



Hawaii Solar Energy Association
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July 31, 2009

Comments to PUC D&O on Docket No. 2008-0249

PUBLIC UTILITIES
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On July 1, 2009 the Public Utilities Commission of the State of Hawaii (commission) issued its decision and order on Docket No. 2008-0249 Instituting a Proceeding to Investigate the Issues and Requirements of Adopting or Establishing Standards for Solar Water Heater Systems as Mandated by Act 204, Session Laws of Hawaii (2008).

As part of its decision and order the commission provided a process to solicit and receive comments from any affected entity (including the Parties and Participant) and the general public. As a Party to this proceeding, the Hawaii Solar Energy Association (HSEA) avails itself of the opportunity to comment on SWHS standards attached as Exhibit I to the commission's decision and order.

In its order initiating investigation to adopt or establish standards for solar water heater systems the commission set forth three preliminary issues for consideration in the docket. HSEA addresses the commission's position on each of these issues separately.

Issue 1: Standards to be Adopted or Established

The commission has adopted the RSWHS Standards over the SRCC OG-300 Standard. HSEA concurs with the commission's decision on this issue but has reservations about some of the commission's modifications to the proposed standards.

Issue 2: Modifications to Proposed Standards

1. Designation of Administrator is Unnecessary

The commission has modified the standards proposed by the Stipulating Parties. HSEA concurs in part, and disagrees in part, with the commissions modifications to the proposed standards.

The commission has accepted the addition of a definition section as proposed by the Stipulating Parties. HSEA concurs with the commission's decision on this addition.

The commission has found that an Administrator for the RSWHS Standards is unnecessary. HSEA disagrees with the commission's decision on this issue. On the contrary, HSEA's position is that an Administrator is essential to comply with the intent and objectives HRS 269-44 HRS 269-124.

Legislative intent is expressed in S.B. 644 C.D.1 of the Twenty-Fourth Legislature, 2008. The legislature found:

“that with a solar water heater system mandate, and with a properly sized and installed solar water heater system, a household can increase its disposable income through this type of prudent, energy savings investment”

The legislature also found:

“that the savings from a home’s electricity bill through the installation of a solar water heater system could result in the system being paid off in eight to ten years without a state tax incentive.”

The legislature stated that:

“the purpose of this Act is to increase the use of renewable energy to protect our environment, reduce pollution, make housing more affordable, and enhance Hawaii’s local economy.”

The legislative intent is further articulated in Conference Committee Report Number 169-08 where it states:

“The purpose of this bill is to lessen Hawaii’s dependence on fossil fuels by:

- (1) Requiring solar thermal water heaters installed in homes constructed after January 1, 2010, to comply with the standards of any ratepayer financed energy efficiency rebate program administered by an electric utility or public benefits fund administrator that is in effect at the time permits are issued for the home;”

The legislature has predicated the economic and environmental benefits from a mandated solar water heater system accruing to the new home buyer, and to the state in general, upon the proven success of the existing ratepayer financed rebate program. Hawaii’s solar rebate program has national and international recognition as the largest and most successful program in the United States.

The success of the solar rebate program is the result of three integral components of the program - RSWHS Standards, administration of the RSWHS Standards, and verification of compliance with the RSWHS Standards.

By deciding not to designate an Administrator of the RSWHS Standards the commission has eliminated one of the three integral components of the most successful program in the nation. This decision jeopardizes the legislative intent in regard to the attainment of the economic and environmental benefits of mandated solar water heater systems.

With respect to compliance with HRS 269-44, the commission has fallen short of fulfilling this section of the statute. While the commission has adopted the RSWHS Standards, it has, by deciding not to designate an Administrator failed to provide a means for ensuring the "performance, materials, components, durability, longevity, proper sizing, installation, and quality to promote the objectives of HRS 269-124."

HRS 269-44 clearly authorizes the commission to do more than just adopt standards for solar water heater systems by stating that the standards are "to include, but not limited to, specifications." Yet the commission has opted to minimally comply rather than embrace the intent of this section of the statute.

The commission justifies its decision to not designate an Administrator for the RSWHS Standards by stating, in part,

"that the building departments of the respective counties already review and have oversight functions over portions of the installation of SWHS, the commission finds it reasonable and appropriate to allow their approval to satisfy certain provisions of the RSWHS Standards. In doing so, the commission is not extending the duties and obligations of the building departments, but merely allowing their approval over matters already under their purview to satisfy the requirements of the RSWHS Standards."

HSEA agrees with the commission that the building departments of the respective counties have oversight of certain portions of the installation of SWHS. The commission fails, however, to identify which provisions of the RSWHS Standards fall under the duties and obligations of the building departments. The commission also fails to identify how the provisions of the RSWHS Standards that do not fall under the duties and obligations of the building departments, such as system design, sizing, performance, and quality, are to be treated.

A review of the Web sites of the building departments of respective counties reveals that the primary duties and obligations of the building departments are to provide minimum requirements for the protection of public health, safety and welfare. SWHS are subject to, but not limited to, these requirements. The RSWHS Standards, in addition to requiring compliance with the requirements of the building departments, exceed building, plumbing, and electrical code requirements by prescribing SWHS quality, performance, and longevity. The purview of the respective county building departments does not pertain to quality, performance, and longevity of SWHS. Therefore, to preserve the performance objectives of the RSWHS Standards an Administrator is required.

The functions of the Administrator include, but are not limited to, maintenance of those aspects of the RSWHS Standards that require timely updates, to answer questions about the RSWHS Standards from affected parties, and to verify compliance with the RSWHS Standards. Without an administrator these functions are not met.

HSEA's position that an Administrator of the RSWHS Standards is necessary was memorialized, along with the other Stipulating Parties, in their Stipulation filed on April 28, 2009 and in their Alternative Stipulation filed on June 1, 2009.

HSEA continues to advocate the necessity of an Administrator. Furthermore, HSEA concurs with the Consumer Advocate, also a Stipulating Party, in its Motion for Clarification filed on July 13, 2009 "that an administrator is essential not only to answer questions by solar water heater contractors and residential customers in implementing the RSWHS Standards, but as discussed in the Alternative Stipulation, to perform such functions as site verification of each system."

2. Other Amendments

a. Output Table, Products List, and Sunshine Maps

The commission has rejected the Stipulated Parties proposal to separate the Output Table, Products List, and Sunshine Maps from the RSWHS Standards and to have these documents kept and maintained by an Administrator. HSEA disagrees with the commission's decision on this proposal.

1) Output Table. The commission correctly finds that the Output Table contains essential information to determine system performance within the RSWHS Standards. The commission, however, fails to recognize that these documents are dynamic, and fails to provide a means for their timely updates.

For example, output ratings of SRCC OG-100 certified collectors change for several reasons. Reasons include, but are not limited to, mandatory re-testing by SRCC, voluntary testing at the request of an applicant, and reporting changes by SRCC. SRCC requires mandatory re-testing when a material change to the collector is made by an existing certificate holder. SRCC also requires mandatory re-testing of every certified collector every twelve years regardless if no material changes were made to the collector.

There are a number of collectors listed on the Output Table whose output ratings have changed but those changes are not reflected on the Output Tables submitted by the electric utilities to the commission on July 13, 2009. In addition to being outdated the submitted Output Tables contain errors. SRCC has a number of collectors currently OG-100 certified that are undergoing re-testing and a number of collectors undergoing their first OG-100 certifications.

SRCC has recently changed its OG-100 collector output reporting method. Until recently SRCC rounded collector output to thousands of BTU's per panel per day. SRCC now rounds collector output to hundreds of BTU's per panel per day. This change in reporting method by SRCC has resulted in changes in OG-100 collector output ratings for every collector listed on the Output Table.

HSEA concurs with the commission's decision to require Solar Collector BTU/Day Output by Hawaii Sunshine Zone tables for the islands of Maui, Molokai, Hawaii, Kauai, and Lanai.

2) Sunshine Maps. The commission correctly finds that the Sunshine Maps contain essential information to determine system performance within the RSWHS Standards. The commission, however, fails to recognize that questions routinely arise regarding the interpretation of these maps, and fails to provide a means for their interpretation.

3) Products List. The commission has decided to remove the Products List from the RSWHS Standards. HSEA disagrees with the commission on this issue. In justifying its decision the commission states:

"inclusion of a product list could result in negative consequences such as, but not limited to, unnecessarily restricting the type of products that can be utilized for the installation of SWHS in Hawaii for the compliance with these standards, which could unreasonably increase the costs to homeowners."

This commission has erred in its reading of the Stipulating Parties position on the Product List. As quoted below, the Stipulating Parties never intended for the Product List to be eliminated.

"The Stipulating Parties agree that, if adopted by the Commission, the September 19, 2007 version of the RSWHS Standards should be modified by (1) deleting the appended 'Table 6. Solar Collector BTU/Day Output by Hawaii Sunshine Zone' and the 'HECO Solar Water Heating Systems Accepted Products List' (i.e. Table and Products List as defined above) **to instead be separately kept and maintained by an administrator.**" [emphasis added by author]

The Products List is an integral part of the RSWHS Standards and serves to insure that products proposed for use in mandated SWHS are objectively screened and listed only if their use is for the purposes intended by the manufacturer and for the conditions experienced by SWHS.

By eliminating the Products List from the RSWHS Standards the commission has created exactly the situation that it stated it wanted to avoid, i.e. restricting the type of products that can be utilized. Before a collector is listed on the Output Table it has to be listed on the Products List. Eliminating the Products List restricts additional collectors from being added to the Output Table.

b. Retrofit Systems and Other Types of Structures

The commission has concluded that "all references to retrofit and other types of structures should be eliminated from the RSWHS Standards. HSEA concurs with the commission's conclusion on this issue.



c. Conforming Amendments

The commission has decided to eliminate references to a "List of Accepted High-Efficiency Electric Water Heaters" and the use of high-efficiency electric water heaters from the RSWHS Standards. HSEA concurs with the commission on this issue.

The commission has revised the RSWHS Standards regarding definitions for consistency. HSEA concurs with the commission on those revisions with which HSEA agrees previously and disagrees with those revisions with which HSEA previously.

Issue 3: Method to Update Standards

The commission finds the Stipulating Parties' proposal to require the filing of an application under HAR Chapter 6-61 to request updates or amendments to the RSWHS Standards for commission review and approval to be reasonable. However, the commission rejects the Stipulating Parties' agreement with respect to the procedures to update the Output Table and Products List.

HSEA disagrees with the commission on this issue. The Output Table and Products List are integral parts of the RSWHS Standards and are dynamic in that they require more frequent and timely updating than the core body of the RSWHS Standards. Requiring a docket to be opened every time the Output Table needs updating would create an unnecessary burden on the affected parties, hinder innovation, and detract from the effectiveness of the RSWHS Standards.

Conclusion

HSEA commends the commission for recognizing the appropriateness of the RSWHS Standards over the SRCC OG-300 for Hawaii mandated solar water heater systems.

HSEA disagrees with some of the modifications the commission made to the RSWHS Standards. The Stipulating Parties presented the commission with a set of documents whose use has demonstrated quantifiable energy savings and capacity deferment. These documents provided for proven results for SWHS installed under their purview. The commission, by not designating an Administrator, by deleting the Products List, by freezing the Collector Output table in stone, by not providing for system inspections, has compromised the RSWHS Standards to the point that measurement and evaluation of impacts becomes guesswork at best.

Recommendations

1. Administrator. HSEA recommends that the commission designate an Administrator for the RSWHS Standards.

2. Third Party Administrator. HSEA believes that the most logical choice for the commission to designate as Administrator for the RSWHS Standards is the Third Party Administrator (TPA). The TPA already administers the RSWHS Standards for SWHS on new (until January 1, 2010) and existing homes. The TPA uses the same RSWHS Standards proposed by the Stipulating Parties. The TPA already inspects SWHS installed under the RSWHS Standards. The TPA is already under contract with the commission to administer the RSWHS Standards.

The TPA can assume responsibility for administering the RSWHS Standards and verifying compliance with the RSWHS Standards for mandated SWHS. The TPA can administer the RSWHS Standards and conduct system inspections for mandated SWHS for minor incremental cost increases to its current contract with the commission. The TPA is the least cost option to administer the RSWHS Standards since it is currently performing identical functions for the commission.

HRS 269-44 provides the commission with the latitude to designate an Administrator of the RSWHS Standards. The commission should embrace the intent of the legislature to optimize the contribution of mandated SWHS towards the state's renewable energy objectives by accepting the complete set of integrated documents proposed by the Stipulating Parties.

3. Collector Output Tables. The commission should not adopted Collector Output Tables submitted by the electric utilities to the commission on July 13, 2009. Each of those tables contains errors as summarized below and detailed in Attachment 1.

Table	No. of Errors
HECO	5
HELCO	1
MECO	15
KIUC	5
Total	26

Furthermore, all of the submitted tables are based on outdated SRCC OG-100 collector output ratings. As stated previously, SRCC has recently changed its OG-100 collector rating method from rounding collector output to thousands of BTU per panel per day to hundreds of BTU per panel per day. This change in reporting method by SRCC has resulted in changes in OG-100 collector output ratings for every collector listed on the Output Table.

To assist the commission with this matter HSEA has updated the Collector Output Tables for Oahu (formerly HECO), Hawaii County (formerly HELCO), Maui County (formerly MECO), and Kauai (formerly HECO as stated by KIUC) based on the SRCC OG-100 collector output ratings posted on SRCC's web site as of July 9, 2009. HSEA used the method prescribed in the Collector Ratings section of the RSWHS Standards

attached to the commission's decision and order in the instant docket to update the tables. These tables are presented in Attachment 2.

HSEA recommends that the commission adopt the tables prepared by HSEA and presented in Attachment 2 to this transmittal so that the most current collector output ratings are incorporated into the RSWHS Standards.

4. Products List. HSEA believes that the Products List is an integral part of the RSWHS Standards and recommends that the commission re-instate this list to the RSWHS Standards for three important reasons. During the administration of the RSWHS Standards by the electric utilities, some contractors used products that were not on the Products List. Use of non-listed products was found to adversely affect SWHS performance and longevity.

SWHS, with the exception of pre-engineered thermosiphon systems, are composed of components manufactured by different companies. System component categories include, but are not limited to, collector storage tanks and heaters, circulating pumps, pump controllers, photovoltaic modules, time switches, piping insulation, valves, and temperature gauges. These components are selected and integrated into SWHS by contractors. Not all components available in the marketplace within these categories are suitable for SWHS applications.

Products intended for use in mandated SWHS need to be screened. The RSWHS Standards administered by the electric utilities recognized that SWHS experience unique conditions not experienced by traditional water heaters. Examples of unique conditions include, but are not limited to, extreme heat and exposure to the elements, such as weather and sunlight. Therefore, the electric utilities screened all components submitted for inclusion into a SWHS and listed those components found suitable on the Products Lists of the RSWHS Standards. The screening process consisted of an objective review of the technical suitability of the products for SWHS applications.

The Products List is dynamic and needs to be maintained and updated. New products within the component categories listed above are continuously introduced into the marketplace. During the twelve plus years the RSWHS Standards were administered by the electric utilities the Products List was updated on average of two times a year. Provisions for determining the suitability of new products for use in mandated SWHS are needed.

The TPA currently under contract with the commission maintains and updates the Products List for SWHS eligible for ratepayer funded rebates for new and existing residential dwellings, including new single-family dwellings. The same Products List can and should be maintained and updated by the TPA for mandated SHWS.

HSEA recommends that the commission re-instate the Products List and designate the TPA to maintain and update the list for mandated SHWS. Without the Products List and

without a means to maintain and update the list, the performance, longevity, and quality of mandated SWHS may be jeopardized.

5. System Inspections. HSEA recommends that the commission provide for system inspection of mandated SWHS. The purpose of system inspection is to verify compliance with the RSWHS Standards. Inspections are in addition to, not in lieu of, any county building department inspection and include critical inspection aspects outside of the scope of the applicable county codes. Inspections are conducted on rebated SHWS. Inspections are essential to insure the economic and environmental benefits accruing to homebuyers and the state are preserved in the same way they are for rebated SWHS.



Rudolf Christ, Vice President
For Mark Duda, President



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Attachment 1.

Missing or Incorrect Collector Output Values

MISSING OR INCORRECT COLLECTOR OUTPUT VALUES

OG-100 Protocol Format	(BTU/sq ft day)	2030	1845	1771	1661	1,587	1476	1292	1107		
Hawaii Sunshine Zone	(Cal/sq cm/day)	550	500	480	450	430	400	350	300		
Table	Nom. Size	Coating	Model								
HECO	4' x 7'	Selective	Gobi 406 002	n/a	0	n/a	0	n/a	0	0	0
HELCO	4' x 10'	Selective	Gobi 410 001	43,634	39,668	n/a	64,633	n/a	29,520	24,280	n/a
MECO	3' x 7'	Selective	SS-21	n/a	19,373	21,000	16,605	15,473	13,776	14,000	14,000
	3' x 8'	Selective	SS-24	n/a	22,140	24,000	18,977	17,684	15,744	16,000	16,000
	4' x 6'	Selective	SS-26	n/a	23,063	25,000	19,926	18,647	16,728	17,000	17,000
	4' x 7'	Selective	SS-28	n/a	25,830	28,000	22,298	20,857	18,696	19,000	19,000
	4' x 8'	Selective	SS-32	n/a	29,520	32,000	25,619	24,031	21,648	22,000	22,000
	4' x 10'	Selective	SS-40	n/a	36,900	40,000	31,787	29,699	26,568	27,000	27,000
KIUC	4' x 7'	Selective	Gobi 406 002	n/a	0	n/a	0	n/a	0	0	0

Notes

1. The highlighted area signify missing or incorrect values.
2. The HECO/KIUC table shows missing collector output values for the Gobi 406 002.
3. The HELCO and MECO tables show collector output values in lower sunshine zones at higher values that respective collector output values in higher sunshine zones.
4. All values shown in this attachment and all values shown in the tables submitted by the electric utilities to the commission on July 13, 2009 are outdated.
5. HSEA recommends that the commission adopted the updated collector output tables presented in Attachment 2 of these comments.



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Attachment 2.

Collector Output Tables For Oahu, Hawaii County, Maui County, and Kauai

Oahu Solar Collector BTU/Day Output by Sunshine Zone Table

OG-100 Protocol Format		(BTU/sq ft day)	1845	1661	1476	1292	1107
Hawaii Sunshine Zone		(Cal/sq cm/day)	500	450	400	350	300
Nom. Size	Coating	Model					
3' x 7'	Paint	AE-21E	17,159	14,660	12,103	9,505	9,505
		EP-21	19,742	17,222	14,662	12,037	12,037
		EPI-308CU (3' X 7')	18,081	15,561	12,989	10,125	10,125
		EPI-308SS (3' X 7')	18,081	15,561	12,989	10,125	10,125
		J Collector	19,926	17,032	14,071	11,055	11,055
		L Collector	14,207	11,813	9,348	7,077	7,077
		MSC-21E	17,804	15,229	12,595	9,919	9,919
		ST-21E	17,528	14,945	12,300	9,609	9,609
		SunPro21	18,358	15,704	12,989	10,177	10,177
3' x 7'	Selective	AE-21	19,096	16,558	13,973	11,314	11,314
		AP-10	10,609	9,441	8,266	7,077	7,077
		Bt	21,310	18,408	15,449	12,347	12,347
		EC-21	20,572	17,886	15,154	12,450	12,450
		Kf	21,402	18,645	15,842	12,967	12,967
		M Collector	17,251	14,802	12,300	9,815	9,815
		MSC-21	19,742	17,127	14,465	11,727	11,727
3' x 8'	Paint	AE-24E	19,649	16,842	13,973	11,004	11,004
		EP-24	23,155	20,163	17,122	14,052	14,052
		EPI-308CU (3' x 8')	20,572	17,601	14,563	11,417	11,417
		EPI-308SS (3' x 8')	20,572	17,601	14,563	11,417	11,417
		IP-24	22,970	20,021	17,023	13,948	13,948
		MSC-24E	20,111	17,222	14,268	11,210	11,210
		Radco 308P-HP	20,941	17,981	14,957	11,778	11,778
		SunPro24	20,941	17,886	14,760	11,572	11,572
3' x 8'	Selective	AE-24	21,863	18,930	15,941	12,915	12,915
		EC-24	23,985	20,875	17,712	14,516	14,516
		IC-24	23,985	20,875	17,712	14,516	14,516
		MSC-24	22,509	19,499	16,433	13,328	13,328
		Radco 308C-HP	24,262	20,970	17,614	14,207	14,207
4' x 6'	Paint	AE-26E	20,941	17,933	14,858	11,675	11,675
		MSC-26E	21,402	18,313	15,154	11,933	11,933
4' x 6'	Selective	AE-26	23,247	20,163	17,023	13,793	13,793
		MSC-26	23,801	20,638	17,417	14,155	14,155
		SLCO-30	24,446	21,112	17,712	14,258	14,258
4' x 7'	Paint	AE-28E	23,155	19,831	16,433	12,915	12,915
		MSC-28E	23,616	20,211	16,728	13,173	13,173
		406-002	24,262	20,685	17,023	13,328	13,328
4' x 7'	Selective	AE-28	25,646	22,251	18,794	15,240	15,240
		MSC-28	26,291	22,773	19,188	15,550	15,550
		336-013	24,170	20,875	17,515	14,155	14,155
		406-001	26,199	22,773	19,286	15,756	15,756
4' x 8'	Paint	AE-32E	26,384	22,583	18,696	14,671	14,671
		EP-32	31,550	27,517	23,419	19,269	19,269
		EPI-308CU (4' x 8')	27,675	23,674	19,750	15,343	15,343
		EPI-308SS (4' x 8')	27,675	23,674	19,750	15,343	15,343
		IP-32	31,365	27,327	23,222	19,114	19,114
		MSC-32E	26,937	23,057	19,090	14,981	14,981
		Radco 408P-HP	27,952	23,816	19,582	14,671	14,671
		SLCO-32P	24,446	20,590	16,630	12,812	12,812
		SP-32	31,550	27,517	23,419	19,269	19,269
		Sunpro 32	28,044	23,959	19,750	15,498	15,498
		408-002	29,705	25,192	20,566	16,170	16,170

Oahu Solar Collector BTU/Day Output by Sunshine Zone Table

OG-100 Protocol Format		(BTU/sq ft day)	1845	1661	1476	1292	1107
Hawaii Sunshine Zone		(Cal/sq cm/day)	500	450	400	350	300
Nom. Size	Coating	Model					
4' x 8'	Selective	AE-32	29,243	25,382	21,451	17,409	17,409
		EC-32	32,564	28,371	24,108	19,786	19,786
		IC-32	32,564	28,371	24,108	19,786	19,786
		MSC-32	29,981	25,999	21,943	17,771	17,771
		Radco 408C-HP	33,487	28,988	24,403	19,786	19,786
		SLCR-30	30,535	26,710	22,829	19,011	19,011
		SLCO-32	31,826	27,517	23,124	18,649	18,649
		SLCR-32	32,195	28,181	24,108	20,044	20,044
		408-001	31,550	27,422	23,222	19,011	19,011
		408-013	29,059	25,097	21,058	16,944	16,944
4' x 10'	Paint	AE-40E	32,841	28,134	23,321	18,339	18,339
		EP-40	39,299	34,301	29,225	24,022	24,022
		IP-40	39,299	34,254	29,126	23,970	23,970
		MSC-40E	33,487	28,655	23,714	18,649	18,649
		Radco 410P-HP	34,963	29,652	24,206	18,598	18,598
		SLCO-40P	29,705	25,002	20,172	15,550	15,550
		ST-40E	31,826	27,137	22,337	17,461	17,461
		Sunpro 40	34,963	29,889	24,698	19,373	19,373
		410-002	36,716	31,455	26,076	20,561	20,561
		4' x 10'	Selective	AE-40	36,531	31,644	26,666
EC-40	40,867			35,582	30,209	24,797	24,797
IC-40	40,867			35,582	30,209	24,797	24,797
MSC-40	38,653			33,495	28,241	22,937	22,937
Radco 410C-HP	41,051			35,487	29,815	23,970	23,970
SLCO-40	39,114			33,779	28,339	22,834	22,834
SLCR-40	40,313			35,297	30,209	25,107	25,107
410-001	39,483			34,349	29,126	23,815	23,815
410-013	36,439			31,455	26,371	21,181	21,181
4' x 12'	Paint			Radco 412P-HP	42,804	35,962	28,930
4' x 12'	Selective	Radco 412C-HP	49,815	43,173	36,408	29,395	29,395
5' X 7'	Selective	AP-20	21,402	19,025	16,630	14,207	14,207
		AP-22	23,616	21,017	18,401	15,705	15,705
7' x 7'	Selective	AP-30	32,103	28,513	24,895	21,284	21,284
Notes:		1. Values for the 350 and 450 Sunshine Zones are interpolated assuming a linear relationship.					
		2. Values for the 300 Sunshine Zone equals the 350 Sunshine Zone per Section 2.02.					

Hawaii County Solar Collector BTU/Day Output by Sunshine Zone Table

OG-100 Protocol Format		(BTU/sq ft day)	2030	1,845	1,661	1,476	1,292	1,107
Hawaii Sunshine Zone		(Cal/sq cm/day)	550	500	450	400	350	300
Nom. Size	Coating	Model						
3' x 7'	Paint	AE-21E	18,874	17,159	14,660	12,103	9,505	9,505
		EP-21	21,716	19,742	17,222	14,662	12,037	12,037
		EPI-308CU (3' X 7')	19,889	18,081	15,561	12,989	10,125	10,125
		EPI-308SS (3' X 7')	19,889	18,081	15,561	12,989	10,125	10,125
		J Collector	21,919	19,926	17,032	14,071	11,055	11,055
		L Collector	15,627	14,207	11,813	9,348	7,077	7,077
		MSC-21E	19,585	17,804	15,229	12,595	9,919	9,919
		ST-21E	19,280	17,528	14,945	12,300	9,609	9,609
		SunPro21	20,194	18,358	15,704	12,989	10,177	10,177
3' x 7'	Selective	AE-21	21,005	19,096	16,558	13,973	11,314	11,314
		AP-10	11,670	10,609	9,441	8,266	7,077	7,077
		Bt	23,441	21,310	18,408	15,449	12,347	12,347
		EC-21	22,629	20,572	17,886	15,154	12,450	12,450
		Kf	23,542	21,402	18,645	15,842	12,967	12,967
		M Collector	18,976	17,251	14,802	12,300	9,815	9,815
		MSC-21	21,716	19,742	17,127	14,465	11,727	11,727
3' x 8'	Paint	AE-24E	21,614	19,649	16,842	13,973	11,004	11,004
		EP-24	25,470	23,155	20,163	17,122	14,052	14,052
		EPI-308CU (3' x 8')	22,629	20,572	17,601	14,563	11,417	11,417
		EPI-308SS (3' x 8')	22,629	20,572	17,601	14,563	11,417	11,417
		IP-24	25,267	22,970	20,021	17,023	13,948	13,948
		MSC-24E	22,122	20,111	17,222	14,268	11,210	11,210
		Radco 308P-HP	23,035	20,941	17,981	14,957	11,778	11,778
		SunPro24	23,035	20,941	17,886	14,760	11,572	11,572
3' x 8'	Selective	AE-24	24,050	21,863	18,930	15,941	12,915	12,915
		EC-24	26,384	23,985	20,875	17,712	14,516	14,516
		IC-24	26,384	23,985	20,875	17,712	14,516	14,516
		MSC-24	24,760	22,509	19,499	16,433	13,328	13,328
		Radco 308C-HP	26,688	24,262	20,970	17,614	14,207	14,207
4' x 6'	Paint	AE-26E	23,035	20,941	17,933	14,858	11,675	11,675
		MSC-26E	23,542	21,402	18,313	15,154	11,933	11,933
4' x 6'	Selective	AE-26	25,572	23,247	20,163	17,023	13,793	13,793
		MSC-26	26,181	23,801	20,638	17,417	14,155	14,155
		SLCO-30	26,891	24,446	21,112	17,712	14,258	14,258
4' x 7'	Paint	AE-28E	25,470	23,155	19,831	16,433	12,915	12,915
		MSC-28E	25,978	23,616	20,211	16,728	13,173	13,173
		406-002	26,688	24,262	20,685	17,023	13,328	13,328
4' x 7'	Selective	AE-28	28,210	25,646	22,251	18,794	15,240	15,240
		MSC-28	28,920	26,291	22,773	19,188	15,550	15,550
		336-013	26,586	24,170	20,875	17,515	14,155	14,155
		406-001	28,819	26,199	22,773	19,286	15,756	15,756
4' x 8'	Paint	AE-32E	29,022	26,384	22,583	18,696	14,671	14,671
		EP-32	34,704	31,550	27,517	23,419	19,269	19,269
		EPI-308CU (4' x 8')	30,443	27,675	23,674	19,750	15,343	15,343
		EPI-308SS (4' x 8')	30,443	27,675	23,674	19,750	15,343	15,343
		IP-32	34,502	31,365	27,327	23,222	19,114	19,114
		MSC-32E	29,631	26,937	23,057	19,090	14,981	14,981
		Radco 408P-HP	30,747	27,952	23,816	19,582	14,671	14,671
		SLCO-32P	26,891	24,446	20,590	16,630	12,812	12,812
		SP-32	34,704	31,550	27,517	23,419	19,269	19,269
		Sunpro 32	30,848	28,044	23,959	19,750	15,498	15,498
		408-002	32,675	29,705	25,192	20,566	16,170	16,170

Hawaii County Solar Collector BTU/Day Output by Sunshine Zone Table

OG-100 Protocol Format		(BTU/sq ft day)	2030	1,845	1,661	1,476	1,292	1,107
Hawaii Sunshine Zone		(Cal/sq cm/day)	550	500	450	400	350	300
Nom. Size	Coating	Model						
4' x 8'	Selective	AE-32	32,168	29,243	25,382	21,451	17,409	17,409
		EC-32	35,821	32,564	28,371	24,108	19,786	19,786
		IC-32	35,821	32,564	28,371	24,108	19,786	19,786
		MSC-32	32,979	29,981	25,999	21,943	17,771	17,771
		Radco 408C-HP	36,835	33,487	28,988	24,403	19,786	19,786
		SLCR-30	33,588	30,535	26,710	22,829	19,011	19,011
		SLCO-32	35,009	31,826	27,517	23,124	18,649	18,649
		SLCR-32	35,415	32,195	28,181	24,108	20,044	20,044
		408-001	34,704	31,550	27,422	23,222	19,011	19,011
		408-013	31,965	29,059	25,097	21,058	16,944	16,944
4' x 10'	Paint	AE-40E	36,125	32,841	28,134	23,321	18,339	18,339
		EP-40	43,228	39,299	34,301	29,225	24,022	24,022
		IP-40	43,228	39,299	34,254	29,126	23,970	23,970
		MSC-40E	36,835	33,487	28,655	23,714	18,649	18,649
		Radco 410P-HP	38,459	34,963	29,652	24,206	18,598	18,598
		SLCO-40P	32,675	29,705	25,002	20,172	15,550	15,550
		ST-40E	35,009	31,826	27,137	22,337	17,461	17,461
		Sunpro 40	38,459	34,963	29,889	24,698	19,373	19,373
		410-002	40,387	36,716	31,455	26,076	20,561	20,561
		4' x 10'	Selective	AE-40	40,184	36,531	31,644	26,666
EC-40	44,953			40,867	35,582	30,209	24,797	24,797
IC-40	44,953			40,867	35,582	30,209	24,797	24,797
MSC-40	42,518			38,653	33,495	28,241	22,937	22,937
Radco 410C-HP	45,156			41,051	35,487	29,815	23,970	23,970
SLCO-40	43,025			39,114	33,779	28,339	22,834	22,834
SLCR-40	44,345			40,313	35,297	30,209	25,107	25,107
410-001	43,431			39,483	34,349	29,126	23,815	23,815
410-013	40,083			36,439	31,455	26,371	21,181	21,181
4' x 12'	Paint	Radco 412P-HP	47,084	42,804	35,962	28,930	22,059	22,059
4' x 12'	Selective	Radco 412C-HP	54,797	49,815	43,173	36,408	29,395	29,395
5' X 7'	Selective	AP-20	23,542	21,402	19,025	16,630	14,207	14,207
		AP-22	25,978	23,616	21,017	18,401	15,705	15,705
7' x 7'	Selective	AP-30	35,313	32,103	28,513	24,895	21,284	21,284
Notes:		1. Values for the 350 and 450 Sunshine Zones are interpolated assuming a linear relationship. 2. Values for the 300 Sunshine Zone equals the 350 Sunshine Zone per Section 2.02.						

Maui County Solar Collector BTU/Day Output by Sunshine Zone Table

OG-100 Protocol Format		BTU/sq ft day	1,845	1,771	1,661	1,587	1,476	1,292	1,107
Hawaii Sunshine Zone		Solar Zone	500	480	450	430	400	350	300
Nom. Size	Coating	Model							
3' x 7'	Paint	AE-21E	17,159	16,472	14,660	14,008	12,103	9,505	9,505
		EP-21	19,742	18,952	17,222	16,456	14,662	12,037	12,037
		EPI-308CU (3' X 7')	18,081	17,358	15,561	14,870	12,989	10,125	10,125
		EPI-308SS (3' X 7')	18,081	17,358	15,561	14,870	12,989	10,125	10,125
		J Collector	19,926	19,129	17,032	16,275	14,071	11,055	11,055
		L Collector	14,207	13,638	11,813	11,288	9,348	7,077	7,077
		MSC-21E	17,804	17,092	15,229	14,552	12,595	9,919	9,919
		ST-21E	17,528	16,826	14,945	14,280	12,300	9,609	9,609
		SunPro21	18,358	17,623	15,704	15,006	12,989	10,177	10,177
3' x 7'	Selective	AE-21	19,096	18,332	16,558	15,822	13,973	11,314	11,314
		AP-10	10,609	10,184	9,441	9,022	8,266	7,077	7,077
		Bt	21,310	20,457	18,408	17,590	15,449	12,347	12,347
		EC-21	20,572	19,749	17,886	17,091	15,154	12,450	12,450
		Kf	21,402	20,546	18,645	17,816	15,842	12,967	12,967
		M Collector	17,251	16,561	14,802	14,144	12,300	9,815	9,815
3' x 8'	Paint	MSC-21	19,742	18,952	17,127	16,366	14,465	11,727	11,727
		AE-24E	19,649	18,863	16,842	16,094	13,973	11,004	11,004
		EP-24	23,155	22,229	20,163	19,267	17,122	14,052	14,052
		EPI-308CU (3' x 8')	20,572	19,749	17,601	16,819	14,563	11,417	11,417
		EPI-308SS (3' x 8')	20,572	19,749	17,601	16,819	14,563	11,417	11,417
		IP-24	22,970	22,051	20,021	19,131	17,023	13,948	13,948
		MSC-24E	20,111	19,306	17,222	16,456	14,268	11,210	11,210
		Radco 308P-HP	20,941	20,103	17,981	17,182	14,957	11,778	11,778
		SunPro24	20,941	20,103	17,886	17,091	14,760	11,572	11,572
3' x 8'	Selective	AE-24	21,863	20,989	18,930	18,088	15,941	12,915	12,915
		EC-24	23,985	23,026	20,875	19,947	17,712	14,516	14,516
		IC-24	23,985	23,026	20,875	19,947	17,712	14,516	14,516
		MSC-24	22,509	21,609	19,499	18,632	16,433	13,328	13,328
		Radco 308C-HP	24,262	23,291	20,970	20,038	17,614	14,207	14,207
4' x 6'	Paint	AE-26E	20,941	20,103	17,933	17,136	14,858	11,675	11,675
		MSC-26E	21,402	20,546	18,313	17,499	15,154	11,933	11,933
4' x 6'	Selective	AE-26	23,247	22,317	20,163	19,267	17,023	13,793	13,793
		MSC-26	23,801	22,848	20,638	19,720	17,417	14,155	14,155
		SLCO-30	24,446	23,468	21,112	20,174	17,712	14,258	14,258
4' x 7'	Paint	AE-28E	23,155	22,229	19,831	18,950	16,433	12,915	12,915
		MSC-28E	23,616	22,671	20,211	19,312	16,728	13,173	13,173
		406-002	24,262	23,291	20,685	19,766	17,023	13,328	13,328
4' x 7'	Selective	AE-28	25,646	24,620	22,251	21,262	18,794	15,240	15,240
		MSC-28	26,291	25,240	22,773	21,760	19,188	15,550	15,550
		336-013	24,170	23,203	20,875	19,947	17,515	14,155	14,155
		406-001	26,199	25,151	22,773	21,760	19,286	15,756	15,756
4' x 8'	Paint	AE-32E	26,384	25,328	22,583	21,579	18,696	14,671	14,671
		EP-32	31,550	30,288	27,517	26,294	23,419	19,269	19,269
		EPI-308CU (4' x 8')	27,675	26,568	23,674	22,622	19,750	15,343	15,343
		EPI-308SS (4' x 8')	27,675	26,568	23,674	22,622	19,750	15,343	15,343
		IP-32	31,365	30,110	27,327	26,113	23,222	19,114	19,114
		MSC-32E	26,937	25,860	23,057	22,032	19,090	14,981	14,981
		Radco 408P-HP	27,952	26,834	23,816	22,758	19,582	14,671	14,671
		SLCO-32P	24,446	23,468	20,590	19,675	16,630	12,812	12,812
		SP-32	31,550	30,288	27,517	26,294	23,419	19,269	19,269
		Sunpro 32	28,044	26,922	23,959	22,894	19,750	15,498	15,498
		408-002	29,705	28,516	25,192	24,073	20,566	16,170	16,170

Maui County Solar Collector BTU/Day Output by Sunshine Zone Table

OG-100 Protocol Format	BTU/sq ft day	1,845	1,771	1,661	1,587	1,476	1,292	1,107	
Hawaii Sunshine Zone	Solar Zone	500	480	450	430	400	350	300	
Nom. Size	Coating	Model							
4' x 8'	Selective	AE-32	29,243	28,074	25,382	24,254	21,451	17,409	17,409
		EC-32	32,564	31,262	28,371	27,110	24,108	19,786	19,786
		IC-32	32,564	31,262	28,371	27,110	24,108	19,786	19,786
		MSC-32	29,981	28,782	25,999	24,843	21,943	17,771	17,771
		Radco 408C-HP	33,487	32,147	28,988	27,699	24,403	19,786	19,786
		SLCR-30	30,535	29,313	26,710	25,523	22,829	19,011	19,011
		SLCO-32	31,826	30,553	27,517	26,294	23,124	18,649	18,649
		SLCR-32	32,195	30,907	28,181	26,929	24,108	20,044	20,044
		408-001	31,550	30,288	27,422	26,203	23,222	19,011	19,011
		408-013	29,059	27,896	25,097	23,982	21,058	16,944	16,944
4' x 10'	Paint	AE-40E	32,841	31,527	28,134	26,883	23,321	18,339	18,339
		EP-40	39,299	37,727	34,301	32,777	29,225	24,022	24,022
		IP-40	39,299	37,727	34,254	32,731	29,126	23,970	23,970
		MSC-40E	33,487	32,147	28,655	27,382	23,714	18,649	18,649
		Radco 410P-HP	34,963	33,564	29,652	28,334	24,206	18,598	18,598
		SLCO-40P	29,705	28,516	25,002	23,891	20,172	15,550	15,550
		ST-40E	31,826	30,553	27,137	25,931	22,337	17,461	17,461
		Sunpro 40	34,963	33,564	29,889	28,561	24,698	19,373	19,373
		410-002	36,716	35,247	31,455	30,057	26,076	20,561	20,561
4' x 10'	Selective	AE-40	36,531	35,070	31,644	30,238	26,666	21,646	21,646
		EC-40	40,867	39,232	35,582	34,001	30,209	24,797	24,797
		IC-40	40,867	39,232	35,582	34,001	30,209	24,797	24,797
		MSC-40	38,653	37,107	33,495	32,006	28,241	22,937	22,937
		Radco 410C-HP	41,051	39,409	35,487	33,910	29,815	23,970	23,970
		SLCO-40	39,114	37,549	33,779	32,278	28,339	22,834	22,834
		SLCR-40	40,313	38,701	35,297	33,729	30,209	25,107	25,107
		410-001	39,483	37,904	34,349	32,822	29,126	23,815	23,815
		410-013	36,439	34,981	31,455	30,057	26,371	21,181	21,181
4' x 12'	Paint	Radco 412P-HP	42,804	41,092	35,962	34,363	28,930	22,059	22,059
4' x 12'	Selective	Radco 412C-HP	49,815	47,822	43,173	41,254	36,408	29,395	29,395
5' X 7'	Selective	AP-20	21,402	20,546	19,025	18,179	16,630	14,207	14,207
		AP-22	23,616	22,671	21,017	20,083	18,401	15,705	15,705
7' x 7'	Selective	AP-30	32,103	30,819	28,513	27,246	24,895	21,284	21,284
Notes:	1. Values for the 350 and 450 Sunshine Zones are interpolated assuming a linear relationship. 2. Values for the 300 Sunshine Zone equals the 350 Sunshine Zone per Section 2.02.								

Kauai Solar Collector BTU/Day Output by Sunshine Zone Table

OG-100 Protocol Format	(BTU/sq ft day)	1845	1661	1476	1292	1107			
Hawaii Sunshine Zone	(Cal/sq cm/day)	500	450	400	350	300			
Nom. Size	Coating	Model							
3' x 7'	Paint	AE-21E	17,159	14,660	12,103	9,505	9,505		
		EP-21	19,742	17,222	14,662	12,037	12,037		
		EPI-308CU (3' X 7')	18,081	15,561	12,989	10,125	10,125		
		EPI-308SS (3' X 7')	18,081	15,561	12,989	10,125	10,125		
		J Collector	19,926	17,032	14,071	11,055	11,055		
		L Collector	14,207	11,813	9,348	7,077	7,077		
		MSC-21E	17,804	15,229	12,595	9,919	9,919		
		ST-21E	17,528	14,945	12,300	9,609	9,609		
		SunPro21	18,358	15,704	12,989	10,177	10,177		
		3' x 7'	Selective	AE-21	19,096	16,558	13,973	11,314	11,314
AP-10	10,609			9,441	8,266	7,077	7,077		
Bt	21,310			18,408	15,449	12,347	12,347		
EC-21	20,572			17,886	15,154	12,450	12,450		
Kf	21,402			18,645	15,842	12,967	12,967		
M Collector	17,251			14,802	12,300	9,815	9,815		
MSC-21	19,742			17,127	14,465	11,727	11,727		
AE-24E	19,649			16,842	13,973	11,004	11,004		
3' x 8'	Paint	EP-24	23,155	20,163	17,122	14,052	14,052		
		EPI-308CU (3' x 8')	20,572	17,601	14,563	11,417	11,417		
		EPI-308SS (3' x 8')	20,572	17,601	14,563	11,417	11,417		
		IP-24	22,970	20,021	17,023	13,948	13,948		
		MSC-24E	20,111	17,222	14,268	11,210	11,210		
		Radco 308P-HP	20,941	17,981	14,957	11,778	11,778		
		SunPro24	20,941	17,886	14,760	11,572	11,572		
		3' x 8'	Selective	AE-24	21,863	18,930	15,941	12,915	12,915
				EC-24	23,985	20,875	17,712	14,516	14,516
				IC-24	23,985	20,875	17,712	14,516	14,516
MSC-24	22,509			19,499	16,433	13,328	13,328		
Radco 308C-HP	24,262			20,970	17,614	14,207	14,207		
4' x 6'	Paint	AE-26E	20,941	17,933	14,858	11,675	11,675		
		MSC-26E	21,402	18,313	15,154	11,933	11,933		
4' x 6'	Selective	AE-26	23,247	20,163	17,023	13,793	13,793		
		MSC-26	23,801	20,638	17,417	14,155	14,155		
		SLCO-30	24,446	21,112	17,712	14,258	14,258		
4' x 7'	Paint	AE-28E	23,155	19,831	16,433	12,915	12,915		
		MSC-28E	23,616	20,211	16,728	13,173	13,173		
		406-002	24,262	20,685	17,023	13,328	13,328		
4' x 7'	Selective	AE-28	25,646	22,251	18,794	15,240	15,240		
		MSC-28	26,291	22,773	19,188	15,550	15,550		
		336-013	24,170	20,875	17,515	14,155	14,155		
		406-001	26,199	22,773	19,286	15,756	15,756		
4' x 8'	Paint	AE-32E	26,384	22,583	18,696	14,671	14,671		
		EP-32	31,550	27,517	23,419	19,269	19,269		
		EPI-308CU (4' x 8')	27,675	23,674	19,750	15,343	15,343		
		EPI-308SS (4' x 8')	27,675	23,674	19,750	15,343	15,343		
		IP-32	31,365	27,327	23,222	19,114	19,114		
		MSC-32E	26,937	23,057	19,090	14,981	14,981		
		Radco 408P-HP	27,952	23,816	19,582	14,671	14,671		
		SLCO-32P	24,446	20,590	16,630	12,812	12,812		
		SP-32	31,550	27,517	23,419	19,269	19,269		
		Sunpro 32	28,044	23,959	19,750	15,498	15,498		
		408-002	29,705	25,192	20,566	16,170	16,170		

Kauai Solar Collector BTU/Day Output by Sunshine Zone Table

OG-100 Protocol Format	(BTU/sq ft day)	1845	1661	1476	1292	1107	
Hawaii Sunshine Zone	(Cal/sq cm/day)	500	450	400	350	300	
Nom. Size	Coating	Model					
4' x 8'	Selective	AE-32	29,243	25,382	21,451	17,409	17,409
		EC-32	32,564	28,371	24,108	19,786	19,786
		IC-32	32,564	28,371	24,108	19,786	19,786
		MSC-32	29,981	25,999	21,943	17,771	17,771
		Radco 408C-HP	33,487	28,988	24,403	19,786	19,786
		SLCR-30	30,535	26,710	22,829	19,011	19,011
		SLCO-32	31,826	27,517	23,124	18,649	18,649
		SLCR-32	32,195	28,181	24,108	20,044	20,044
		408-001	31,550	27,422	23,222	19,011	19,011
		408-013	29,059	25,097	21,058	16,944	16,944
4' x 10'	Paint	AE-40E	32,841	28,134	23,321	18,339	18,339
		EP-40	39,299	34,301	29,225	24,022	24,022
		IP-40	39,299	34,254	29,126	23,970	23,970
		MSC-40E	33,487	28,655	23,714	18,649	18,649
		Radco 410P-HP	34,963	29,652	24,206	18,598	18,598
		SLCO-40P	29,705	25,002	20,172	15,550	15,550
		ST-40E	31,826	27,137	22,337	17,461	17,461
		Sunpro 40	34,963	29,889	24,698	19,373	19,373
		410-002	36,716	31,455	26,076	20,561	20,561
		4' x 10'	Selective	AE-40	36,531	31,644	26,666
EC-40	40,867			35,582	30,209	24,797	24,797
IC-40	40,867			35,582	30,209	24,797	24,797
MSC-40	38,653			33,495	28,241	22,937	22,937
Radco 410C-HP	41,051			35,487	29,815	23,970	23,970
SLCO-40	39,114			33,779	28,339	22,834	22,834
SLCR-40	40,313			35,297	30,209	25,107	25,107
410-001	39,483			34,349	29,126	23,815	23,815
410-013	36,439			31,455	26,371	21,181	21,181
4' x 12'	Paint	Radco 412P-HP	42,804	35,962	28,930	22,059	22,059
4' x 12'	Selective	Radco 412C-HP	49,815	43,173	36,408	29,395	29,395
5' X 7'	Selective	AP-20	21,402	19,025	16,630	14,207	14,207
		AP-22	23,616	21,017	18,401	15,705	15,705
7' x 7'	Selective	AP-30	32,103	28,513	24,895	21,284	21,284
Notes:	1. Values for the 350 and 450 Sunshine Zones are interpolated assuming a linear relationship. 2. Values for the 300 Sunshine Zone equals the 350 Sunshine Zone per Section 2.02.						