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.

Joseph E. Bodovitz, Executive Director

APPENDIX A
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## Method Used to Process the King Model 600R Solar Water Heater Test Results

The ECB analyzed the results of the Solar Energy Analysis Lab test of a single 600R unit. Those results were daytime heat gain, and overnight heat loss, under the known test conditions of insolation, air temperature and wind recorded at the test site in San Diego in June, 1981. By converting these actual results to those conditions which represent California statewide and year-around, under the OII 42 program, the predictable solar energy gain of a single 600R unit under OII 42 conditions was obtained.

Several 600R units were combined into analysis model systems of two or three units, as sold by King's primary retail outlet Servamatic Solar Systems, Inc. The analysis was extended to include systems of four 600R units because King provided materials suggesting that four-unit systems were being marketed. Withdrawals of solar heated water from such systems were calculated to meet OII 42 standard loads of 20 gallons per bedroom per day.

Full-tank withdrawals were used in the calculating to most accurately account for all of the energy available regardless of stratification.

The losses resulting from solar heated water remaining in piping after draws of less than 20 gallons were ignored, although they are signficant under some use profiles.

A range of annual solar contributions was found. The solar contribution depended on the number of 600R units in the system. However, the solar contribution depended on the time of day of hot water use more than on the number of 600R units. The predicted contribution was compared to the minimum required solar contribution for program eligibility, as summarized in Tables 1 and 2.

The analysis underlying these tables is conservative, in that the benefit of doubt is given to the applicant whenever an engineering value is chosen. For example, the test data available were taken at wind speeds of less than 2 mph. The effect of wind is to reduce performance. A statewide average wind speed is 6.8 mph. A speed of 7.5 mph adopted by the Solar Rating and Certification Corporation (SRCC) underlies all of its systems test results. Yet a speed of only about half that, or 4 mph, was used in analysis in order to give the purchasers of record every chance to have their King units qualify for the utility rebates.

As a second example of the conservative analysis, most King systems are installed in areas receiving from 1,600 to 1,700 Btu per day on an annual average. The ECB has previously assumed radiation of 1,600 Btu per day to conservatively represent California statewide conditions. Insolation of only 1,500 Btu per day was adopted for the SRCC-OG200 system test. Yet, 1,700 Btu per day was chosen for this analysis, since higher insolation improves system output.

## Method Used to Process the SRCC-OG200 Solar Water Heater Test Results

The minimum number of King 600RD units per bedroom served under OII 42 follows when the results of the SRCC-OG200 test are compared to the 101-therm minimum criterion for a three-bedroom dwelling. However, the test results reflect national average values, not California values, for available solar radiation and other variables. Therefore, the annual solar output under California conditions was determined from the SRCC-OG200 results by using the following conversion method.

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 consensus method may not be available before the OII 42 program is over, the ECB staff, with informal review from the solar community, is using the following objective approach.

Three of the many conditions chosen for the SRCC-OG200 test vary significantly for ICS systems installed in California. These are the incident solar energy, the volume and timing 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 a California value to the test value, or (1700/1500), in Btus per sq. ft. per day.

### Hot Water Usage

The effect of varying the second factor, the amount and timing of hot water drawn per day, is difficult to quantify for ICS systems. However, the direction of the effect is clear. Reducing the volume from approximately 100 gallons per day during the test, to 60 gallons per day for a three-bedroom dwelling under OII 42

conditions will reduce the net solar energy delivered.a/ (Shifting the timing of usage from evening toward morning also reduces the energy delivered. However, 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 value chosen depends on the extent of analysis, quality of any data used, and on the assumptions made. In the absence of a recognized method to calculate this factor, ECB staff believes that (1500/1700) is a reasonable one.

Therefore, the factors for radiation and water usage are assumed to cancel, and the output under OII 42 conditions is assumed to be unchanged from the SRCC-OG200 value except overnight losses.

Overnight Heat Losses

The importance of this factor in the net solar energy delivered by a solar system is recognized in the SRCC-OG200 test process. A separate 16-hour temperature decay test is conducted to determine the rate of heat loss under the known test conditions. But the actual amount of energy lost in any given locality or installation 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 method of determining the actual loss, using local temperatures and SRCC heat loss rate data, will eventually have national agreement, as with the other factors which modify the SRCC test result. A reasonable engineering estimate of that loss is recommended by the ECB staff for use in the OII 42 program until another method is developed and recognized.

The ECB recommends using two items of test data to make this estimate. One is the temperature difference between the solar heated water remaining in the solar system after the standard test day, and the annual average overnight temperature in California population centers, as the factor affecting the overnight heat loss.

The second item is the rate of heat loss. The rate used in this analysis should be greater than the rate determined in the SRCC test because the test value was measured under conditions of zero wind.

These two data items, combined with an exponential heat loss model, produce for King an overnight heat loss of 10% of the net solar energy delivered under the SRCC rating as reported.

APPENDIX C
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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 C
Page 2

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 C
Page 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 |

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

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

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

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

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

King and its installers should meet the minimum criteria contained in D.92251, D.92501, and D.92769 and all subsequent decisions, and should meet the current standards of the CEC's Solar Energy Tax Credit Guidelines when installing King systems.

Any reference by manufacturers, distributors, wholesellers, retailers, or installers including King and Servamatic, 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".