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"A COMMERCIALIZATION STRATEGY FOR THE DEPARTMENT OF ENERGY'S SOLAR BUILDINGS DEMONSTRATION PROGRAM"

Prepared by:

Stephens Engineering Company, Inc.
and its subcontractor
Planning and Management Associates of Greater Washington, Inc. 951 3285

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Oakland, California 94612

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FOREWARD

The following report provides a categorization of existing solar commercial demonstration projects with recommendations essential to determining the general feasibility of continuing or aborting specific projects. These recommendations include specific selection criteria for which projects to abort or refurbish.

This report constitutes an account of work performed and information developed exclusively for task one of a four task project being conducted by Stephens Engineering Company, Inc., and its subcontractor, Planning and Management Associates of Greater Washington, Inc.

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1.0 Introduction

This report contains a description and summary of the research effort to survey and record the status of commercial demonstration projects, which will serve to assist in accomplishing the goals of the National Solar Buildings Demonstration Program of the U. S. Department of Energy (DOE).

The objective of this effort is to examine the National Commercial Solar Demonstration Program status and recommend to DOE how to obtain the most benefit from this program in terms of promoting the commercialization of solar energy, now and in the future. These recommendations take the form of program management options, the development of criteria for disposition of problems at specific sites, and methods for improving data and information transfer.

This is the final product of Taks One. It is a complete current listing of commercial demonstration projects and includes recommendations on the value of continuing or discontinuing these projects.

2.0 Summary of Research Activities and Survey Findings

The purpose of this section is to provide an overview of the research conducted in surveying commercial demonstration projects.

This effort has entailed an extensive review of all available literature on commercial demonstration projects. Specifically, this literature review has included the most current reports from DOE field offices and laboratories having responsibility for the technical monitoring of commercial demonstration projects, as well as topical reports on the goals, status and history of the demonstration program.

In addition to researching the status of commercial demonstration projects, research has been conducted to review previous reports written and approaches developed for evaluating the feasibility of continuing or aborting specific projects. A detailed review of our findings and recommended approaches is contained in Section 3.0.

3.0 TASK I - Solar Commercial Demonstration Project Survey

The work which has been carried out under Task I has included the following:

- conduct a survey of existing commercial demonstration projects
- categorize these projects
- determine criteria for continuing/aborting demonstration projects
- apply the criteria and make recommendations for which projects to continue and abort

Each of these items will be discussed in detail below.

3.1 Survey of Existing Commercial Demonstration Projects

An extensive review of all available literature on commercial demonstration projects has been carried out. Specifically, this literature review has included the most current reports from DOE field offices and laboratories having responsibility for the technical monitoring of commercial demonstration projects, i.e., NASA, SAN, CHI, RSECS and SERI, as well as topical reports on the goals, status and history of the demonstration program. A current status of Federal Building Projects is listed in Appendix B. For a complete listing of the sources used, see Section 4.0.

In cases where more specific and recent data were required, direct contacts with cognizant project personnel from government laboratories have been made.

3.2 Categorization of Existing Commercial Demonstration Projects

This section contains a listing and status review of commercial demonstration projects, based on the survey discussed in Section 3.1. It includes

projects in the following categories:

- I. Fully Operational
- II. Partially Operational - Reportable
- III. Partially Operational - Non-reportable
- IV. Systems Down
- V. Systems in Checkout
- VI. Systems Under Construction
- VII. Systems in Design
- VIII. Systems in Refurbishment
- IX. Owner Fixing Problem
- X. Unknown

The projects are broken down according to the following regional centers.

- Western Solar Utilization Network/Solar Energy Research Institute (WSUN/SERI)
- Northeast Solar Energy Center (NESEC)
- Mid American Solar Energy Center (MASEC)
- Southern Solar Energy Center (SSEC)

For each regional center private projects are listed separately.

Each of the projects are characterized by the following designations:

- identification number (I.D. No. is taken from the last 4 digits of the DOE contract).
- location
- project name
- operational date
- instrumentation date (if applicable)

Table 3-1 is a summary of the projects and the associated information discussed above. The regional breakdown of these projects is shown in Table 3-2.

Table 3-1

Summary of Demonstration Sites

<u>Category</u>	<u>WSUN/SERI</u>	<u>Regional Office</u>		<u>SSEC</u>	<u>Total</u>
		<u>NESEC</u>	<u>MASEC</u>		
I	26	25	31	49	131
II	2	1	0	1	4
III	4	0	0	1	5
IV	3	1	1	5	10
V	6	3	2	5	16
VI	11	4	8	15	38
VII	2	4	2	3	11
VIII	0	1	2	0	3
IX	0	0	0	0	0
X	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	54	39	46	79	218

Table 3-2

SERI/WSUN

<u>Ident. No.</u>	<u>Location</u>	<u>Project Name</u>	<u>Opr. Date</u>	<u>Instr. Date</u>
Fully Operational				
2139	Danville, CA	Church of the Valley	2/79	
3457	El Toro, CA ¹	Fredericks Development Corp.	4/76	
2384	Fresno, CA ¹	Aratex Services, Inc.	9/77	9/77
1524	San Jose, CA	Oak Grove School Dist.	8/79	
1083	Santa Clara, CA ¹	City of Santa Clara (Community Center)		
1523	Saratoga, CA	City of Saratoga	2/80	
1522	Stanford, CA	Stanford University	12/78	
3457	Upland, CA ¹	Southern California Gas		
1518	Aurora, CO	Adams-Arapahoe Joint School Dist.	2/78	
2125	Denver, CO	Big Green Investments	1/80	
1536	Littleton, CO	City of Littleton	2/78	
2124	Telluride, CO	Telluride School District	4/80	
1534	Honolulu, HI	Airport Ramada Inn		
1639	Kona, HI	Hawaiian Pacific Resort	11/79	
2146	Boise, ID	Independent School District		
1537	Billings, MT	Billings Shipping Corp	11/78	
2147	Bozeman, MT	Life of Montana Insurance	1/80	
2128	Albuquerque, NM	Wolfe Comm. Inc.		
2127	Albuquerque, NM	Burns/Peters Group	1/79	
1656	Las Cruces, NM	Coachlight Inn	6/78	
3652	Las Cruces, NM ¹	New Mexico State University		
1654	Las Vegas, NV	La Quinta Motor Inn	4/79	

¹ Transferred from NASA to Regional Office

² Transferred from CHO to Regional Office

³ Transferred from SFO to Regional Office

Table 3-2 (Continued)

<u>Ident. No.</u>	<u>Location</u>	<u>Project Name</u>	<u>Opr. Date</u>	<u>Instr. Date</u>
2144	Sweet Home, OR	E. Keith Keesecker		
1515	Salt Lake, UT	La Quinta Motor Inn	5/80	
2404	Richland, WA ¹	Development Dynamics (Olympic)	3/78	
1507	Casper, WY	Wyoming Rural Electric Assoc.	5/80	

Partially Operational Reportable

2398	Irvine, CA	Irvine Unified School District	5/78	5/78
1514	Albuquerque, NM	Animal Control Center	3/78	

Partially Operational Non Reportable

2166	Scottsdale, AZ	City of Scottsdale	5/80	
1496	Ceritos, CA	City of Cerritos	1/79	
1521	Santa Clara, CA	Renault and Hendley	4/79	
1513	Taos, NM	Property Control Division	1/79	

System Down

2393	Tempe, AZ	Tempe Union High School	3/78	
2383	Mill Valley, CA ¹	Iris Images, Inc.	6/76	
2387	So. Lake Tahoe, CA	Lake Valley Fire District	4/78	

Systems In Checkout

1500	Orange, CA	Ridgeline Racquet Club		
2141	Palo Alto, CA	Western Energy, Inc.		
1516	Lakewood, CO	Jefferson County School		

Table 3-2 (Continued)

<u>Ident. No.</u>	<u>Location</u>	<u>Project Name</u>	<u>Opr. Date</u>	<u>Instru. Date</u>
2126	San Luis, CO	City of San Luis		
2129	Las Cruces, NM	New Mexico State Univ.		
2142	Ashland, OR	Ashland Community Food Stores		
System Under Construction				
2140	Berkeley, CA	Pacific School of Religion		
1501	El Toro, CA	Orange County		
1499	San Diego, CA	San Diego Unified School District		
2374	San Francisco, CA	Storek and Storek		
2137	Sacramento, CA	State of California		
2138	Tahoe Vista, CA	North Tahoe Public Utilities		
2135	Westlake Village, CA	Felburg and Sons		
1640	Honolulu, HI	Metropolitan YMCA		
2143	Portland, OR	Multhomah County		
1520	Ogden, UT	Permaloy Corp.		
1638	Casper, WY	LaQuinta Motor Inn		
System In Design				
2133	LaCanada, CA	Decanso Gardens Guild		
1632	Denver, CO	Days Inn of America, Inc.		

Table 3-2 (Continued)

Ident. No.	Location	SSEC <u>Project Name</u>	Opr. Date	Instru. Date
		Fully Operational		
4071	Huntsville, AL ¹	City of Huntsville	11/78	
4070	Lister Hill, AL ¹	Reynolds Metal Co.	3/78	
1623	Mobile, AL	LaQuinta Motor Inns	4/79	
5188	Little Rock, AR ¹	Shoney's South, Inc.	4/80	
2544	Washington, D.C. ¹	Marriott Corp.	4/78	7/78
5190	New Castle, DE ¹	Wilmington Swim Club	5/79	
4073	Brandon, FL	Brandon Swimming Association	11/76	9/77
4074	Cape Caneveral, FL ¹	Florida Solar Energy Center	5/79	
1632	Jacksonville, FL	Days Inn of America		
1632	Key West, FL ¹	Quality Inn	4/78	
2401	Lake Buena Vista, FL ¹	Reedy Creek Utilities Co., Inc.	10/77	12/77
1632	Atlanta, GA	Days Inn of America, Inc.	8/79	
4075	Dalton, GA ¹	North Georgia Planning & Development Comm.	7/78	
1632	Savannah, GA	Days Inn of America, Inc.	7/79	
4942	Shenandoah, GA ¹	Shenandoah Development Corp.	3/79	
2385	Louisville, KY ¹	Rademaker Corp.	3/77	
2738	Cockeysville, MD	Baltimore County (Padonia)	4/78	2/79
4081	Germantown, MD ¹	Montgomery Community College	12/77	
2627	Timonium, MD ¹	Baltimore County (Timonium School)	3/74	
2380	Annapolis, MD	Ferguson Corporation	9/80	
2390	Baltimore, MD	City of Baltimore	9/80	
5199	Marks, MS ¹	First Nat'l Bank of Clarksdale	9/79	
5198	Starksville, MS ¹	Security State Bank	6/79	
2394	Charlotte, NC	Charlotte Memorial Hospital	6/79	10/78

Table 3-2 (Continued)

<u>Ident. No.</u>	<u>Location</u>	<u>Project Name</u>	<u>Opr. Date</u>	<u>Instr. Date</u>
5202	Abbeville, SC ¹	City of Abbeville	11/78	
1663	Anderson, SC ¹	Days Inn of America, Inc.	11/77	
1657	Charleston, SC	Days Inn of America, Inc.		
4092	Jackson, TN	Coca-Cola Bottling Works	5/79	
5210	Memphis, TN	Beltz Investment Co.	11/80	
2396	Austin, TX ¹	Radian Corp.	3/77	
4093	Dallas, TX ¹	Travis-Braum & Associates	5/79	
5204	Dallas, TX ¹	Dallas Independent School Dist.	12/79	
1632	Dallas, TX	Forrest Lane-Days Inn of America		
1632	Dallas, TX	Garland, Days Inn of America, Inc.		
1632	Dallas, TX	Valley View, Days Inn of America, Inc.		
2593	Dallas, TX ¹	City of Dallas	6/78	
2403	San Antonio, TX	Trinity University	4/77	
1666	Taylor, TX	John W. Thompson	6/78	
1670	Texas City, TX	LaQuinta Motor Lodge	8/78	
5211	Arlington, VA	ARC Associates -	6/80	
4095	Charlottesville, VA	Wilson Psychiatric Hospital	12/79	
4662	Hampton, VA	Allen Management Inc.(Econotravel)	3/78	
2388	Lynchburg, VA ¹	Terrell D. Moseley, Inc.	11/76	
4664	Sandston, VA	Allen Management, Inc. (Econotravel)	4/79	
4661	Woodbridge, VA	Allen Management, Inc. (Econotravel)		
4663	Cheasapeake, VA	Allen Management, Inc. (Econotravel)		
4676	St. Johns, VI	Rock Resorts, Inc.		

Table 3-2 (Continued)

<u>Ident. No.</u>	<u>Location</u>	<u>Project Name</u>	<u>Opr. Date</u>	<u>Instr. Date</u>
4096	Bethany, WV	Bethany College	12/78	
4665	Bluefield, WV	Allen Management, Inc.(Econotravel)		

Partially Operational - Reportable

2400	Montevello, AL	Alabama Power Co.	3/78	
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Partially Operational - Non-Reportable

4926	Charlestown, WV	Page Jackson (Jefferson Co. Brd. of Education)		
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System Down

2395	Yulee, FL	Florida Dept. of Commerce	10/78	9/78
5477	Atlanta, GA ¹	City of Atlanta (Touns School)		
2391	Baton Rouge, LA	Louisiana State	6/78	5/78
2389	Greenwood, SC	Blakedale Professional Center	11/76	11/76
2586	Warrenton, VA ¹	Fauquir County	3/74	

System in Checkout -

5209	Union Mills, MD	Carrol County	1/80	
1668	The Woodlands, TX	Woodlands Commercial Development	12/79	
1667	The Woodlands, TX	Woodlands Commercial Development	10/79	
2381	Leesburg, VA	Loudoun County Schools		
5228	Phillippi, WV	Alderson Broadus College	2/80	

Table 3-2 (Continued)

<u>Ident. No.</u>	<u>Location</u>	<u>Project Name</u>	<u>Opr. Date</u>	<u>Instr. Date</u>
System Under Construction				
4034	Coral Gables, FL	Dade County School		
5191	Savannah, GA	Savannah Science Museum		
4083	Baltimore, MD	City of Baltimore (Fire Station)		
2378	Gaithersburg, MD	Maryland National Capitol Parks and Recreation		
5195	Towson, MD	Baltimore County		
1657	Charlotte, NC	Office of Parks of Charlotte, Inc.		
1657	Charlotte, NC	Office of Parks of Charlotte, Inc.		
1657	Statesville, NC	Office of Parks of Charlotte, Inc.		
5200	Troy, NC	Charles Newton		
4917	Canovenus, PR	Commonwealth of Puerto Rico		
5212	Charleston, SC	Charleston County School Dist.		
1664	Nashville, TN	LaQuinta Motor Inns, Inc.		
1632	Houston, TX	Days Inn of America		
5203	San Antonio, TX	Southwest Independent School District		
5205	Portsmouth, VA	Portsmouth Public Schools		
System In Design				
1632	Ft. Lauderdale, FL	Days Inn of America		
5192	Atlanta, GA	Georgia Power Co.		
1632	Charleston, SC	Days Inn of America (Mt. Pleasant)		

Table 3-2 (Continued)

MASEC

<u>Ident. No.</u>	<u>Location</u>	<u>Project Name</u>	<u>Opr. Date</u>	<u>Inst. Date</u>
		Fully Operational		
2383	West Branch, IA ¹	Scattergood School	5/77	7/77
4403	St. Charles, IL ²	Community Union District	4/79	
4096	Chicago, IL	Chicago Navy Pier		
4404	Chicago, IL	Museum of Science & Technology	4/79	
4076	Clarksville, IN ¹	Clarksville Community School	12/78	
5039	Terre Haute, IN ²	Byron Rutledge	5/79	
4077	Gypsum, KS ¹	Unified School Dist. (Mentor)	8/78	
4079	Kansas City, KS	DuCat Investments, Inc.	12/78	12/78
5193	Leavenworth, KS ¹	Citizens Mutual Savings & Loan	12/79	
4080	Topeka, KS	Kaw Valley State Bank & Trust	9/78	
4411	Traverse City, MI ²	John Esslinger	12/77	
5062	Pellston, MI	Sunrise Energy Products	9/79	
4414	Apple Valley, MN ²	Minnesota Zoological Board	8/75	
2376	Blue Earth, MN ¹	Telex Communications, Inc.	2/78	
4565	Minneapolis, MN ²	University of Minnesota	8/79	
	Brooklyn Center, MN	North View School	4/74	
4084	Columbia, MO ¹	Stephens College	12/78	
2373	Kansas City, MO ¹	City of Kansas City	5/79	
4085	St. Louis, MO ¹	William Tao & Associates	4/78	
4228	Bismark, ND ²	Basin Electric Power Coop	9/78	
4089	Columbus, OH	Columbia Gas System Service Co.	10/79	9/78
4090	Columbus, OH	Columbus Technical Institute	4/79	
5043	Toledo, OH ²	Entelco Corp.	3/79	
2375	Troy, OH	Troy-Miami County Library	1/78	1/78
1510	Aberdeen, SD	First Baptist Church	8/78	

Table 3-2 (Continued)

<u>Ident. No.</u>	<u>Location</u>	<u>Project Name</u>	<u>Opr. Date</u>	<u>Inst. Date</u>
2399	Keystone, SD	National Park Services	11/79	11/77
1509	Spearfish, SD	Spearfish School	9/79	
4425	Howards Grove, WI ²	School District of Howards Grove	3/78	11/78
4424	West Bend, WI ²	Dr. Walter Handzlik	6/79	
5050	Cleveland, WI	Lakeshore Board of Education (Sheboygan)		
5048	Gays Mills, WI ²	John P. Feyen		

Partially Operational - Reportable

None

Partially Operational - Non-Reportable

None

System Down

1508	Lincoln, NE	Lincoln Housing Authority	4/78	10/78
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System in Checkout

2382	Okemos, MI	Ingham Co. Board of Comm.	4/79	4/79
4413	Troy, MI	Troy School District		

System Under Construction

5049	Iowa City, IA	Johnson County		
5047	Springfield, IL	State of Illinois		
5207	Hutchinson, KS	Kansas Cososphere & Discovery		
4078	Wichita, KS	Charles F. Henning		
4415	Hibbing, MN	Minnesota Community College		
2392	St. Paul, MN	Radisson Hotel Corp		
5196	Waverly, MO	World Plan Executive Council		
4673	Deer Park, OH	Ohio Department of Natural Resources		

Table 3-2 (Continued)

<u>Ident. No.</u>	<u>Location</u>	<u>Project Name</u>	<u>Opr. Date</u>	<u>Inst. Date</u>
System In Design				
2150	Jamestown, ND	Jamestown College		
2149	Hastings, NE	YMCA		
Refurbishment				
4406	Marion, IA	Marion Independent School Dist.	8/77	
4412	Cedar Springs, MI	Jordan College	12/77	

Table 3-2 (Continued)

NESEC

<u>Ident. No.</u>	<u>Location</u>	<u>Project Name</u>	<u>Opr. Date</u>	<u>Inst. Date</u>
Fully Operational				
4399	Danbury, CT ²	Danbury Hospital	12/78	
4401	New Haven, CT ²	Albie Booth Memorial Boys Club	4/79	
5040	North Haven, CT ²	Charles & John Cristoforo	4/79	
2377	Stamford, CT ¹	Lutz-Sotrie Partnership	5/77	6/78
4407	Boston, MA ²	Childrens Hospital Medical Center	7/78	
4408	Boston, MA	Christian A. Herter Center		
2626	Boston, MA ¹	City of Boston (Dorchester)	3/74	
4410	Amherst, MA ²	Hampshire College		
4409	Burlington, MA	Technology Properties Trust	1/79	
5044	Bourne, MA	Fern Engineering	5/79	
4994	Concord, MA ²	Town of Concord	2/78	9/78
5054	Hallowell, ME ²	Northeast Carry	6/79	
5052	Winslow, ME ²	Mother Goose Nursery School	11/79	
4416	Walpole, NH ²	Contemporary Systems (Jeffreys)	9/79	
5053	Manchester, NH	New Hampshire College	10/79	
2372	Manchester, NH ¹	Kalwall Corp	9/76	10/77
2731	Basking Ridge, NJ ¹	Environmental Education Center	9/76	
4086	Cherry Hill, NJ ¹	Garden State Racing Assoc.	11/78	
5061	Moorestown, NJ ²	Stanley R. Lane, MD		
5046	Tinton Falls, NJ	Friends of Animals	11/79	
4420	Ballston Spa, NY	Ballston Spa Central School	1/80	
4421	Bohemia, NY	Dayton T. Brown, Inc.	8/78	
5059	Reading, PA ²	Reading School District	12/79	
4098	West Goshen, PA ²	Bell Telephone of PA		
4675	Woodstock, VT	Woodstock Resort		

Table 3-2 (Continued)

<u>Ident. No.</u>	<u>Location</u>	<u>Project Name</u>	<u>Opr. Date</u>	<u>Inst. Date</u>
Partially Operational-Reportable				
4419	Millbrook, NY ²	New York Botanical Garden	3/78	
Partially Operational Non-Reportable				
None				
System Down				
4400	Bradford, CT	McColl-Wade		
System In Checkout				
4417	Durham, NH	University of New Hampshire		
2397	Lumberton, NJ	RKL Controls, Inc.	5/80	
4423	Rutland, VT ²	Rutland Corp		
System Under Construction				
5063	Florham Park, NJ	The Washington Press		
5051	Trenton, NJ	Mercer County Community College		
5037	New York, NY	Bigred Association		
4422	Troy, NY	Mr. Carl Grimm (Uncle Sam Mall)		
Systems In Design				
5058	Hardwick Twp., NJ	Princeton Education Center		
4087	Sunmaster, NJ	Sea Loft Restaurant		
4418	New Rochelle, NY	City of New Rochelle		
5055	Pittsburg PA	Pittsburg History and Landmarks		
Refurbishment				
2596	Hamden, CT	Hamden Housing Authority	5/78	

3.3 Criteria for Evaluating the Feasibility of Continuing/Aborting Projects

The objective of this section is to develop procedures for analyzing the solar commercial demonstration projects for the purpose of:

- categorization of all projects
- recommending continuation/abandonment of selected projects
- developing selection criteria for continuation/abandonment
- developing rationale for determining program worth of operational as well as non-operational projects.

In order to carry out the specific objectives outlined above, a uniform methodology is proposed which will allow all projects to be evaluated.

This methodology which is shown in Figure 3-3 involves the following:

- identification of key project variables
- selection of suitable algorithms which combine the variables into ranking figures of merit or matrices
- interpretation of figures of merit for purposes of recommendation
- assigning values to each variable for each project
- calculation of figures of merit and making recommendations

Each of these items will be discussed in this section.

FIGURE 3-3 - METHODOLOGY FLOW CHART

3.3.1 Identification of Key Project Variables

Ideally, in order to properly characterize the demonstration projects, detailed data on monthly system performance, subsystem performance, operating costs, maintenance costs, capital costs, and fuel savings are needed.

Unfortunately, almost none of this data exists and where it does there are large gaps in the data. Furthermore, cost data for the current projects bears little relation to future project costs owing to their unique nature and therefore are of little use for the purpose of ranking.

In view of these facts, the approach taken has concentrated on what little technical performance data is available and has neglected economic measures. Demonstration projects to be touted should perform well. Those that perform well despite the fact that they require more sophistication of design and components are worth more than those that could be expected to perform well because of their simplicity. Projects with owners who are willing to keep the system in good operation and to support the government publicity efforts are worth more than those whose owners are uncooperative. Furthermore, projects with good potential for replication without major redesign are worth more than one-of-a-kind-systems.

The following four major elements are the criteria proposed for determining the worth of the demonstration unit: performance, degree of difficulty, owner attitude and replicability. The criteria utilize a two step process that provides an initial ranking of results including performance and degree of difficulty. Owner attitude is given equal weight to performance.

The discussion that follows relates to the individual parameter development on an item by item basis.

Performance

The performance measure proposed is a measure of collector array output referenced against a standard collector array output. This form was chosen over the more commonly used measures of solar fraction and fuel saved in order to divorce the solar system from the bias that can be interjected by poor load estimation (for this rationale see Appendix C). From the data available and from talking with recognized experts in the solar field, a reasonably good collector output for the heating months of December, January and February is 40,000 BTU/ft²/time period. Similarly a reasonably good collector array output for cooling during the months of June, July and August is 70,000 BTU/ft²/time period. The time periods were selected to put the solar system in its best performance period when the system cannot meet the entire load and the collectors should be operating at a nearly optimum level.

Data obtained from the National Solar Data Network was used as the primary data source. Estimates were made for missing data points. Data for one other site was obtained from Ames Laboratory and those two days results were estimated to obtain heating season data.

The results of this analysis for projects on the National Solar Data Network are shown in Table 3-4.

TABLE 3-4
PERFORMANCE RATING FOR PROJECTS ON NATIONAL SOLAR DATA NETWORK (NSDN)

	Heating Season Index		Cooling Season Index	
	BTU/ft ² during Dec., Jan., Feb.	Performance/ 40,000 BTU/ft ²	BTU/ft ² during June, July, Aug.	Performance/ 70,000 BTU/ft ²
Manchester	55,334	1.58		
Stamford	41,474	1.04		
Irvine	41,452	1.04	69,902	1.00
Lynchburg	38,525	0.96		
Ballston Spa *	35,500 to 40,000	0.89-1.00		
West Branch	34,771	0.87		
Kirkland	34,135	0.85		
Hogate's	24,912	0.62		
Howards Grove	24,633	0.62		
Concord	24,271	0.61		
Blue Earth	24,076	0.61		
Louisville	23,857	0.60		
Billings	23,627	0.59		
Clemson	23,354	0.59		
Topeka	21,948	0.55		
Keystone	21,556	0.54	23,041	0.33
Page Jackson	19196	0.48	23,544	0.34
Leesburg	18,554	0.46		
Greenwood	15,334	0.38		
Troy	14,770	0.37		
Lake Buena Vista	13,711	0.34	18,581	0.27
Fresno	11,325	0.28		
Kansas City	11,325	0.28		
Columbus	10,667	0.27	21,591	0.31
Cockeysville	9,362	0.23	22,771	0.33
Austin	3,552	0.09		
Dallas	--		49,978	0.71
Shenandoah	--		40,302	0.58
Monte	--		2,655	0.04

*Data for this project not on the NSDN
was estimated by Ames Laboratory

In order to simplify the analysis and remain consistent with data quality, a further simplifying step in performance ranking has been taken. A performance ranking value of 1 to 5 will be assigned as follows:*

- system performance > 90% of standard value = 5
- system performance between 75 and 90% of standard value = 4
- system performance between 50 and 75% of standard value = 3
- system performance less than 50% but system running = 2
- system down = 1

*Average values should be taken of performance factors for heating and cooling systems.

Degree of Difficulty

The performance measures must be tempered by the complexities of the system. Some measure of system complexity can be determined by the number of system control points. This, in effect, is a measure of the expected system reliability. Solar systems show an increase in the number of control points when going through the different solar technologies. A ranking in order of complexity is as follows:

Passive	=	1
Hot Water	=	2
Heating	=	3
Cooling	=	4
Cooling & Heating	=	5

There are several possible intermediate systems; however, they will fall inside the overall ranking

The degree of difficulty fits within the concepts of system reliability. A system with one component with a reliability of 0.90 will have a system reliability of 0.90, however, with two components each with a reliability of 0.90 the system reliability is 0.81. As the complexity of the system goes up, the individual components must be more reliable to insure some reasonable degree of system reliability.

Adding the degree of difficulty to the equation provides a slightly higher emphasis on complex systems that work well. These systems demonstrate good engineering, design and installation and should be among the prime examples of the solar demonstration program.

Owner Attitude

The owner attitude is scored on a 1 - 5 scale with the ratings as follows:

Very Favorable	=	5
Favorable	=	4
Indifferent	=	3
Negative	=	2
Very Negative	=	1

The owner attitudes were obtained by contacting the field office and technical monitors which have had personal contacts with the owners.

3.3.2 Selection of Algorithms

The first algorithm selection is expressed by the following equation:

$$\frac{3(\text{Performance}) + \text{Degree of Difficulty}}{7} + 3(\text{Owner Attitude}) = \text{First Rating}$$

The first rating rounded to the nearest whole number is a 1 - 5 as follows

Excellent	=	5
Good	=	4
Average	=	3
Poor	=	2
Failure	=	1

At the conclusion of the first ratings, the sites are aggregated by the replicability of the design. There are three values designated in the replicability factor, as follows:

System is completely replicable	=	3
System replication requires some change in major components	=	2
System replication requires major changes in major components	=	1

Based upon the first rating and replicability a 5 x 3 matrix was constructed as shown in Figure 3-2.

Figure 3-2 Rating Matrix

First Rating	Replicability		
	3	2	1
5	Shaded Area	Shaded Area	Shaded Area
4			Shaded Area
3		Stipled Area	Stipled Area
2	Stipled Area	Stipled Area	Stipled Area
1			

Projects which have a high first rating and a high replicability (shaded area) are the most important demonstration projects to continue and publicize. Those with a low first rating and a low replicability (stipled area) are good candidates to abandon.

3.3.3 Interpretation of Rating Matrix For Recommendation

The following recommendation concerning the rating matrix values are suggested to determine whether or not to continue or abandon projects:

<u>First Rating</u>	<u>Replicability</u>	<u>Recommendation</u>
4.5 - 5.00	3	Continue - good PR site
4.5 - 5.00	2	Continue - good PR site
4.5 - 5.00	1	Continue - no PR
3.5 - 4.49	3	Continue - good PR site
3.5 - 4.49	2	Continue - refurbish
3.5 - 4.49	1	Continue - no PR
3	3	Continue - refurbish
3	2	Continue - refurbish
3	1	Abandon - no PR
2	3	Continue - refurbish
2	2	Abandon
2	1	Abandon
1	3	Abandon
1	2	Abandon
1	1	Abandon

3.3.4 Discussion of Methodology

The methodology selected endeavored to provide an analytical tool which could be used without the necessity of gathering a vast amount of data (which appears to be not obtainable). The methodology uses performance data when available, and subjective judgements when measured data is not available. The subjective data is obtained by the technical representatives which have been involved with the projects since their inception. As a result the fully operational sites Category I (which are providing over one half of their estimated energy quantity) are assigned a value of 3 on the performance scale. If the performance is better than average, the sites relative matrix position can only rise. For categories II and III, sites operating but provided less than one half of their estimated energy quantity a value of 2 is assigned.

A non-equal weight was assigned to the degree of difficulty factor to allow performance and owner attitude the greater weighting. A value of three times owner attitude and performance was used and a single value for the degree of difficulty. While there can be an argument over the selection of the use of three times owner attitude and performance, this device is used to provide a spread in the relative site matrix position and does not change their absolute rankings.

The methodology is easy to apply when additional data is available, and is consistent with judgement factor as pointed out in the "Program Plan for the Commercial Demonstration Program," January 1981. Overall, it provides a quantitative method of separating and evaluating demonstration sites.

3.4 Application of Methodology

Of the total 218 sites in the demonstration program, 154 have been operated or are being operated. 16 sites are in system checkout, 38 are under construction and 11 are in design (See Table 3-2). Data from the National Solar Data Network is available for 28 units, and a performance estimate on one more unit can be made from the Ames National Laboratory Data (See Table 3.4). The performance measure for the noninstrumented sites is based upon the operating criteria established by the program managers and described in "Solar Heating and Cooling Commercial Demonstration Program Project Data". The criteria are as follows: The noninstrumented sites are assigned a performance rating of 3 for fully operational sites, category I, and a performance rating of 2 for categories II and III. Solar systems-related failures for installed units in categories IV, XII and IX are assigned a rating of 1. Systems in categories V and VIII have not been rated because they are not operational but will be in the future.

Degree of difficulty has been assigned on the basis of system type. Owner attitude has been obtained from the technical monitors. Replicability has been obtained from system descriptions or technical monitors. Values for each site of the key project variables, first ratings and replicability factors are shown in Table 3-5.

TABLE 3-5 PROJECT VARIABLES AND RANKING FACTORS

Field Office	Contract No., Location, Owner	Performance Cat - Meas		Degree of Difficulty	Owner Attitude	Prelim. Factor	Replicability Factor
CHONSF	4228, Bismark, ND, Basin Electric Power Corp.	1	3	3R	3	3.00	3
	4048, Weschester Co., PA Bell Telephone of Pennsylvania	1	3	3N	5	3.87	3
	4096, Chicago IL Chicago Navy P.W	1	3	2R	3	2.87	3
	2596 Hamden, CT Hamden Conn. Housing Authority	4	1	3N W	1	1.28	
	2738, Cockeysville, MD Padonia School	1	2	5R	3	2.87	3
	4994, Concord, MA Town of Concord	1	3	3R	4	3.43	3
	4565, Minneapolis, MN Univ. of Minnesota Bookstore	1	3	5N	5	4.14	3
H-M	4661, Woodbridge, VA Allen Management, Inc.	1	3	2R	4	3.28	3
	4662, Hampton, VA. Allen Management, Inc.	1	3	2R	4	3.28	3
	4663, Chesapeake, VA Allen Management, Inc.	1	3	2R	5	3.71	3
	4664, Sandston, VA Allen Management, Inc.	1	3	2R	4	3.28	3
	4665, Bluefield, VA Allen Management, Inc.	1	3	2R	4	3.28	3
	4613, Deer Creek Park, OH Ohio Dept. of Natural Resources	6		2R			

Field Office	Contract No., Location, Owner	Performance Cate.	Meas	Degree of Difficulty	Owner Attitude	Prelim. Factor	Replicab Factor
	4676, St. John, VI Rock Resorts, Inc.	1	3	2	5	3.71	3
	4675, Woodstock, VT Woodstock Resort Corp	1	3	2	3½ - 4	3.07	3
	4618, Petoskey, MI- Petoskey Motel-----						
POM-2	4399, Danbury, CT Danbury Hospital	1	3	3N	5	3.87	3
	4401, New Haven, CT Albee Booth Memorial Boys Club	1	3	3R	4	3.43	3
	4420, Ballston Spa, NY Ballston Spa Central School Dist.	1	3-5	3	5	4.28	3
	4422, Troy, NY Carl Grimm (Uncle Sam Mall)	6		3N	-	-	
	4407, Boston, MA Childrens Hospital Medical Center	1	3	3R	4	3.43	3
	4408, Boston, MA Christian A.	1	3	3R	3	3.00	3
	4418, New Rochelle, NY City of New Rochelle Library	7		3N		-	
	4403, St. Charles, IL Community Union District 303	1	3	3N	5	3.87	3
	4416, Jeffrey, NH Contemporary Systems, Inc.	1	3	3N	5	3.87	3
	4421, Bohemia, NY Dayton T. Brown, Inc.	1	3	3R	4	3.43	3

Field Office	Contract No., Location, Owner	Performance Cat.	Meas	Degree of Difficulty	Owner Attitude	Prelim. Factor	Replica. Factor
	4411, Traverse City, MI Esslinger Medical Building	1	3	3N	3	3.00	3
	4410, Amherst, MA Hampshire College	1	3	5N	5	4.14	3
	4425, Howards Grove, WI Howards Grove School District	1	3	3N	4	3.43	3
	4405, Gary, IN- Indiana Vocational-Tech College						
	4402, Cedar Springs, MI Jordan College	6+	2	3R	5	3.43	3
	4406, Marion, IA Marion Independent School Dist.	6+		3R			
	4400, Branford, CT McColl-Wade	4	1	3N	5	3.00	3
	4415, Hibbing, MN Minnesota Community College	6		3N			
	4414, Apple Valley, MN Minnesota Zoological Board	1	3	3N	5	3.87	3
	4404, Chicago, IL Museum of Science & Industry	1	3	5R	3	3.29	3
CHO PON-2	4419, Millbrook, NY New York Botanical Garden	2		3N	2 active, 5 passive	2.44-3.43	3
	4423, Rutland, VT Rutland Corporation	5		3N	-	-	
	4409, Burlington, MA Technology Properties Trust	1	2	3N	5	3.43	3

Field Office	Contract No., Location, Owner	Performance Cat.	Meas.	Degree of Difficulty	Owner Attitude	Prelim. Factor	Replica. Factor
	4413, Troy, MI Troy School District	5		3N			
	4417, Durham, NH The University of New Hampshire	5		3R			
	4424, West Bend WI Walter A. Handzlink	1	3	3N	5	3.86	3
PON-3	5037, New York, NY Bigred Associates	6		5R	-		
	5039, Terre Haute, IN Bryon Rutledge	1	3	3R	4	3.43	3
	5040, North Haven, CT C & J Christofore	1	3	3R	3	3.00	3
	5043, Toledo, OH Entelco Corp.	1	3	5N	4	3.71	3
	5044, Broune (Cape Cod) MA Fein Engineering Co.	1	3	3N	4	3.43	3
	5046, Tinton Falls (Eatontown) NJ Friends of Animals	1	3	3N	3	3.00	3
	5047, Springfield, IL Illinois CDB	6		5N	-		
	5048, Gays Mills (LaCrosse WI John P. Feyen	1	3	3R	4	3.43	3
	5049, Iowa City, IA Johnson County	6		3N	-		
	5050, Cleveland (Sheboygan), WI Lakeshore Board of Education	1	3	3N	4	3.43	3

Field Office	Contract No., Location, Owner	Performance Cat.	Meas.	Degree of Difficulty	Owner Attitude	Prelim. Factor	Replica. Factor
	5051, Trenton, NJ Mercer Co. Community College	6		3R			
	5052, Winslow (Augusta) ME Motor Goose Nursery School	1	3	3R	5 5	3.86	3
	5053, Manchester, NH New Hampshire College	1	3	1N	4	3.14	3
	5054, Hallowell (Augusta) ME Northeast Carry	1	3	1R	5	3.57	3
	5055, Pittsburgh, PA Pittsburgh History & Landmark	7		3R			
	5058, Princeton, NJ Princeton Educational Center	7		3N			
	5059, Reading, PA Reading School District	1	3	5R	3	3.29	3
	5061, Moorestown (Philadelphia) NJ Stanley R. Lane	1	3	3R	4	3.43	3
	5062, Pellston (MacKinnon) MI Sunrise Energy Products	1	3	3R	3	3.00	3
	5063, Maplewood (New York City) NJ The Washington Press	6		5N	Not Rated		
	5065,--Providence,--RI-- University-of-Rhode-Island--						
SFO NSF	1534, Honolulu, HI Ramada Inn	1	3	2R	5	3.71	2
	2166, Scottsdale, AZ City of Scottsdale Court House	3	2	5R	5	3.71	3

Field Office	Contract No., Location, Owner	Performance Cat. Meas.		Degree of Difficulty	Owner Attitude	Prelim. Factor	Replica. Factor
H-M	1639, Kona, HI Kona Lagoon Hotel	1	3	2R	4	3.29	3
H-M	1640, Honolulu, HI Ha. Wa. Woy YMCA	6		2R			
	1656, Las Cruces, NM Coachlight Inn	1	3	2R	5	3.71	3
PON-2	1496 Cerritos, CA City of Cerritos, City Hall	3	2	3N	2	2.14	3
	1498, Los Angeles, CA-----Cancelled- City of Los Angeles Police Station-						
	1499, San Diego, CA San Diego Unified School Dist.	6		5N	5 -		
	1500, Orange, CA Ridgeline Racket Club	5		5N	4½		
	1501, El Toro, CA County of Orange, Library	6		5N	- 4		
	1507, Casper, WY Marks Associates, Office Bldg.	1	3	3N	3	3.00	3
	1508, Lincoln, NB Lincoln Housing Authority	4	1	3N	1	1.29	1
	1509, Spearfish, SD High School	1	3	3N	5	3.86	3
	1510, Aberdeen, SD First Baptist Church	1	3	3N	5	3.86	6
	1513, Taos, NM State of New Mexico	3	2	1N	3	2.29	3

Field Office	Contract No., Location, Owner	Performance Cat.	Meas.	Degree of Difficulty	Owner Attitude	Prelim. Factor	Replica. Factor
	1514, Albuquerque, NM City of Albuquerque Animal Shelter	2	2	1-3N	3	2.43	3
	1516, Lakewood CO Jefferson Co. School for Retarded	5		3R	—		
	1518, Aurora, CO Yale Elementary School	1	3	3N	4	3.43	3
	1519, Salt Lake City, UT La Quinta Motor Inns	1	3	3N	3	3.00	
	1520, Ogden, UT Permaloy Corporation	6		3N	--		
	1521, Santa Clara, CA Renault & Hendley, Comm. Bldg.	3	2	3N	4	3.00	3
	1522, Stanford, CA Stanford University, Food Service	1	3	3R	4	3.43	3
	1523, Saratoga CA Saratoga Library	1	3	3N	4	3.43	3
	1524, San Jose, CA San Anselmo Elem. School	3	2	5R	3	2.56	3
	1536, Littleton, CO Littleton City Hall	1	3	3N	5	3.86	3
	1537, Billings, MT Billings Shipping Corp.	1	3 3	3N	4	3.43	3
PON-3	2123, Boulder, CO ----- Canceled Celestial-Sensoriser, Inc.						
	2124, Telluride, CO Telluride School	1	3	1R	5	3.57	3

Field Office	Contract No., Location, Owner	Performance Cat.	Meas.	Degree of Difficulty	Owner Attitude	Prelim. Factor	Replica. Factor
	2125, Denver, CO Big Green Investments	1	3	3N	5	3.86	3
	2126, San Luis, CO Cultural Center	5		3R	--		
	2127, Albuquerque, NM The Burns/Peters Group Office	1	3	3R	5+	3.86	3
	2128, Albuquerque, NM Wolfe Co., Inc. Office	1	3	3N	5+	3.86	3
	2129, Las Cruces, NM New Mexico State Univ. Lab.	5		3N	4		
	2132, Glendore, CA Glendore Racquet Club	Cancelled		3N			
SFO	2133, La Canada, CA Descanso Garden Guild	7		5N	- 3	-	
PON-3	2136, Westlake, CA Robert Felburg, Shopping Center	6		5N	- 5+		
	2137, Sacramento, CA State of California Office	6		5N	- 4		
	2138, Tahoe Vista, CA No. Tahoe Public Rec. & Visitors Center	6		3R			
	2139, Danville, CA Church of the Valley	1	3	3N	5	3.86	3
	2140, Berkeley, CA Pacific School of Religion	6		3N	--		
	2141, Palo Alto, CA Western Energy Offices	5		3N			

Field Office	Contract No., Location, Owner	Performance Cat.	Meas.	Degree of Difficulty	Owner Attitude	Prelim. Factor	Replica. Factor
	2142, Ashland, OR Ashland Comm. Food Store	5		1 - 3 R	3		
	2143, Portland, OR Multnomah, County	6		5N	5		
	2144, Sweet Home, OR Office Facility	1	3	5N	3	3.29	3
	2146, Boise, ID Amity Elementary School	1	3	3N	5	3.86	3
	2147, Bozeman, MT Life of <u>Montana</u> Ins. Co.	1	3	3N	5	3.86	3
	2148, Laramie, WY ----- Cancelled ----- Night Insulation Factory						
	2149, Hastings, NE YMCA of Hastings	7		3N			
	2150, Jamestown, ND Jamestown College	7		3N	3		
NASA	2400, Montevallo, AL Alabama Power Company	2	1	5N	5	3.29	2
PON-1	2384, Fresno, CA Arate Services, Inc.	1	2	2R	4	2.86	3
	2389, Greenwood, SC Blakedale Professional Center	4	2	3N	3.5	2.79	2
	2394, Charlotte, NC Charlotte Memorial Hospital & Medical Center	1	3	3R	4	3.43	3
	2398, Irvine, CA El Camino Elementary School	2	5	5R	4	4.57	3

Field Office	Contract No., Location, Owner	Performance Cat.	Meas.	Degree of Difficulty	Owner Attitude	Prelim. Factor	Replica. Factor
	2395, Yulee, FL I-95 Visitors Center	4	1	5R	4.5	3.07	2
	2383, Mill Valley, CA Iris Images, Inc.	1	3	2N	5	3.71	3
	2372, Manchester, NH Kalewall Corporation	1	5	1R	5	4.43	3
	2387, South Lake Tahoe, CA Lake Valley Fire District	4	1	3.5R	5	3.07	3
	2381, Leesburg, VA Loudon County School Board	5	2	2N	3	2.43	3
	2391, Baton Rouge, LA LSU Field House	4		3R	3*	2.14	3
	2377, Stamford, CT Lutz Sotire Partnership	1	5	3R	3*	3.86	3
	2399, Keystone, SD Mt. Rushmore Visitors Center	1	3/2	5R	5	3.93	3
	2404, Richland, WA Olympic Engineering Corp.	1	3	5R	3*	3.29	2
	2385, Louisville, KY Rademaker Corporation	1	3	3R	5	3.86	3
	2396, Austin, TX Radian Corporation	1	1	5R	4.5	3.07	3
	2401, Lake Buena Vista, FL Reedy Creek Utilities Co.	1	2	5N	3*	2.86	3
	2336, West Branch, IA Scattergood School	1	4	3N	5	4.29	3

Field Office	Contract No., Location, Owner	Performance		Degree of Difficulty	Owner Attitude	Prelim. Factor	Replica. Factor
		Cat.	Meas.				
	2376, Blue Earth, MN Telex Communications, Inc.	1	3	2R	5	3.71	3
	2388, Lynchburg, VA Terrell E. Mosley, Inc.	1	5	3R	5	4.71	3
	2403, San Antonio, TX Trinity University	1	3	5R	5	4.14	2
	2370, Troy, OH Troy-Miami Public Library	1	2	3R	4	3.00	3
	2396, Baltimore, MD City of Baltimore	1	3	3N	4	3.43	3
	2374, San Francisco, CA Environmental Center	6		3N			
	2386, Annapolis, MD Ferguson Corporation	1	3	1R	3.0*	2.71	3
	2382, Okemos, MI Ingham Co. Board of Commissioners	5		1N	4		
	2373, Kansas City, MO City of Kansas City Fire Station	1	3	3N	3*	3.00	3
	2378, Gaithersburg, MD Maryland National Park & Planning Commission	6		3N			
	2392, St. Paul MN Radisson Plaza	6		3N			
	2397, Lumberton, NJ RKL Factory	5		5N	5		
	2393, Tempe, AZ Tempe Union High School	4	1	5	3*	2.43	3
	2544, Washington, D.C. Marriott Corp.		3	2R	4½	3.50	3

Field Office	Contract No., Location, Owner	Performance Cat.	Meas.	Degree of Difficulty	Owner Attitude	Prelim. Factor	Replica. Factor
NASA/HQ	4094, Austin, TX The Ornamental Metals Co.	Cancelled		IN*			
	4083, Baltimore, MD City of Baltimore Fire Station	6		5N	4		
PON-2	4096, Betheny, WV Betheny College	1	3	3R	5	3.86	3
	4073, Brandon, FL Brandon Swimming Assoc.	1	3	5R	5	3.86	3
	4076, Clarksville, IN Clarksville Community School	1	3	3R	3*	3.00	3
	4092, Jackson, TN Coca Cola Bottling Works	1	3	3R	3*	3.00	3
	4089, Columbus, OH Columbia Gas System Service Group	1	2	5R	5	3.71	3
	4090, Columbus, OH Columbus Technical Institute	1	3	5N	4½ - 5	4.04	3
	4079, Kansas City, KS Du Cat. Investments, Inc.	1	4	3N	3	3.43	3
	4074, Cape Canaveral, FL Florida Solar Center	1	3	5R	5	4.14	3
	4086, Cherry Hill, NJ Garden State Racing Association	1	3	3R	5	3.86	3
	4071, Huntsville, AL Huntsville Senior Citizen Center	1	3	3R	4	3.43	3

Field Office	Contract No., Location, Owner	Performance Cat.	Meas.	Degree of Difficulty	Owner Attitude	Prelim. Factor	Replica. Factor
	4080, Topeka, KS Kaw Valley State Bank	1	3	5N	3*	3.29	3
	4078, Wichita, KS Medical Office Center	6		3N	4.5		
	4081, Germantown, MD Montgomery Community College	1	3	3N	4	3.43	3
	4075, Dalton, GA Georgia Planning & Development Comm.	1	3	5N	2	2.86	3
	4070, Lister Hill, AL Reynolds Metal Co.	1	3	3N	3*	3.00	3
	4087, Long Branch, NJ Sea Loft	7		5N			
	4084, Columbia, MO Stephens College	1	3	3N	3*	3.00	3
	4091, Nashville, TN-----Cancelled-----3N- Building-Materials-Assoe-						
	4093, Dallas, TX Travis Braun & Associates	1	3	3N	3*	3.00	3
	4077, Mentor, KS (Gypsam) Unified School District 306	1	3	3N	3*	3.00	3
	4085, St. Louis MO William Tao	1	3	3R	4	3.43	3
	4095, Charlottesville, VA Wilson Psychiatric Hospital	1	3	3R	4	3.43	3

Field Office	Contract No., Location Owner	Performance Cat.	Meas.	Degree of Difficulty	Owner Attitude	Prelim. Factor	Replica. Factor
NSF	4034, Coral Gables, FL Dale County Elementary School	6		4N	5		
	2593, Dallas, TX City of Dallas	1	3	5R	4	3.71	3
	4917, San Juan, PR Factory	6		4N			
	4296, Charlestown, WVA Page Jacks - School	3	2	5	3*	2.86	2
NASA	5202, Abbeville, SC City of Abbeville Fire Station	1	3	3N	4	3.43	3
POM-3	5228, Philipp, WV Aldesson-Broddus College	5		3N			
	5211, Arlington, VA Arlington Racquet Club	1	3	3R	3*	3.00	3
	5195, Towson, MD Baltimore County Jail	6		3N			
	5210, Memphis, TN Belz Investment Co.	1	3	3N	5	3.86	3
	5209, Westminster, MD County Commissioners of Carol Co.	5		3R			
	5212, Charleston, SC Charleston County School District	6		5R			
	5193, Leavenworth, KS Citizens Mutual Savings & Loan	1	3	5N	4	3.71	3
	5199, Clarksdale, MS The National Bank of Clarksdale	1	3	4N	5	4.00	3

Field Office	Contract No., Location, Owner	Performance Cat.	Meas.	Degree of Difficulty	Owner Attitude	Prelim. Factor	Replica. Factor
	5192, Atlanta, GA Georgia Power Co.	7		5N	4.5		
	5207, Hutchinson, KS Cosmophere & Discovery Center	6		3N	5		
	5200, Troy, NC Montgomery County Schools	6		3N	4		
	5204, Dallas, TX North Dallas High School	1	3	3	5	3.86	3
	5201, Oklahoma City, OK Dept. of Transportation	1		5N			
	5205, Portsmouth, VA Portsmouth Public Schools	6		3N	5		
	5206, Richmond, VA City of Richmond						
	5191, Savannah, GA Savannah Science Museum	6		5R			
	5198, Starkville, MS State Bank	1	3	3N	4½	3.64	3
	5188, North Little Rock, AK Shoney's Big Boy	1		3N	4½	3.64	3
	5203, San Antonio, TX Sky Harbor Elementary School	6		5N	4.5		
	5270, Tempe, AZ Tempe Union (Corona Del Sol) High School	2		4R			

Field Office	Contract No., Location, Owner	Performance Cat.	Meas.	Degree of Difficulty	Owner Attitude	Prelim. Factor	Replica. Factor
	5190, Newcastle, DE Wilmington Swim School, Inc.	1	3	3NR	4	3.5	
	5196, Waverly, MO World Plan Executive Council	6		?			
MPSA	1663, Anderson, SC Days Inn of America	1		2R	3*	2.75	
	1632, Clermont, FL Days Inn--			2R			
	1634, Hallandale, FL Diplomat Golf & Racket Club			Cancelled	2R		
	1661, Kingston, OK Lake Texoma Lodge			Cancelled	2R		
	1672, Beaumont, TX La Quinta Motor Inn	6		2N	1		
	1638, Casper, WY La Quinta Motor Inn	6		2N	1		
	1647, Champaign, IL La Quinta Motor Inn			Cancelled	2N	1	
	1645, Indianapolis, IN La Quinta Motor Inn	7		2N	1		
	1657, Las Vegas, NV La Quinta Motor Inn	1	3	2N	1	1.75	
	1676, Merriville, IN La Quinta Motor Inn			2N	1		
	1623, Mobile, AL La Quinta Motor Inn	1	3	2N	1	1.75	

Field Office	Contract No., Location, Owner	Performance Cat.	Meas.	Degree of Difficulty	Owner Attitude	Prelim. Factor	Replica. Factor
	1664, Nashville, TN La Quinta Motor Inn	6		2N	1		
	1665, San Antonio, TX La Quinta Motor Inn	6		2R	1		
	1670, Texas City, TX La Quinta Motor Inn	1	3	2N	1	1.71	3
	1657, Charlotte, NC Office Parks of Charlotte	1	3	2R	3*	.86	3
	1633, Key West, FL Quality Inn	1	3	2R	3*	2.86	3
	1666, Taylor, TX Thompson Motel	1	3	2N	3*	2.86	3
	1668, Woodlands, TX Woodlands Aquatic Center	5		2R			
	1667, Woodlands, TX The Woodlands Inn	5		2R			
	1632, Atlanta, GA Days Inn	1	3	2R	3*	2.86	3
	1632, Mt. Pleasant, SC Days Inn	7		2N			
	1632, Forrest Lane, Dallas, TX Days Inn	1	3	2R	3*	2.86	3
	1632, Garland, TX Days Inn	1	3	2R	3*	2.86	3
	1632, Dallas, TX Valley View Days Inn	1	3	2R	3*	2.86	3
	1632, Denver CO Days Inn	7		2N			

Field Office	Contract No., Location, Owner	Performance Cat.	Meas.	Degree of Difficulty	Owner Attitude	Prelim. Factor	Replica. Factor
	1632, Ft. Lauderdale FL Days Inn	7		2R			
	1632, Houston, TX Days Inn	6		2R			
	1632, Jacksonville, FL Days Inn	1	3	2R	3*	2.86	3
	1632, Savannah, GA Days Inn	1	3	2R	3*	2.86	3
	-----Charlotte, NC----- Days Inn--	1	3	2R	3*	2.86	3
	1657, Charlotte, NC Office of Parks of Charlotte	6		2R			
	1657, Charlotte, NC Office of Parks of Charlotte	6		2R			
	1657, Charlotte, NC Office of Parks of Charlotte	6		2R			

Field Office	Contract No., Location, Owner	Performance Cat.	Meas.	Degree of Difficulty	Owner Attitude	Prelim. Factor	Replica. Factor
HQ	1083, Santa Clara CA Community Center	1	3	5	5	4.14	3
	3457, Upland, CA Southern California Gas	1	3	2	3	2.86	2
	5477, Atlanta, GA Towns School	4	1	5	3	2.43	2
	4942, Shenandoah, GA Recreation Center	1	3	5	3	3.29	3
	2626, Boston, MA Grover Cleveland School	1	3	3	3	3.00	2
	2627, Timonium, MD School	1	3	5	3	3.29	2
	2586, Warrenton, VA Fauquir High School	4	1	3	3	2.14	3
	3457, El Toro, CA Southern California Gas	1	3	5	3	3.29	3
	, Brooklyn Center, MA North View	1	3	3	3	3.00	3
	3652, Las Cruces, NM University of NM	1	3	5	3	3.29	3
	2731, Basking Ridge Environmental Education Center	1	3	5	5	4.14	2

3.5 Recommendations

Based upon the calculated matrix values, the following recommendations for continuing/abandoning are made.

- Projects with High PR value

Fifty two sites rating 3.5 & greater, replicability 3 and 2

- Projects to Refurbish

One Hundred Fourteen, includes the fifty two sites above plus sixty two in the 3.0 - 3.49 range, replicability 3 and 2.

- Projects to Continue No PR

The Sixty two sites listed as part of the refurbishment

- Projects to Consider for Abandonment

Forty one sites - tend to abandon sites less than 3.0 on first rating regardless of replicability.

Figure 3-5

Decision Matrix

Rating	Replicability Factor			<u>Total</u>
	3	2	1	
4.50	2	0	0	2
4.00 - 4.49	9	2	0	11
3.50 - 3.99	39	1	0	40
3.00 - 3.49	61	5	0	66
2.50 - 2.99	20	3	0	23
2.00 - 2.49	6	2	0	8
1.50 - 1.99	3	0	0	3
1.00 - 1.49	1	0	1	2
0.50 - 0.99	0	0	0	0
0.00 - 0.49	0	0	0	0
Total	141	13	1	155

First Ratings 4.50 - 5.00 Replicability - 3

<u>Ident.</u> <u>No.</u>	<u>Location</u>	<u>Name</u>		
2388	Lynchburg, VA	Terrel E. Mosley, Inc.	4.71	3
2398	Irvine, CA	El Camino Elementary School	4.57	3

First Ratings 4.00 - 4.49

2372	Manchester, NH	Kalwall Corp.	4.43	3
2386	West Branch, IA	Scattergood School	4.29	3
4420	Ballston Spa, NY	Ballston Spa School District	4.28	3
1083	Santa Clara, CA	Community Center	4.14	3
4074	Cape Canaveral, FL	Florida Solar Center	4.14	3
4410	Amherst, MA	Hampshire College	4.14	3
4565	Minneapolis, MN	Univ. of Minn. Bookstore	4.14	3
4090	Columbus, OH	Columbus Technical Institute	4.04	3
5199	Marks, MS	1st National Bank of Clarksdale	4.00	3

First Ratings 4.50 - 5.00 Replicability - 2

2403	San Antonio, TX	Trinity University	4.14	2
2731	Basking Ridge, NJ	Environmental Education Center	4.14	2

First Ratings 3.50 - 3.99 Replicability - 3

2399	Keystone, SD	Mt. Rushmore Visitors Center	3.93	3
4048	West Goshen	Bell Telephone of PA	3.87	3
4399	Danbury, CT	Danbury Hosp. Fac.	3.87	3
4403	St. Charles, IL	Community Union School	3.87	3

4414	Apple Valley, MN	Minnesota Zoological	3.87	3
4416	Jeffreys, NH	Contemporary Systems	3.87	3
1509	Spearfish, SD	Spearfish High School	3.86	3
1510	Aberdeen, SD	First Baptist Church	3.86	3
1536	Littleton, CO	City Hall	3.86	3
2125	Denver, CO	Big Green Investments	3.86	3
2127	Albuquerque, NM	Burns/Peters Group	3.86	3
2128	Albuquerque, NM	Wolfe, Co., Inc.	3.86	3
2139	Danville, CA	Church of the Valley	3.86	3
2146	Boise, ID	Amity Elementary School	3.86	3
2147	Bozeman, MT	Life of Montana	3.86	3
2377	Stamford, CT	Lutz-Sotrie Partnership	3.86	3
2385	Louisville, KY	Rademaker, Corp.	3.86	3
4073	Brandon, FL	Brandon Swimming Assoc.	3.86	3
4086	Cherry Hill, NY	Garden State Racing Assoc.	3.86	3
4096	Bethany, WV	Bethany College	3.86	3
4424	West Bend, WI	Walter A. Handzlink	3.86	3
5052	Winslow, ME	Mother Goose Nursery School	3.86	3
5204	Dallas, TX	North Dallas High School	3.86	3
5210	Memphis, TN	Belz Investment Co.	3.86	3
1656	Las Cruces, NM	Terry J. Carper	3.71	3
2166	Scottsdale, AZ	Court House	3.71	3
2376	Blue Earth, MN	Telex Communications	3.71	3
2383	Mill Valley, CA	Iris Images	3.71	3
2593	Dallas, TX	City of Dallas	3.71	3
4089	Columbus, OH	Columbus Gas Systems	3.71	3
4663	Chesapeake, VA	Allen Management	3.71	3
4676	St. John, VI	Rock Resorts, Inc.	3.71	3
5043	Toledo, OH	Entelco	3.71	3

5193	Leavenworth, TX	Citizens Mutual Savings & Loan	3.71	3
5188	Little Rock, AR	Shoney's Big Boy	3.64	3
5198	Starksville, MS	State Bank	3.64	3
2124	Telluride, CO	School	3.57	3
5054	Hallowell, ME	Northeast Carry	3.57	3
2544	Washington, D.C.	Marriott Corp.	3.50	3

First Ratings 3.50 - 3.99 Replicability - 2

1534	Honolulu, HI	Ramada Inn	3.71	2
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First Ratings 3.00 - 3.49 Replicability - 3

1518	Aurora, CO	Elementary School	3.43	3
1522	Stanford, CA	Stanford, Univ.	3.43	3
1523	Saratoga, CA	Library	3.43	3
1537	Billings, MT	Billings Shipping Corp	3.43	3
2390	Baltimore, MD	City of Baltimore	3.43	3
2394	Charlotte, NC	Charlotte Memorial Hospital	3.43	3
4071	Huntsville, AL	Senior Citizens Center	3.43	3
4079	Kansas City, KS	DuCat Investment, Inc.	3.43	3
4081	Germantown, MD	Montgomery Community College	3.43	3
4085	St. Louis, MO	William Tao	3.43	3
4095	Charlottesville, VA	Wilson Psychiatric Hospital	3.43	3
4401	New Haven, CT	Albie Booth Boys Club	3.43	3
4407	Boston, MA	Childrens Hospital	3.43	3
4409	Burlington, MA	Technology Properties Trust	3.43	3
4412	Cedar Springs, MI	Jordon College	3.43	3
4421	Bohemia, NY	Dayton T. Brown	3.43	3

4425	Howards Grove, WI	Howards Grove School	3.43	3
4994	Concord, MA	Town of Concord	3.43	3
5093	Terre Haute, IN	Byron Rutledge	3.43	3
5044	Bourne, MA	Fern Engineering	3.43	3
5048	Gays Mills, WI	John P. Feyen	3.43	3
5050	Cleveland, WI	Lakeshore Board of Education	3.43	3
5053	Manchester, NH	New Hampshire College	3.43	3
5061	Moorestown, NJ	Stanley R. Lane	3.43	3
5190	New Castle, DE	Wilmington Swim Club	3.43	3
5202	Abbeville, SC	Fire Station	3.43	3
1639	Kona, HI	Kona Lagoon Hotel	3.29	3
2144	Sweet Home, OR	Office	3.29	3
3457	El Toro, CA	Southern California Gas	3.29	3
3652	LaCruces, NM	University of New Mexico	3.29	3
4080	Topeka, KS	Kaw Valley	3.29	3
4404	Chicago, IL	Museum of Science & Industry	3.29	3
4942	Shenandoah, GA	Recreation Center	3.29	3
5059	Reading, PA	Reading School District	3.29	3
4661	Woodbridge, VA	Allen Management	3.28	3
4662	Hampton, VA	Allen Management	3.28	3
4664	Sandston, VA	Allen Management	3.28	3
4665	Bluefield, WV	Allen Management	3.28	3
2387	Southlake Tahoe, CO	Lake Valley Fire District	3.07	3
2396	Austin, TX	Radian Corp.	3.07	3
4675	Woodstock, VT	Woodstock Resort Corp.	3.07	3
	Brooklyn Center, MN	Northview School	3.00	3
1507	Casper, WY	Marker Assoc. Office Bldg.	3.00	3

1519	Salt Lake City, UT	LaQuinta Motor Inns	3.00	3
1521	Santa Clara, CA	Renault & Hendley	3.00	3
2373	Kansas City, MO	Fire Station	3.00	3
2375	Troy, OH	Troy-Miami Public Library	3.00	3
4070	Lister Hill, AL	Reynolds Metals	3.00	3
4076	Clarksville, IN	Clarksville Community School	3.00	3
4077	Gypsum, KS	Unified School District #306	3.00	3
4084	Columbia, MO	Stephens College	3.00	3
4092	Jackson, TN	Coca-Cola Bottling	3.00	3
4093	Dallas, TX	Travis-Braun	3.00	3
4228	Bismark, ND	Basin Electric	3.00	3
4400	Branford, CT	McColl-Wade	3.00	3
4408	Boston, MA	Christian Herter Center	3.00	3
4411	Traverse City, MI	Esslinger Medical Building	3.00	3
5040	North Haven, CT	C & J Christofore	3.00	3
5046	Tinton Falls, NJ	Friends of Animals	3.00	3
5062	Pellston, MI	Sunrise Energy Products	3.00	3
5211	Arlington, VA	Racquet Club	3.00	3

First Ratings 3.00 - 3.49 Replicability - 2

2400	Montevallo, AL	Alabama Power Co.	3.29	2
2404	Richland, WV	Olympic Engineering	3.29	2
2627	Timonium, MD	Timonium School	3.29	2
2395	Yulee, FL	I-95 Visitors Center	3.07	2
2666	Boston, MA	Grover Cleveland School	3.00	2

First Ratings 2.50 - 2.99 Replicability - 3

2738	Cockeysville, MD	Padonia School	2.87	3
4096	Chicago, IL	Chicago Navy Pier	2.87	3
1524	San Jose, CA	San Anselmo School	2.86	3
1632	Savannah, GA	Days Inn	2.86	3
1632	Dallas, TX	Days Inn Valley View	2.86	3
1632	Jacksonville, FL	Days Inn	2.86	3
1632	Atlanta, GA	Days Inn	2.86	3
1632	Dallas, TX	Days Inn, Garland	2.86	3
1632	Dallas, TX	Days Inn	2.86	3
1632	Key West, FL	Quality Inn	2.86	3
1657	Charlotte, NC	Office Parks of Charlotte	2.86	3
1663	Anderson, SC	Days Inn	2.86	3
1666	Taylor, TX	Thompson Motel	2.86	3
2384	Fresno, CA	ARATEX Services Inc.	2.86	3
2401	Lake Buena Vista, FL	Reedy Creek	2.86	3
4075	Dalton, GA	North Georgia Planning & Dev. Commission	2.86	3
4419	Millbrook, NY	Botanical Garden	2.79	3
2129	Las Cruces, NM	New Mexico St. Univ.	2.75	3
2380	Annapolis, MD	Ferguson Corp.	2.71	3
2382	Okemos, MI	Ingham County Brd. of Supv.	2.71	3

First Ratings 2.50 - 2.99 Replicability - 2

3457	Upland, CA	Southern California Gas	2.86	2
4296	Charlestown, WV	Page Jackson School	2.86	2
2389	Greenwood, SC	Blakesdale Professional	2.79	2

First Ratings 2.00 - 2.49 Replicability - 3

1514	Albuquerque, NM	Animal Shelter	2.43	3
2381	Leesburg, VA	Loudon County School	2.43	3
2393	Tempe, AZ	High School	2.43	3
1513	Taos, NM	State of New Mexico	2.29	3
1496	Cerritos, CA	City Hall	2.14	3
2391	Baton Rouge, LA	Field House	2.14	3

First Ratings 2.00 - 2.49 Replicability - 2

5477	Atlanta, GA	Towns School	2.43	2
2587	Warrenton, VA	Fauquier High School	2.14	2

First Ratings 1.50 - 1.99 Replicability - 3

1623	Mobile, AL	LaQuinta Motor Inn	1.71	3
1654	Las Vegas, NV	LaQuinta Motor Inn	1.71	3
1670	Texas City, TX	LaQuinta Motor Inn	1.71	3

First Ratings 1.00 - 1.49 Replicability - 3

2596	Hamden, CT	Hamden Housing Authority	1.28	3
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First Ratings 1.00 - 1.49 Replicability - 1

1508	Lincoln, NE	Lincoln Housing Authority	1.29	1
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First Ratings 0.50 - 0.99

First Ratings 0.00 - 0.49

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APPENDIX A

This Appendix provides answers to several questions raised by DOE personnel. The response provides valuable insight into how the demonstration program should be run.

A.0 OBJECTIVE:

In this Appendix A several questions which were raised by DOE personnel with respect to solar heating and cooling demonstration projects are discussed and ideas are presented for dealing with the projects.

A.1 SUMMARY:

It is strongly believed that only those projects which are known to work well should be highly publicized. This publicity should be an all out program with reports, documentaries, tours, etc. An effort should be made to get annual performance figures for the projects as a minimum measure of degree of success of a project.

It is believed that costs as high as 20% of the original cost of a project are reasonable investments to make a system work if it is believed that the system will meet minimum performance standards.

RSEC's should begin to get involved with projects immediately. However, this should be done in such a manner as to avoid the process of learning all over again which the industry cannot tolerate financially.

A.2 DISCUSSION:

Q. Facilities are established - how can we take advantage of them?

(1) Assume that a project has been instrumented -- if it has not then you cannot tout the system because it is not known whether or not it works well. To test a poorly working system would be counter to the objective of the program.

Based upon the instrumented data does it appear that the system works well? (i.e. Does it meet some "minimum performance standards") (for example, those set forth in Section 3.0.) If yes, then the system may be worth touting -- if no, then this project should be analyzed as to why it is not performing well -- is there a problem or is it an inherently poor system? If there is a problem which can be repaired say at less than 10 - 20% of the project cost then it should be done if correcting of the problem will enable the "minimum performance standard" to be met.

This analysis should be carried forth to costs, cost/perf ratios, O&M cost, simple payback and life cycle cost ratio to ensure that the minimum requirements are met. If they are not, then the reason should be understood - if corrections can be made then they should -- for example, actual project cost may not be indicative of future costs and so estimated realistic future costs could be substituted.

The entire point of this discussion is that advantage can only be taken if there is something worthwhile to take advantage of. Poor projects should not be tested because they will ultimately hurt the program.

If all the criteria are met, then it is suggested that great publicity be given to those projects. The design should be well documented, performance values set forth in detail. Costs presented down to the component levels. A documentary should be made illustrating the key features of the system and why it is such a good system. It should be shown how this design relates to other potential customers needs. It is suggested that several versions of the documentary be made -- one for users and one for engineers. Engineers need to know how to design better systems and they need more detail than users.

Detailed written reports need to be made available to a variety of audiences concerning technical, economic and institutional factors. These include A & E's, owners, lending institutions, insurance companies, installers, code officials, etc. Public tours could be encouraged and arranged for at mutually agreeable times between the owner and the RSEC personnel and a public display set up.

Documentaries should be given good publicity on TV, radio and movie theaters.

Installers should be brought into the picture because they need to understand key features of the system and how to properly install the components.

It is believed that every working project should have at least a simple instrumentation system. This system should be capable of giving array performance in 10^3 BTU/ft²-yr. and energy delivered to loads in 10^3 BTU/ft²-yr. An RFP should be issued for such a low cost system with 5-10% overall accuracy.

(2) In many cases sparse data on system performance exists, but certain aspects of the system are recognized to represent good technical solutions at reasonable costs. For example, an above ground storage tank may be neatly installed and properly insulated all at a reasonable cost (say \$1.50 gallon of capacity). In such instances, that aspect of the system could be highlighted in publications and documentaries. For example, a series of reports and films could be presented on various subsystems such as storage, arrays, controls, interface, etc.

Implementation of such a set of reports and documentaries could be difficult in the sense that selection of subsystems which were well done, particularly within systems that are not performing well, is a large engineering job (perhaps one to be handled by the RSECS).

(Q) How, when and under what conditions do we transfer projects to the field?

(1) It is important that continuity in project understanding and owner repaire be maintained. Within this context, the RSEC's immediately should become involved in projects eventually to be under their domain. This involvement should initially be secondary to whomever is currently managing the project, but should allow for project understanding to be developed and good relations with the owner to be established. Transfer of project management to the RSEC's should be done as soon as the project has been installed and accepted (formal acceptance test). The former manager should remain involved on an as needed basis in the event technical difficulties need to be corrected which the RSEC's cannot handle.

(2) It is warned that the-process of transfer of projects to the field should not be just another learning process. The SHAC industry is fragile and needs strong, knowledgeable people leading the government programs. Lessons learned need to be implemented and used as stepping stones not learned over again.

Assuming that a project is working well and has been chosen as a high publicity project, the owner has much to gain from free exposure on TV, radio, newspapers,

tours, etc. The first caveat is that he should desire such exposure -- if not, then care should be exercised so that a man's business is not jeopardized or hampered. These plans for publicity should be reviewed and discussed with the owners before actual implementation begins. It may be that a great deal of effort in publicity preparation can be donated by the owners. Publicity should be controlled fairly tightly so that only true claims are made, because they may have a large impact and raise the expectation levels of what the solar system can do.

Q. What is criteria for fixing systems which breakdown?

It is believed that normal maintenance and repair is the responsibility of the owner. This includes repair of such items as pumps, valves, controls, etc. However, problems occurring which are specific to solar systems and the fact the good design practices were not clear should be repaired by the government. This is especially true for projects which are given high visibility. The question of solar component warranties is difficult, since many of the companies involved tend to be marginal -- if some don't have to meet warranties, why should others be expected to? Negotiations should be conducted with companies who gave warranties to determine an equitable solution to repair. Repairs costing as much as 10 - 20% of the initial cost of the system are reasonable investments

to keep a project going. Higher costs should be avoided if possible and abandonment should be considered in the event costs greater than 20% are needed for repair. Of course, the value of the project to the publicity program should be evaluated under special cases.

Q. What about systems which are not working well now?

If a system is instrumented, it represents a considerable investment and strong efforts to repair the system should be employed. Of course, it is important to determine that if repaired a minimum set of performance standards will be met, otherwise, the value of the project cannot be great since DOE cannot tout projects which are inherently poor performers.

A certain degree of responsibility to the owners for a good working system is on DOE's shoulders. It is, therefore, reasonable that sincere efforts be made to ensure that a working system is in place. In some cases, problems that are industry problems need to be worked out so that SHAC is closer to being economically viable. DOE should spend greater amounts to solve these problems.

A rough estimate is that amounts up to 20% of the cost of the system is reasonable depending on the nature of the problems and value of the project. In some cases, the reason for poor performance or lack of performance may not be understood. Before investments are made in the

project the reason for poor performance should be ascertained and costs for repair estimated. It may be wise to hire an experienced investigative team to determine the problems since designers often don't have sufficient experience to determine the problem.

Owners will vary in the degree of responsibility they take for a system. Some will maintain the system be interested in its performance and be glad to show it off -- others will not perhaps for economic reasons or because of a bad experience. This attitude will be reflected in many ways ranging from cooperation with the government to willingness to publicize the project. In the disposition stage attitudes can be important. Disposition can be as simple as giving full responsibility to the owner after removing government instrumentation. If the system is performing well, this is not a problem. If a system is broken down, legal questions may arise as to whom shall pay to remove the system and return the building to the same condition it was previously in -- or if legally it is the owner's responsibility, then what damage has been caused to the solar program by throwing the problem in the owner's lap. It may be reasonable to offer the owner a nominal disposition fee which will allow him to either remove the system or make repairs -- but with the realization that the system and its problems are totally his and the government is no longer involved with the system.

It is possible that in some cases doing nothing is legally acceptable and an owner does not wish to do anything with the system. If the project is not important to the program, then just forgetting it may be best. It is important to remember, however, that those owners who were energy conscious and willing to support the national program by having solar systems installed on their buildings should not be penalized for so doing. An equitable agreement for disposition should be negotiated.

APPENDIX B

FEDERAL BUILDING PROJECTS

WSUN / SERI

Federal Buildings

I Fully Operational

0472 Davis, CA
1055E Edwards AFB, CA
1055F Moffett Field, CA
0225 Grand Junction, CO
0020 Mercury, NV
0165D Bread Springs, NM
1026 Richland, WA

II Partially Operational - Reportable

1058 - Irvine, CA

III Partially Operational - Non-reportable

0548B Berkley, CA

IV Systems Down

None

V Systems in Checkout

0122 Colorado Springs, CO

VI Systems Under Construction

99000 Barstow, CA
4276 Pueblo City, CO

VII Systems in Design

9900 Davis AFB, AZ

1066 Denver, CO

9900G Mt. Home, ID

9900E Cannon AFB, NM

9900P West of Glen Rio, NM

VIII Refurbishment

None

IX Owner Fixing Problem

None

X Unknown

Port Hueueme, CA

NESEC

Federal Buildings

I Fully Operational

0013A Upton, NY

5109 Bruceton, PA

II Partially Operational - Reportable

None

III Partially Operational - Non-Reportable

None

IV Systems Down

Down

V Systems in Checkout

1102 Hamlin, ME

VI Systems Under Construction

9900W Glastonbury, CT

99000 Clinton City, PA

VII System in Design

None

VIII Refurbishment

None

IX Systems Complete (Owner Fixing Problem)

None

X Unknown

Bangor, ME

Manchester, NH

MASEC

Federal Buildings

I Fully Operational

0228 Argonne, IL

1034A Saginaw, MI

II Partially Operational - Reportable

None

III Partially Operational - Non-reportable

None

IV Systems Down

None

V Systems in Checkout

None

VI Systems Under Construction

3000A Batavia, IL

9900A Custrhill, KS

9900N Lincoln, NE

VII Systems in Design

9900M Plainfield, IN

9900R Rugby, ND

9900S Medicine Creek, SD

VIII Refurbishment

None

IX System Complete (Owner Fixing Problem)

None

X Unknown

Chicago, IL

SSEC

Federal Buildings

I Fully Operational

1055D Huntsville, AL
1055A Huntsville, AL
1055B Huntsville, AL
1055C Huntsville, AL
6050 Ft. Meyers Beach, FL
9900C Annapolis, MD
9283B Ft. Meade, MD
9900D Gulfport, MS
0241 Bartlesville, OK
0246 Houston, TX

II Partially Operational - Reportable

1055H Hampton, VA
1049 Bastrop, TX

III Partially Operational - Non-reportable

8812 Kennedy Space Flight Center, FL
1046 Land Between The Lakes, KY
9900I Kirkland AFB, NM
 Randolph Field, TX

IV Systems Down

None

V Systems in Checkout

9900J Fort Polk, CA

0131 Sheppard AFB, TX

VI System Under Construction

9900K Bolling AFB, DC

1055G Cape Canaveral, FL

9900Q Gordon City, GA

9900L Yukon, OK

VII Systems in Design

9900X Tallahassee, FL

9900B Ft. Campbell, KY

9900U Campbell City, VA

9900I Campbell City, VA

VIII Refurbishment

None

IX Systems Complete (Owner Fixing Problem)

None

X Unknown

Kennedy Space Flight Center, FL

10481 Sheppard AFB, TX

APPENDIX C

The performance of solar systems should be compared against a reference which is not related to the building load. The rationale being that the building load predictions are not accurate. Reference Steve Diamond's Report* on DOE-2 validation studies. The inaccuracies of solar fraction or fossil fuel saved are potentially greater for new buildings than for buildings with a measured load. In many cases, however, even for retrofit systems, the loads were only estimates.

The physical performance of a system is better measured by examining some of the systems parameters rather than the external parameters. This is not to say that the solar fraction and fossil fuel saved are probably not the most important factors, but rather that the measure of a system's effectiveness should be measured for that system.

The easiest parameter to develop is a measure of collector output as compared to some attainable output. Water heating systems, have the most historical data and it can be easily shown that for the New England area outputs of 200,000 BTU/ft² of collector are not unreasonable. Water heating systems can now be compared in an area using this as a threshold.

Heating and cooling systems, even when results are available show some strange results when the changeover months of the spring and fall are included. The systems tend to work best when there is a considerable load for the system. If the system performance is analyzed only for the time of large loads, i.e. December, January and February for heating and June, July and August for

cooling, thresholds for heating and cooling can be easily established.

(Note, the threshold values are for comparison purposes not collector values that will be delivered to the heating and cooling system.

An evaluation of the existing body of data (Appendix 4.0) indicates that a threshold value of 40,000 BTU/ft² heating and 70,000 BTU/ft² cooling are attainable by good systems.

Using this approach increases the number of sites which can be analyzed and allows for some relative ranking. For sites with at least one month's data, correction factors are applied to provide an estimate of the three month average. This again increases the sites which can be analyzed. The next step will be to develop a one, two or three day approximation which can be used to determine a relative ranking of sites for which only the acceptance that data is available. While these approximations introduce some error factors, however, it does offer a method of ranking the demonstration projects against some performance measure.

*Diamond, S.C., "Validation of Building Energy Analysis Computer Programs and Effects of User Interpretation of Data," Presented at ASHRAE, Atlanta, GA Meeting 1981.