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Performance of the Southern California Edison Company Stirling Dish

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PERFORMANCE OF THE SOUTHERN CALIFORNIA EDISON COMPANY STIRLING DISH

Charles W. Lopez
Southern California Edison Company
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Mako Enterprises

Abstract

McDonnell Douglas and United Stirling AB of Sweden (USAB) formed a joint venture in 1982 to develop and produce a Stirling dish solar generating system. In this report, the six year development and testing program continued by the Southern California Edison Company are described. Test data is presented and used to estimate the performance of a commercial system.

Foreword

The Stirling dish solar electric power system owned by the Southern California Edison Company (SCE) underwent an extensive test program during a joint venture program initiated by McDonnell Douglas Astronautics Company (MDAC) and United Stirling AB of Sweden (USAB), in 1982 and completed by the SCE in September 1988. Each Stirling dish module consists of a sun tracking dish concentrator developed by the MDAC and a Stirling engine driven power conversion unit (PCU) developed by the USAB. The Stirling dish system demonstrated twice the peak and daily solar-to-electric conversion efficiency of any other system then under development. This system continues to set the performance standard for solar to electric systems being developed in the early 1990's.

USAB designed the only available commercial Stirling engines in the late 1970's and early 1980's. These are the fossil-fuel-fired 4-295 engines used in submarine service, the V-160 engines licensed to Stirling Power Systems for auxiliary power units, and the 4-95 engines licensed to Mechanical Technologies, Inc., for automotive application and to MDAC and subsequently to Southern California Edison for solar or solar hybrid application. USAB supplied the 4-95 engine for three successful Stirling dish test programs: Jet Propulsion Laboratory for test at Edwards Air Force Base, California, Advanco for test at Rancho Mirage, California, and the joint venture program initiated by MDAC and USAB and completed by SCE. The Jet Propulsion Laboratory and Advanco programs were sponsored by the U.S. government.

The Stirling dish joint venture program initiated by USAB and MDAC was intended to commercialize the technology during a period of high fuel prices ($47/barrel of oil). The Stirling engine and the dish were designed for mass production while maintaining system performance. The MDAC/USAB/SCE program demonstration that the system with comparatively minor revisions would have been cost competitive at the prevailing fuel price level. However, due to the sharp drop in fuel prices and lack of evidence that the fuel prices would return to their previous level in the near term, USAB, MDAC and then SCE discontinued their participation in this Stirling dish commercialization effort. This report summarizes the MDAC/USAB/SCE test program and test results. The authors conclude that Stirling dish system development should continue. 1985 production cost estimates for the first 1000 units indicated the units could be installed at less than $2000/kW, thus producing electrical energy at a cost of less than $0.10/kWhr. Current estimates indicate that the units could be installed at a cost of $1500 to $2000/kW at production rates as low as 10,000 units per year. The Stirling dish system did not encounter any technical barriers that would prevent commercialization of the technology. The absence of technical barriers and the system modularity will reduce the development expenditures required to refine the technology for commercial application.

This report was sponsored by SCE and the original draft was completed in 1988. The report was originally prepared to respond to the many inquiries received by SCE regarding the successful test program. The report was edited in the subsequent four years and the intermediate revisions were disseminated in response to continuing requests for information on MDAC/USAB/SCE demonstration program. This final edition was prepared at the request of Sandia National Laboratories and its contents are intended to supersede all previous report drafts.

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I. INTRODUCTION

The Stirling dish solar electric power system owned by the Southern California Edison Company (SCE) consists of a sun tracking parabolic dish concentrator developed by the McDonnell Douglas Astronautics Corp. (MDAC) and a Stirling engine power conversion unit (PCU) developed by the United Stirling AB, Sweden (USAB). The dish concentrates the sun's energy on the PCU heater elements contained in the receiver enclosure mounted near the concentrator's focal point. The power conversion unit converts the solar radiant energy into electrical energy. The PCU utilizes a directly illuminated receiver, Stirling cycle engine with hydrogen as the working fluid, and standard generator to transduce the energy. A photograph of the unit at the SCE Test Site with the Solar One Central Receiver in the background is shown in Figure 1-1. Previous Stirling dish programs indicated that the Stirling dish systems have a good commercialization potential. The results of the USAB/MDAC/SCE program confirmed this conclusion. A brief summary of the test program results is:

- Demonstrated net peak power efficiency of 30% at 1000 W/m^2 insolation
- Demonstrated net daily energy efficiency of 27% at 10 kWh/m^2 insolation
- On-sun power-generating time of over 13,852 hours
- Generated over 118 MWh of energy
- Sun insolation for sustained operation of 200 to 300 W/m^2
- No receiver operating problems
    - Uniform flux distribution maintained
    - Low heater head temperature difference maintained
    - No receiver failures
- Low hydrogen gas consumption
    - Gas leaks not a problem
    - Low refill frequency
- High mirror performance maintained over 8 years
    - No change in reflectivity (91%)
    - No change in radius of curvature or surface waviness
    - Some stress cracks where experienced, they did not affect performance
- Mirror alignment maintained over 8 years
    - Concentrators disassembled and transported around the world without effecting mirror alignment
    - DIR provides an accurate low cost method of mirror alignment
- Demonstrated potentially high system availability
    - Test program availability of 87-90 %, limited by MDAC & USAB divestiture
    - Estimate commercial system availability could be better than 95 % to 99 %

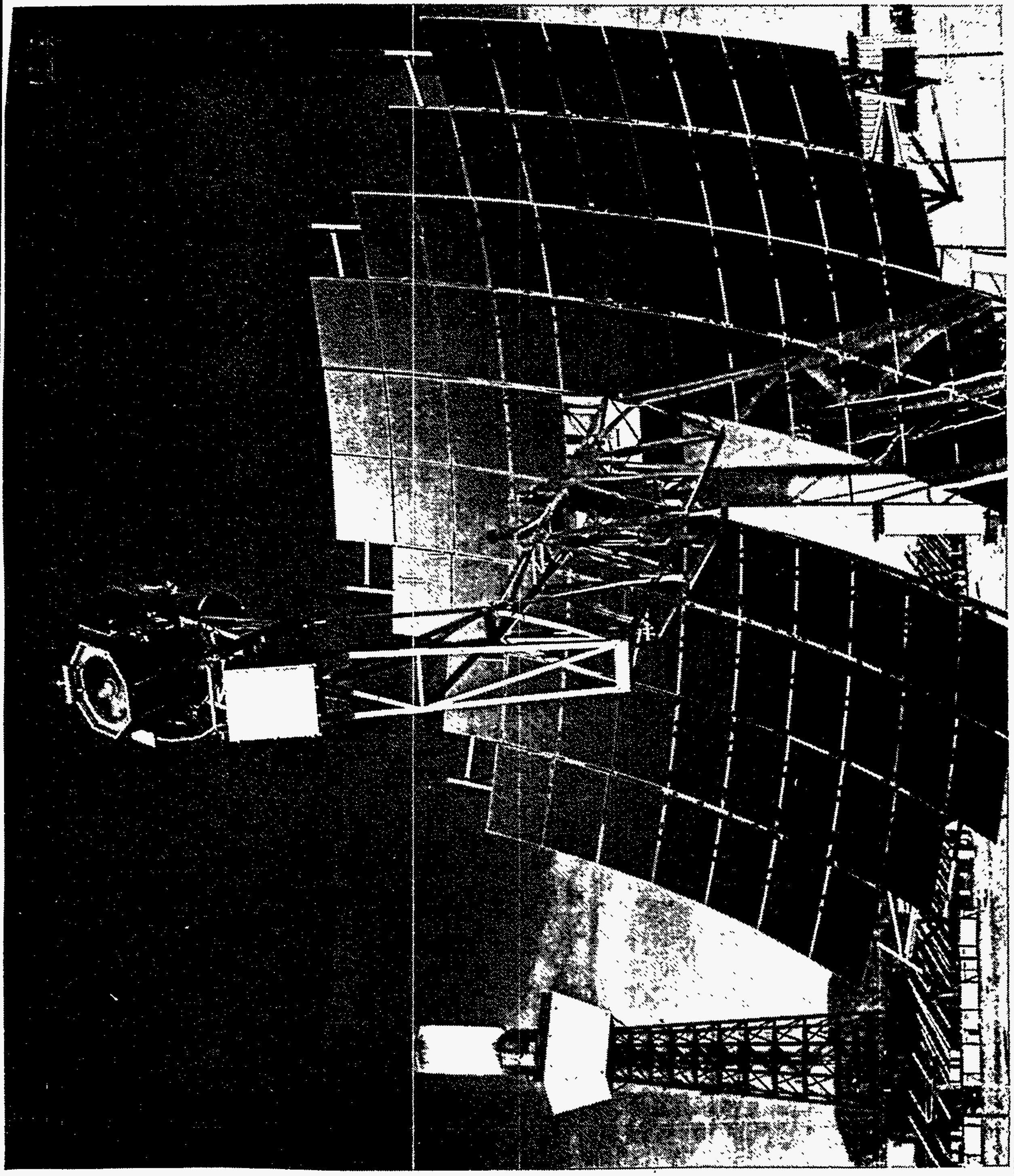


Figure I-1. Stirling Dish Operating at the SCE Test Site With Solar One in the Background.

The design characteristics of the concentrator and the Stirling engine are summarized in Table I-1. Eight concentrators were manufactured by McDonnell Douglas Astronautics Corp. in 1984 and 1985. Six of the units were installed and tested for various periods of time. This section discusses the background in the development of the MDAC/USAB/SCE Stirling dish program. The remainder of this report discusses the results of the test program. In order to preserve as much of the actual test data as possible, a summary is presented in Appendixes A, B, and C. Section 8 uses the test results of previous sections to estimate the annual energy performance of the system and combines this information with the MDAC cost data to estimate the levelized energy cost of a power plant.

Table I-1. Stirling Dish Design Characteristics.

Net Power Rating	25 kW at 1000 W/m^2 insolation
Electrical Power	480V, 60 Hz, 3 Phase
Generator	1800 rpm Induction
Concentrator Glass Area	91.01 m^2 (979.72 ft^2) @ 82 mirrors
Aperture	87.67 m^2 (943.76 ft^2) @ 82 mirrors
Area Ratio	0.963
Focal Length	7.45 m (24.44 ft)
Concentration Focus Pt/Receiver	7500 Suns/780 Suns
Design Wind Speed - Operating	30 mph
Survival	90 mph
Number of Mirrors	82 to 88 (82 for this test program)
Glass Type	Commercial Grade Float
Mirror Type	Silvered Glass
Glass Thickness	0.7 mm
Radius of Curvature	599, 616, 640, 667, and 698 inches
Waviness	<0.6 milliradians
Reflectivity	>91%
Module Height	11.89 m (39 ft)
Module Width	11.28 m (37 ft)
Module Weight	14,900 lbs
Engine Type	Kinematic Stirling
Number of Cylinders	Four Double-Acting Pistons
Displacement	Each Piston at 95 cc
Operating Speed	1800 rpm
Working Fluid	Hydrogen
Engine Temperature	720°C (1328°F)
Engine Pressure	20 MPa
Power Control	Variable Pressure
Cooling	Water/Air Radiator
Coolant Temperature	50°C (122°F)
Power Conversion Weight	<1500 lbs

Background of Stirling Engine Development

The Stirling engine principle was invented in 1816 by Robert Stirling. NV Philips initiated a comprehensive research program to develop the Stirling engine in Sweden in 1938. Thirty years later, in 1968, USAB was licensed by Philips to continue research on a Stirling engine. United Stirling began the design and development of the 4-95 Mark I Stirling engine in 1975, based on a revised concept. In this design, the engine had a "U" configuration that simplified its design and manufacture. This configuration allowed the engine's power to be controlled through variable pressure operation. The engine design allowed for conversion to variable-displacement power should variable pressure power operation prove unacceptable.

USAB initially was contacted by Jet Propulsion Laboratory (JPL) in 1978 regarding installation of a Stirling engine on a solar concentrator. United Stirling was selected to participate in the U.S. Department of Energy's (DOE) sponsored JPL Solar Dish Electric Program in 1979. During this test program, the first solar designed USAB Mark I engine demonstrated 29 percent peak power efficiency (Reference 1). Because of the success of this program and continued interest by the U.S. Department of Energy, USAB developed a second generation 4-95 engine in 1981-83 designated as the 4-95 Mark I PCU. This engine provided for mounting all energy devices (receiver, engine, generator, controls) above the solar concentrator focal point. USAB then continued with the development of the 4-95 Mark II PCU in 1982 and completed it in 1985. The engine design goal was to retain the performance level of the Mark I, while improving reliability and reducing the production cost. USAB supplied a Mark II PCU for DOE's Vanguard program (Reference 2 & 3). A summary of the development and testing of the USAB 4-95 Mark I and Mark II engines for these two programs is shown in Figure I-2. USAB has developed and tested many Stirling engines for different applications, as summarized in Table I-2.

MDAC was contacted by USAB in 1982 regarding joint participation in developing a Stirling dish system, MDAC's market analysis indicated a large market for Stirling dishes existed in the United States based on 1982 and expected future fuel prices. United Stirling joined with MDAC to develop, manufacture, and market worldwide the Stirling dish electric system. The first phase of the commercialization plan for the

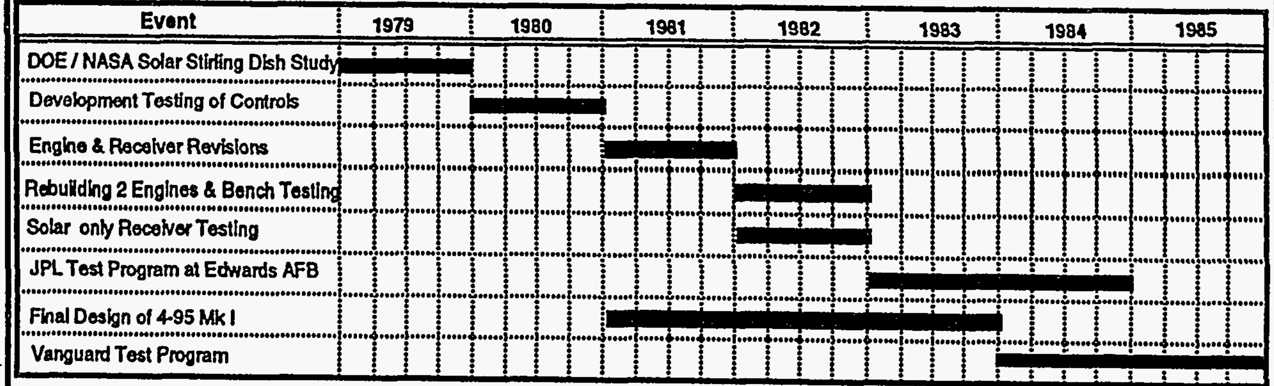


Figure I-2. Development of the USAB 4-95 Mark I and Mark II Stirling Engine.

Stirling dish was to design a concentrator for the USAB 4-95 engine, build eight units, involve four US utilities with testing the systems at utility test sites, and locate one unit at an international location. The significant events of this program are shown in Figure I-3.

SCE/MDAC/USAB Stirling Dish Program

The first MDAC Stirling dish module shown in Figure I-4 began operation in November 1984 at the MDAC test facility in Huntington Beach, California. At least one

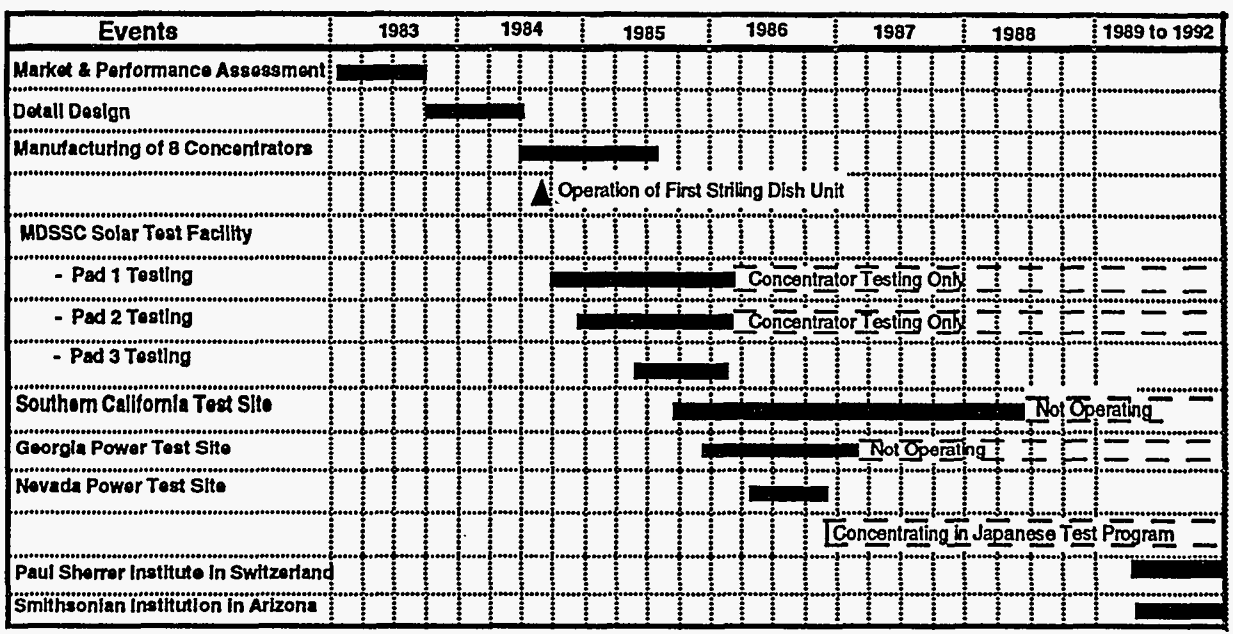


Figure I-3. MDAC/USAB Test Program.

Table I-2. Development of the USAB Stirling Engine.

Engine Type	Years in Operation	No. of Engines Prod.	Accum. Operating Time (hrs)	Type of Drive Mechanism	Application	Number of Cylinders/ Swept Volume cc/Cylin.	Max. Power (kW)	Maximum Efficiency (%)	Field Test
1-96	1970-1976	3	6,200	Rhombic	Auxiliary Power Unit	1-98	7	25	Pleasure boat, Auxiliary Power Unit
4-615	1971-1973	4	650	Rhombic	Truck and Underwater	4-615	147	31	-
V4X	1971-1976	6	2,600	V4	Passenger Car	4-90	35	27	Ford Pinto, Ford Taurus
4-189	1972-1977	5	800	V4	Truck and Auxiliary Power Unit	4-189	75	32	Volvo 405
V-160	1973-	95	150,000	V2	Auxiliary Power Unit	1-160	10	30	Twenty auxiliary power units
4-95	1976-	25	60,000	U4	Development Test, Auxiliary Power Unit Underwater, Solar, and Passenger Car				Open R, AMC Concord, Mercedes Van, two Auxiliary Power Units, three Solar, and Underwater
4-275	1978-	9	16,000	U4	Truck Auxiliary Power Unit, and Solar	4-275	110	42	Auxiliary Power Unit and Solar
MOD1	1961-	8	6,000	U4	Passenger Car	4-123	55	37	AMC Lerma
V4-275R	1984	2	500	V4	Underwater	4-275	120	42	-

<u>Solar Engine Operation:</u>

Simulated Solar #7 Units @ 39,000 hrs.
Actual Solar #4 units @ 3,400 hrs.

Stirling dish operated every day from November 1984 until September 1988. MDAC built eight parabolic solar concentrators during 1984 and early 1985. Three of the units were installed in the MDAC test facility shown in Figure I-5. In this figure, one unit is operating with a Stirling engine, a second unit is operating with a flux measurement system and the third unit in the distance is in a night stow position. These three units operated until June of 1986. Only the first two units operated with an engine. The third concentrator completed functional checkout testing and flux mapping. An engine was mounted on this unit but it was never operated. In 1985, MDAC signed a cooperative agreement with the SCE, Georgia Power Company, and Nevada Power Company under which a Stirling dish was installed at each utility. MDAC agreed to help operate and test the units for 33-months. A unit was installed at SCE's Test Site which was located at the Solar One Central Receiver Test Site near Barstow, California, in August 1985. Another unit was installed at Georgia Power's Shenandoah facility in November 1985, and a third unit was installed at Nevada Power in April 1986. In June 1986, MDAC decided to divest itself of this and other energy ventures. Southern California Edison acquired the rights to the Stirling dish technology from MDAC by year's end, and in January 1987, SCE also acquired the Stirling dish hardware owned or held by MDAC.

Southern California Edison continued testing and improving the performance of the system at the SCE Test Site. One unit remains at Shenandoah, Georgia. It was operated occasionally through 1988 but has not operated since that time. The third unit, originally installed at a Nevada Power site, was removed in the spring of 1987, and the concentrator was shipped to Aisin Seiki Company, Japan. This concentrator is being used to test the Aisin Seiki Stirling engine. As of early 1993, two of the concentrators are still operating without PCUs at McDonnell Douglas, Huntington Beach, as a part of a space power test lab. One of the concentrators was sold to the Smithsonian Institution (Fred Lawrence Wipple Observatory) and is being used as part of a space telescope in Amado, Arizona. A third concentrator was sold to the Paul Scherrer Institute in Switzerland and is being used as a solar furnace.

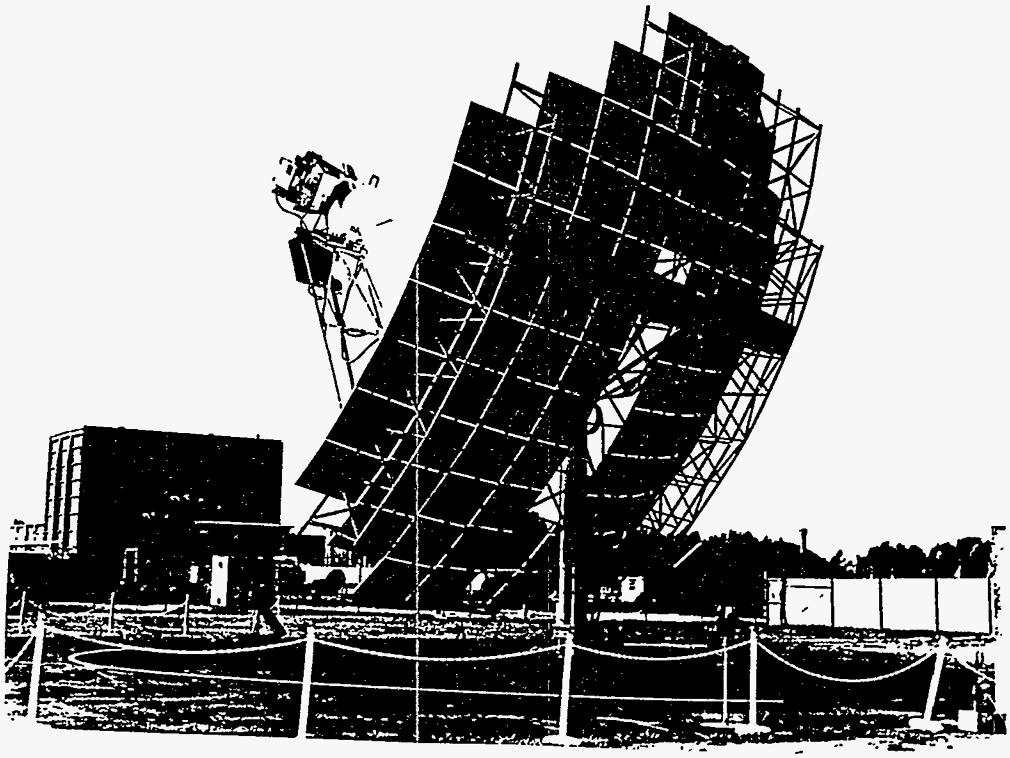


Figure I-4. First Stirling Dish operated in November 1984.

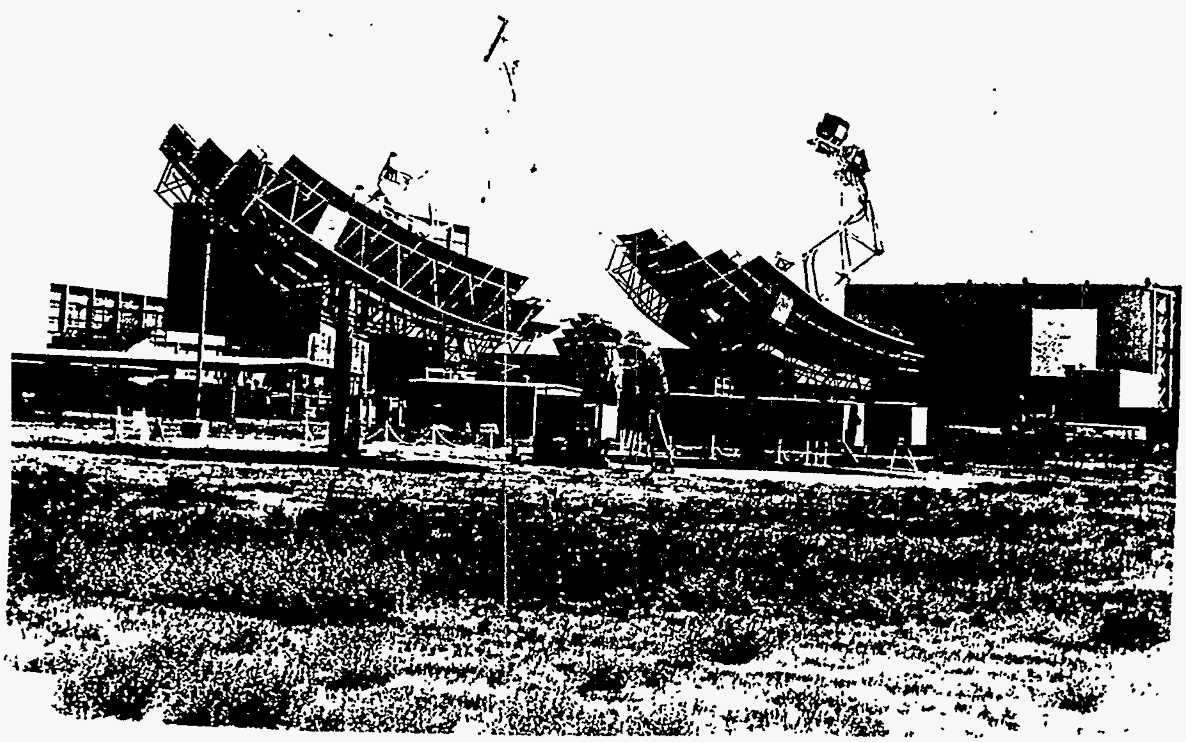


Figure I-5. View of the MDAC Solar Test Facility.

II. DESCRIPTION OF STIRLING DISH SYSTEM

- System consists of two components - concentrator and power conversation unit
- Concentrator facet alignment can be done very accurately at a low cost
- High open loop tracking accuracy can be obtained at a low cost
- Concentrator maintains uniform PCU flux distribution

The principle of operation of the Stirling dish is shown in Figure II-1. The Stirling dish tracks the sun daily by rotating about two axes: azimuth and elevation. The azimuth axis is the local vertical and the elevation axis is perpendicular to the local vertical axis. The curved mirrors reflect and focus the sun's energy onto the PCU's receiver. The concentrated solar energy is absorbed by hydrogen gas going through the receiver heater head. As the hydrogen gas expands, it pushes a piston which turns a crankshaft. The linear mechanical energy is converted to rotational mechanical energy by the Stirling engine. The engine crankshaft rotates an induction generator, which converts this mechanical energy to 480V, 3-phase, 60 hertz AC electrical energy.

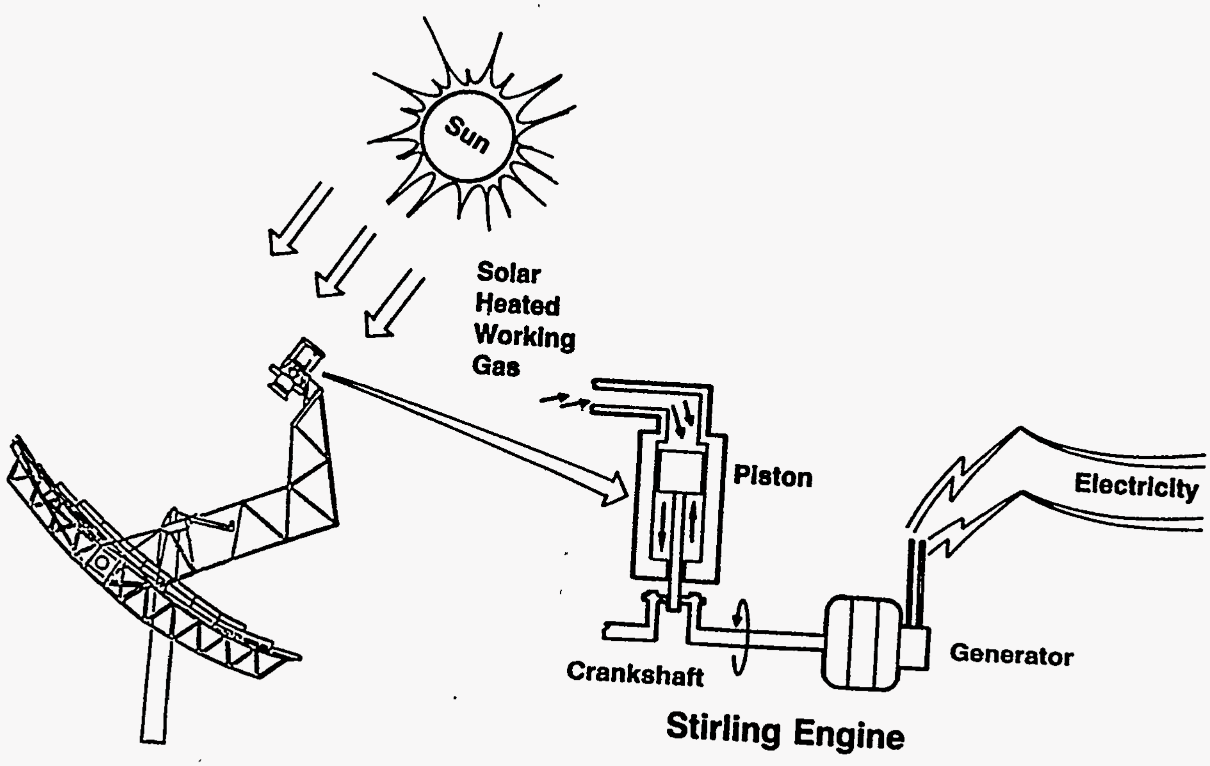


Figure II-1. Stirling Dish Principle of Operation.

Solar Concentrator

The dish consists of curved glass-mirrored facets, a mirror support or truss structure, a pedestal, a PCU support structure and an elevation support/drive system as shown in Figure II-2. Eighty-two curved facets give a total reflective area of 91 m^2 (980 ft^2). Locations are provided for the installation of six additional mirror facets, which would increase the total area to 97 m^2 (1040 ft^2). Each mirror measures 3 ft by 4 ft and is curved in two directions. There are five different nominal curvature radii: 599, 616, 640, 667, and 698 inches. Each mirror is aimed at a different point on the receiver (Figure II-3) to provide an uniform flux on the receiver surface. The resulting flux (Figure II-4) was measured using the Digital Image Radiometer (DIR) flux mapper (Reference 4 & 5). The DIR flux mapper consists of a high temperature target that rotates through the reflected beam. When the target is perpendicular to the concentrator centerline, a camera mounted on the axes of the dish takes an image of the flux contours.

In order to create the desired flux distribution, each mirror facet on the concentrator was aligned using a DIR mirror-alignment system developed by MDAC. The DIR mirror-alignment system is composed of a camera, digitizer, computer, and a panel of lights. The accuracy of the DIR alignment system was verified to be less than 0.2 mr,

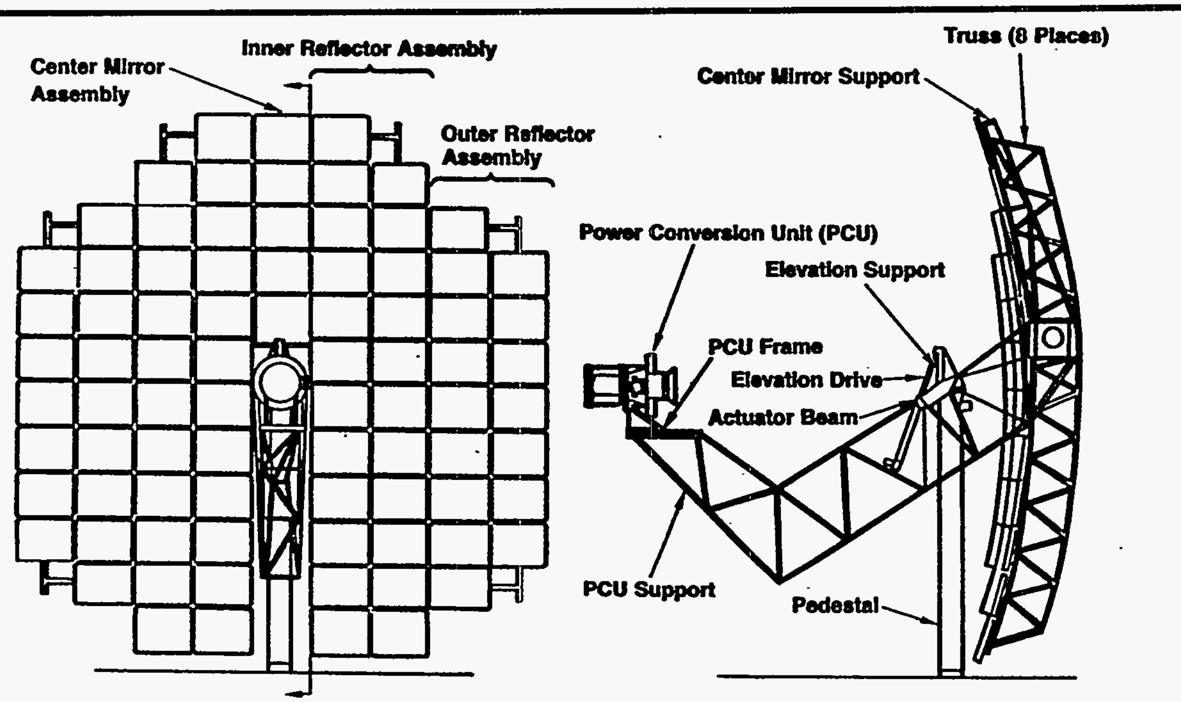


Figure II-2. Stirling Dish Main Components.

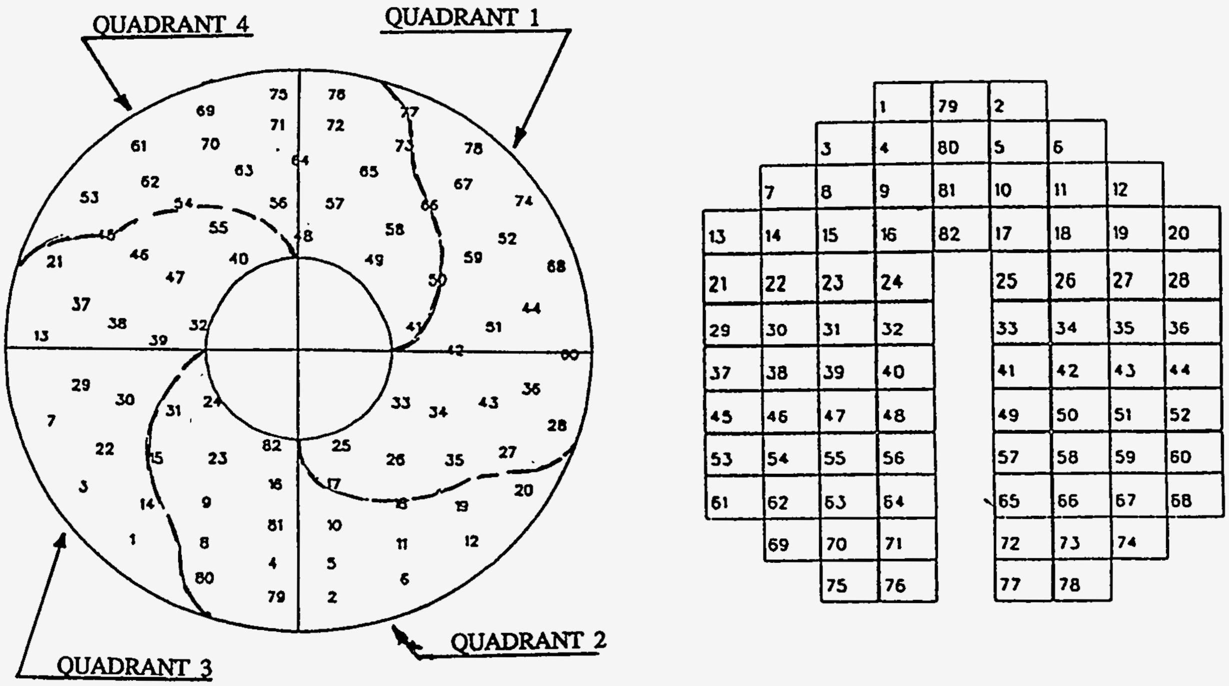


Figure II-3. Aim Points on the Receiver of Concentrator Individual Mirror Modules.

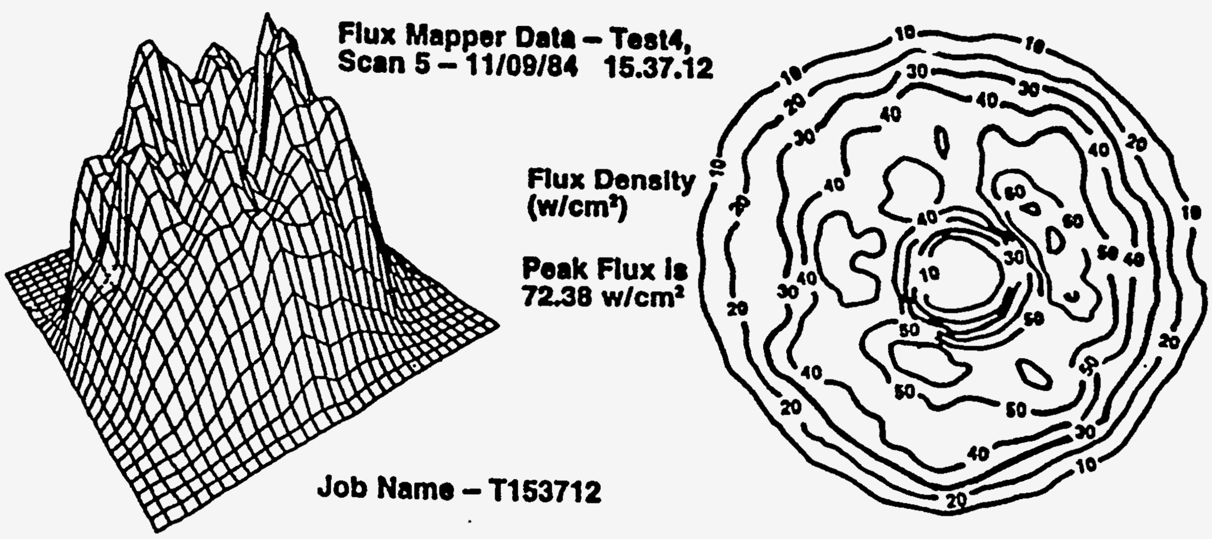


Figure II-4. Receiver Flux Measured with the DIR System.

and it took 4 to 8 man-hours to take the alignment data, adjust the position of the mirrors, and take a final measurement to verify the alignment. With the newer equipment now available, it is possible that the concentrator could be aligned nearly as quickly as the mirror facets could be mounted and bolted to the structure.

The dish is manufactured in six subassemblies (Figure II-5). The six subassemblies were the two outer reflector assemblies, the two inner reflector assemblies, the center mirror assembly, and the tracking assembly consisting of the pedestal, azimuth support drive, elevation drive and PCU support structure. The assembling of the reflector support structure and PCU structure for one of the units is shown in Figure II-6. Each of these subassemblies can be transported by a regular size semi truck, thereby reducing transportation costs. A final assembly plant would be used for assembling Stirling dishes for large solar power plants located a long distance from the main concentrator factory to reduce transportation costs. In this scenario, all of the components, truss assemblies, cross braces, etc. are made at the main factory and shipped to the field factory. In this way, several concentrators could be shipped on one truck. At the field factory, the reflector structure would be assembled, the inner and outer assemblies would be joined to the PCU structure, mirrors mounted and aligned, and the completely assembled concentrator and PCU carried as a single unit into the field and set on the pedestal.

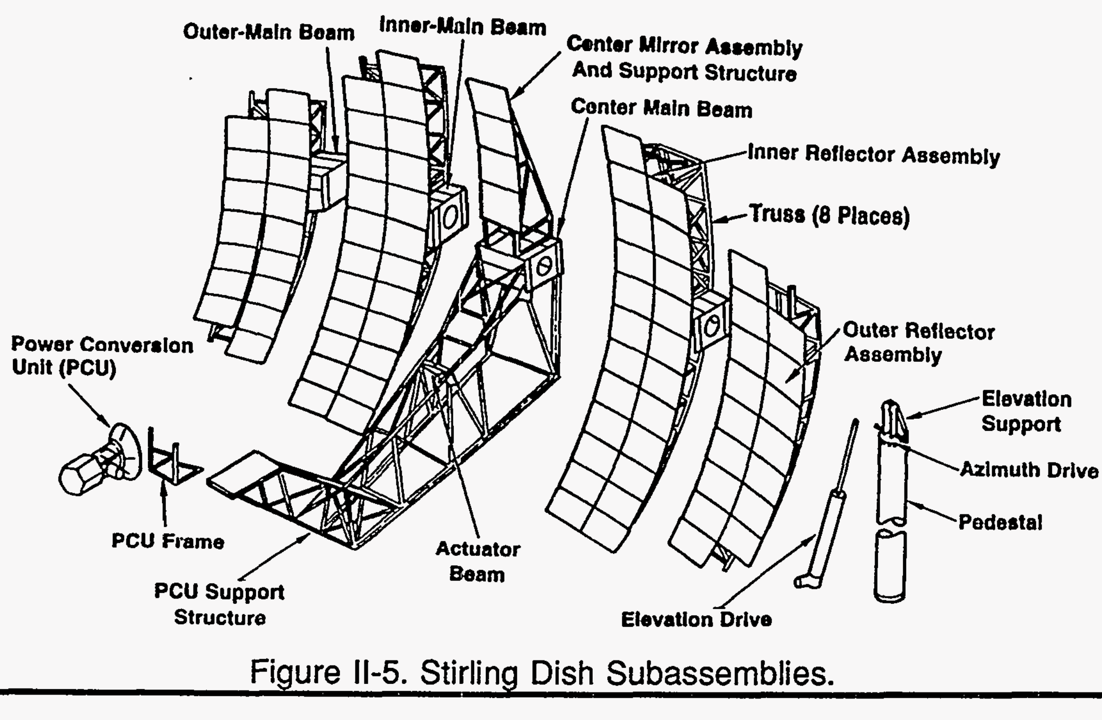


Figure II-5. Stirling Dish Subassemblies.

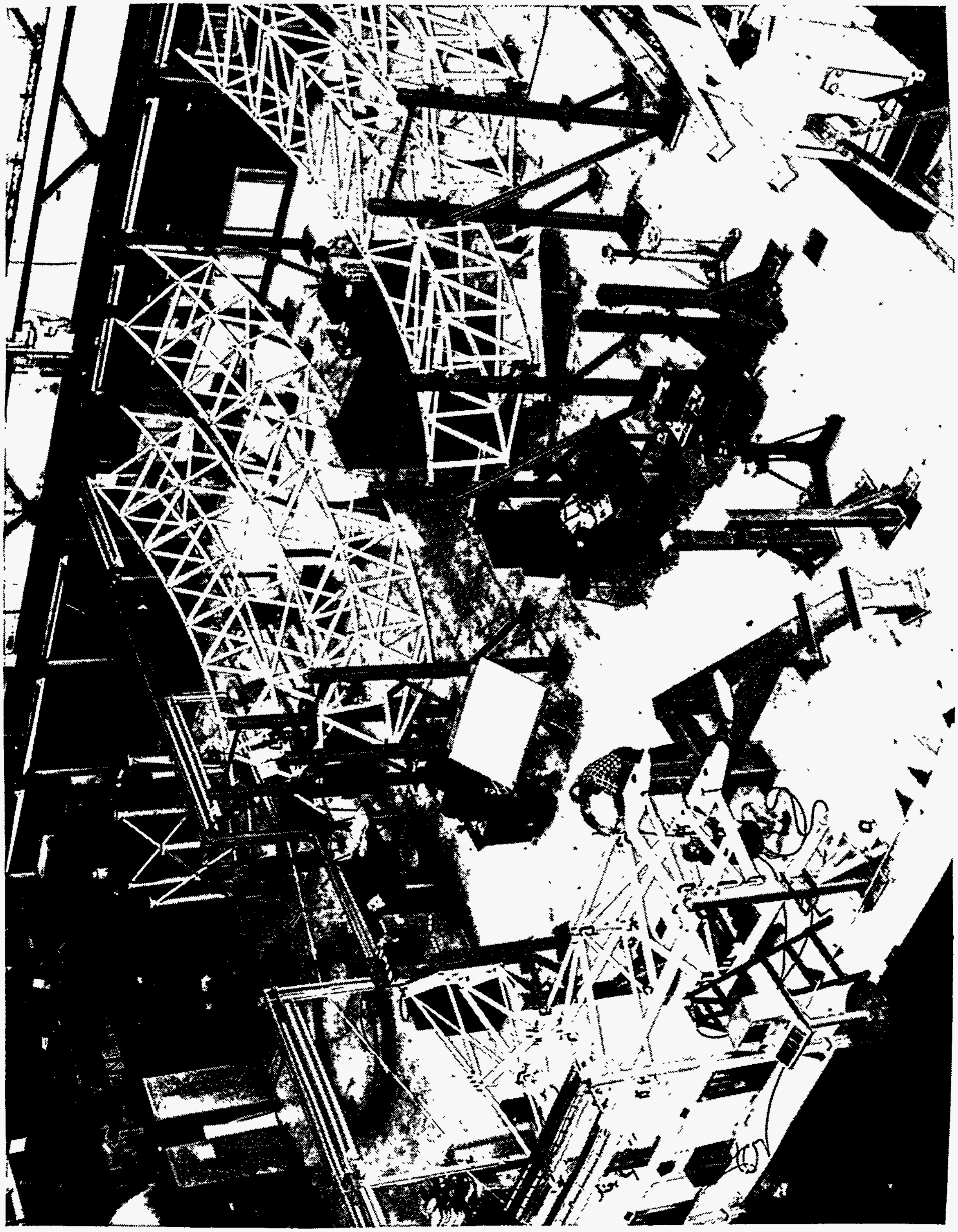


Figure II-6. Assembly of the Reflector and PCU Support Structure.

Field installation of the six subassemblies at each site was accomplished in four to six hours using standard lift equipment available at the sites. It is estimated that in mass production, the units could be installed in two hours, employing three or four people and special lift equipment. First, a 12-16 ft deep concrete foundation with a tapered steel cone that extends approximately four feet above the ground, and the field wiring were installed prior to the actual concentrator installation. Next, the pedestal and PCU support structure were placed, as illustrated in Figure II-7, onto the tapered cone. Two hydraulic jacks pulled the concentrator pedestal down onto the tapered cone. Then the PCU was mounted and the assembly was rotated to a vertical position with the PCU directly above the pedestal. The reflector structure was assembled by mounting the center mirror assembly, the first inner reflector assembly, the second reflector assembly, the first outer reflector assembly, and then the second outer reflector assembly. Special slings were used to lift the reflector assemblies into place. Each reflector assembly had alignment pins that made the mating of each assembly very easy. After the assembly was aligned on the pins, it was bolted into place.

In the MDAC/USAB/SCE program the mirror support structure was assembled in the MDAC factory, then the mirrors were mounted and aligned. Following this, each unit was disassembled and transported to a test site, where they were installed. Even though the concentrators were transported in subassemblies, the structural design of the concentrator maintained the required optical performance by the use of two alignment pins in each of the mirror subassemblies box beams. One of the concentrators was assembled, aligned, disassembled, transported to and from Barstow, and reassembled in the factory. The alignment was re-checked and it was still within the accuracy requirement.

The slot in the concentrator mirror assembly avoids interference between the concentrator mirror assembly and the pedestal. This allows the PCU to be lowered for installation, inspection, repair, and replacement without costly motorized lifts. A ball-screw jack changes the elevation, and a 10-inch-diameter harmonic drive changes the azimuth angles of the concentrator. Because of the low wind-load capability of the harmonic drive, a Sumitomo azimuth gear drive was developed during the program replace the harmonic gear drive. One of the Sumitomo drives has been in operation on a concentrator at MDAC since 1989.

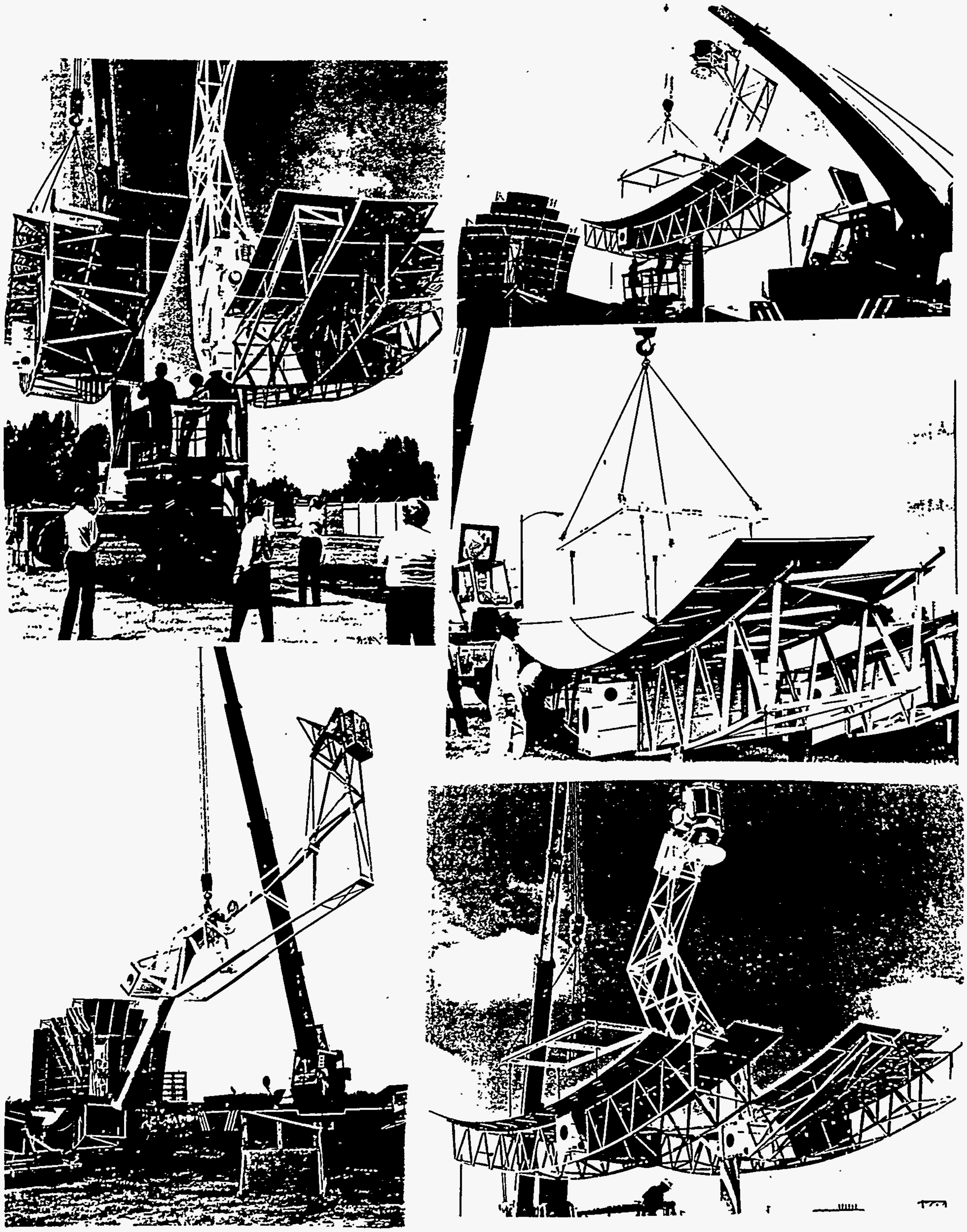


Figure II-7. Field Assembly of the Concentrator.

The Stirling dish control system illustrated in Figure II-8 is composed of a concentrator controller (CC) located in the pedestal, a system controller (SC) and data logger located in the remote control room, and a weather station. The concentrator controller was a specially designed microprocessor controller that performed all local operations of the concentrator as directed by the system controller. The system controller was a DEC PDP 11/23. The system controller displayed all concentrator operating information, executed operator commands; gathered operating information from the concentrator controller, the PCU, and weather station; and calculated operating positions for the concentrator. Although the operator interface with the system controller was for a single concentrator, the DEC operating software and hardware was designed to control a large field of concentrators.

The Stirling dish system could operate both automatically or manually. In the automatic state, the concentrator would unstow in the morning when the sun reached a defined elevation angle and then move to a standby point. From standby, when the average sun insolation was above a threshold value, it would go to a sun-tracking position, track the sun all day, and move to the night-stow position when the sun position was lower than a defined elevation. If a problem occurred during the day, the controller would move the concentrator to the night-stow position. This was performed automatically without operator intervention. In the manual state, each of the operating steps had to be performed by the operator, except for an automatic detrack when a PCU problem was detected or the wind stow when the measured wind speed exceeded the safe limit.

Because of the high energy concentration, the movement of the concentrator from one position to another position had to be performed in a controlled manner to prevent energy spillage and damage to electrical wiring, mechanical equipment, or structures. This was accomplished by defining a set of operating modes and the dish movement trajectory required to safely change operating modes. The different operating modes are defined in Table II-1. The controlled movements required to change from a night-stow mode to a tracking mode illustrates the process. First the concentrator would rotate in elevation from the night stow position of -32° to 0°, then rotate about the azimuth axis to an angle 90° from the sun, rotate in elevation to an angle approximately 10° above the sun's elevation, then rotate about the azimuth axis to align with the sun's azimuth position. This was the standby position. When the system was ready to generate power, the concentrator would rotate down in

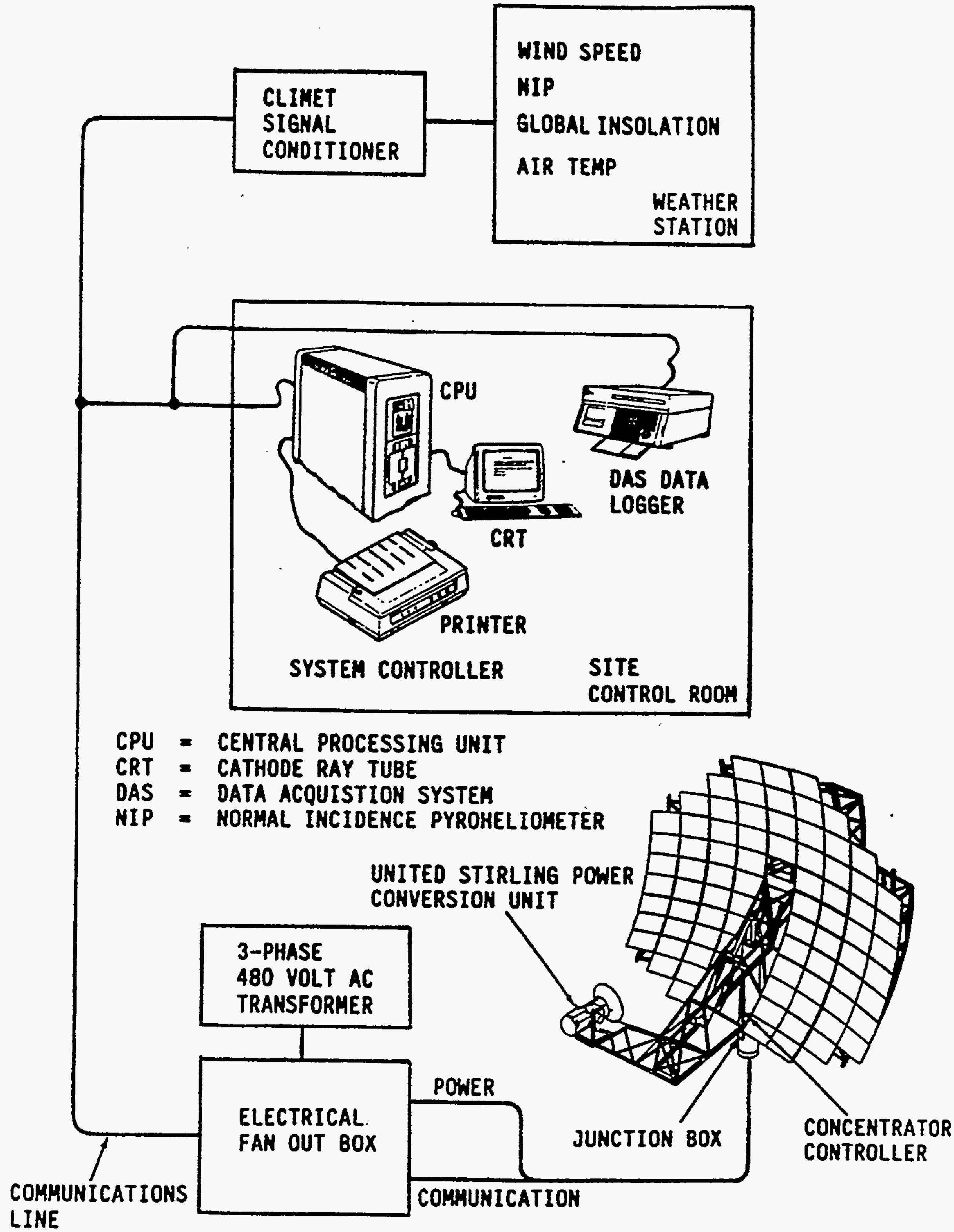


Figure II-8. Stirling Dish Control System Configuration.

Table II-1. Stirling Dish Operating Modes.	
Mode	Description
Night Stow	A static position at an azimuth angle facing North and an elevation angle of -32° relative to local horizontal.
Standby	A sun tracking position with the elevation of the concentrator centerline 10° above the sun.
Track	A sun tracking position with the concentrator pointing at the center of the sun.
Faceup Stow	A static position at an azimuth angle point South and an elevation angle of 90°, centerline of concentrator line in a vertical direction.
Maintenance	A static data base position.position. Used for washing, engine oil/water check, etc.
Gimbal	A static position at angles entered by the operator.
Reference Update	A procedure used to find the reference position after a power loss.
Detrack	A transition from track to a standby position when a problem occurs with the PCU
Emergency Detrack	A transition from any azimuth position to an elevation angle of 90° in the event of grid loss or similar conditions.

elevation, concentrating the solar energy in the receiver's cavity. This movement provided the maximum aberration of the sun's image as it crossed the PCU support structure.

The concentrator sun tracking control system is an open-loop tracking system. The system calculates the position of the sun and commands the concentrator to move to the position where it will be pointing at the sun. Although a sun sensor was added during the test phase to gather tracking error data, it is not required for the unit's operation. The open-loop tracking error for the unit is less than 0.01 deg (0.2 milliradians) rms over the day. Achieving this accuracy did not place stringent requirements upon the structure, mechanical, or installation requirements. It was achieved through a track alignment method. Development of this track alignment method was started and patented (Reference 6) by MDAC in the 1980's for improving solar central receiver heliostat tracking accuracy while decreasing costly requirements on the structure, mechanical components, and installation procedures. Early heliostat testing showed that this method could be used to reduce the tracking error caused by pedestal tilt, elevation nonorthogonality, gravity bending, atmospheric refraction, etc. In this method of track alignment, an error model of the system is developed and the algorithms are derived which will correct for the errors. Track data from a sun sensor, PCU power point tracking or DIR tracking system are used to calculate the alignment error parameters of the model. The alignment parameters are used in the open-loop control algorithms to correct for these errors. A comparison of the tracking accuracy with and without this track alignment method for a heliostat was obtained by Sandia (Reference 7). A comparison of the track accuracy of the Stirling dish system with and without this track alignment system is shown in Figure II-9. When fully implemented, this alignment process would be fully automatic like the system used at Solar One. Therefore, obtaining this high tracking accuracy does not result in costly requirements upon the structure and mechanical systems or upon the installation procedure. Since it can be completely automated, it does not require significant manpower to perform open loop track alignment.

The interface between the concentrator controller and the PCU controller was a single high/low signal A high signal indicated that the PCU was operational and ready to produce power and a low signal indicated that the PCU was not ready to produce power. If the unit was on-sun, the low signal would cause the concentrator controller to move the concentrator to a standby position (normal detrack) . The normal detrack was for such things as high receiver temperature difference, too many engine starts, cooling fan fault, high cooling fluid temperature, etc. There was also an emergency system (fast slew) that detracked the unit in the event of a grid power loss or a PCU emergency signal (emergency detrack). The fast slew system was independent of the concentrator control system and consisted of a battery, control electronics, and a dc motor connected to the normal elevation drive system. The fast slew system, which could only rotate the concentrator in an up elevation direction, would move the concentrator from the present position to a faceup position. Because of the high speed of the dc motor, the sun's energy was removed form the receiver faster than the normal concentrator tracking control system. Therefore, the emergency detrack was for such things as having no oil pressure, loss of hydrogen gas in the receiver or engine, gas control valve problem, etc.

Each site also had a weather station and data acquisition systems, discussed later. The weather station consisted of six measurement devices: two wind-speed measuring elements, one wind direction, a normal incidence pyroheliometer,

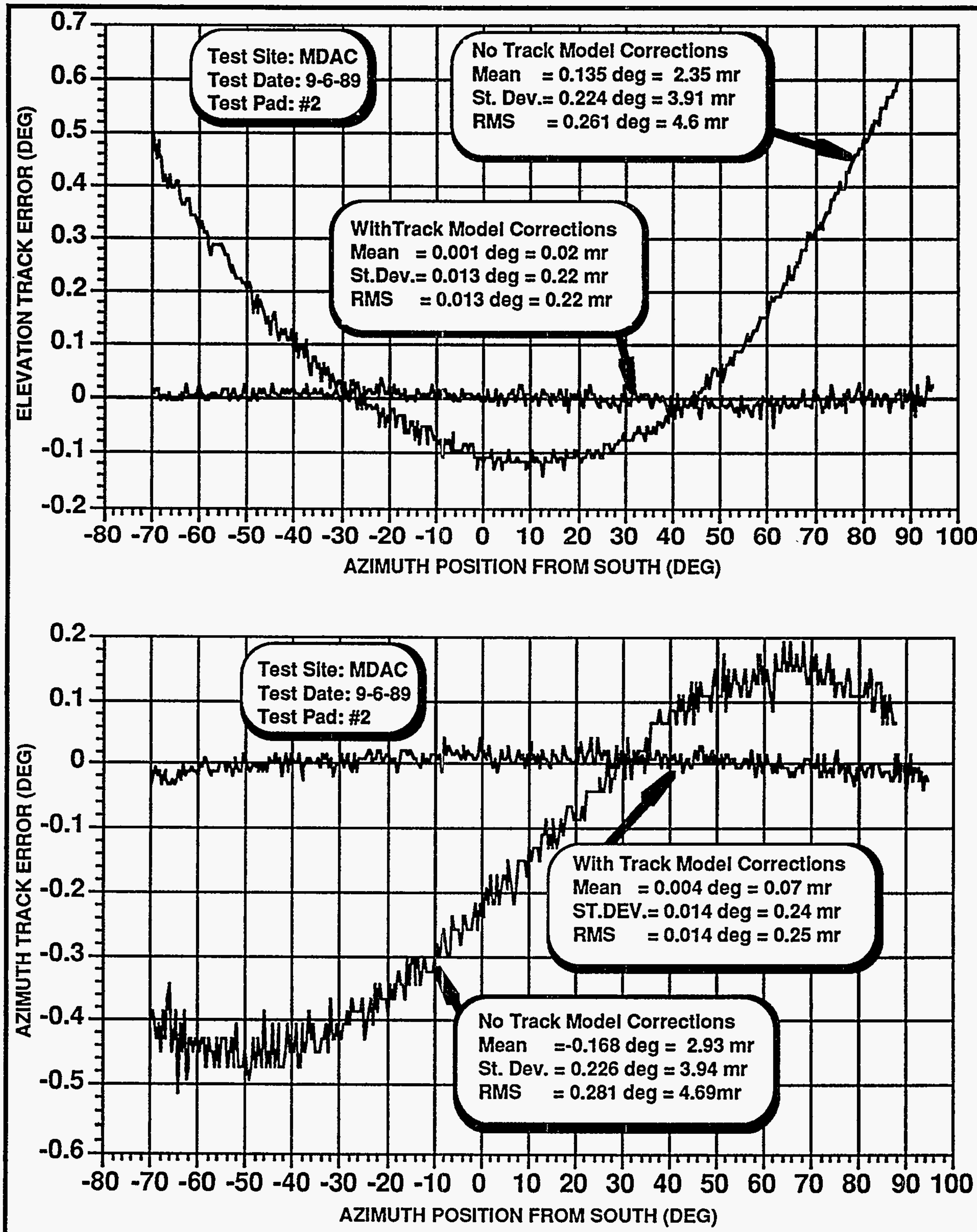


Figure II-9. Comparison of Track accuracy Without and With Track Alignment Parameters.

a global insolation, and air temperature.

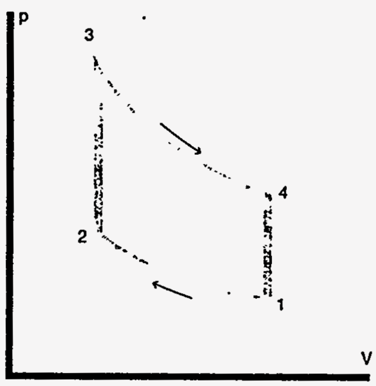
Power Conversion Unit

The Stirling engine thermal cycle is shown in Figure II-10. Ideally, the thermodynamic cycle consists of two isothermal and two constant-volume processes: isothermal compression, constant-volume heat addition, isothermal expansion, and constant-volume heat rejection. The actual cycle, with crankshafts and sinusoidal motion of pistons, can only approach the thermodynamic efficiency of the ideal cycle. The difference in the areas inside the ideal and the actual pressure-volume (P-V) curves represents inefficiencies introduced by the hardware.

The Stirling engine hydrogen-gas system is shown in Figure II-11. When insolation is incident upon the receiver, hydrogen gas passes back and forth through the receiver, absorbing the energy. As the gas passes through the receiver on the way to piston A, energy is absorbed which heats the gas. It then expands and pushes the piston down. When the piston reaches the bottom of the stroke, it starts moving up,

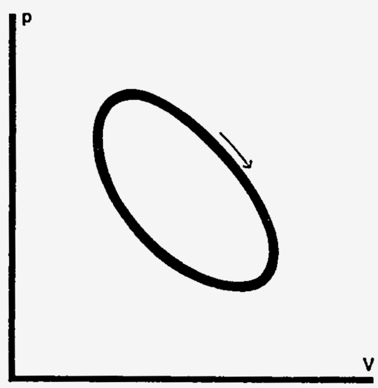
1–2 Compression
Work is supplied by compressing the working gas on the cold side; the gas is cooled at low pressure.
2–3 Displacement
The gas is moved from the cold to the hot side at constant volume. The regenerator gives off stored heat. Pressure increases.
3–4 Expansion
Work is performed when the working gas expands on the hot side while it is heated at high pressure.
4–1 Displacement
The gas moves from the hot to the cold side at constant volume. Heat is stored in the regenerator. Pressure declines.

The total volume of the space between the cylinders is thus reduced (compression) when most of the gas is on the cold side and the pressure is low. And the volume increases (expansion) when most of the gas is on the hot side and pressure is high. Theoretically, the Stirling process can be illustrated by a pressure/volume diagram like this one:



Theoretical pressure/volume curve

In reality, the curve has a somewhat different shape because the process entails continuous piston movements and continuous heating and cooling.



Actual pressure/volume curve

Figure II-10. Stirling Engine Thermal Cycle.

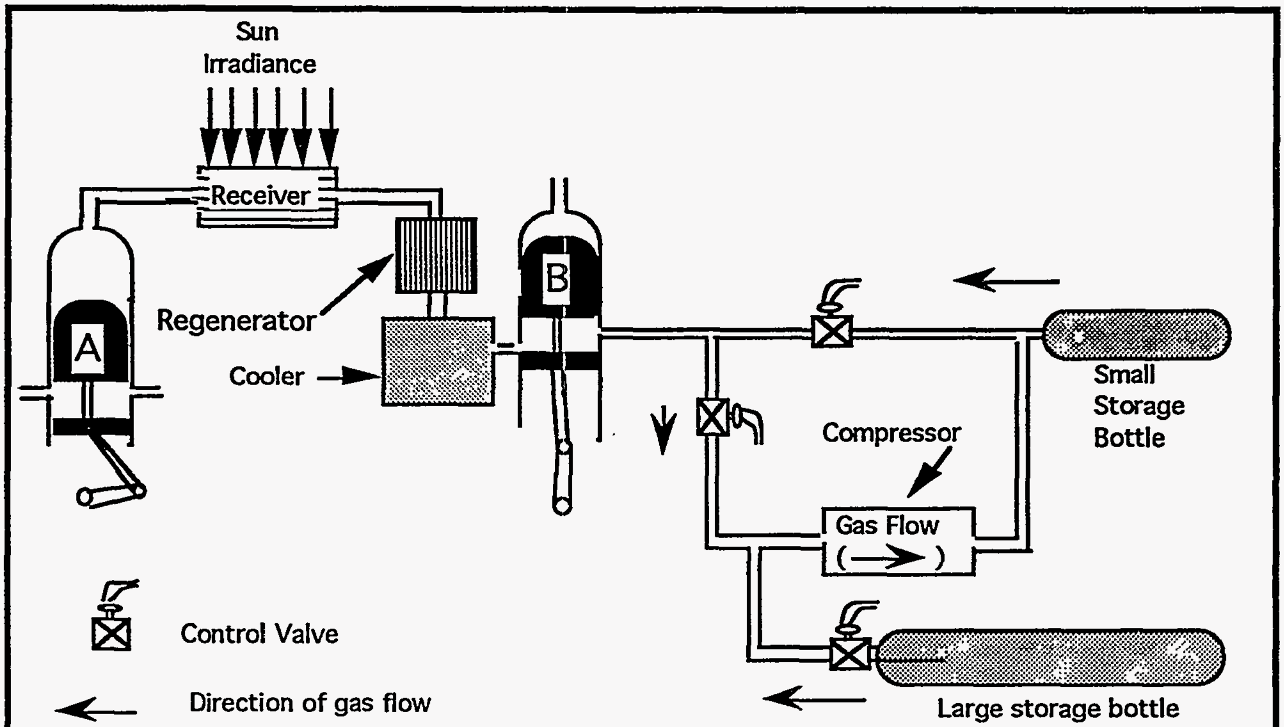


Figure II-11. Description of USAB 4-95 Stirling Engine Operation.

forcing the gas back through the receiver where additional energy is added. After the hydrogen gas passes through the receiver, it enters the regenerator where it gives up energy to the regenerator, thereby cooling the gas. From the regenerator, the gas enters the cooler where it is further cooled. The reduction in gas pressure due to cooling allows piston B to move down. As piston B moves down, the gas is forced back through the cooler. The gas temperature does not change much since it has already been cooled. After having flowed through the cooler, the gas enters the regenerator, where the energy that was taken out is now reintroduced. Then the gas enters the receiver, where more energy is added. This completes the cycle. Four cylinders, configured similar to Figure II-11, are connected together in what is called the Siemens arrangement.

Hydrogen gas is added to or removed from the cold section to maintain a constant hot gas temperature, which is inferred from the highest receiver tube temperature. As the controlling tube temperature increases due to an increase in incident power, gas is added to the cycle from the storage bottle, which increases the coolant flow through the receiver and brings the tube temperature back to the set-point value. When the tube temperature drops due to a reduction in incident power, gas is removed from the cycle, compressed, and returned to the high-pressure storage bottle, which reduces coolant flow through the receiver and increases the working gas temperature.

The main components and functions of the PCU are:

- Receiver — Converts incident sun energy to thermal energy and transfers the heat to the hydrogen gas flowing through the tubes.
- Engine — Converts heat energy stored in the hydrogen gas into rotational mechanical energy.
- Generator — Converts rotational mechanical energy to electrical energy.
- Cooling system — Collects waste heat from the engine and rejects it to the air.
- Control system — Controls the engine operating temperature, maintains status of operation, detracks system, connects the system to the grid line, etc.

A Mark II Stirling engine cross section is shown in Figure II-12 and a photograph of the PCU is shown in Figure II-13.

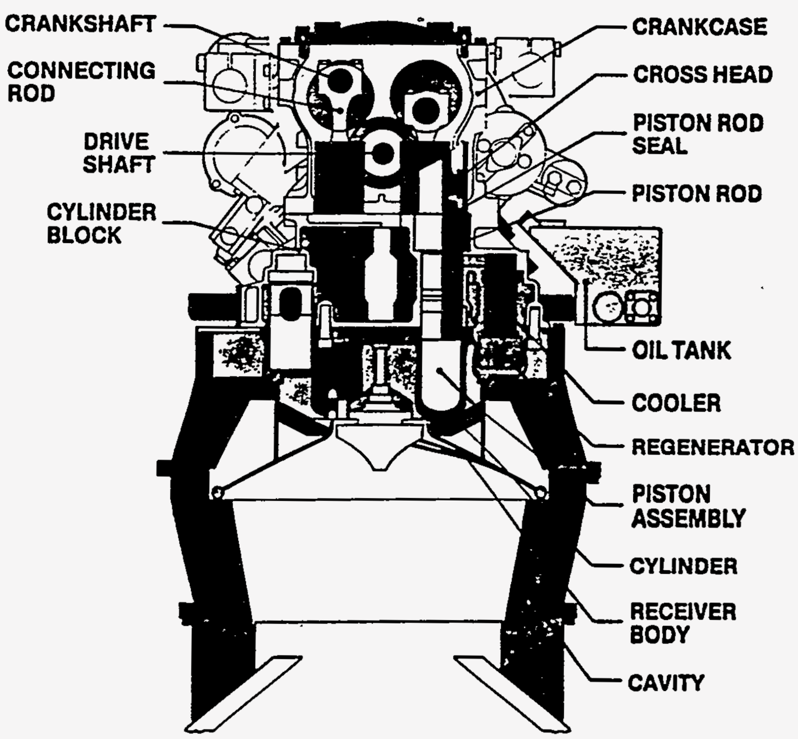


Figure II-12. Main Component of the Mark II Stirling.

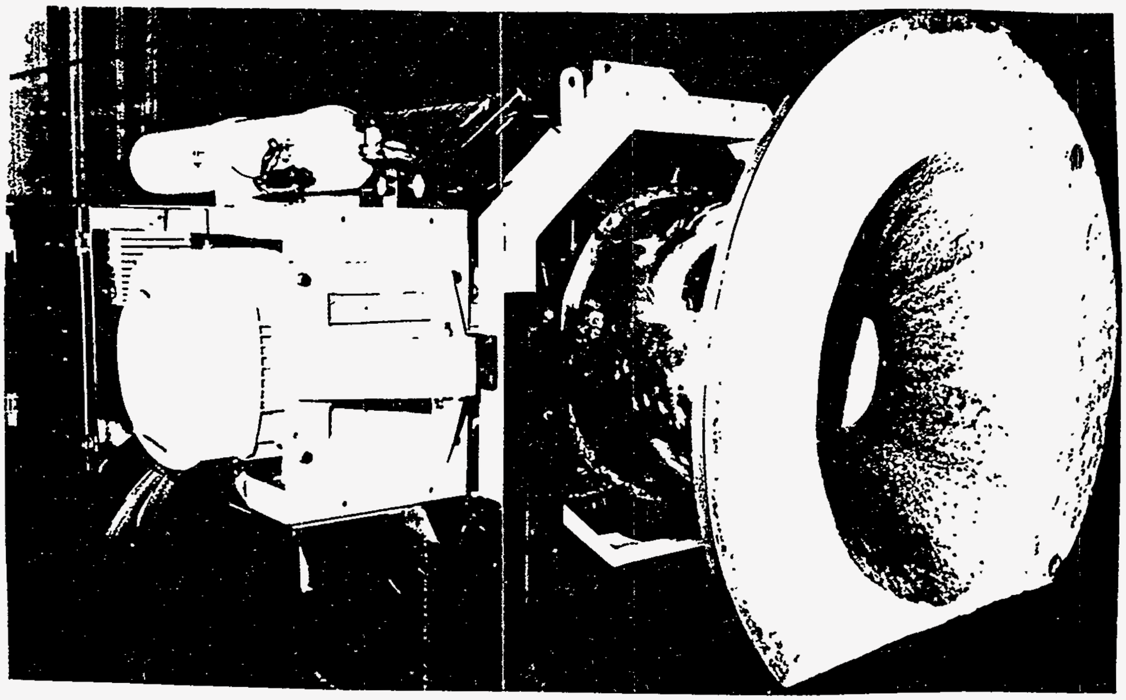


Figure II-13. Side view of the USAB Mark II Power Conversion Unit.

The normal morning startup sequence for the PCU shown in Figure II-14 is:

- The concentrator moves to a track position focusing the sun's radiant energy on the PCU receiver.
- The gas temperature rises to 720°C and the grid relay is closed, connecting the generator to the grid line. The startup current transient is shown in Figure II-15.
- The generator acts as a starter motor and spins the Stirling engine up to 1800 rpm.
- The grid relay opens and the engine speed decreases to match the thermal level on the receiver.As the thermal energy in the receiver increases, the speed of the engine increases

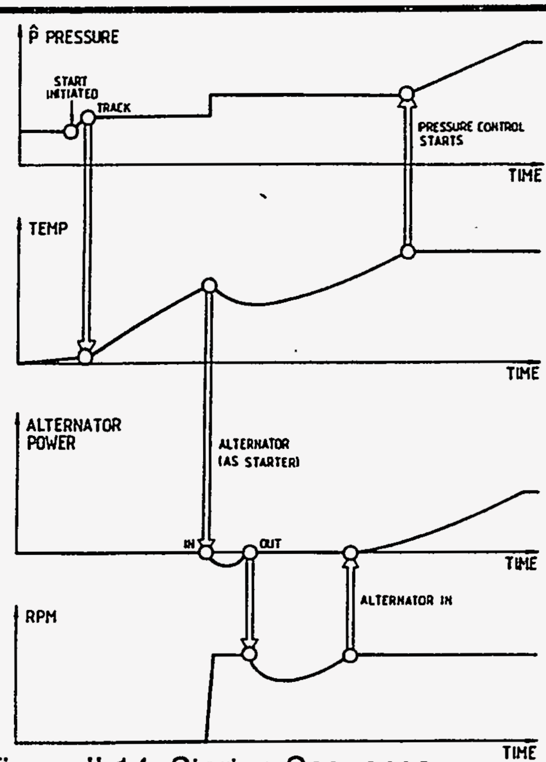


Figure II-14. Startup Sequence.

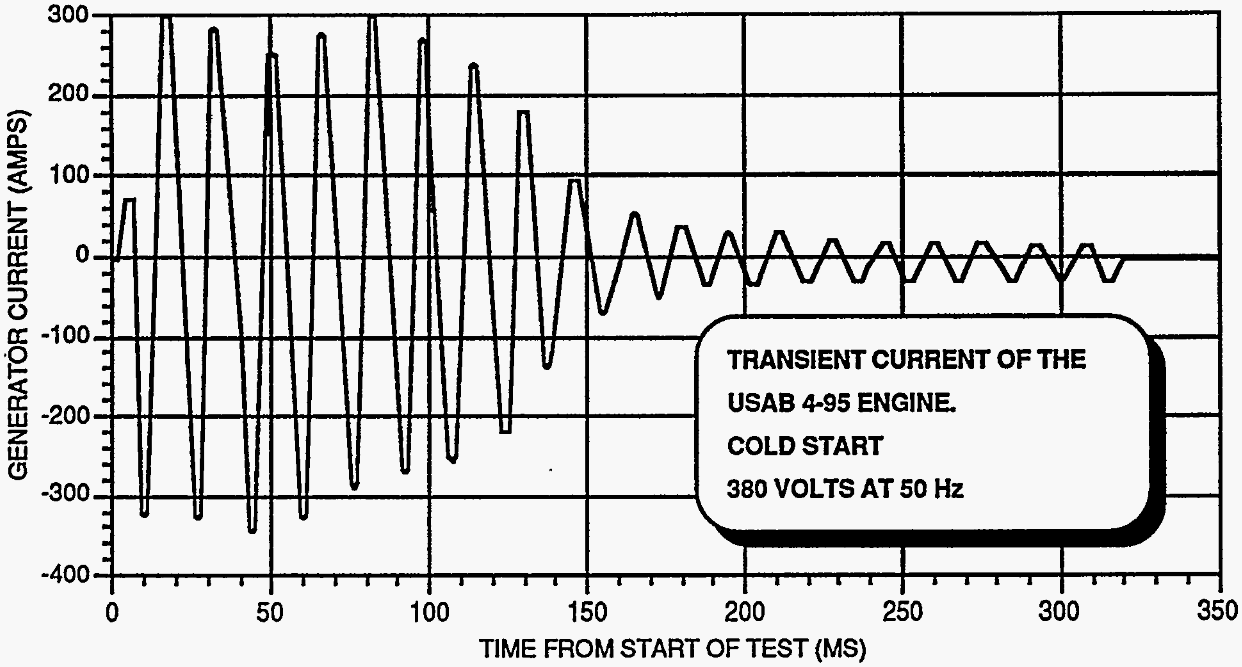


Figure II-15. Cold Startup Current Transient.

- When the speed reaches 1800 rpm, the grid relay closes and the generator is now supplying power to the grid line.

The difference in the working gas temperature between the four receiver quadrants affects the system's performance. Because all four pistons are connected through a common crankshaft, a lower temperature in one quadrant takes energy away from the other three. As discussed earlier in the system description, each mirror was aimed at a different point on the receiver to provide an even flux over the receiver (Figure II-4). An example of the working gas temperature of the four different quadrants is shown in Figures II-16 and the maximum temperature difference between the four quadrants is shown in Figure II-17. Under most operating conditions, the maximum difference in the working gas temperature ranged between 30° and 60°C. Temperature differences as high as 100° to 130°C were observed during the test period. These were usually the result of clouds, uneven dirty mirrors, winds, etc. but were not found to be a problem. When the mirrors were so dirty that there was a large temperature difference, the amount of power lost due to the lower reflectivity made it cost effective to wash the concentrator.

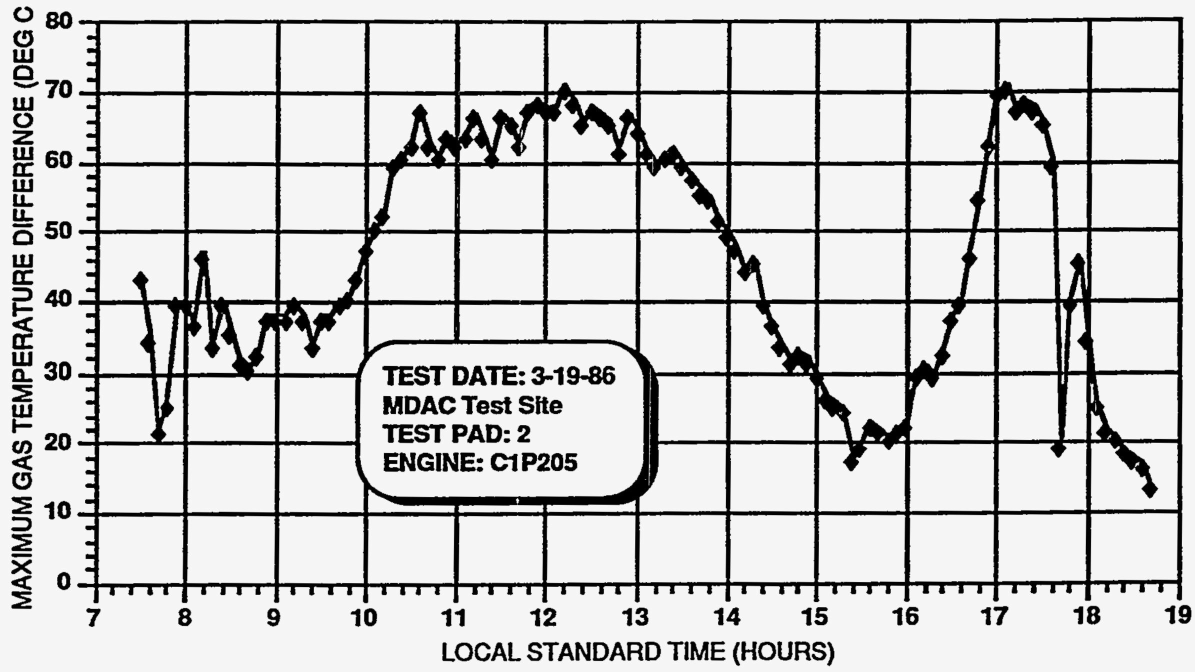


Figure II-16. Maximum Working Gas Temperature Differential.

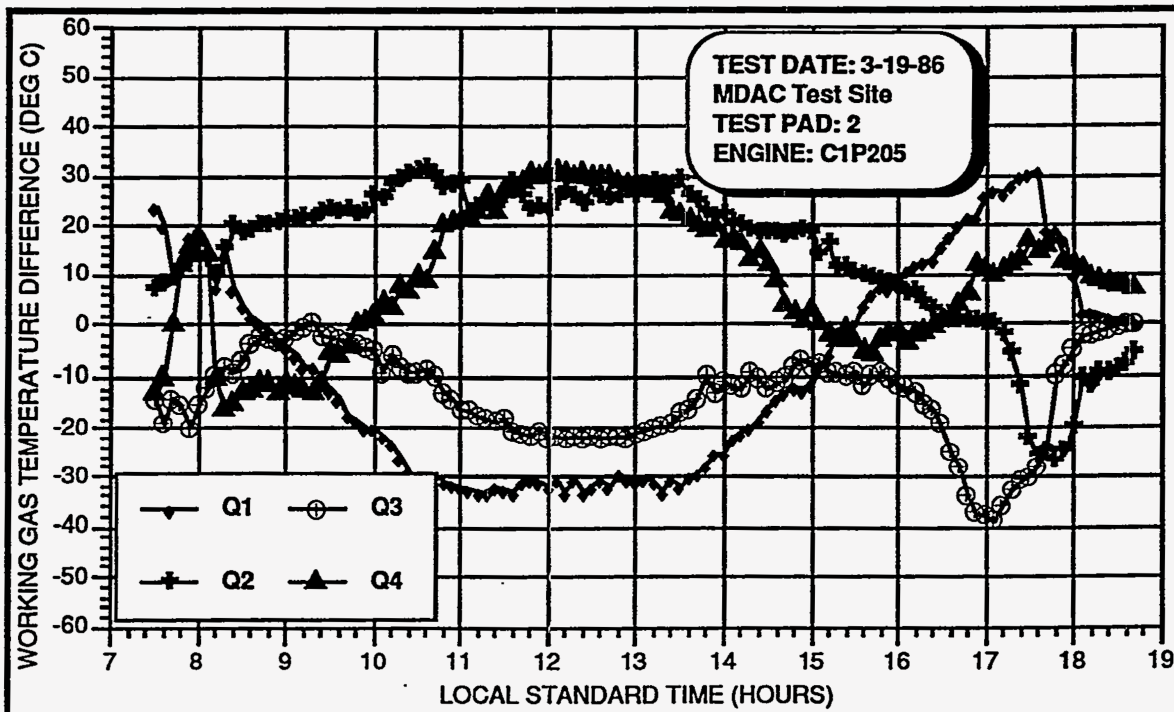


Figure II-17. Working Gas Temperature Differences.

The program included testing of two different versions of the USAB 4-95 engine, the Mark I and Mark II power conversion units (PCU). The Mark I unit was tested at Edward's Air Force Base, and the refined Mark II design was first tested at Rancho Mirage, California. In the joint venture with MDAC, USAB upgraded and modified the Mark II PCU for installation on the MDAC solar concentrator. Mark I engines were used at the start of the MDAC/USAB/SCE program while the Mark II upgrades and modifications were being performed.

The original objectives of the Mark II were to reduce production cost, retain the high power performance level, and increase the system reliability. The Mark II production cost was estimated to be less than for the Mark I and the test program showed that the power performance level of the Mark II was the same as the Mark I. Because the program was not completed, there was not sufficient test time to verify that improved reliability was obtained.

The requirement to integrate a USAB PCU to a MDAC solar concentrator and to further refine the performance of the Mark II resulted in the prototype commercial Mark II PCU. The revised unit had the following design refinements:

- Optimized receiver
- Gas compressor integration to the engine
- New oil pump
- Gas refill system for extended operation
- PCU frame for installation on the solar concentrator
- Integral PCU control system
- Solar concentrator interface logic
- Combined generator/starter motor (the generator is motored to start the engine)

The differences in the Mark I, the original Mark II, and the MDAC version are described in "Design Summary of USAB 4-95 Stirling Power Conversion Unit," United Stirling AB, January 1986. As noted earlier, the MDAC/USAB joint venture tested the Mark I and the commercialized Mark II PCUs. A summary of the comparisons between the Mark I and Mark II is shown in Table II-2. Table II-3 compares the original and commercial Mark II.

TABLE II-2. Changes Made From Mark I to Mark II.	
Receiver	Heater element was redesigned to integrate solar concentrator and PCU requirements.
Regenerator	A smaller size and new design were selected, improving the cost. The design of the regenerator housing was improved by eliminating the regenerator housing manifolds, which were required for hybrid operation. The regenerator matrix enclosure was eliminated. The matrix was installed directly in the receiver. The new design meant a one-time assembly of a receiver, including regenerators. The regenerators could not be removed without destroying them.
Cylinder Liner/System	The cylinder and cross head liner were combined into a single piece, which improved the alignment of seal and piston rings.
Oil System	The location of the oil tank was altered to improve the return oil flow to the oil tank.
Drive System	The Mark I engine has an output shaft connected to the generator via a gear system. The Mark II engine crankshaft gears are connected directly to a generator gear. Because the oil system lubricates this gear, the generator shaft provided an oil seal. In this arrangement, a fly wheel and a separate flange between engine and alternator are not needed.
Gas Control System	Components were integrated into modular blocks to minimize the number of connections. A simplified control system based in the experience gained on previous tests was utilized. The reduction in connections minimized gas leakage from the system.

TABLE III-3. Comparison of the Original and Commercial Mark II Components.

Aperture Cone Cavity	The aperture was designed specifically for the MDAC solar concentrator and flux distribution. A new cavity was made of two cast pieces rather than a large stack of ceramic pieces.
Gas Compressor	The compressor was connected directly to the PCU crankshaft. Previous design provided for a ground-mounted unit to service multiple engines.
Oil System	Because of the dedicated gas compressor noted above, a new pump was used that required relocation
Gas Refill System	In addition to the 10-liter (0.3 ft^3) gas bottle, a large gas bottle with a capacity of 11,330 liters (400 ft^3) was added to the concentrator structure. The engine compressor was used to pump gas from the large bottle to the small bottle. This allowed the unit to operate for extended periods between refills.
Electrical	All PCU electrical and control equipment were mounted on the PCU.
Control System	Control logic was modified for integration with the MDAC solar concentrator.
Generator	The generator was replaced with a unit that allowed installation of a shaft gear and could be used as the engine starter motor. The generator was replaced with a unit capable of both 50 and 60 Hz operation.
Frame Structure	Because of flux patterns of the MDAC solar concentrator and the noted revisions, the PCU support design was revised.

Data Acquisition System

The configuration of the data acquisition system is shown in Figure II-18. Except for a couple of minor differences, this data logging configuration was identical at the Huntington Beach Test Site, SCE Test Site and Georgia Power Test Site. The only major difference, as far as data analysis were concerned, was at Barstow and Georgia Power. The weather station at these sites operated on the same power lines as the lines furnishing power to the concentrator. Therefore, the daily power and energy usage recorded for the Stirling dish were biased by the power and energy consumed by this equipment. The amount of power/energy consumed by the weather station equipment is small, approximately 110 watts and 2.6 kWh per day. Also note that at the SCE test site an Intersol PV system was installed on the same power lines as the Stirling Dish system. This system operated during the last two years of the test program. There was a meter to measure the generated power by the PV system which was subtracted from the Stirling Dish system. There was no meter to measure the power consumed by the PV system. The PV system parasitic power could not be measured separately from the power consumed by the Stirling dish. The parasitic power was estimated to be less than 1 kWh per day. Attempts were made to measure the parasitic energy of these components when the concentrator was not operating but because of the granularity of the utility's metering, the measurements were not that accurate. It is estimated that the daily energy for the Georgia Power unit is low by 2 to 3 kWh per day and the SCE unit is low by 3 to 4 kWh per day. The data presented in this report have not been corrected for these factors.

The data that was recorded by the Fluke data logger as a function of time are shown in Table II-4. This data were transferred to cassettes from the Fluke and an IBM program was used to analyze the data. The IBM program produced a hard copy report and stored the data on floppy diskettes. There were eight monthly reports made for the SCE Test Site unit and six monthly reports made for the Georgia Power unit. These reports are listed in Reference 8.

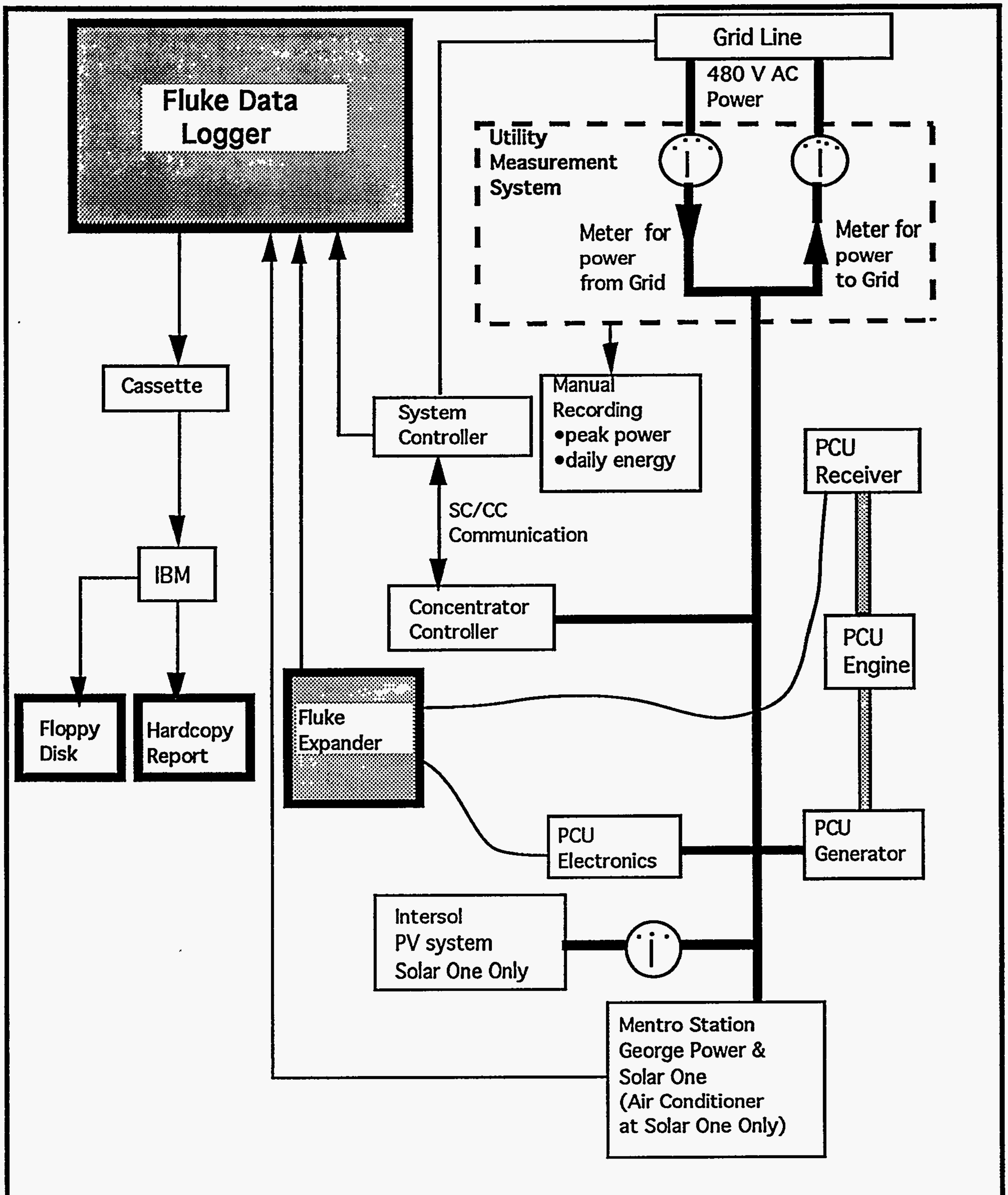


Figure II-18. Test Site Data Acquisition System.

Table II-4. Parameters Recorded During Testing

Channel Number	Variable	Units	Description
C1010	GA ENR IN	Counts	Pulses from "energy in" meter*
C1000	GA ENR OUT	Counts	Pulses from "energy out" meter*
C1020	GA VARS OUT	Counts	Pulses from "KVAR-HR out" meter*
C 650	GA ENR OUT TOT	KWH	Energy out (integrated counts)
C 660	GA ENR IN TOT	KWH	Energy in (integrated counts)
C1030	GA VARS IN	Counts	Pulses from "KVAR-HR in" meter*
C 1	NIP	W/M2	Direct Insolation
C 2	GLOBAL FLUX	W/M2	Total Insolation
C 3	TOTAL POWER	KWATTS	"Net" utility power meter
C 6	WIND SPD-1	MPH	Instantaneous wind speed - sensor 1
C 7	WIND SPD-2	MPH	Instantaneous wind speed - sensor 2
C 8	WIND DIR	DEG	Winection (0 deg = north)
C 9	AIR TEMP	DEG F	Ambient air temperature
C 100	FIT5Q1	DEG C	Front inner tube temperature (quadrant 1)
C 101	FIT5Q2	DEG C	Front inner tube temperature (quadrant 2)
C 102	FIT5Q3	DEG C	Front inner tube temperature (quadrant 3)
C 103	FIT5Q4	DEG C	Front inner tube temperature (quadrant 4)
C 104	ROT5Q1	DEG C	Rear outer tube temperature (quadrant 1)
C 105	ROT5Q2	DEG C	Rear outer tube temperature (quadrant 2)
C 106	ROT5Q3	DEG C	Rear outer tube temperature (quadrant 3)
C 107	ROT5Q4	DEG C	Rear outer tube temperature (quadrant 4)
C 108	WGTQ1	DEG C	Working gas temperature (quadrant 1)
C 109	WGTQ2	DEG C	Working gas temperature (quadrant 2)
C 110	WGTQ3	DEG C	Working gas temperature (quadrant 3)
C 111	WGTQ4	DEG C	Working gas temperature (quadrant 4)
C 112	CRIT	DEG C	Cavity receiver inner temperature
C 113	CRMT	DEG C	Cavity receiver middle temperature
C 114	CROT	DEG C	Cavity receiver outer temperature
C 120	TANK PRESS	MPA	PCU GH2 storage tank pressure
C 121	ENG SPEED	RPM	PCU engine speed
C 122	GEN POWER	KWATTS	PCU gross generator power
C 123	TOIL	DEG C	PCU oil temperature
C 124	WGDT	DEG C	Maximum difference between quadrant working gas temps
C 125	CONT	DEG C	PCU control temperature
C 126	T/D STAT	ON/OFF	Track/Detrack status
C 127	WP STAT	ON/OFF	PCU water pump status
C 128	FH STAT	ON/OFF	PCU fan high status
C 129	FL STAT	ON/OFF	PCU fan low status
C 130	E/D STAT	ON/OFF	Emergency detrack status (fast slew)
C 131	P MAX	MPA	Maximum PCU working gas pressure
C 132	P MIN	MPA	Minimum PCU working gas pressure
C 306	WIND SPD-1 AVG	MPH	One minute average of wind speed #1
C 316	WIND SPD-2 AVG	MPH	One minute average of wind speed #2
C 326	WIND DIR AVG	DEG ANGL	One minute average of wind direction
C 500	DATE+SUN FLAG	NONE	Coded date and sun up flag
C 501	SUN UP FLAG	0/1	Sun up flag to initiate PCU data scanning

Table II-4. Parameters Recorded During Testing			
Channel Number	Variable	Units	Description
C 502	DATE		Current date (coded)
C 510	TIME	N2SEC	Coded GMT time
C 520	AZ MOTOR TURNS	COUNTS	Coded azimuth motor turns
C 530	EL MOTOR TURNS	COUNTS	Coded elevation motor turns
C 540	SUN INTEN+CMODE	NONE	Coded insolation level & CC operating mode
C 550	SUN AZ+EL ERROR	NONE	Coded azimuth/elevation sun sensor error
C 560	WGTM	DEG C	PCU working gas mean temperature
C 4	TOTAL VARS	KVARS	Net utility KVAR meter
C 670	GA VARS OUT TOT	KVARS	KVAR-HR out (integrated counts)
C 680	GA VARS IN TOT	KVARS	KVAR-HR in (integrated counts)

III. POWER PERFORMANCE

- Peak power efficiency of 30% at 1000 W/m^2 sun irradiance
- Operation at low sun irradiance levels as low as 200 W/m^2 sun irradiance
- Fast response to changes in sun irradiance caused by clouds

The power design performance goal for the Stirling dish set by MDAC/USAB at the beginning of the program was that the system generate positive power at sun's irradiance levels between 300 W/m^2 and 1000 w/m^2 and 25 kW net power at 1000 W/m^2. This section presents the peak power performance and estimates the power performance of each component. The performance measurement techniques and information supporting the performance estimates are also presented. A summary of the daily test data is contained in Appendix A for the MDAC test site, Appendix B for the Georgia Power test site, and Appendix C for the Solar One test site.

Power Output Performance

Operation of the Stirling dish generally started very early in the morning after sunrise when the sun's irradiance level was very low and power performance would increase throughout the morning as the sun's irradiance level increased. In the afternoon, the power level would decrease as the sun began to set and the sun's irradiance level decreased. A typical example of this power profile is shown in Figure III-1 by the direct normal sun's irradiance and instantaneous net-power output versus time on a clear day at the Huntington Beach test site. The small variations in the net output power during the day are caused by a small variation in the sun's irradiance level and the on/off operation of the PCU cooling fan. The same data are plotted in Figure III-2 as a function of the direct normal sun irradiance level. As shown in this figure, the Stirling engine will start producing positive net power by the time the sun's irradiance level reaches 300 W/m^2. However, the engine will produce power in the evening at sun's irradiance levels as low as 200 W/m^2, as shown in this figure. This difference was caused by the thermal mass of the receiver. In the morning, the engine reached the operating temperature at a sun's irradiance level of 200 W/m^2 to 250 W/m^2 and the engine started rotating, but because the receiver started cold, it took a few minutes for the receiver to fully heat up and the engine to obtain the required speed to connect to the grid line. By this time, the irradiance level had risen to approximately 300 W/m^2.

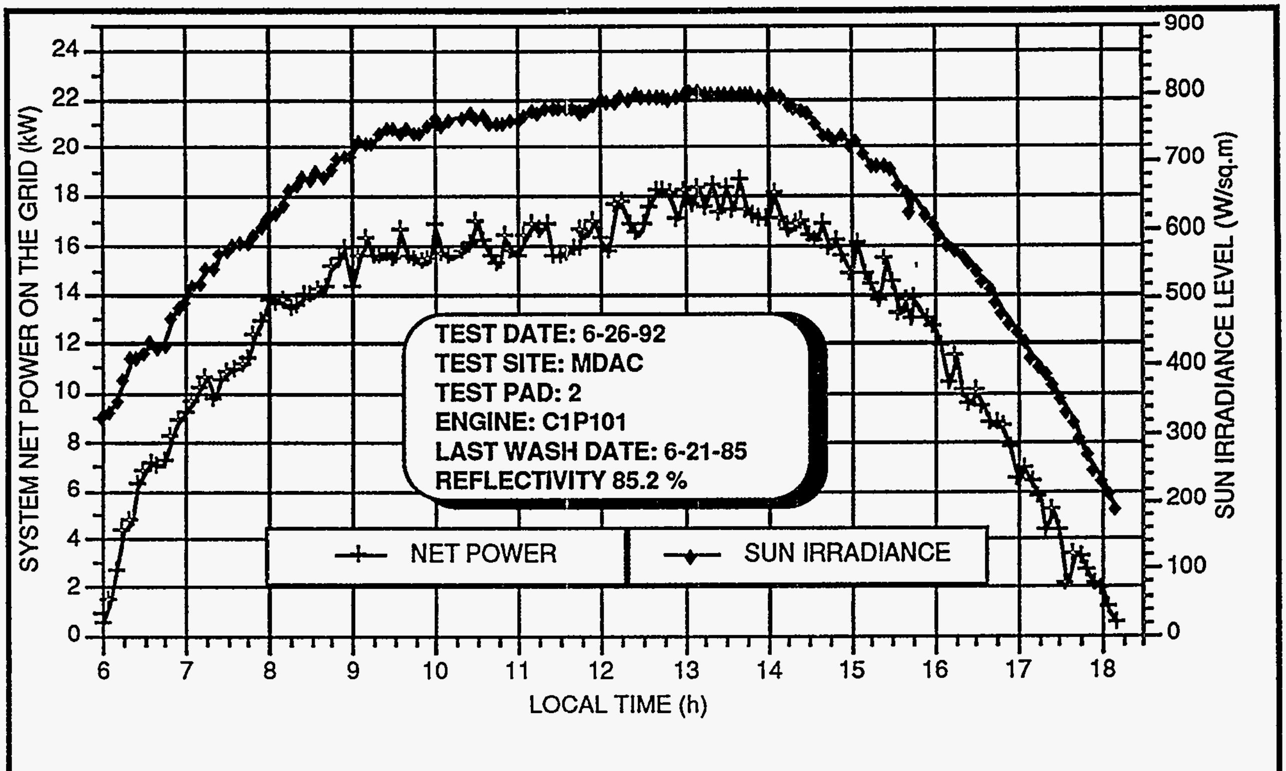


Figure III-1. Typical Power Performance of the System as a Function of Time.

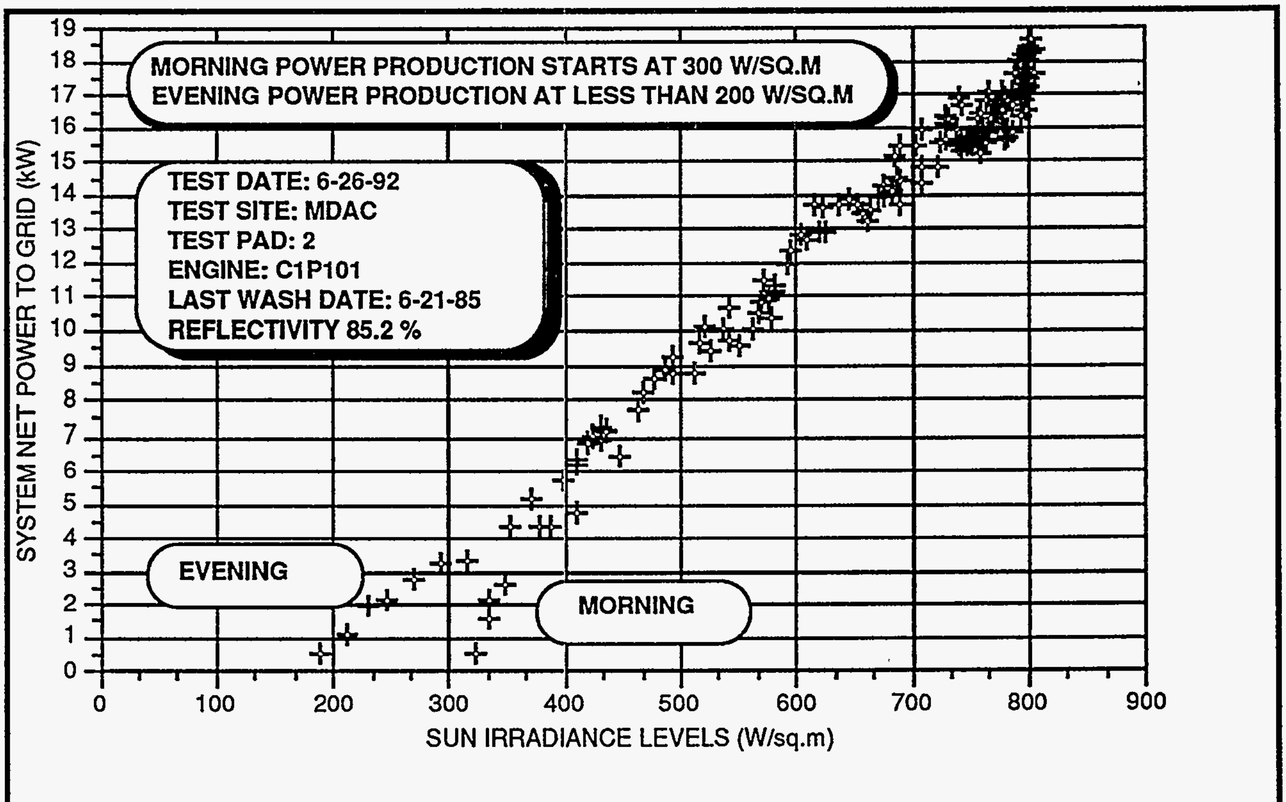


Figure III-2. Power Performance as a Function of the Sun Irradiance Level.

As shown in these plots, the Stirling dish has a very low operating threshold and it responds very quickly to changes in the sun's irradiance level. This is an advantage for a solar conversion system because the sun's irradiance level can rise and fall significantly from clouds passing over. When the sun's irradiance level recovers to 300 W/m^2, the PCU produced electrical power within 20 seconds. This rapid response to changes is illustrated in Figure III-3 by the power transient response to the sun's irradiance level on a cloudy day at Huntington Beach. There is enough thermal mass in the receiver to carry the PCU through very short periods of low solar insolation. The data in this figure shows, even when the sun's irradiance level falls below 200 w/m^2 for several minutes, the system will still generate positive power.

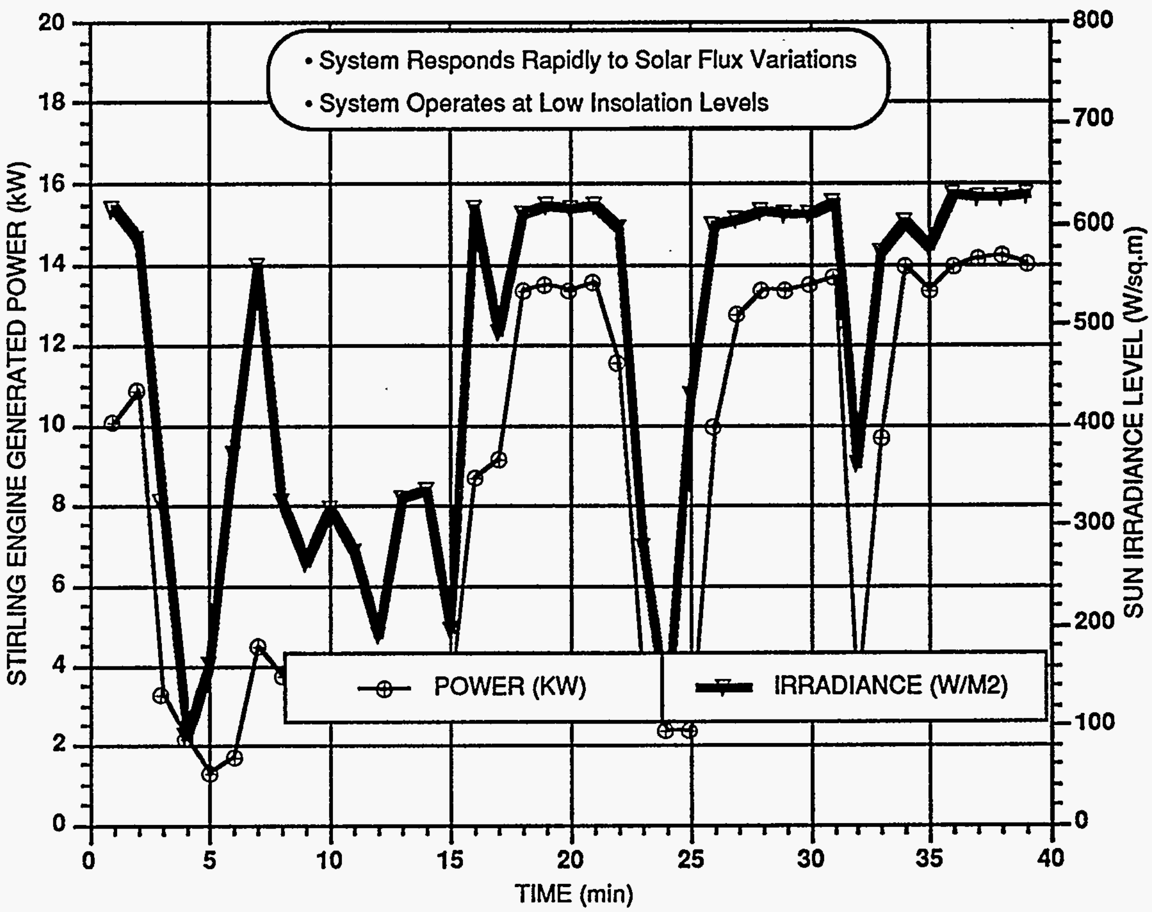


Figure III-3. Typical Response of the Stirling Dish System on a Cloudy Day.

Power Efficiency

One measure of system performance is the power efficiency. The power efficiency of the Stirling dish is defined as:

$$\text{Power Efficiency} = \frac{\text{Instantaneous Net Power}}{\text{(Sun Irradiance) (Dish Sun Aperture Area)}}$$

The dish aperture area or sun-normal reflective area is 87.67 m^2. This was found by taking the individual mirror area of 1.11 m^2 and projecting it on a plane perpendicular to the sun. The resulting sun-normal reflective area for each mirror is shown in Table III-1. The total glass surface area is 91.01 m^2. The net power level and power efficiency are shown in Figure III-4 as a function of the sun's irradiance level for the MDAC test site. These data shows that the system produces net power at irradiance levels of approximately 200 W/m^2. The power output is greater than the design performance requirement between 200 W/m^2 and 1000 W/m^2. Since the sun's

TABLE III-1. Concentrator Reflective Area.

Mirror module glass area = 47.91 in. x 35.91 in. = 1720.45 in^2

Total glass area = 1720.45 x 82 = 141,076.74 in^2 = 979.69 ft^2 = 91.01 m^2

Concentrator Sun Normal Area (Aperture area in m^2)

ID	Area	ID	Area	ID	Area	ID	Area	ID	Area
1	1.040	18	1.082	35	1.076	52	1.049	69	1.039
2	1.047	19	1.064	36	1.053	53	1.042	70	1.055
3	1.054	20	1.042	37	1.053	54	1.064	71	1.065
4	1.065	21	1.049	38	1.076	55	1.082	72	1.065
5	1.065	22	1.072	39	1.094	56	1.093	73	1.054
6	1.054	23	1.090	40	1.105	57	1.093	74	1.039
7	1.053	24	1.101	41	1.105	58	1.081	75	1.037
8	1.070	25	1.101	42	1.094	59	1.064	76	1.047
9	1.080	26	1.090	43	1.076	60	1.042	77	1.046
10	1.080	27	1.072	44	1.049	61	1.031	78	1.037
11	1.070	28	1.049	45	1.049	62	1.053	79	1.050
12	1.053	29	1.053	46	1.073	63	1.070	80	1.068
13	1.042	30	1.076	47	1.090	64	1.080	81	1.084
14	1.064	31	1.094	48	1.101	65	1.080	82	1.110
15	1.082	32	1.105	49	1.101	66	1.070		
16	1.093	33	1.105	50	1.090	67	1.053		
17	1.093	34	1.094	51	1.072	68	1.031		

Total Aperture Area = 87.69 m^2

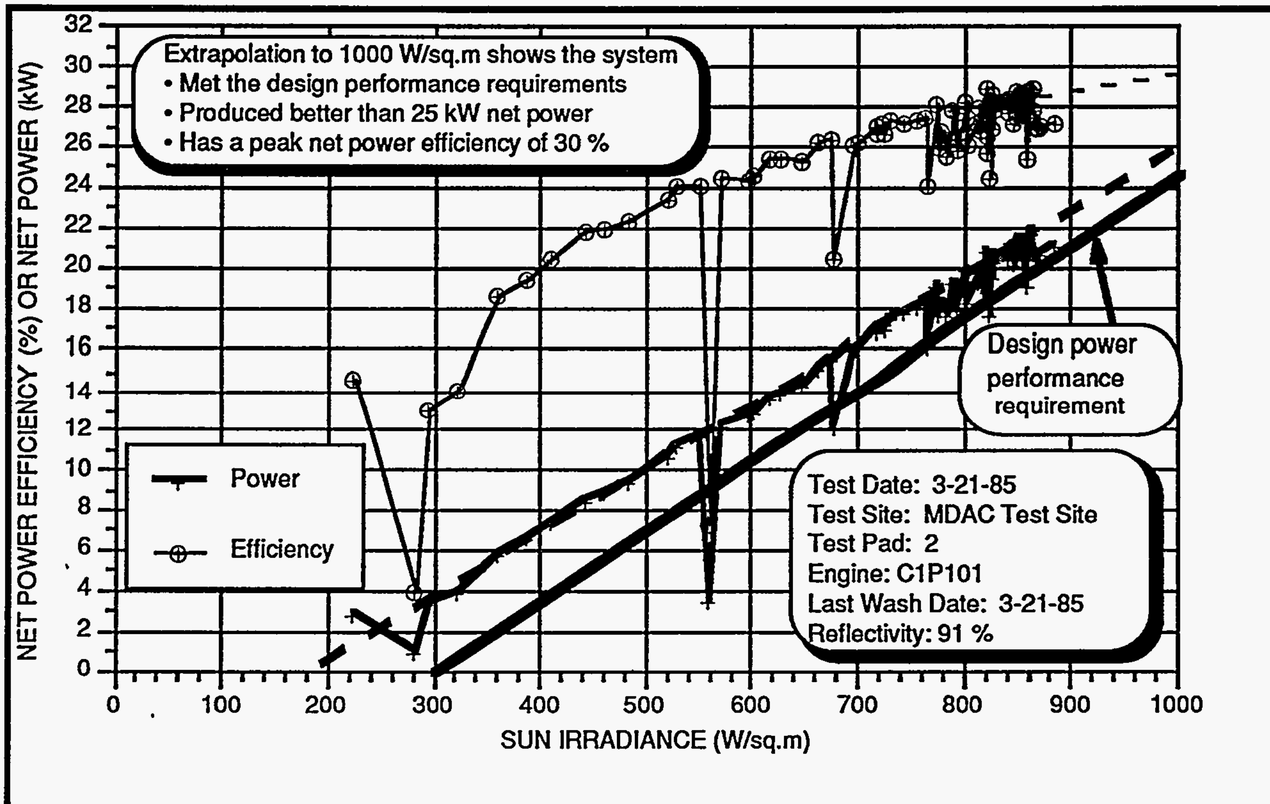


Figure III-4. Peak Net Power and Efficiency Performance.

irradiance level very seldom gets above 900 W/m^2 at Huntington Beach, the estimated upper power level is determined by extrapolating the net power data to a sun's irradiance level of 1000 W/m^2. Again by extrapolating to 1000 W/m^2, the power efficiency data in this figure shows that the system had a peak power efficiency of approximately 30% at a sun's irradiance level of 1000 W/m^2. Another example is the set of data shown in Figure III-5 for March 19, 1986 at the SCE One Test Site. In this case the sun irradiance level was higher than 990 W/m^2. The system produced a peak of 26 kW of power with a net efficiency of a little over 30%. The mirror reflectivity for this day was unknown and the log does not indicate when the unit was last washed. The data logs also shows that the Georgia Power Test Site exceeded 26 kW several times when the irradiance level reached 1000 W/m^2.

Peak Power Efficiency

The peak power efficiencies of the subsystems are shown in Figure III-6. This section analyzes the system's peak power efficiency and discusses supporting test and collaborating data. The major sources of power loss are listed in Table III-2. The Peak

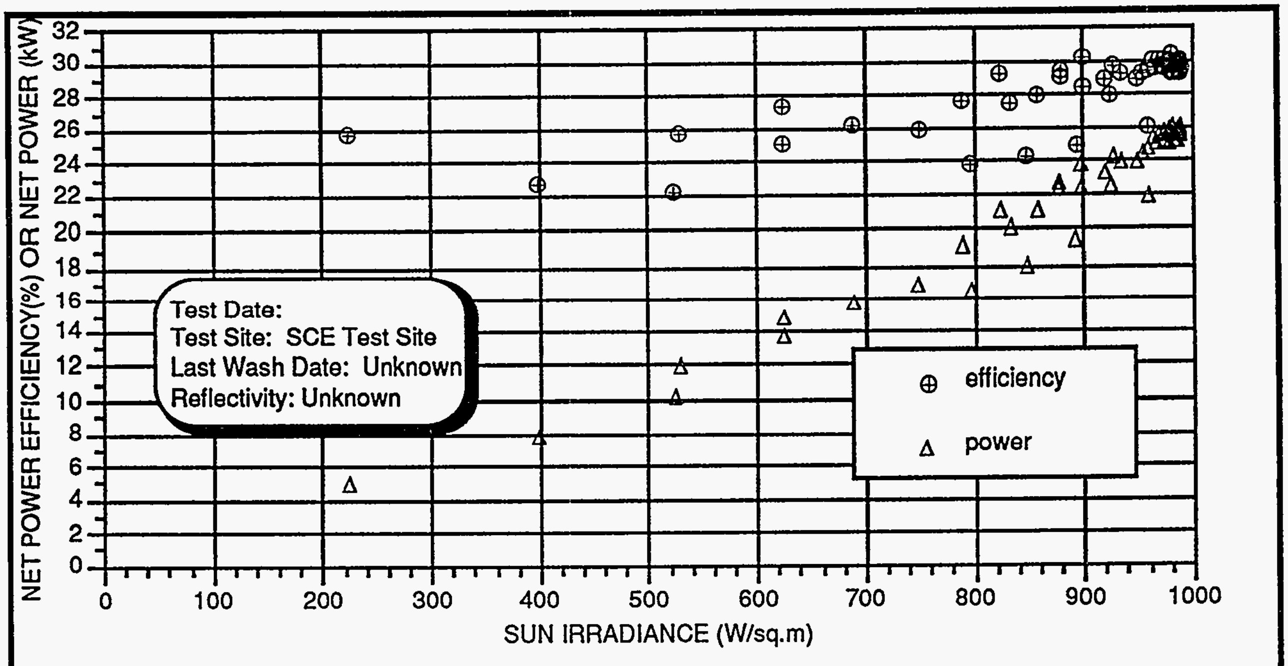


Figure III-5. Peak Power and Peak Power Efficiency at the SCE Test Site.

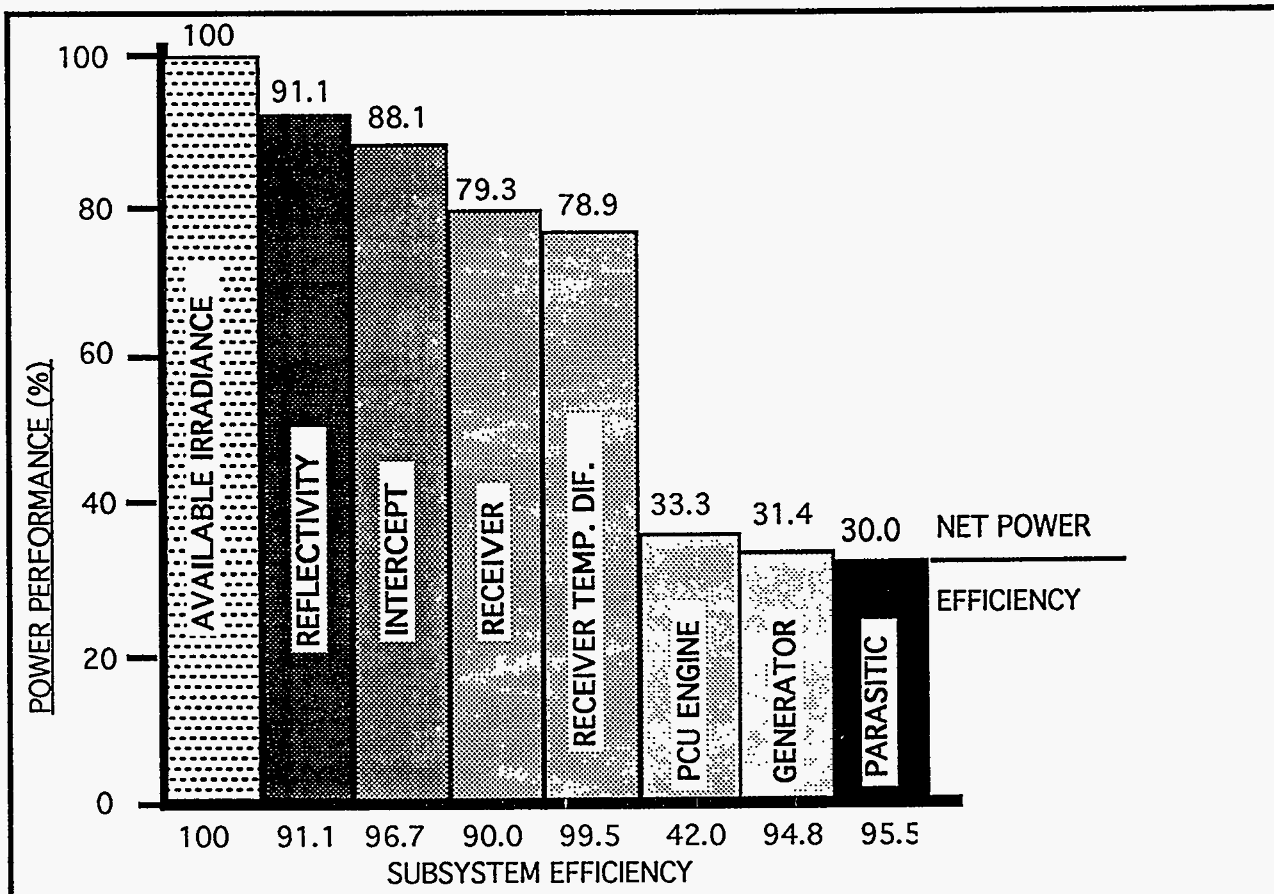


Figure III-6. System and Subsystem Peak Power Efficiency.

Table III-2. Power Losses.				
Source	Subsystem Efficiency (%)	Cumulative Efficiency (%)	Delta Power (watts)	Total Power (watts)
Available Isolation (1000W/m2				87,670
Reflectivity	91.10	91.10	7,803	79,867
Intercept	96.70	88.09	2,636	77,232
Tracking				
Surface Waviness				
Cant Error				
Receiver	90.00	79.28	7,723	69,509
Conduction				
Reflectivity				
Temperature Difference	99.00	78.51	348	69,161
PCU Engine	42.40	33.12	40,113	29,047
Generator	94.8	31.40	2,047	27,537
Parasitic	95.55	30	904	26,301

power efficiencies were obtained from the data presented in Figure III-4 and Figure III-5. The subsystem efficiency was obtained by direct measurement, analytical analysis, or manufacture specifications. The method for determining subsystem efficiencies are discussed in the following sections.

AVAILABLE INSOLATION

The available insolation is assumed to be 1000 W/m^2 over a sun-normal reflective area of 87.67 m^2. The total available power is 87,670 watts.

REFLECTIVITY

The peak power efficiency will vary directly with the reflectivity of the mirrors. Soiling of the mirrors not only causes a loss in power because of lower reflectivity, but because the lower mirrors soil more quickly, resulting in uneven flux on the receiver. The reflectivity for the dish on pad #2 at the MDAC test site is shown in Figure III-7 for a little over one year of the testing period. The reflectivity measurement is an average of six measurements per facet for four different facet locations. The data in Table III-3 shows the reflectivity before and after washing.

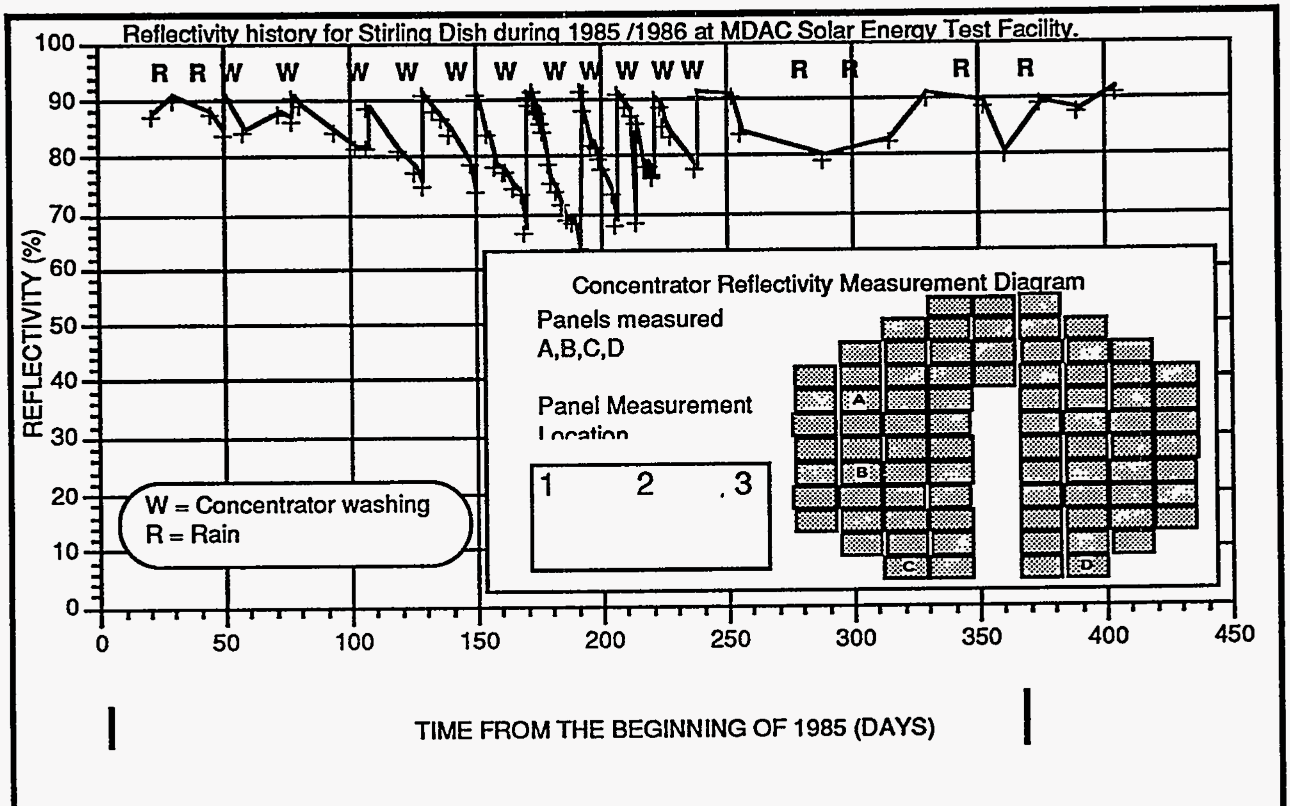


Figure III-7. Mirror Reflectivity History for MDAC Test Site.

Table III-3. Reflectivity Before and After Washing.

Date	Reflectivity (%) Before Washing	Reflectivity (%) After Washing
6/18/85	67.7	91.4
6/21/85	90.0	92.0
7/11/85	64.3	92.2
7/25/85	68.9	91.7
8/02/85	69.1	86.6
8/09/85	77.1	90.7
		Mean = 91.1
		Standard Dev. = 1.63

This data shows that a mean reflectivity of 91.1% was obtained after washing. The washing technique is a non-contact spraying method developed by MDAC which takes about 10 to 15 minutes per dish. Because of the difficulty in taking the measurements on the higher mirrors, some of the data are an average of the readings from mirrors C and D only. The reflectivity data from other test sites were not recorded regularly.

The variation in the rate of soiling is shown in Figure III-8 as a function of the number of days since washing. The mean soiling rate for the MDAC test site is shown in Figure III-9. This rate of soiling is considered to be higher than normal because land excavation was going on nearby during several months covered by the test period.

INTERCEPT

Intercept losses are defined as energy spillage caused by tracking errors, mirror module cant error, mirror surface waviness, aperture size, variation in the radius of curvature of the mirror, position error resulting from winds, etc. No measurements were made to determine the magnitude of intercept losses, but measurements were made to determine the magnitude of some of the contributors such as tracking, waviness, and cant error. An analytical program was used to estimate the magnitude of the intercept losses. The calculated sensitivity curves for different error sources are given in Figure III-10. These curves show spillage out of the receiver aperture as a

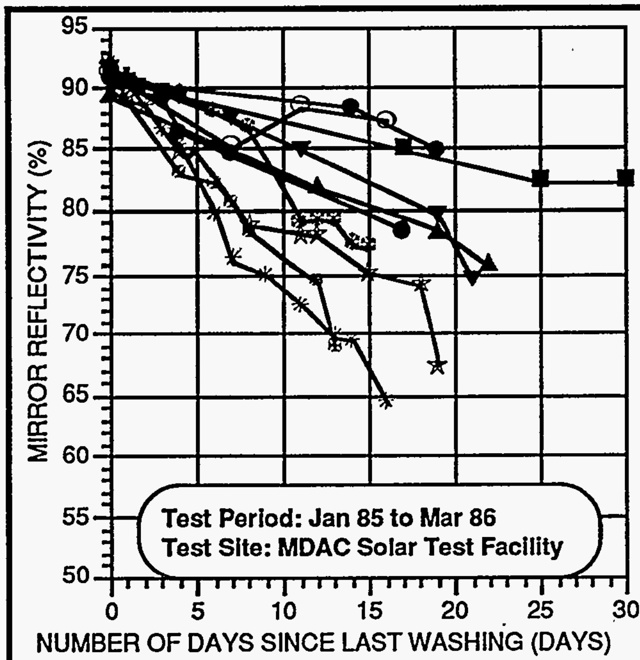


Figure III-8. Variation in Soiling Rate at the MDAC Solar Test Site.

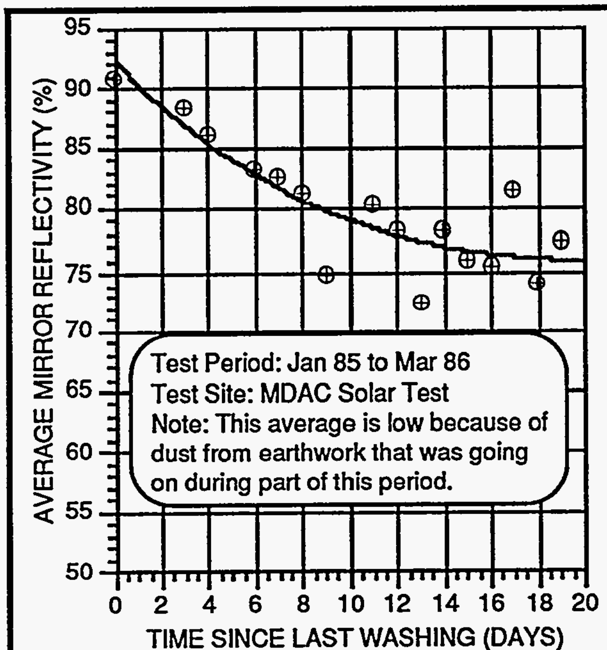


Figure III-9. Average Soiling Rate at the MDAC Solar Test Site.

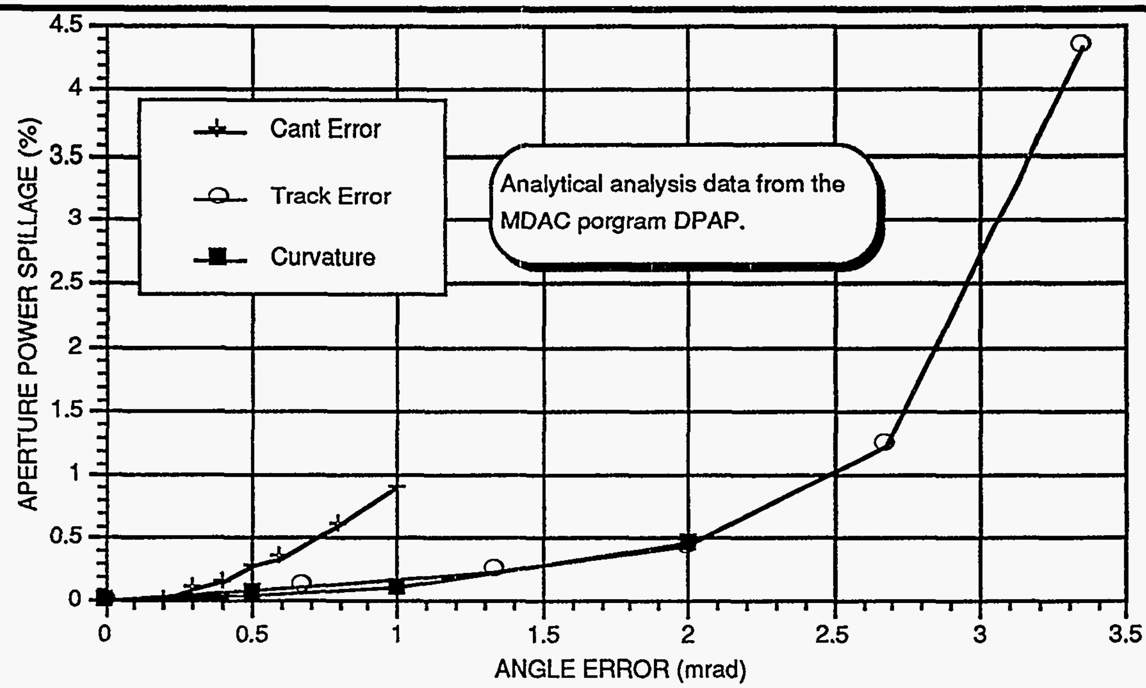


Figure III-10. Sensitivity of Receiver Spillage to Intercept Losses.

function of angular slope error. As discussed in Section II, the tracking error was less than 0.5 mrad rms over the day, and the DIR system is capable of aligning the mirrors to less than 0.3 mr, and the DIR can measure the radius of curvature to less than 10 inches. Based upon the curves in Figure III-10, the total power spillage is estimated to be less than 0.5%. A value of 2.8% has been allocated for the remaining errors. In the past, it was assumed that the spillage energy was lost from the system, but non qualitative experience and observation have raised doubt about this hypothesis. For instance, the tracking errors show very little sensitivity to errors of less than 1 mr, but experience has shown the quadrant temperature is fairly sensitive to tracking errors larger than 1.0 mr. Temperature differentials results in a lower system efficiency, but the relationship has not been measured. Therefore, a tracking error results in lost energy from spillage and also lower engine efficiency because of the quadrant temperature differential.

RECEIVER CONDUCTION AND REFLECTIVITY LOSSES

This is the power that is not absorbed by the receiver tubes and is radiated back out of the cavity to the atmosphere. The number used for receiver losses is estimated from design data provided by USAB. This data was derived from analytical programs and receiver test data.

RECEIVER TEMPERATURE DIFFERENCE

This efficiency was determined by a statistical analysis of the Huntington Beach test data. Efficiencies were calculated for over 2000 data points. The normalized efficiency was plotted as a function of the mean gas temperature difference. The mean efficiency shown in Figure III-11 was calculated as a function of the mean gas temperature difference Except for cloudy conditions, high winds, or uneven mirror soiling, the mean gas temperature difference was generally maintained at less that 80°C which means less than 1.0%.

POWER CONVERSION UNIT ENGINE

This is the power not converted to mechanical power that is dissipated as waste heat by the cooling system. Because the total efficiency was measured and a reasonable estimate or measurement was known for each of the other losses, the number for engine loss was calculated to make the total efficiency agree.

GENERATOR

The generator efficiency (Figure III-12) was obtained from a curve believed to originate

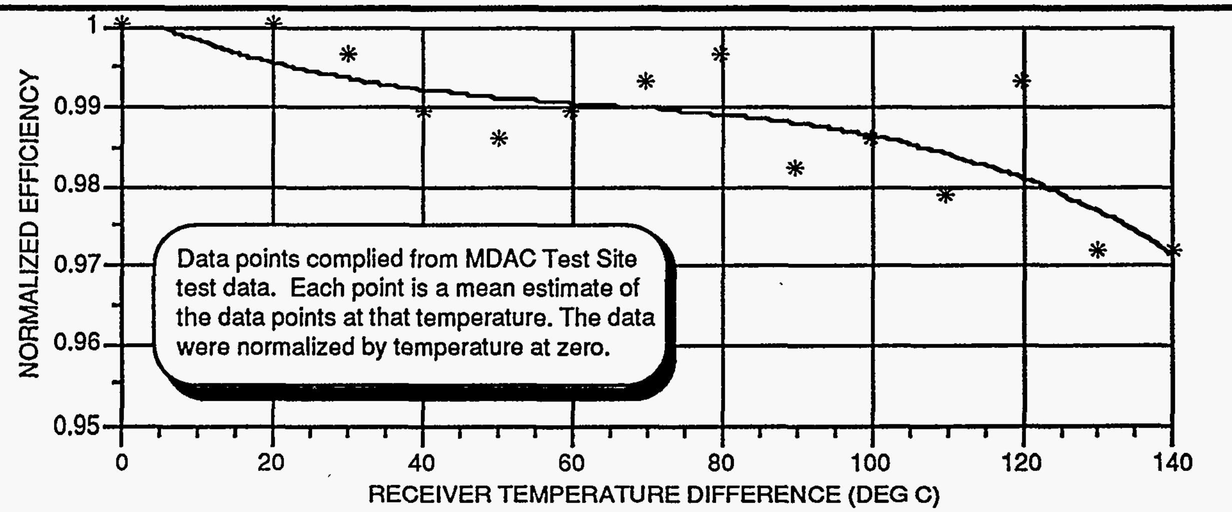


Figure III-11. Engine Efficiency as Function of Gas Temperature Difference.

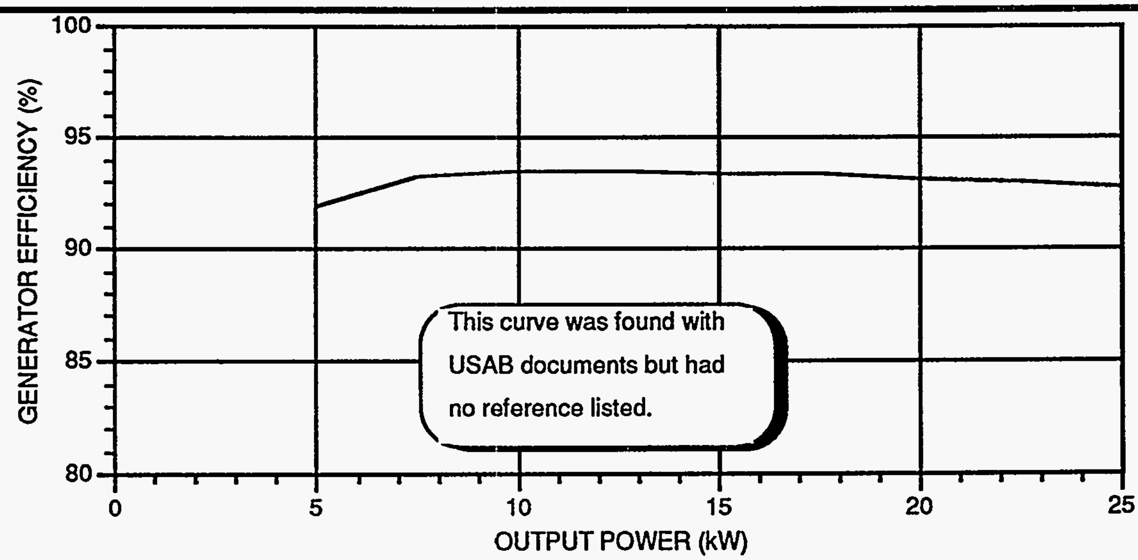


Figure III-12. Generator Efficiency.

with the manufacturer, but it is not known whether it is estimated or is based upon test data.

PARASITIC POWER

Throughout the program, a number of tests were performed to determine the parasitic power used by the system. The results of an electrical energy consumption test that was conducted in June of 1985 are shown in Figure III-13. In this test, energy consumption was measured while the system was commanded to change operating modes. A list of the electrical components that were operating during the different modes of operation are shown in the same figure. From this data, the power requirements can be calculated. From this data the power required for the different electrical components on the concentrator and PCU can be estimated, as shown in Table III-4. The values in this table represent a mean estimate for the stowing and tracking operation. The actual values will vary depending upon the time of day and time of year. During the tracking period, depending on the ambient temperature, the PCU cooling fan could be off or on at either its low or high-speed setting. The power range shown represents the variation that might be expected under these conditions. It should be noted that during high ambient temperature conditions the cooling fan normally cycled between its low-speed setting and off. The fan operated at high speed infrequently at the test sites. An estimate of the parasitic power consumed during the

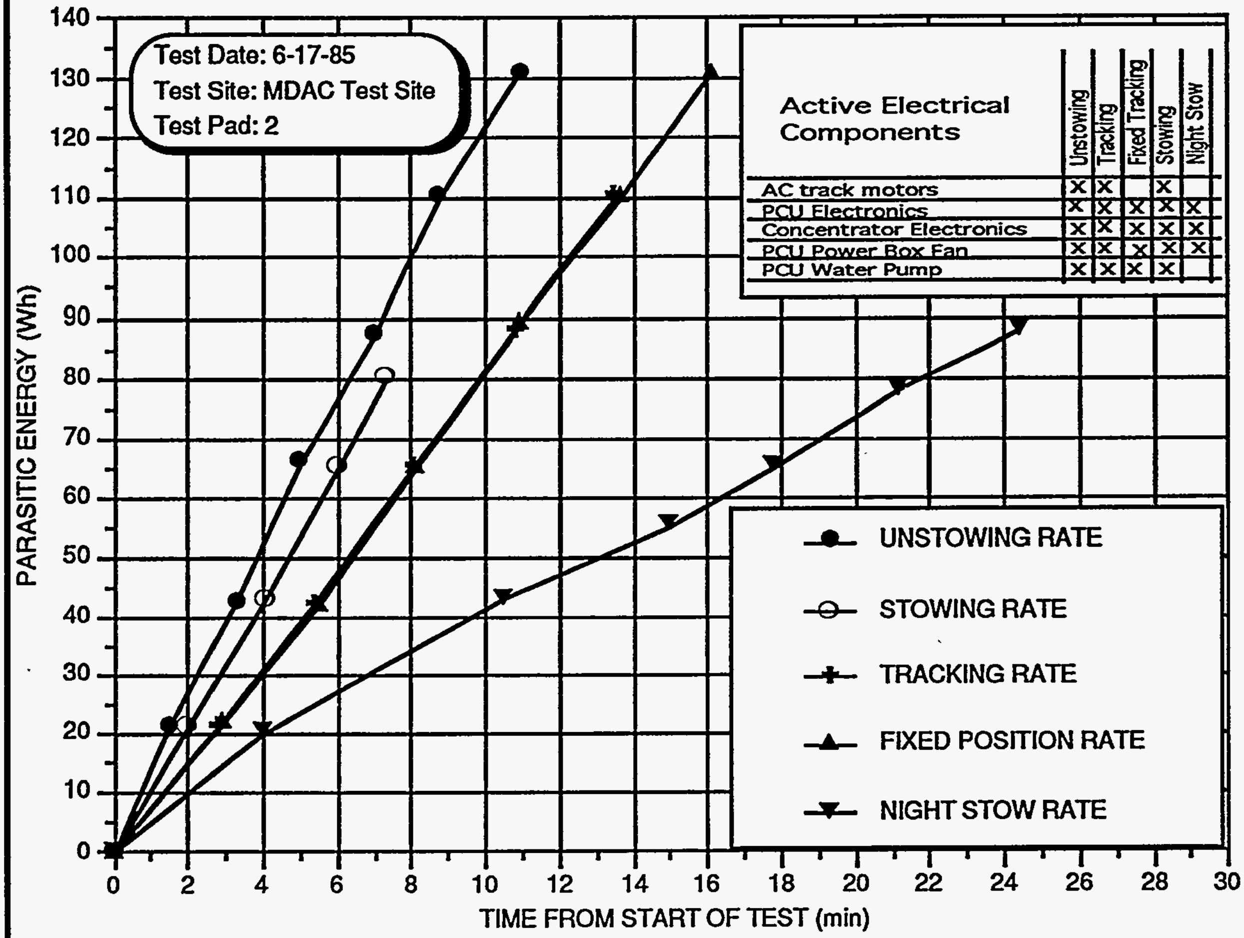


Figure III-13. Energy Consumed for Different Operating Modes.

Table III-4. Stirling Dish Parasitic Power.

Electronic Component	Night Stow (watts)	Tracking (watts)	Stowing (watts)
Dish			
Control Electronics	40	40	40
AC Motors	0	20	154
PCU			
Control Electronics	180	180	180
Water Pump	0	264	264
Cooling Fan			
Low Speed	0	800	0
High Speed	0	1200	0
TOTAL	220	1304-1704	638

operating mode is 904 watts. This was reached by assuming the fan is on low speed half the time. This is believed to be a conservative assumption.

In future parasitic measurements, caution needs to be taken because electronic components in both the solar concentrator and the PCU are single-phase low voltage, such as power for the microprocessors, sensors, valves, contactors, etc. The power for these components is obtained from one phase of the 480V to neutral in the case of the PCU and from phase to phase for the dish controller, which is located in the pedestal. In either case, this unbalances the three-phase circuit. The metering was set up for a balanced circuit and therefore will not give accurate measurement in this situation. Depending upon how the metering was connected, the parasitic could range from a factor of 1.3 too high to only a fraction of the measured value. Also the power for the south weather station at the Solar One test site was taken from the Stirling dish power line. This equipment not only consumed power but further unbalanced the load. In the future, it is recommenced these components be measured using an oscilloscope to measure the voltage, current and phase angle.

It should be noted that the above parasitic power numbers may not necessarily agree with the data shown in the appendix for the system at SCE Test Site. This is because the Intersol 2.5-kW photovoltaic concentrator was added to the Stirling dish circuit. A power generating meter was added, but a power consumption meter was not. Therefore, all of the power/energy readings for the dish include the Intersol electronic and drive-motor power consumption. Also, the south meteorological station was on this line which increased the parasitic power for the Stirling dish system even more. Because this equipment was single phase, the power load was further unbalanced. Several attempts were made to determine the power level by turning off the Stirling dish electrical power overnight, but the lower power level could not be measured because of the unbalanced load and coarse scale on the power meter. For these reasons the SCE Test Site parasitic power shown in Appendix C is higher than normal for the Stirling dish system.

IV. ENERGY PERFORMANCE

- Over 118 MWh of energy was generated during the test program.
- Produces power at daily sun irradiance energy lower than 1 $kWh/m^2/day$
- Daily net energy efficiencies higher than 27% on a good solar day

The energy performance of the Stirling dish is analyzed in this section using the test data recorded during the test program. Using this data, an estimate of the efficiency of the major system components is presented. Following this section, the results of this analysis will be used to estimate the annual energy performance. The total net energy generated by all units during the test program is shown for each test site in Figure IV-1. A summary of the test data is given for the Stirling dish in Appendix A for the MDAC Test Site, Appendix B for the Georgia Power Test Site and Appendix C for the SCE Test Site.

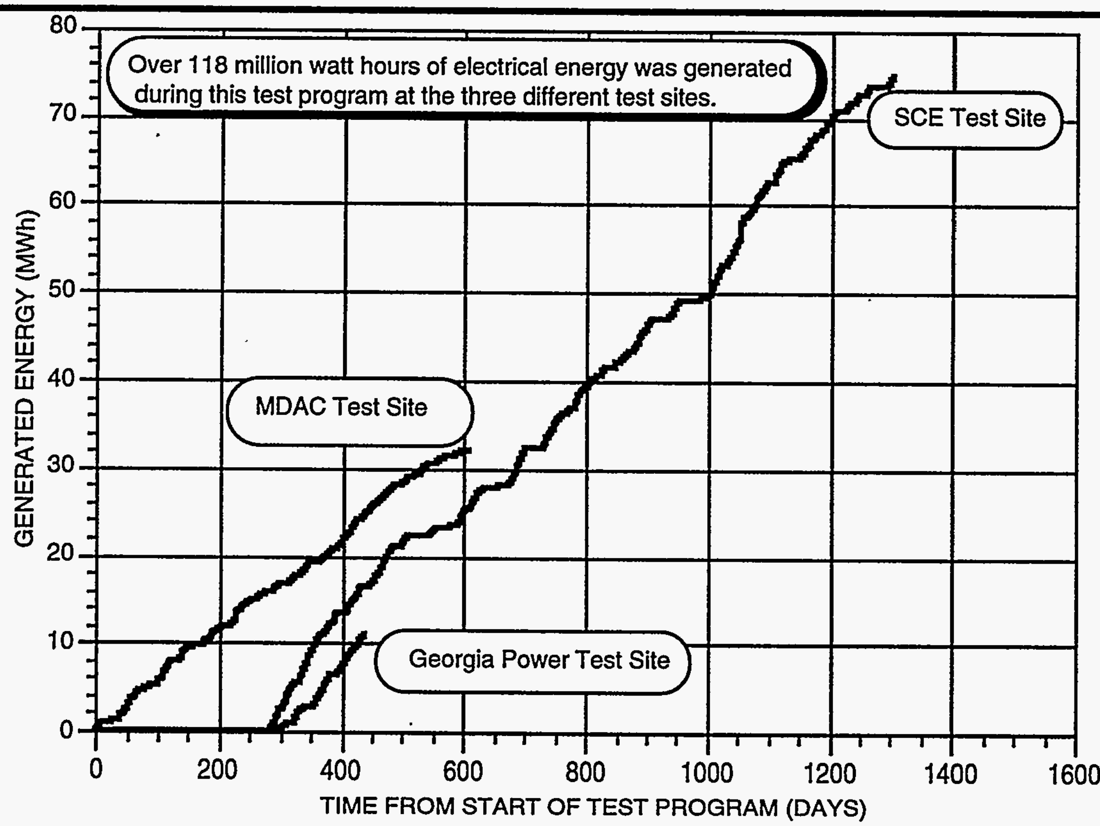


Figure IV-1. Total Net Energy Generated for the Three Test Sites.

Daily Energy Performance

The daily energy performance of the Stirling dish can be illustrated by dividing the total daily net electrical energy generated by the reflective normal area of the dish (87.69m^2) and plotting this as a function of total daily solar irradiance energy received per square meter. The energy performance for test pad 2 at the Huntington Beach Test Site is shown in Figure IV-2, for the Georgia Test Site in Figure IV-3 and for the SCE Test Site in Figure IV-4. The data points were calculated from manual readings of the utility site meters. The sun's daily irradiance energy was obtained from the Solar One weather station or by integrating the output of the normal incidence pyroheliometer (NIP). The diagonal line drawn along the top of the data point envelope represents the performance line or system peak performance as a function of the sun's irradiance energy. This line represents the line of best performance under ideal conditions, i.e., clean mirrors, little winds, low tracking error, etc. The performance line shows that the Stirling dish can produce a positive net energy at daily sun irradiance levels of 1 kWh/m^2. The system can obtain a peak energy

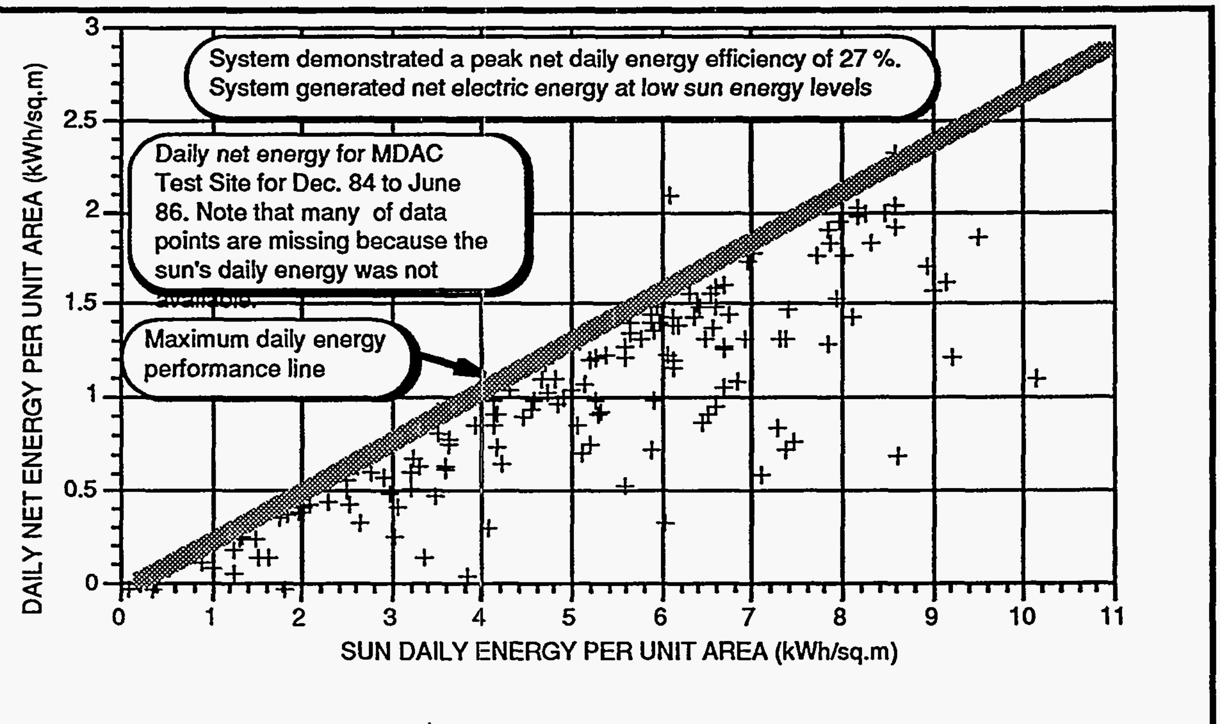


Figure IV-2. Energy Performance Test Data From MDAC Test Site, Pad 2.

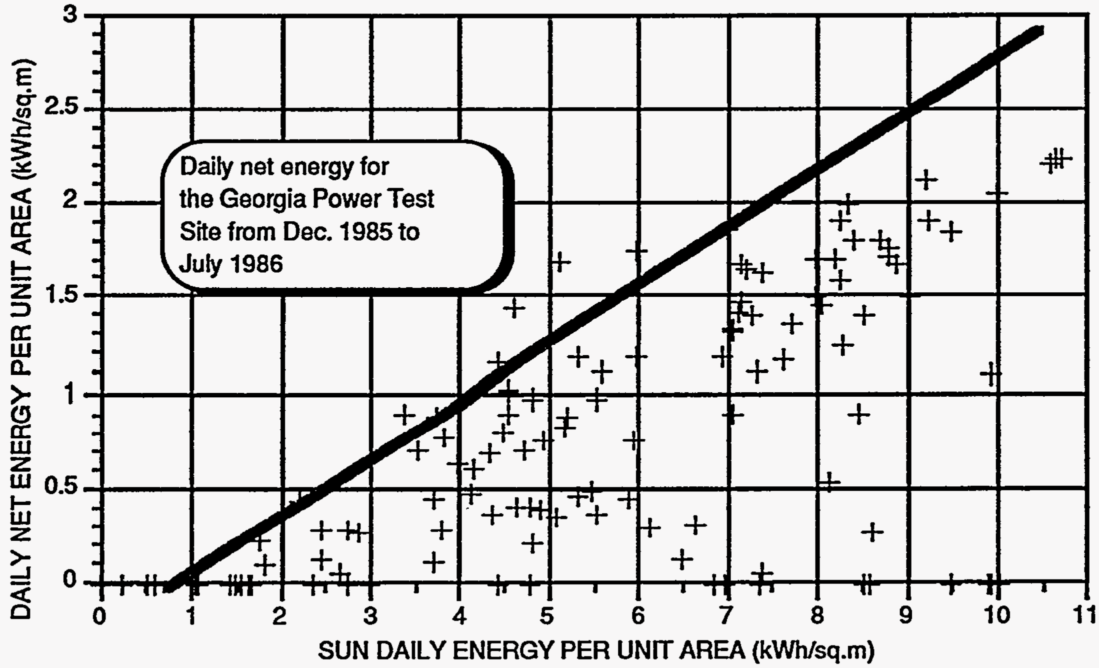


Figure IV-3. Energy Performance Test Data From the Georgia Test Site.

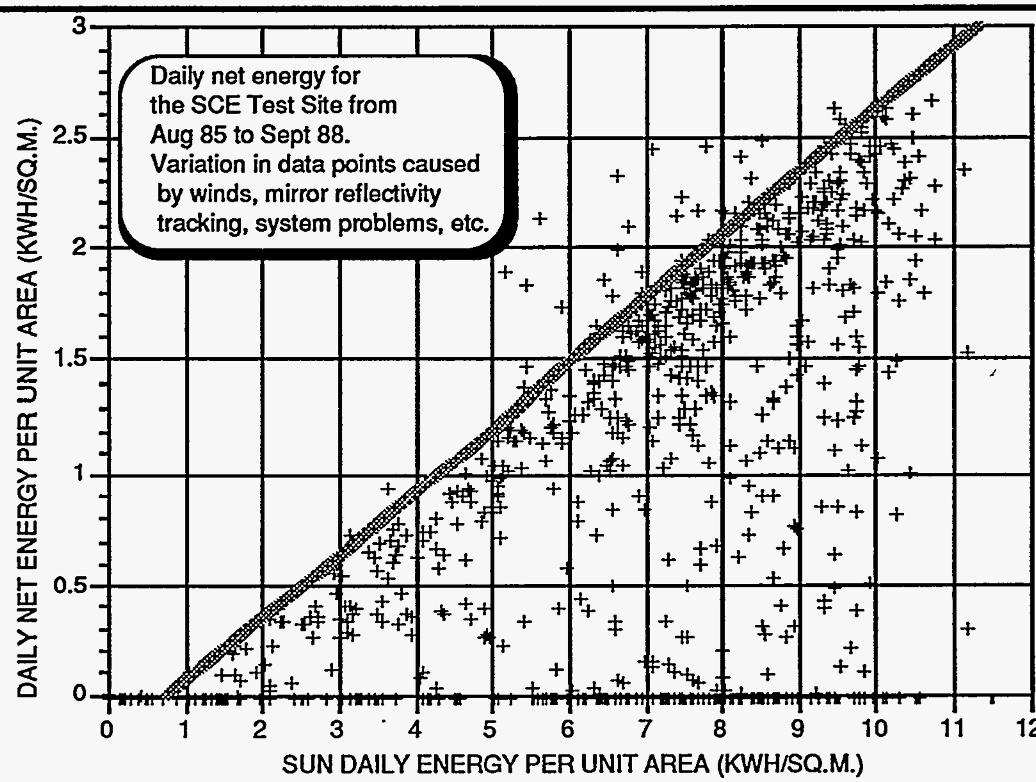


Figure IV-4. Energy Performance Test Data From the SCE Test Site.

efficiency of greater than 27% at a daily sun energy level of 10 kWh/m^2.

The data points that lie above the performance line are considered to be in error. These points could have been recorded in error since the utility meters were dial scale meters and were read manually. Also at times the NIP would become dirty or tracking drift errors would occur which made the sun energy appear lower than the actual level. Cleaning and adjusting the NIP tracking was part of the weekly operating procedure.

The wide spread of points below the performance line is the result of a number of factors. These can be summarized as:

1.0 Soiling of the mirrors reduced the mirror reflectivity and the daily generated energy.
2.0 Winds blowing across the receiver increased the heat loss from the receiver.
3.0 Winds caused movement of the receiver and reflective structure and increased receiver spillage.
4.0 High winds resulted in the concentrator going to high wind stow even though there was a good sun irradiance level.
5.0 The units at the Huntington Beach Test Site were frequently taken off line in order to conduct a specific development test.
6.0 The majority of the days that the SCE unit did not operate was due to delays in receiving spare parts. This was a result of the USAB and MDAC divestiture discussed later.
7.0 System operating problems interrupted the operation of the system.
8.0 The units were taken off line during the day to wash the mirrors, add gas to the system, system tests or for special demonstrations such as picture taking.

The wide spread of data points shown in Figure IV-4 at the SCE Test Site was a result of the USAB and MDAC divestiture. This divestiture resulted in a lack of spare parts and trained support personnel to repair the problems. During the mid part of 1988 (May and June) a new engine was mounted on the SCE Test Site

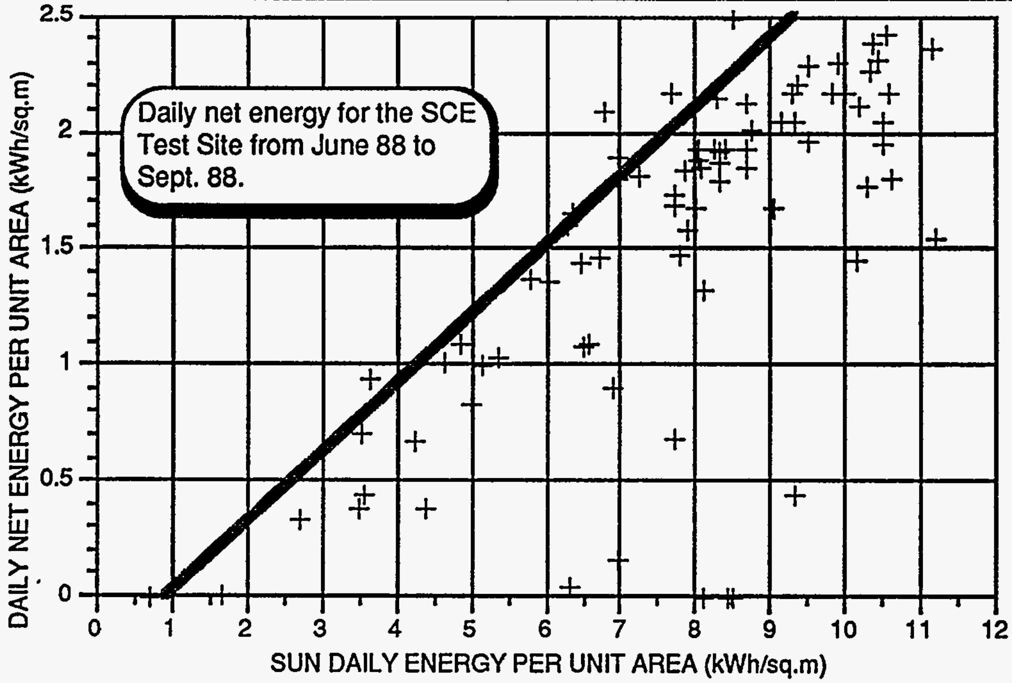


Figure IV-5. Daily Net Energy at the SCE Test Site from June 88 to Sept. 88.

concentrator and a number of changes and modifications were made in order to fix some of the more frequently experienced problems. The data from testing this unit is shown in Figure IV-5 for the period from mid-June to early September 1988. During this time, the unit operated nearly every day.

Energy Component Performance

The energy performance of the test units is analyzed here to identify the sources of energy losses and quantify the amount of energy lost from each source. This analysis is performed for a daily energy level of 10 kWh/m^2. The resulting component efficiencies are given in Table IV-1 and illustrated in the energy waterfall diagram shown in Figure IV-6. The losses are discussed in the following section.

TABLE IV-1. Energy Performance of the Stirling Dish Test Unit				
Source	Efficiency (%) Component	Efficiency (%) Cumulative	Energy (kWh) Delta	Energy (kWh) Total Available
Daily Energy				876.9
Reflectivity Losses	91.00	91.00	78.92	797.98
Intercept Losses Tracking Surface Waviness Cant Error	96.70	88.00	26.33	771.65
Receiver Conduction Reflectivity	90.00	79.20	77.16	694.49
Temperature Difference	99.5	78.80	3.47	691.02
PCU Engine Losses	38.78	30.56	423.01	268.00
Generator Losses	93.00	28.42	18.76	249.24
Parasitic Losses	94.88	26.97	12.76	236.48

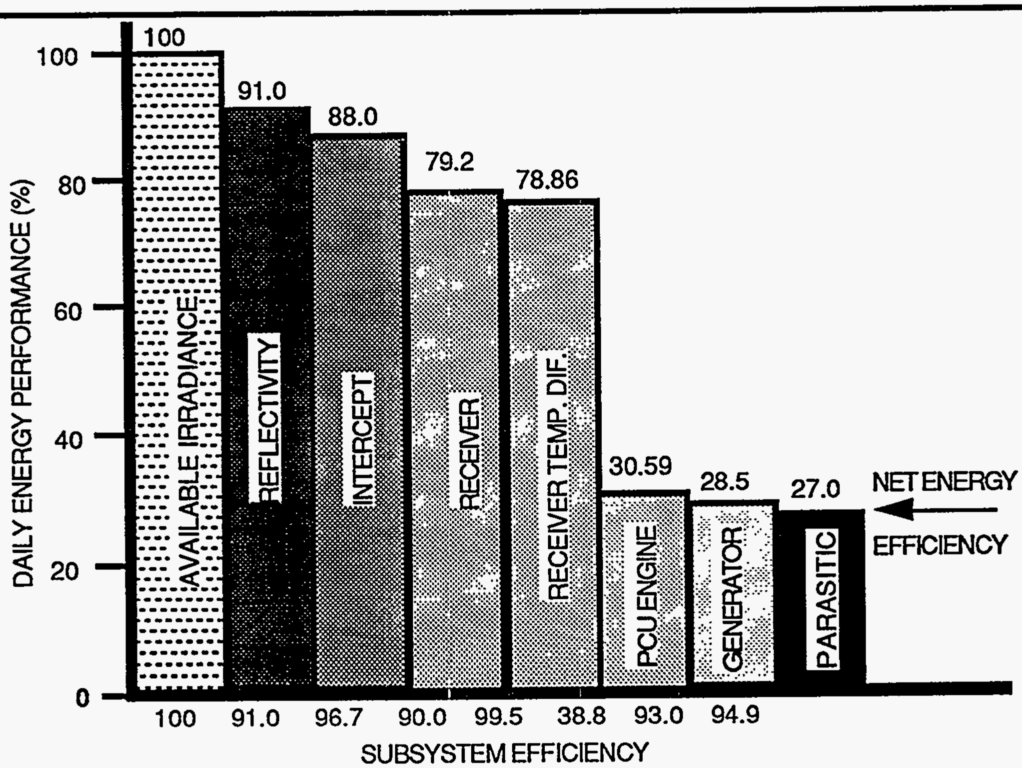


Figure IV-6. Daily Energy Waterfall.

AVAILABLE INSOLATION -- For this analysis, the available daily solar energy is assumed to be 10 kWh/m^2, which would result in 876.9 kWh solar energy falling daily on the concentrator.

REFLECTIVITY -- This analysis identifies the subcomponent efficiency at the peak energy operating point with a clean mirror reflectivity of 91%.

INTERCEPT -- The same percentage loss was used for this source as was used in the power-loss calculation in Section 3.

RECEIVER -- The same percentage loss was used for this source as was used in the power-loss calculation in Section 3.

POWER CONVERSION UNIT ENGINE -- The peak power efficiency analysis implies that the Stirling engine has a thermal efficiency of 42%. As shown in Figure IV-7, the engine efficiency varies over the day as the sun irradiance level varies. This curve was calculated by dividing the efficiency at each time point by the maximum efficiency for the day. The second curve in this figure shows a density function for the normalized efficiency. The average efficiency factor over a day is 0.92344. The average Stirling engine efficiency is obtained by multiplying 0.92344 by 42% to get 38.78%.

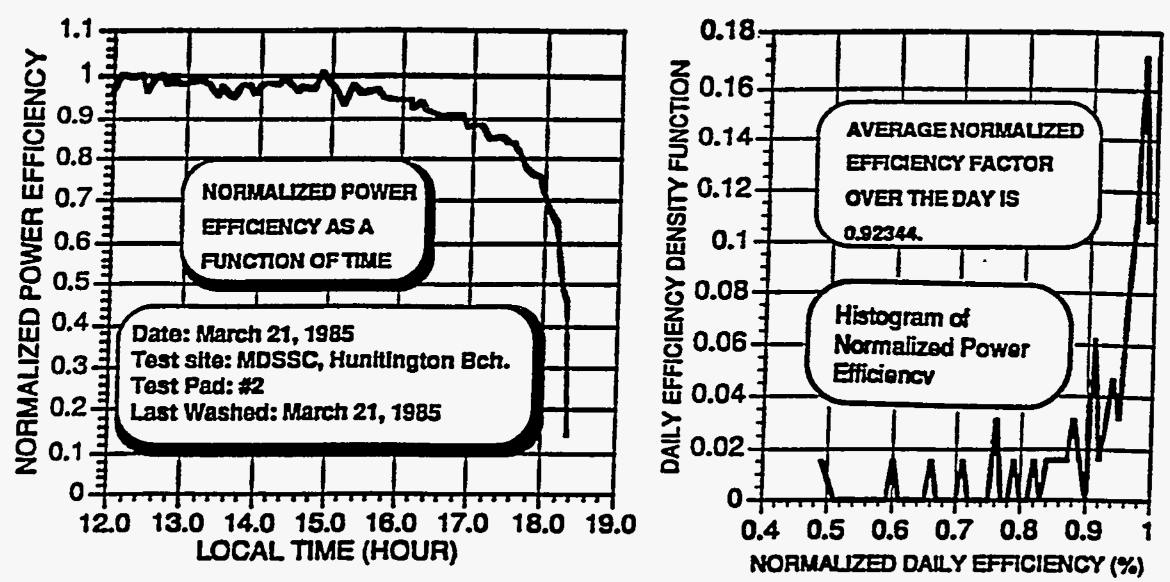


Figure IV-7. Stirling engine efficiency over the day.

GENERATOR -- The generator efficiency given in the last section shows that the generating efficiency is constant for a given speed. Since the system operates at a constant speed, the daily energy efficiency was assumed to be the same as for power, 93%.

PARASITIC -- The daily parasitic energy varies with the time of day and time of year, but from the data presented in the Power Performance Section, an estimate can be made of an average value for the daily 24-hour parasitic energy required. This estimate is shown in Table IV-2.

In the present control logic, the water pump is on while the dish is tracking. It shuts off when the dish detracks and the PCU has cooled to ambient. The estimate of fan time was based upon a ratio of fan on-time to total generating time shown in the summaries of the Mark I and Mark II Operation.

Table IV-2. Estimate of 24 Hour Parasitic Energy.

Component	Time	Required Power	Energy
Electronics			
Concentrator	22 h.	40 w	0.96 kWh
PCU	24 h.	180 w	4.32 kWh
Concentrator Motors			
Stowing	0.7 h	154 w	0.1 kWh
Tracking	10 h	20 w	0.2 kWh
PCU Water Pump	12 h	264 w	3.2 kWh
PCU Cooling Fan	5 h	800 w	4.0 kWh
		Total Parasitic Energy =	12.78 kWh

V. POWER AND ENERGY COMPARISON WITH OTHER SOLAR SYSTEMS

- Produces 2 to 5 times more power per aperture area than other solar systems
- Produces 1.5 to 2.5 times as much daily energy per area than other solar systems
- A previous program also verified the high performance of the Stirling Dish

The SCE Test Site offered a unique opportunity to compare four different solar systems. The 10 MW Solar One Central Receiver Plant, an Intersol photovoltaic concentrator, the Solar Electric Generation Station (SEGS), and the Stirling dish were all located in the same general Mojave Desert area. The side-by-side energy performance of these systems will be compared in this section. In addition, the energy performance of the Vanguard Stirling dish unit, which used a similar Stirling engine, but a different concentrator design, will be compared to the MDAC/USAB/SCE system.

The normalized power performances of the four solar systems are shown in Figure V-1 for summer solstice and for spring equinox of 1986 as a function of time. The SEGS 1 power curve lags the others because the early morning energy is used to charge the thermal storage system which is then used to produce power after sundown. These data shows that the Stirling dish produced 2 to 5 times as much power as the other systems. The average daily energy performance of the MDAC/USAB/SCE system, Vanguard system, Intersol PV system, SEGS 3, and the Solar One Plant is shown in Figure V-2. This data shows that the Stirling dish produces 1.5 to 3 times the energy per unit aperture area as the other systems. The Stirling dish system not only produces more energy on clear days, but also is capable of producing energy on cloudy days when the other systems did not produce any energy. As might be expected, the MDAC/USAB/SCE Stirling dish and the Vanguard Stirling dish demonstrated comparable energy performance. These two programs substantiate the improved performance predicted for Stirling dish system.

Solar One

A considerable amount of performance data is available on the energy performance of the Solar One Central Receiver. There are a total of 1,818 heliostats at Solar One,

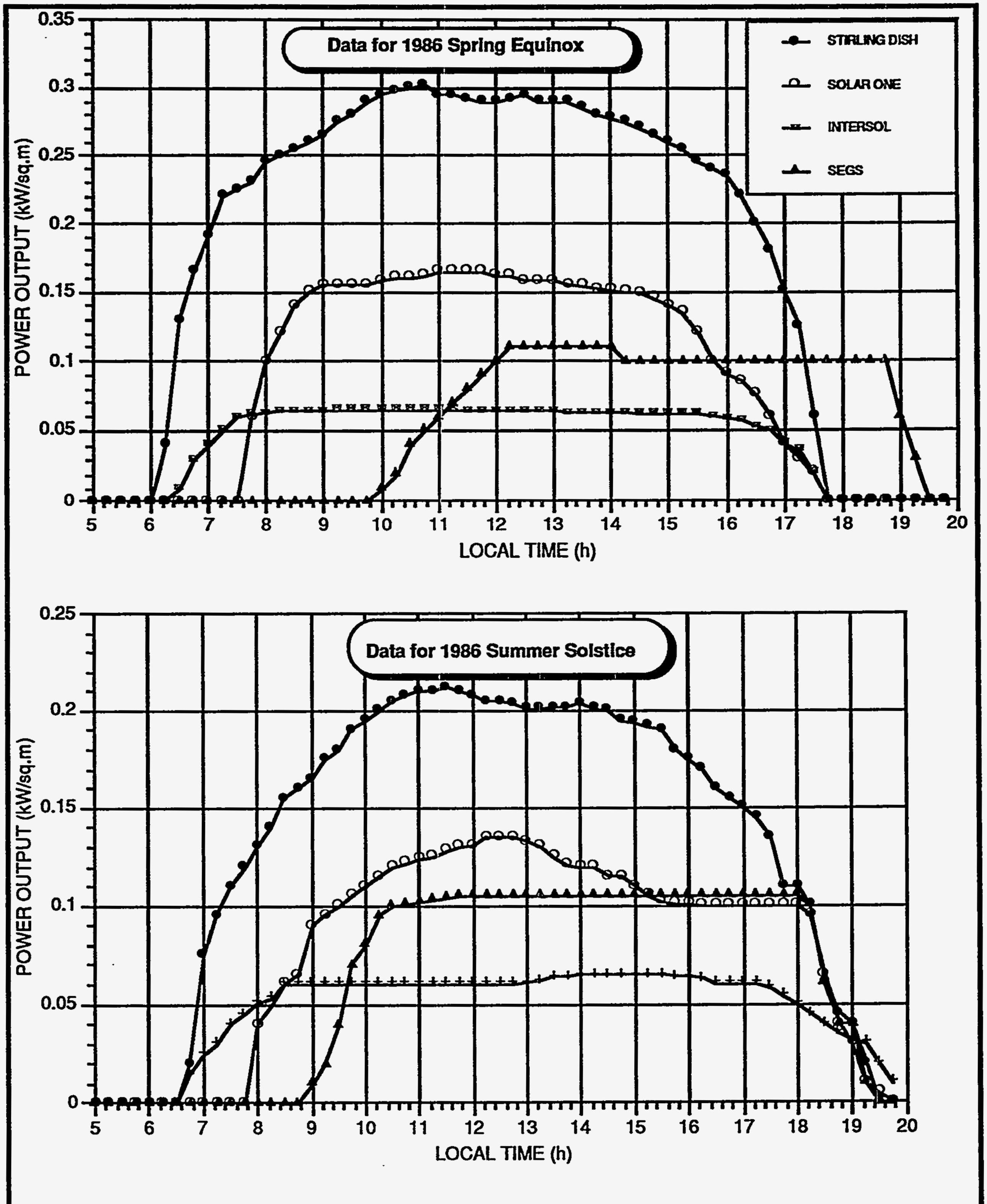


Figure V-1. Power Comparison of the Stirling Dish, Solar One, Intersol PV and SEGS 3.

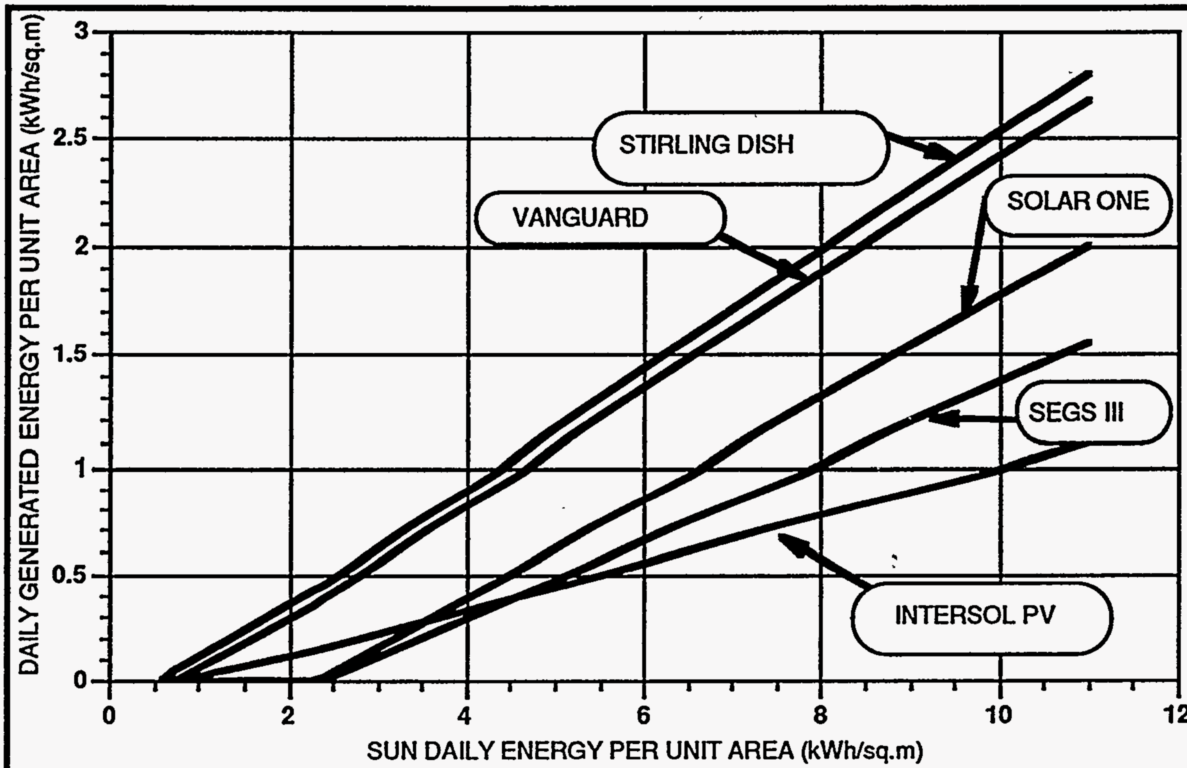


Figure V-2. Daily Energy Performance of Stirling Dish Compared with Solar One, Intersol PV, SEGS Trough and Vanguard Program

and each one has a total glass area of 423 ft^2. It is assumed that an average of eight heliostats are out of service. The total glass area would be 71,122 m^2 (765,630 ft^2). The effective glass area was calculated by multiplying the total area by an average cosine angle, an average blocking factor and an average shading factor. All of these factors were obtained from Reference 9. These data were plotted as a function of time, with the factor incremented at half-hour intervals (Table V-1). The average value was calculated by summing the values over the day and the year as shown in this table. A plot of the Solar One daily energy performance is shown in Figure V-3 using the total effective aperture reflective area. These data cover only the last two years of performance, 1987 and 1988.

The Vanguard Unit

The Vanguard program demonstrated a Stirling dish system similar to the MDAC/USAB/SCE program. The information in the section was obtained from

TABLE V-1. Cosine, Blocking, and Shadowing at Solar One.

Hour	June 22	May/Jul 21/23	Apr/Aug 21/23	Equinox
0	0.833	0.833	0.835	0.837
0.5	0.830	0.830	0.832	0.834
1.0	0.828	0.828	0.830	0.832
1.5	0.826	0.826	0.828	0.828
2.0	0.810	0.810	0.810	0.810
2.5	0.800	0800	0800	0.800
3.0	0.790	0.790	0.790	0.791
3.5	0.765	0.766	0.765	0.745
4.0	0.739	0.735	0.738	0.685
4.5	0.706	0.690	0.680	0.620
5.0	0.660	0.641	0.605	0.530
5.5	0.600	0.572	0.530	0.400
6.0	0.520	0.500	0.430	—
6.5	0.415	0.390	—	—
7.0	0.250	—	—	—

Hour	Feb/Oct 21/23	Jan/Nov 21/22	Dec 21	Equinox
0	0.836	0.819	0.805	0.837
0.5	0.830	0.819	0.800	0.834
1.0	0.829	0.811	0.790	0.832
1.5	0.820	0.795	0.770	0.828
2.0	0.805	0.765	0.740	0.810
2.5	0.785	0.740	0.700	0.800
3.0	0.748	0.680	0.645	0.791
3.5	0.695	0.610	0.580	0.745
4.0	0.679	0.535	0.506	0.685
4.5	0.530	0.440	0.410	0.620
5.0	0.400	0.300	0.240	0.530
5.5	—	—	—	—
6.0	—	—	—	—
6.5	—	—	—	—

Average = 0.699

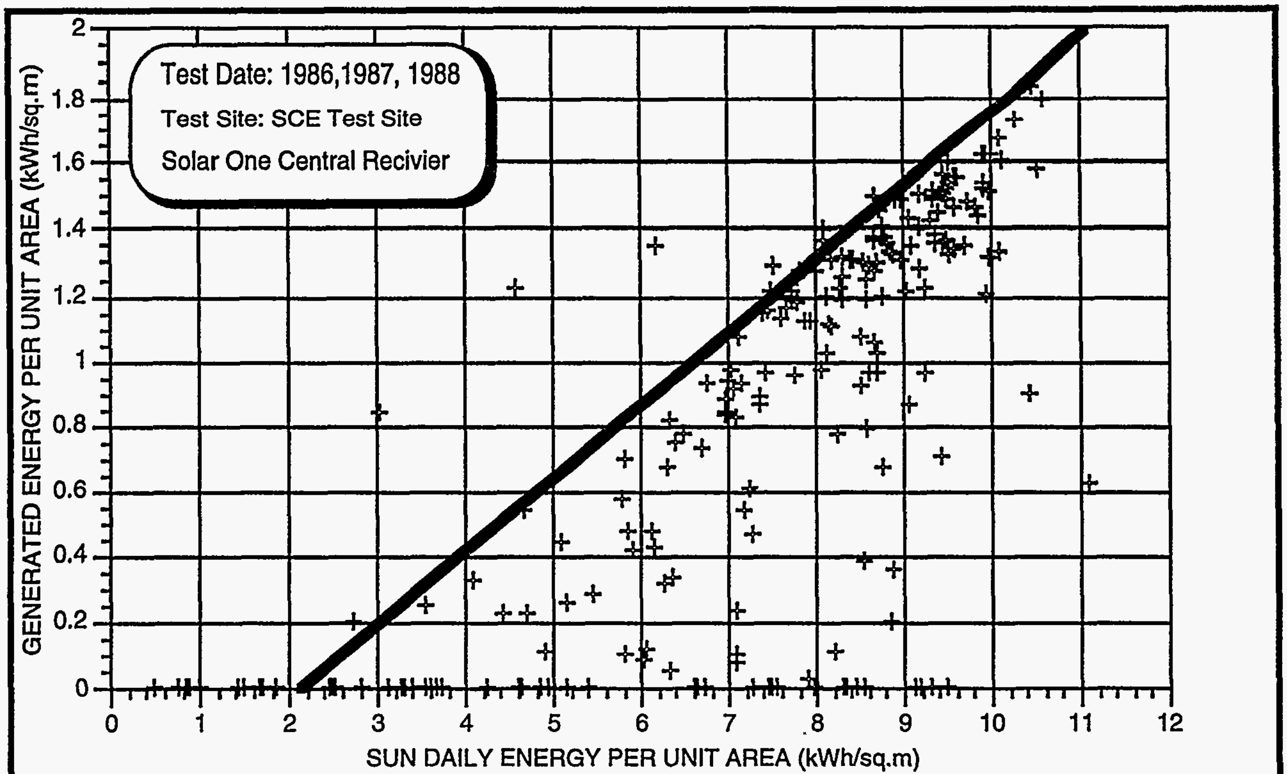


Figure V-3. Daily Energy Performance of Solar One.

References 2 & 3. A comparison of the characteristics of the two units is summarized in Table V-2. The daily energy performance for the Vanguard unit shown in Figure V-4, was taken from Reference 2. The data shown were not equivalent to the MDAC/USAB Stirling dish data presented previously because of the method that was used to calculate the total insolation. If the Vanguard unit only operated for part of a day, then only the sun's energy while it was operating was recorded. The MDAC/USAB Stirling dish data used the total daily insolation whether or not the system operated all day. The Vanguard data showed a higher efficiency for part-day operation and much less scattering of data points than the MDAC data. This difference in data gathering methods did not affect the peak performance line.

Intersol Photovoltaic Concentrator

An Intersol photovoltaic (PV) concentrator was installed at Solar One in 1987. The unit was originally designed by the Martin Marietta Corporation for mounting 60

Table V-2. Comparison of MDAC/USAB and Vanguard Stirling Dish System.

Characteristics	MDAC/USAB	Vanguard
Number of facets	82	336
Total Mirror Area	$91.0m^2$($979.7ft^2$)	$91.4m^2$
Aperture Area	87.7 m^2($943.7ft^2$)	$86.7m^2$
Ratio Aperture/Total	0.963	0.949
Facet Size	0.91m X 1.22m (3 ft X 4 ft)	0.451m X 0.603m (1.5 ft X 1.98 ft)
Reflectivity (clean)	91-92%	93%
Weight (excluding PCU & foundation)	6,803kg(15,000 lbs)	10,400 kg (22,927 lbs)
Sun Tracking	Open Loop	Closed Loop
Energy at focal plane ($850W/m^2$)	68.4kWt	63.1kWt
Structure blocking & shadowing	0.998	0.92
Gimbal	Azimuth/Elevation	Exocentric

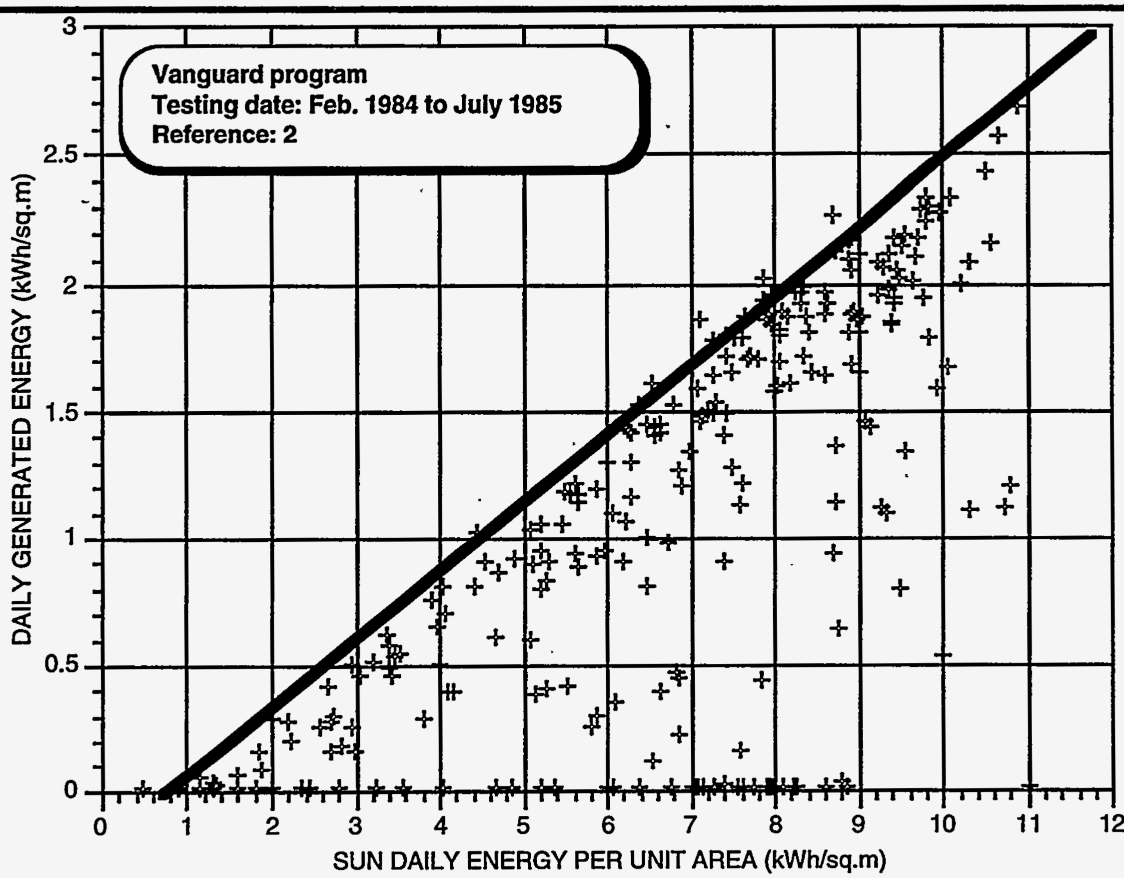


Figure V-4. Daily Energy of the Vanguard Stirling Dish.

photovoltaic modules. This unit uses the Martin Marietta tracker but is equipped with 32 concentrating photovoltaic modules supplied by the Intersol Company. The modules consist of 14 photovoltaic cells contained in a weatherproof enclosure. Each cell is provided with a Fresnel lens, which concentrates the solar flux density incident on the cell by a factor of 70.

The unit's rated electrical output is 2.5 kW @ a solar insolation level of 1,000 W/m^2 and an ambient air temperature of 28°C (83°F). The unit operates unattended and has had an extremely low operating and maintenance cost since its installation in early 1987. Refer to Figures V-5 and V-6 for structural details. The energy produced per m^2 by the photovoltaic unit is presented in Figure V-7.

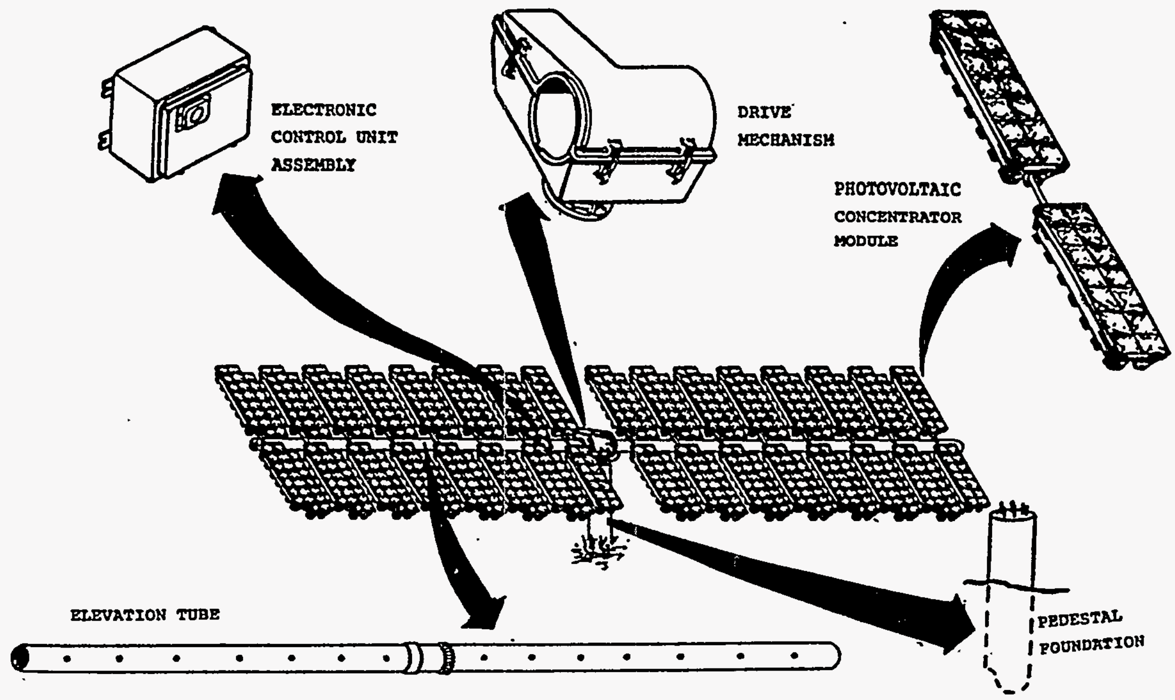


Figure V-5. Intersol PV Concentrator Key Components.

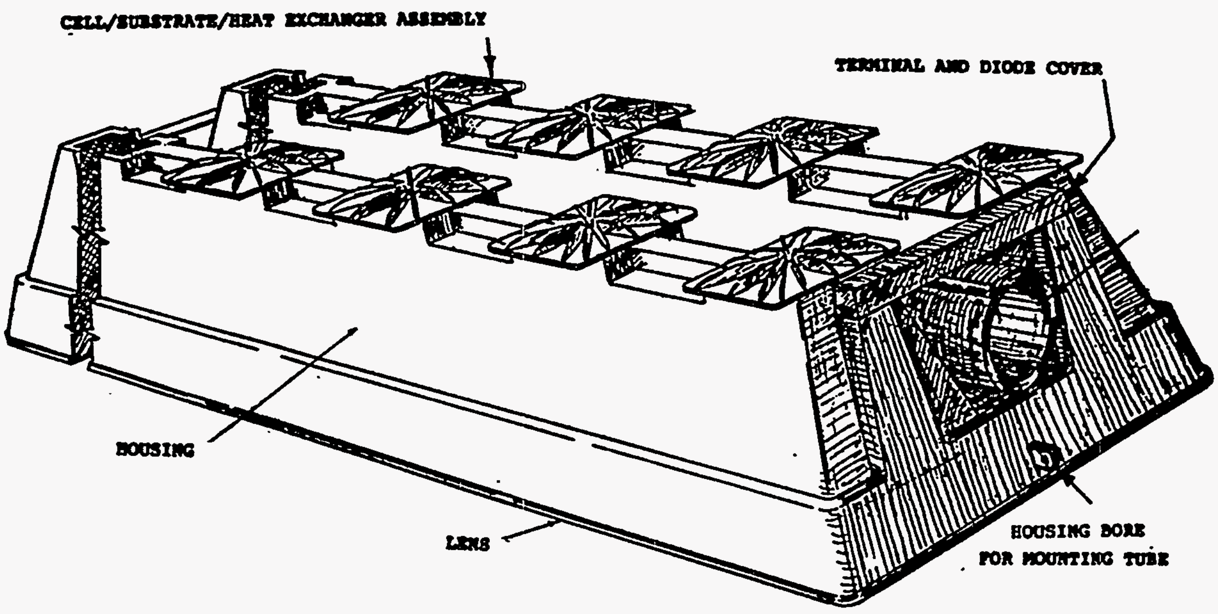


Figure V-6. Intersol PV Module Design.

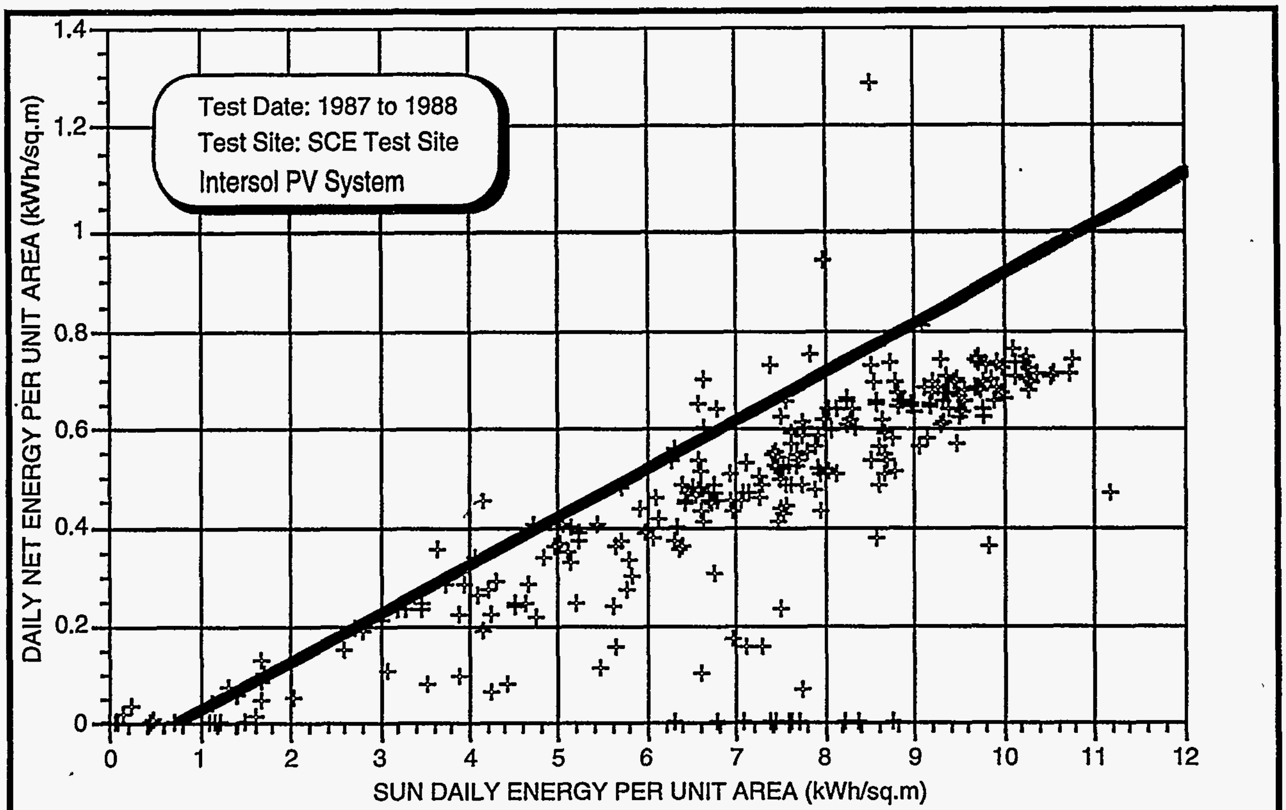


Figure V-7. Daily Energy Performance of Intersol PV System.

Operationally, the Stirling dish and the photovoltaic unit share the attributes of operating unattended and of modularity with respect to future growth. Based on the current operating experience, the Stirling dish has the advantage of high efficiency and the disadvantage of requiring routine operating intervention and higher maintenance cost. During the operation of the Stirling dish, it was demonstrated that its required operating intervention could be significantly reduced primarily by PCU software revisions and minor equipment modifications.

Solar Electric Generation System (SEGS)

The SEGS plants are located next to the Solar One plant at Barstow. SEGS-1 generates 13.8 megawatts and SEGS-2 produces 30 megawatts. SEGSs 3, 4, 5, 6 and 7 are 30 megawatt plants near Kramer Junction, 40 miles west of Barstow. SEGS 8 & 9 are 80 MW plants located approximately 15 miles northwest of Barstow. These facilities are the largest commercial solar electrical generating plants in the world. The plants consist of a field of parabolic trough collectors which heat oil going through a receiver tube at the focus line of the troughs. The oil serves as the thermal transfer fluid and is pumped from a cold storage tank, held at approximately 465°F through the solar collector to absorb the sun's energy. The hot oil coming directly from the field or the hot storage tank is used to convert water into superheated steam. The superheated steam is used to power a turbine generator. Further information on the SEGS plants is in Reference 10 & 11.

The gross daily energy performance of the SEGS plant is shown in Figure V-8 (data furnished to Southern California Edison by Luz Engineering). Note that this data are gross daily energy and the daily sun energy was multiplied by a cosine

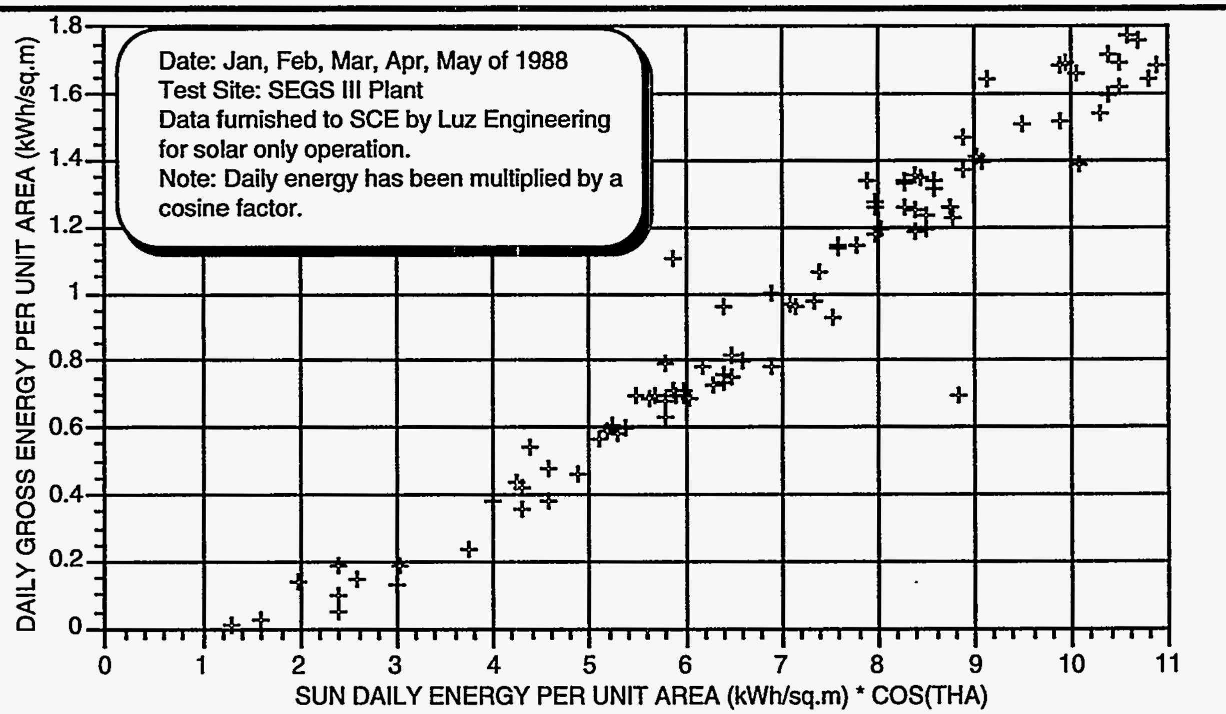


Figure V-8. Daily Energy Performance of SEGS.

factor (cosine(THA)). Therefore, this data are not directly comparable as furnished by Luz Engineering to the data of the previous system. This data were collected on days when gas was not used and, therefore, is for solar-only operation. Based upon estimates of parasitic system energy consumption obtained from Luz Engineering, the generated daily energy was modified to obtain the net energy. Each month of daily sun energy was divided by the cosine factor in order to obtain information comparable with the data from the other systems. The component power efficiency for the system is shown in Figure V-10. This data were furnished to SCE by Luz Engineering.

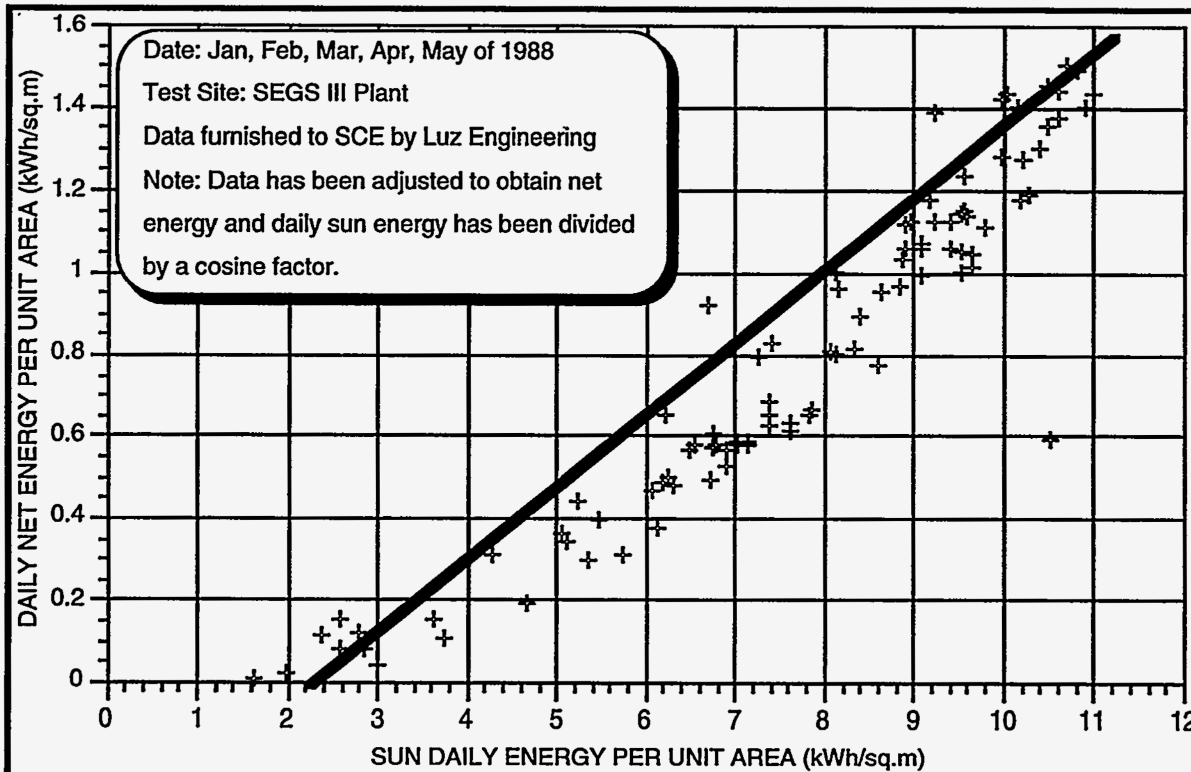


Figure V-9. Modified Daily Energy Performance for the SEGS Plant.

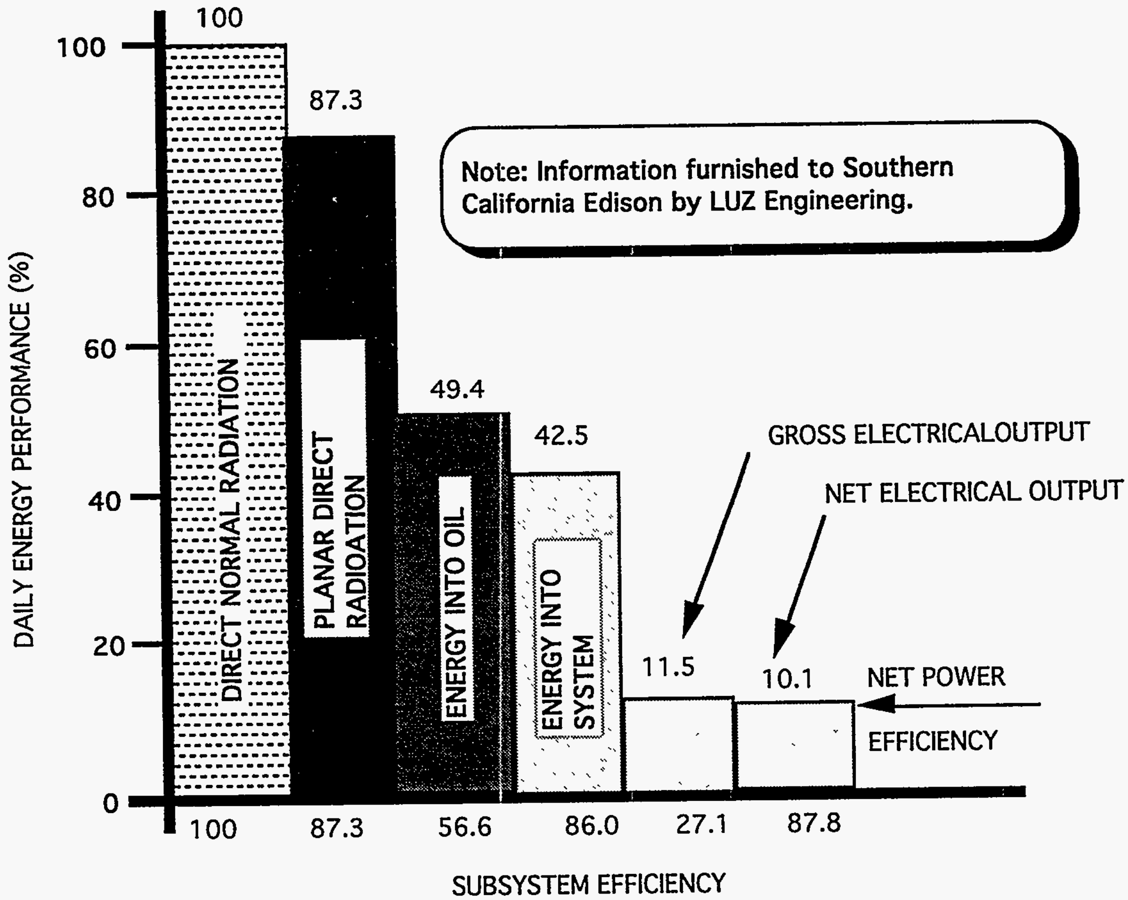


Figure V-10. Typical Efficiency Chain for SEGS III-V.

VI. SYSTEM AVAILABILITY

- Test program achieved a system availability of greater than 86%
- Demonstrated that commercial plant availability could be better than 90%
- Divestiture of USAB followed by MDAC detracked from true system availability

This section uses the operating performance data from the test sites to calculate the system availability during the demonstration program. The results are then extrapolated to estimate the system availability for generating power in a commercial power plant consisting of multiple Stirling dishes. This analysis is derived from the event log at each test site, the monthly reports (Reference 6), and first-hand interviews with personnel involved with the program. A summary of the major operating events is given in Appendix A for the MDAC Test Site and in Appendix B for the Georgia Power Test Site.

A summary of the system availability (defined later) is shown in Table VI-1. During the test program, a system availability of 86 to 90% was demonstrated. An analysis of the test program and lessons learned about how a commercial system should operate, indicated that a commercial system could have a system availability higher than 96% as shown in Table VI-2. It is conceivable, a system availability of 96% to 99% could be achievable with current state-of-the-art technology. Since the end of this Stirling Dish demonstration program in September 1988, simple concentrator modifications have been identified which would significantly increase the concentrator availability.

Although the system availability and the mean time between failures (MTBF) are of major interest, it is difficult to reduce the test data from this program to numbers that reflect the performance of commercial systems or that can be compared with other systems. Some of the reasons that make this task difficult are as follows:

1. The MDAC Test Site was used as a test bed where the PCU was operated for the first time on solar energy. Therefore, down time occurred because of first time PCU start-up problems and longer times were required for check-out. After a unit was operating satisfactorily, it was removed, and a new unit replaced it. As part of the test program, the units would be shut down for routine inspections even though they were operating satisfactorily.

Table VI-1. Test Program System Availability.	
Test Site	**System Availability**
1. MDAC Test Site	
• Including first 4 months of startup problems	89%
• After first 4 months of operation	90%
2. Georgia Power Test Site	
• Total Program	72%
• Before MDAC/USAB Divestiture	86%
3. SCE Test Site	
• Total Program	50%
• From June 1988 to September 1988	87%
• Estimate with spare parts, manuals, trained personnel, etc.	87 - 88%

Table VI-2. Estimate of a Commercial Plant Availability.		
Reason for Outage	**Outage %**	**Total System Outages**
1. Washing Concentrator	0.05-0.2	0.05-0.2
2. Availability of Personnel	0.1-0.4	0.15-0.6
3. Grid Power Loss	0.05-0.2	0.2-0.8
4. General Maintenance	0.1-0.2	0.3-1.0
5. Fill Hydrogen System	0.05-0.1	0.35-1.1
6. Wind Stow	0.2-0.4	0.55-1.5
7. Dish Trouble-Shooting, Repair, and Testing	0.2-0.6	0.75-2.1
8. PCU Trouble-Shooting, Repair, and Testing	0.4-1.2	1.15-3.3
System Availability = 96.7 % - 98.85 %		

2. The PCU control system was not a production-quality unit designed for a desert environment. In addition, implementing permanent fixes were not cost- effective, considering the remaining program duration. This resulted in reduced power generation time from problems that would have been corrected before producing a commercial system.

3. Although there was a vast amount of performance data compiled during the demonstration program, it was fragmented because of DAS software problems, instrumentation calibration, insufficient operator logs of maintenance and operating times at the different sites. This fragmentation made it difficult to determine the system test availability.

4. The program became the victim of circumstances when first USAB and then MDAC divested themselves of the program. The divestiture resulted in the loss of personnel trained to maintain the units. Consequent to the year long negotiations for the sale of the technology and subsequently sale of the remaining hardware, the availability of spare parts, manuals, and technical assistance to SCE, the purchaser, was limited. The divesting of USAB and MDAC from the program made it nearly impossible to determine and make permanent solutions to problems encountered in the SCE phase of the test program. Therefore, certain problems recurred throughout the remainder of the test program.

5. Plans were made during the SCE test program to correct some frequently occurring problems, but they were not completed before SCE decided to discontinue the Stirling dish development program. These improvements were limited to those provided by the authors and Lenoard Lundstrom, Intersol. A major portion of the time was spent during the SCE phase of the program repairing the old parts, searching for replacement parts, completing system manuals and drawings, etc.

6. Lack of operating personnel on the weekends often led to shut-down of the units even though the units did not have a problem and automatic operation was possible. During the last year of operation at the SCE's Solar One Test Site, the office building where the PCU monitor was located was locked on the weekends. If one of the erroneous detracks occurred, the unit had to wait until Monday when an operator had access to the office building to reset the monitor before operation

could resume. Accordingly, it would be out of service for one or two days pending this reset action.

The data are summarized for each site with as few assumptions as possible. At the end of this section, the test data are used to estimate the availability of a commercial plant. After reviewing the available information, the availability of the unit to generate power on a nominally clear day (Figure VI-1) was determined to be the most meaningful compilation of the data. The availability or the fraction of the day that the dish was available to track the sun and produce power is the track time ($t_1 + t_2$) divided by the time of the operating day. The length of the operating day is defined as the length of time during which the insolation exceeds 300 W/m^2 in a "clear" environment. This is the time during the day when the PCU could operate and should be available to generate power (revenue generating time). Even if power could not have been produced because there was low sun irradiance during the outage, it was still counted as system down time. System outage time is divided into four main categories, with a number of subcategories. These categories are:

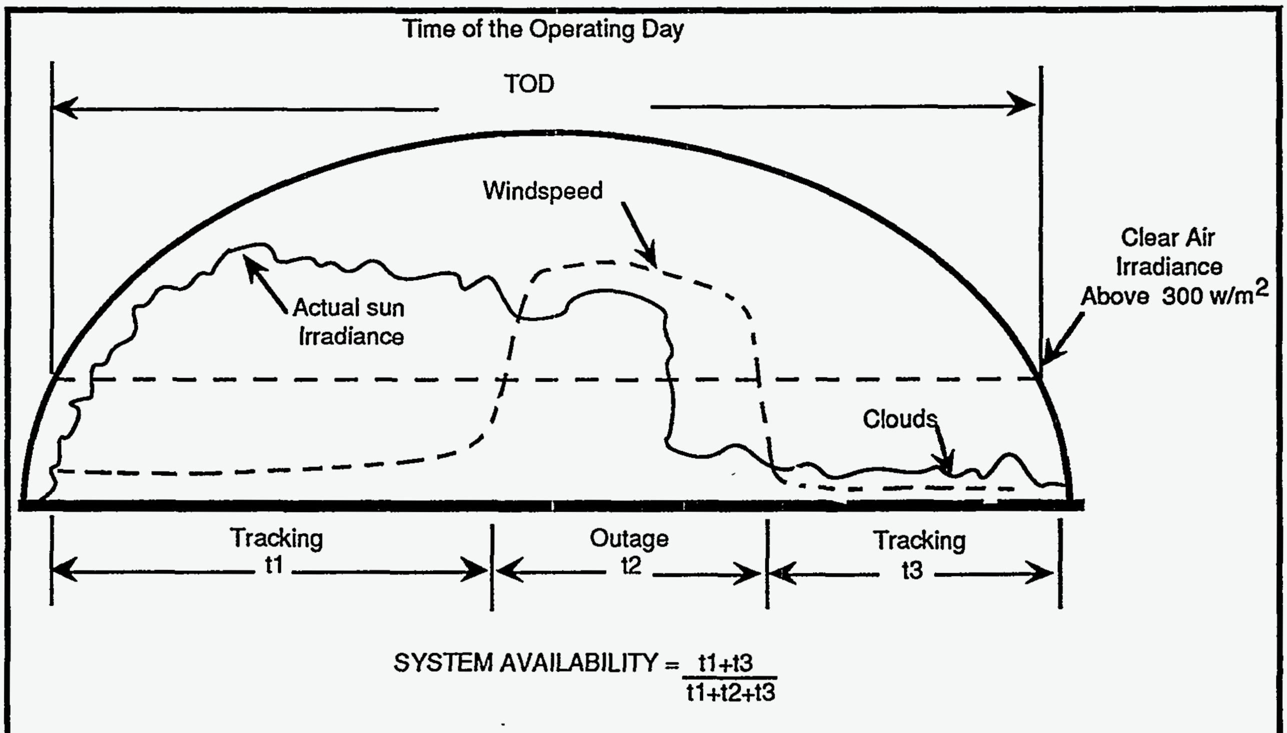


Figure VI-1. System Availability is the Ratio of Track Time to Time of Operating Day.

A. GENERAL OPERATION - The first outage category was general plant operation, which includes:

1. Washing the concentrator - The time to wash the dish, to initialize the system, and to put it back in a track position.

2. Availability of personnel - The operation and maintenance personnel at both SCE and Georgia Power Test Site had other responsibilities. The main function of the operators and maintenance personnel at the SCE Test Site was to keep Solar One operating, therefore, personnel were not always available to provide timely troubleshooting and repair. Lost time is the time that between problem detection and personnel availability to service the system.

3. Grid power loss - The grid line feeding the dish and/or control room lost power. Lost time includes the time power was off, time to reset, time to initialize the system, and time to go back to a track position.

4. General maintenance - Lost time was when general maintenance was performed, such as maintenance inspection, checking oil and water, etc.

5. Fill hydrogen system - Lost time to add hydrogen to the bottle or add a new bottle plus time to return the system back in service.

6. System Controller (SC) preventive maintenance - Lost time the DEC computer was down for general preventive maintenance, plus the time to return the system to service. There was no backup SC, so the system was down during this SC outage time.

B. DISH PROBLEMS - The second outage category, problems with the dish, included problems specific to solar concentrators such as:

1. Wind stow - The system outage time while the dish was in a wind-stow position due to high winds. Also, the time to go to and return from this wind-protected mode was included in the wind-stow outage time. This outage time was considered a dish problem because the azimuth drive did not meet its performance requirement and the wind stow limit was lowered to 25 mph.

2. Waiting for parts and service - The lost time spent waiting for a spare part or for a technical service person to arrive at the site and investigate the problem. Lack of updated service manuals, incomplete training, and lack of available spare parts at MDAC during the transition of the technology to SCE.

3. Repairing and troubleshooting - This included the time needed to determine the problem, and the time to repair, test, and return the unit to service.

4. Fast Slew Repair - Time to service, troubleshoot, modify, and test this emergency system.

C. PCU PROBLEMS - The third outage category included all problems specific to the PCU.

1. Lightning protection stow - The PCU electronics were found to be very sensitive to lightning. The PCU electronics (which were really a development prototype and not a production unit) were not designed for this type of environment. Some "band-aid" modifications were made during 1988 that demonstrated the problem could be resolved. Since the concentrator electronics which were in the same environment, never had a problem, this also indicates the problem could be resolved. The SCE unit was put into a lightning-stow protection condition when lightning was in the area or if a lightning storm was anticipated. This consisted of disconnecting the PCU monitor cable at the PCU and the control room monitor and placing the dish in a face-up stow position. This included the time to disconnect, travel to face-up stow, time at wind stow, time to reconnect the cables, and return the system to service.

2. Waiting for parts and service - The time spent waiting for spare parts before the system could be repaired. Most of this time was the result of USAB's departure from the program and completion of the system sale to SCE. During this time, available spare parts could not be obtained.

3. Troubleshooting - This time included the travel time for a specialist to travel to the site and diagnose the problem, or time for O&M personnel to work with the service person over the phone to diagnose the problem.

4. Repairing and testing - This included time to repair the problem, test the system, and return the system to service.

5. Detracks - A number of false detracks occurred where the subsequent investigation did not find a problem. The PCU control system had a number of diagnostic tests which stopped the system when there wasn't a real problem, such as "oil pressure but not running". A high oil pressure indication occurred on cool mornings with hazy sun. The engine started and then stopped because of low sun irradiance. Because the oil was cold, the engine oil pressure stayed high longer than normal, causing the alarm. "Too many starts" is a second example of a frequent detrack outage. This occurred on partly cloudy days. This outage included the time it took to clear the alarm and put the system back in service. At the SCE site, the operator had to go to the dish control room from the Solar One control room to clear the alarm. If the alarm was the result of a valid problem, then the time to fix the problem was charged to one of the other categories. During the last year and a half, the SCE dish control room was locked, so the operator would have to wait until Monday before the unit could be put back into service. This was counted as down time.

6. PCU monitor problems - The monitor is not required to operate the PCU except to clear a detrack or to investigate a PCU problem. The time included in this category represents the time the system was down and could not be cleared because of a monitor problem.

7. Insolation too high - At high insolation levels, above 1,000 W/m^2, the engine could not remove heat from the receiver fast enough to maintain the receiver temperature at the setpoint temperature. The system would detrack and stay at standby until the insolation dropped and an operator commanded the system to return to track. This situation would be resolved in the next generation system.

D. MISCELLANEOUS - The fourth outage category was for events that did not fall into the above three categories. This category included the initial installation and checkout, and problems with the Fluke DAS. Although this system was not required for the operation of the Stirling dish, the dish had to be shut down several times for repair of the DAS.

Availability of SCE Unit at the SCE Test Site

Analysis of the SCE test site data in Table VI-3 shows that over the period of the test program, the SCE unit was available 50.8% of the solar operating day. Fractions of the day during which the dish was not available to generate power are also shown in this table. This unacceptably low availability was not a result of low-hardware reliability but was primarily due to the absence of spare parts (see Items B-2 and C-2 in Table VI-3). This problem was caused by the USAB and MDAC divestiture and the time required to transfer the remaining hardware and spare parts to SCE. During this period the inventory of spare parts was not available to SCE. The divestiture occurred before the SCE maintenance personnel were trained and before manuals could be updated. Therefore, trained personnel were unavailable for this portion of the test program. This accounts for a major portion of the repair and troubleshooting outage time. The number of days of continuous operation is presented for the SCE system in Figure VI-2. An estimate of the mean time between outages was five days. Some of the more common reasons for the outages and the frequency are listed in Table VI-4. The mean time between outages caused by the dish was 48.5 days and for the PCU was 11.1 days. The majority of these outages were for short periods of time as a result of PCU false detracks. No problem could be found and the operator would clear the detrack and put the system back in operation. The false detracks will be discussed more in the next section.

The two most significant problems that occurred during the test period were the failure of the concentrator azimuth drive and PCU rod/bearing problems. Both of these problems are also discussed in detail in the following section.

Expected Barstow System Availability

The low availability of the SCE unit was not a result of hardware reliability, but was more the result of the divestiture of the program by MDAC and USAB. Due to the circumstances, it is felt that 50.4% is not representative of the true system availability. The predicted Barstow system availability, adjusted for the divestiture consequences, is given in Table VI-5.

Table VI-3. Availability of SCE Unit.					
	System Availability (%)				
Item	1985	1986	1987	1988	Average
System Availability	54.4	55.0	39.9	58.6	50.8
Outages:					
A. GENERAL OPERATION					
1. Washing Concentrator	0.0	0.2	0.5	0.8	0.4
2. Availability of Personnel	0.0	0.1	0.8	1.1	0.6
3. Grid Power Loss	0.6	0.4	0.4	0.5	0.4
4. General Maintenance	0.4	1.7	0.9	0.9	1.1
5. Fill Hydrogen System	0.2	0.1	0.3	0.2	0.2
6. DEC Preventive Mainten.	0.0	0.2	0.0	0.2	0.1
	1.2	2.7	2.9	3.7	2.8
B. DISH PROBLEMS					
1. Wind Stow	5.6	6.8	5.4	5.5	6.0
2. Waiting for Parts & Service	0.0	2.8	2.3	3.4	2.6
3. Repairing & Troubleshoot	1.8	0.6	1.5	1.7	1.3
4. Fast Slew Repair	0.0	4.5	0.0	0.0	1.5
5. Azimuth Drive Problem	29.2	0.0	0.0	0.0	2.5
	36.6	14.7	9.2	10.6	13.9
C. PCU PROBLEMS					
1. Lightning Protection Stow	0.0	0.0	0.6	1.4	0.6
2. Waiting for Parts & Service	1.5	19.4	36.6	2.8	19.5
3. Troubleshooting	0.2	1.3	2.8	5.9	2.8
4. Repairing & Testing	0.6	6.5	2.8	2.8	3.8
5. Detracks	0.1	0.3	0.9	1.7	0.8
6. PCU Monitor Problems	0.0	0.0	1.9	0.0	0.6
7. Insolation Too High	0.0	0.1	1.0	0.4	0.1
8. Rod/Bearing Problem	0.0	0.0	2.4	12.1	3.9
	2.4	27.6	49.0	27.1	32.1
D. MISCELLANEOUS	5.4	0.1	0.0	0.2	0.5

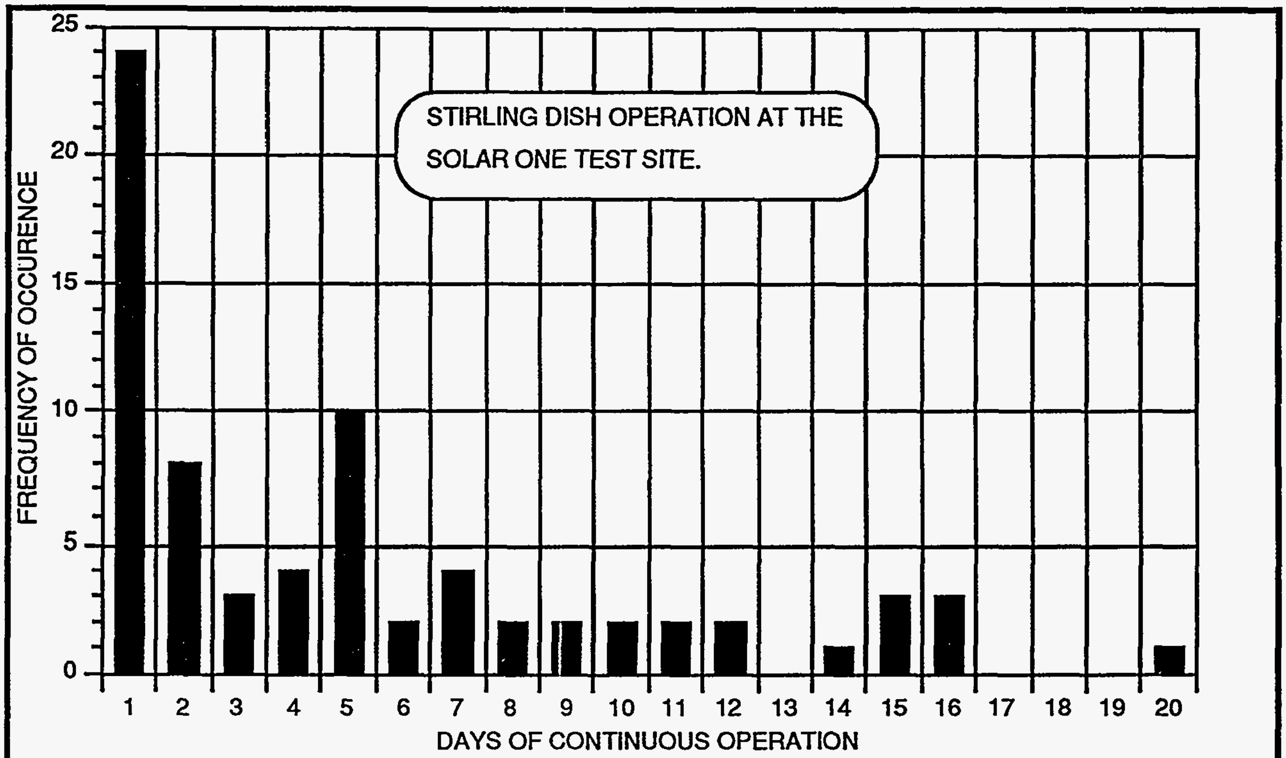


Figure VI-2. The Number of Days of Continued Operation at the SCE Test Site.

Table VI-4. Most Frequent Cause of Outage at the SCE Test Site.

System Outages		**PCU Outages**	
Wash	18	False Detracks	25
Grid Outages	10	Lightning Induced	6
Inspection	6	Valves/Nuts	5
Hydrogen	5	Cone Insolation	4
Concentrator Outages		Speed Sensor (Adj.)	3
Fast Slew	5	Thermocouple	3
Ref. Sensor	2	Rod/Bearing	2
Azimuth Drive	1	Monitor	2
Encoder	1	Water Level Sensor	2
		Power Supply	1
		Cooler	1
		Oil Pressure Sensor	1
		Compressor	1
		Relay	1

Table VI-5. Availability Analysis of the SCE Unit at Solar One.

Availability Component	Test Value (%)	Adjusted Value (%)	Adjusted Availability (%)
Average System Availability	50.8	---	50.8
A. Waiting for Spare Parts	19.5	0	70.3
PCU Spare Parts	19.5	0	70.3
Dish Spare Parts	2.6	0	72.9
B. Dish Azimuth Drive			
Azimuth Drive Problem Changeout	2.5	0	75.4
Wind Stow	6.0	1.2	80.2
C. PCU Rod/Bearing Problem	3.9	0.0	84.1
D. PCU Monitor Problems	0.6	0.0	84.7
E. PCU Problems			
Troubleshooting	2.8	1.8	85.7
Repair and Testing	3.8	2.5	87.0
F. Detracks	0.8	0.5	87.3
G. Dish Problems			
Troubleshooting	1.3	1.0	87.6
Fast Slew Report	1.5	0.5	88.6
Estimated Availability			88.6
Actual System Availability from 6/12/88 - 9/20/88			86.5

Examples of the assumptions that were made to develop the adjusted values are listed below. A.) Spare parts would be available in an actual power plant, thus there will be no waiting for spare parts (2.6% for the dish and 19.5% for the PCU); B.) The dish azimuth drive failure decreased availability as a result of having to wait for the new drive and the low wind stow limit that was used to prevent another failure. There would have been no waiting (2.5%) in an actual plant, a spare drive would have been available. The new dish azimuth drive exceeds the wind load requirement, therefore the wind stow limit would be increased back to 35 mph and the loss of operating time would be greatly reduced (6.0%); C.) The long outage of the PCU due to the rod/bearing problem resulted from a combination of a shortage of personnel to analyze the problem and make a decision as to what action to take. In a utility power plant, the PCU would have been replaced immediately with a spare (3.9%); D.) The PCU monitor would not be required in commercial production, therefore this outage would not occur; E.) Up-to-date PCU manuals and readily available test equipment would have greatly reduced the PCU trouble shooting time (2.8%) and the repair and testing time (3.8%); F.) Changing the PCU detract software logic would greatly reduce or eliminate the false detracks. An estimate of the detrack loss is (0.5%); G.) Updating the dish manuals, development of ground test equipment and design modifications to the fast slew system would decrease the outage time for dish troubleshooting and repair (1.3%) and the fast slew system (1.5%). During the last few months of the SCE test program, a number of temporary fixes were made to the system and the system was available 86.5% of the time. The availability could also be improved by making limited design changes to correct frequent operating and maintenance problems, such as removing unused components and upgrading the hardware.

Availability of Georgia Unit

Even though this unit was installed in October of 1985 and was operated for demonstration purposes, through 1988, only operational data from its installation in November 1985 to July 1986 were considered for this analysis. After that time, technical support and spare parts were not available to resolve operating and maintenance problems. Since it was operated only for demonstration purposes after July 1986, the operational data are not applicable for an availability analysis.

The results of the analysis (Table VI-6) for the initial nine-month period shows the system had an availability of 72.3%. Waiting for spare parts and technical service for the dish (6.4%) and the PCU (11.4%) was the major reason for the system's unavailability (17.8%). If spare parts had been available, system availability would have been 90.1%. Even though both USAB and MDAC were active in the test program during this test period, a large amount of time transpired trying to work out the problems over the phone, mailing parts back and forth, waiting for parts to come from Sweden, and/or waiting for the technician to fly from California to Georgia.

If one outage period, from late May to the end of June is removed from the analysis, the availability of the Georgia unit was better than 85%. This outages began with a PCU control problem coupled with a fast slew design problem, which led to drive-motor damage and burned wires. While the system was down, the Mark II PCU replaced the original Mark I PCU and an additional hydrogen bottle was added. USAB and MDAC personnel were not available to complete the check-out, so it was delayed. Only 1.7% of the Georgia outage time is associated with general operation versus 3.2% for SCE. This difference is partly due to the test-log level of detail. The

Table VI-6. Availability of Georgia Unit

Item	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Average
System Availability	97.5	82.4	79.4	94.0	68.8	92.8	58.2	25.0	79.8	72.3
Outages										
A. GENERAL OPERATION										
1. Washing Concentrator	0.0	0.5	0.0	0.3	0.3	0.3	0.2	0.0	0.3	0.2
2. Grid Power Loss	0.0	0.0	2.1	0.0	2.8	0.0	0.0	0.0	0.0	0.7
3. General Maintenance	0.4	0.8	0.5	0.4	0.3	0.3	0.3	0.0	0.2	0.2
4. Fill Hydrogen	0.2	0.2	0.3	0.2	0.2	0.2	0.1	0.0	0.2	0.2
	0.6	1.0	2.9	0.6	3.3	0.5	0.4	0.0	0.5	1.6
B. DISH PROBLEMS										
1. Waiting for Parts and Service	0.0	0.0	0.5	0.0	0.0	0.6	10.2	30.6	1.9	6.4
2. Repairing and Troubleshooting	0.0	1.8	2.9	0.7	0.7	1.2	10.9	4.2	1.1	3.0
3. Fast Slew Repair	0.0	3.2	0.0	0.0	0.0	0.0	0.0	3.2	0.0	0.7
	0.0	5.0	3.4	0.7	0.7	1.8	21.1	38.0	3.0	10.1
C. PCU PROBLEMS										
1. Waiting for Parts and Service	0.8	5.2	4.3	0.9	23.6	1.3	10.2	32.0	9.9	11.4
2. Troubleshooting	0.0	0.0	4.9	0.9	0.7	0.0	10.2	3.0	2.9	1.7
3. Repairing/Testing	1.7	6.7	5.4	3.5	3.1	2.2	5.2	1.6	4.3	2.8
4. Detracks	0.0	0.5	1.2	0.0	0.7	0.0	0.1	0.1	0.0	0.1
	2.5	12.4	15.8	5.3	28.1	3.5	25.7	36.7	17.1	16.0

Georgia Power log time for such things as technicians and operators not being available, etc. was included in other outage categories, such as, repair.

Availability of MDAC Units

The availability of the MDAC units is shown in Table VI-7 for the month of December, 1984 and three six-month time periods starting in January 1985 and ending in June 1986. Although the first unit ran at the MDAC Test Site in late November 1984, the test plan did not actually begin until January 1985. Most of December was devoted to development tests, for holidays, and vacations. At the beginning of the test period, the unit was not operated on weekends because operators were not available. Later in the test program, if the unit operated on Friday with no problems it would be allowed to run in automatic mode during the weekend. Weekend time was only included in the

Table VI-7. Availability of MDAC Units.

Item	Dec 84	Jan 85-Jun 85	Jul 85-Dec 85	Jan 86-Jun 86	Average
SYSTEM AVAILABILITY					
A. Power Generating	59.2	85.1	82.7	84.7	83.5
B. Development Testing	18.9	8.1	2.4	6.3	35.6
	78.1	93.2	85.1	91.0	89.1
OUTAGES					
A. General Operation					
1. Washing Concentrator	0.2	0.4	0.3	0.2	0.3
3. Grid Power Loss	0.0	0.0	0.7	0.4	0.5
4. Fill Hydrogen System	0.3	0.3	0.2	0.2	0.2
	0.5	0.7	1.2	0.8	1.0
B. Dish Problems					
1. Wind Stow	0.0	0.1	0.2	0.2	0.2
3. Repairing	3.3	1.7	0.8	0.6	0.9
4. Fast Slew Repair	0.0	0.0	1.0	0.2	0.4
	3.3	1.8	2.0	1.0	1.5
C. PCU Problems					
3. Troubleshooting	1.2	1.1	2.8	2.2	2.1
4. Repairing and Testing	16.3	3.0	8.6	4.9	6.1
5. Detracks	0.6	0.2	0.3	0.1	0.2
	18.1	4.3	11.7	7.2	8.4

availability calculations when the unit was left to operate automatically or an operator came in on the weekend to operate the unit. Weekends, when the unit was not put into automatic operation or it was not operational and no one was available to work on it were not included in the availability calculations.

As discussed previously, the MDAC units were used as a test bed. The time that the units were used for development testing was included in the availability calculations (special category B in Table VI-7).

The system availability for the MDAC unit was 86.9%. Examination of the availability percentages reveals that the main reason for the higher availability at the MDAC Test Site is because trained personnel and spare parts were available. The PCU repair time is higher than might be expected because PCUs were replaced frequently as part of the development test program and not as a consequence of PCU failure. The new PCUs required considerably more outage time to allow complete prestart test of each PCU.

Estimate of Availability of Commercial Unit

This was a developmental test program and, as such, the units were not operated as a commercial plant: Different maintenance procedures, additional test hardware that caused outages, no redundancy, minimal spare parts and trained personnel, data logging equipment, etc. The following analysis presents a rationale why each of the previous outage categories would require less outage time at a commercial plant and estimates the outage time for a commercial plant. These numbers are estimates based upon the experience gained in the test program. The actual numbers can only be determined through a longer test program and more units and designed to emulate a commercial plant operation. An estimate of what a commercial plant could achieve is shown in Table VI-2. The basis for these estimates is as follows:

1. Concentrator Washing - The washing outage times were 0.4% for SCE, 0.2% for Georgia, and 0.3% for MDAC, for an average of 0.3%. The washing equipment furnished to each test site was a prototype of what was envisioned for a commercial plant but required more manual labor. The washing process proved very effective and if mechanized similar to the final Solar One process, the outage time should be

reduced by at least 50%. The outage time because of washing for a commercial plant was estimated to be 0.05% to 0.2%

2. Personnel Availability - Only the SCE test log had sufficient detail to estimate the amount of time that was required for operating and maintenance personnel to respond to a problem with the unit. SCE personnel were mainly responsible for the operation of the Solar One plant and not the Stirling dish. Although a Stirling dish plant would have devoted personnel, there will still be times when operating personnel will be involved in other tasks and will not be able to respond immediately when there is a problem with a unit. Some of the SCE outage time (0.6%) was due to test related equipment that would not be part of a commercial plant, such as the PCU monitor. An estimate of the outage for a commercial plant is 0.1%-0.4%

3. Grid Loss - Grid power loss accounted for an average of 0.6% of the outage time for the three sites. An outage this high is probably due to the fact that these units were an add on to the existing grid. This outage would be greatly reduced in a commercial plant connected to a grid line with backup grid connection. An estimate of this outage time is 0.05%-0.2%.

4. General Maintenance - General maintenance time for the MDAC test site was lower than for the other two sites because the operating personnel would either stay late or come in early and perform the tasks outside the power generating period. Therefore, only the SCE and Georgia site data will be used for this time determination. Part of this outage time was involved with test equipment that would not be part of a commercial system. At the SCE test site, inspection and special testing were conducted routinely due to developmental problems. This testing would not have been done in commercial plant. The Georgia test data are felt to be more representative of a commercial plant (0.1%-0.2%).

5. Hydrogen Fill - The hydrogen fill time at all three sites was 0.2%. The majority of the hydrogen was lost as result of maintenance on the engine. When the engine developmental problems have been resolved, it is estimated that this outage time would be than 0.05%-0.1%.

6. Wind Stow - No significant wind-stow outage time was recorded at the MDAC and Georgia sites because the wind-stow limit was higher at these sites during the test period. The SCE limit was set at 25 mph throughout most of the test program. The new azimuth drive would allow the SCE limit to be increased to 35 mph. Using statistical wind data, an estimated outage time for a commercial plant is 0.2%-0.4%.

7. Concentrator Maintenance - The maintenance estimate for a commercial plant would be similar to the MDAC site data since spare parts and trained maintenance personnel would be available. Therefore, the time lost waiting for spare parts and technical service should not be considered for a commercial plant. The troubleshooting and repair time was 5.4% for SCE, 3.7% for Georgia, and 1.3% for MDAC, which reflects the availability of trained personnel at the MDAC Test Site. The MDAC number can be reduced by implementing some design changes and following a field replacement policy instead of trouble-shooting in the field. Based upon the component performance since the end of the testing by SCE in 1988 and following a replacement policy instead of in field repair, it is estimated that the outage time could be as low as 0.2%-0.6%.

8. PCU Maintenance - The same reasoning applies to the PCU maintenance time. The repair time was longer at MDAC than at the other sites, because MDAC was used as a testbed to operate engines for the first time. The troubleshooting and repair for the other sites would be a better upper basis, although still very conservative (5.6% and 4.5%). If design changes were implemented and a replacement policy were followed, these numbers would be reduced by more than a factor of 2. The outage resulting from the PCU monitor, monitor cable, and lightning would be eliminated because these components were only test components and would not be part of a commercial plant. The PCU is more complex than the concentrator, therefore it is estimated that the PCU outage time could be higher than the concentrator's (0.4%-1.2%).

VII. OPERATION OF THE STIRLING DISH

- Over 13,852 hours of on-sun generating time
- Expected PCU hydrogen seal and piston ring problems did not occur, more testing required to confirm life expectancy
- No PCU heater head problems, more testing required to confirm life expectancy
- No major system design changes are required in the system
- Concentrator modifications have been made and under test, MTBF has increased

The previous section on system availability indicated a number of problems, which are discussed here in more detail. Of the eight dishes built, six were installed and operated for the periods shown in Table VII-1. Three concentrators were installed at the MDAC Test Site, where they were used to obtain performance data and to accumulate time on PCU engines before the engines were shipped to Barstow, Georgia, or Las Vegas.

Concentrator

A summary of the concentrator status and current location is given in Table VII-1. The operating times are estimates based upon the test logs at the different sites of how many operational cycles (unstow, track, and stow) were accomplished during the testing period. The time for the dishes at Huntington Beach include life-cycle testing at night and on cloudy days in which the units would unstow, track for 15 minutes, and then stow.

A summary of the problems at all sites since the start of the testing is given in Table VII-2. The comment column describes the temporary fix to continue the testing and/or a possible permanent solution to the problem. The most significant problem during this time was the failure of the azimuth drive and the elevation drive helicon gear for reasons unclear at this time. The drives were designed to operate in wind speeds up to 35 mph at the worst angle of attack, but it is estimated that the azimuth harmonic drive gear jumped a tooth at a wind speed around 30 mph. Although the drive will operate after this occurs, the wind load capability is greatly reduced. The drive used in the load test also jumped a gear tooth, but at a wind speed of 37 mph. There were a number of other units during the test program that continued operating at or higher than 35 mph. Concentrator #1 at Huntington Beach, before the above problem was

Table VII-1. Summary Of Concentrator Status As Of August 1992.

Present Location	Period	Operating Time	Comments
Huntington Beach	11/84-Present	7.0 yr (1)	1 MDAC Space Lab. Operated until June of 1986 with a Stirling engine. Operated as a solar furnace in the MDAC Space Power Lab.
Huntington Beach	5/85-Present	5.0 yr (1)	Operated until June of 1986 with a Stirling engine. Operated as a solar furnace in the MDAC Space Power Lab
Switzerland	6/85-10/86	1.5 yr	Moved from MDAC to SCE Alhambra in 1987. Moved to Paul Sherrer Institute, Switzerland in 1989. Used as a solar furnace.
SCE Test Site	8/85-10/88	3.2 yr	Operated at SCE Test Site until September of 1988. Only moved twice since that time.
Georgia	11/85-6/88	1.0 yr	Operated through July of 1986. Limited operation through 1988. Not operated since that time.
Japan	4/86-6/87 6/87-Present	0.2 yr Unknown	Operated at Las Vegas, Nevada test site. Sold to Aisin Seiki Stirling in Japan. Testing with a Japanese Stirling engine.
SCE Test Site	Not Installed	None	Never installed. Stored at SCE Test Site. One outer and inner assemblies were damaged when high winds overturned assembly. Support structure bent and mirrors broken. All damage has been repaired.
Arizona/Spain	1990 - Present	1.5 yr	Stored at SCE Test Site until 1989. Structure drive and controls sold to Smithsonian Institution to be used as a space telescope. Mirrors sold to Spain. for use in a solar furnace.

[1] Life-cycle testing was done on this unit.

Table VII-2. Concentrator Problems.

Problem	Description	Comment
Azimuth	Harmonic gear drive on Barstow unit stripped at approximately 30 mph wind speed while going to wind stow position.	Could have been an assembly or manufacturer problem because several drives have operated in 35 to 45 mph winds with no problem. The wind speed was lowered to 25 mph for the test program. New drive developed by Sumitomo should have greater than 35 mph capability and cost less.
	On 10/12/88, the azimuth helicon of Huntington Beach gear unit stripped.	It appears that the harmonic gear jammed, which resulted in stripping of the helicon gear. It has not been taken apart so the cause and extent of damage has not been identified.
Elevation Jack	On 11/20/88, the elevation helicon gear on the Georgia Power unit stripped.	The gear teeth wore down to approximately 1/2 the normal size. This could have been caused by water in the grease or damage that was done in June 1986 when the system was driven into the pedestal because of a PCU failure coupled with two control design problems. At that time, it was observed that many small grains of the Helicon gear were in the grease. It was decided not to change the gear.
	In February 1989, jack rod broke on pad #2 at Huntington Beach.	A crack was found in the jack rod. It was determined that crack occurred during manufacturing because plating was in crack. Believed to be a one-of-a-kind problem; no action being taken.
Fast Slew	Bushing in motor failed because of side loading at the SCE Test Site.	Caused by tightening the drive belt too tight, replacing motor with one that has ball bearings or different drive mechanisms.
	Pulley came off because it was not installed properly at the SCE Test Site.	Replace present compression pulley system with a key way pulley system.

Table VII-2. Concentrator Problems (Continued).		
Problem	Description	Comment
Fast Slew (cont.)	System would not disarm under certain operating conditions.	Modified electronic logic to correct problem.
Dish Controller	Heat fatigue of coils after long periods of operation in hot weather at the SCE Test Site.	Vent controller in pedestal and add heat sinks to contactors. Replace contactors with solid state relays. Use a latching-type contactor.
Center Mirror Section	Upon assembling the SCE unit, center four mirrors were out of alignment.	Only two 1/4 in. alignment bolts were used. Added two more bolts and increased bolt size to 1/2 in.
Cables	Data and PCU cables hanging down the outside of the pedestal would catch on the jack screw at the SCE Test Site.	Found that the cables could be routed down the center of the pedestal. Did not cause problems after the modification.
Sun Sensor	Erratic levels at the Georgia Power and SCE Test Sites.	Caused by condensation in the chamber. Fixed by venting chamber to ambient air. Note: sun sensor for development testing only and would only be used during the alignment of a production unit.
Reference Sensor	Performance of sensor at SCE and MDAC Test Sites.	Appears that the strength of the magnets degrades with time. Modify brackets so that sensor is within 1/4 in. of magnet.
	In three out of six units the elevation helicon sensor did not work at installation.	The sensor face was even with the drive casting, and the magnet was moved closer to the sensor. Design should be changed so that the sensor extends beyond the drive casting.

known to be a limitation, operated routinely in winds of 45 mph and at a wide range of angles of attack with no problems. The Georgia unit operated in winds of up to 35 mph with no problems. A number of reasons could account for the failures:

A. The drives were not assembled correctly. A new crew did the assembly for the Barstow unit. It is possible the crew did not follow the correct procedure in shimming the drive to get the required gear clearance.

B. The dynamics of having a 1500-lb PCU at the end of a long lever arm, coupled with pulsating wind loads, exceeded the load capability of the drive.

C. The manufacturer had several machines that had different tolerances. The manufacturing tolerances on the various components may have resulted in lower load capabilities. This could account for units operating in winds up to 45 mph with no problem while one unit failed at 30 mph.

There were two different mirror designs developed by MDAC during the program. The first one was referred to as the eggcráte design. It had very good optical qualities but was considered to be too expensive to manufacture commercially. Therefore, a second design shown in Figure VII-1 was developed. Two concentrators were manufactured with the eggcrate design and six concentrators were manufactured with the second design referred to as the stamped facet design. Both of these designs met the required optical performance and have maintained this performance for over eight years. A number of the mirrors have stress cracks. A stress crack is a crack that have a circular pattern as a result of the high stress created by the double curving of the mirror combine with thermal forces. Most of the damaged mirrors can be related to incidents during testing such as the following:

A. Two receivers (one at the MDAC and one at the SCE Test Site) were destroyed because of problems with the safety system. Pieces of the hot receiver tubes hit the mirrors and caused stress cracks and pitting of the mirrors.

B. The flux mapper at Huntington Beach broke while in operation, and the tiles got so hot that they exploded. Hot pieces of tile hit the mirrors and caused stress cracks and pitting of the mirrors.

C. Mirror covers were left on the unit for several months while special tests were being done. When the covers were taken off, many mirrors had stress cracks. This is believed to be caused by the wind blowing on the covers and putting high loads on the mirrors.

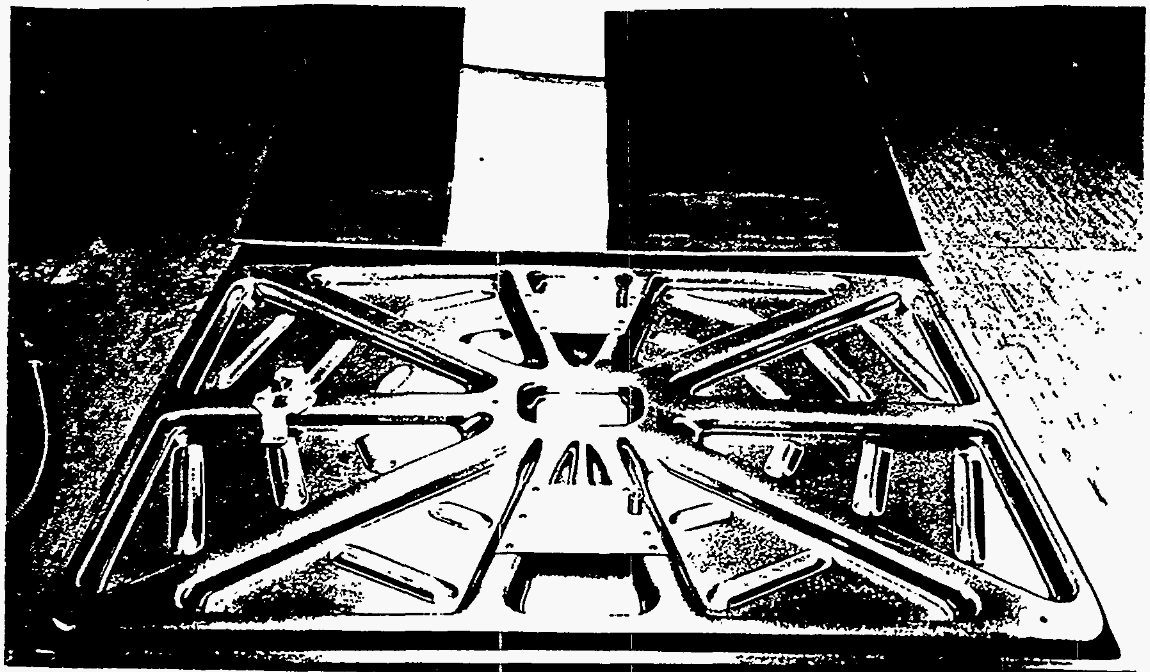


Figure VII-1. Stamped Facet has Maintained Performance for Over Eight Years.

D. Tools were dropped on the mirrors while performing maintenance on the units.

E. Personnel, such as visitors pulled on the mirrors to see the beam move on the receiver or to see how much the concentrator would move.

The majority of the cracks have occurred on the eggcrate design at Huntington Beach, mostly for the above reasons. A much lower number of the stamped facets have had any cracks appear over this operating period. Five stamped facet mirrors developed cracks at the Georgia Power Test Site during the first six months of operation. One of them occurred when a tool was dropped on it. After seven additional years, no new cracks have occurred. There are eight stamped facets at the SCE Test Site that have developed cracks. Several of these occurred when the safety system malfunctioned which resulted in the receiver melting and hitting the mirrors. Although the cracked mirrors are discerning, tests at Huntington Beach could not detect any power loss. Because of the construction of the mirror, the surface slope across the crack does not change and the design prevents moisture from entering and corroding the reflective coating. Since the surface slope does not change, little if any energy is lost. Because moisture is restricted from reaching the silver, little corrosion has occurred along the cracks. In that the above does not account for all of the cracked mirrors, the other reasons need to be investigated and resolved before mass production begins. Several of the mirrors have been tested after eight years in the field, and their reflectivity is the same as the day they were manufactured. The radius of curvature and surface waviness were also measured and found to be the same as the day the mirror was manufactured.

Power Conversion Unit

A summary of the operating time, current condition, and location is given for the Mark I (Table VII-3) and for Mark II engines (Table VII-4). A summary of the problems with the Stirling engines since the start of the test program is also given (Table VII-5). Again the comment column describes the temporary fix made to allow the test to continue or contains a possible permanent solution to the problem.

Table VII-3. Summary Of Mark I Engine Operation.

	Operating Hours.					
PCU#	En	Pump	Fan H	Fan L	Description	Comments
103	1,384	1.326	1	979	Controls destroyed in shipping. Parts taken to repair other engines.	Need new control electronics, valves, sensors, and radiator.
101	1,575	2,563	2	974	Sensors used on other units.	Need to check the system out before operation.
110	308	471	1	523	Sensors used on other units.	Need to check the system out before operation.
102	2,923	2,171	1	729	Electronic cards lying loose in the cabinet.	Need to check the system out before operation.

The most significant malfunction during the test period was a rod bearing problem in the two Mark II engines. This is significant because a permanent solution requires major design changes. Other problems were solved (or could be solved) with relatively less effort (see Table VII-5).

The two Mark II engines were not disassembled to determine the cause of the bearing failures. Stirling Power Systems (SPS) thinks the bearings were too small to withstand the loads caused by repeated starting for a solar application. This is possible, but the factors described below should be considered:

Table VII-4. Summary Of Mark II Engine Operation.

	Operating Hours.					
PCU#	Gen.	Pump	Fan H	Fan L	Description	Comments
208	1,556	2,572	331	1,304	Operated at Barstow until 9/21/88. Connecting rod crank shaft bearing failure.	Needs overhaul before operating again
205	1,602	2,938	886	0	Parts taken for use on other units.	An intermediate Mark II. Suspect high and low fan meters were reversed.
209	915	960	0	623	Mounted on dish at Georgia Power.	Has not operated since 1987, requires service before operating.
207	980	1,581	0	357	Bad receiver	No other problem with PCU.
211	1,912	661	13	1,380	Bad connecting rod crank shaft bearing.	Requires overhaul.
206	697	1370	0	355		
210, 213					Test operated only	
211,212 214,215					Never shipped from USAB	

A. Logic circuitry was added to the system controller after the first failure. If the five-minute average solar insolation went below 280 W/m^2, the concentrator would be pointed at a standby point until the average insolation was above 320 W/m^2 for a few minutes. Although no data were recorded, it is estimated that this reduced the number of starts by around a factor of 10 over the first failure. The number of cold starts would also be reduced, but by a much lesser amount, perhaps 10 to 25% fewer starts.

Note: There were no bearing failures on the Mark I engines that operated in the same start/stop environment before the logic change in A above was made. One of these Mark I engines had 30 to 50% more running time than either of the two failed Mark II engines, and another had about the same running time as the Mark II or I.

B. The second failed Mark II engine could have had an oil pressure problem. A month before the failure, detracks caused by low oil pressure were experienced. After checking the oil level, the operating personnel concluded that the problem was a continuation of the oil sensor problem experienced with other engines. This engine was returned to service following these incidents without any apparent difficulty. One of the differences between the Mark I and Mark II is the way the engine interfaces with the generator. This difference may be a contributing factor.

Table VII-5. Stirling PCU Problems.		
Problem	**Description**	**Comment**
Detrack	Numerous detracks occurred when no operating problem existed, such as cloud transients, that the software does not accommodate.	Ignored the alarm and reset system. Added logic board in concentrator controller to go to stand-by when average insolation was below a threshold value. Software test in PCU controller needs to be modified or removed.
Radiator Leak	When the PCU was shipped, the radiator leaked.	Remove radiator or constrain radiator from vibrating during shipment
Oil Leak	Small amount of oil leaked around the generator shaft on the Mark II. Did not require adding oil, but resulted in a mirror soiling problem.	Design better oil seal.
Oil Sensor	Several oil sensors failed.	Replaced sensor. Replace with more reliable sensor.
Lightning	Lightning caused numerous failures of electronic components.	Field wiring grounds not installed correctly. PCU electronics need to be repackaged. Lightning considerations to include twisted pair data wiring, cable shield grounding outside enclosure, etc.
Water Level Sensor	Problem with ambient light leaking into the sensor housing	Wrapped with tape. Replace with better quality sensor.
Gas Valve	Several gas valves had problems due to manufacturing defect.	Leaking normally occurs when engine has not operated for two or more days. Many problems thought to be valve related were in fact a different problem.
	Several times solenoid retaining nuts fell off.	May have to use lock nuts. New valve will not be required.
Insolation	When insolation goes too high (>1,000 W/m^2), PCU usually detracks because it cannot utilize all the power.	Need design change so that system does not have to detrack,; e.g., a few adjustable mirrors, blowing air into the receiver, change engine temperature set point, several defocusing mirrors, etc.

Table VII-5. Stirling PCU Problems (concluded).		
Problem	Description	Comment
Cavity	Insulation around the cavity entrance falls off with time and moisture.	Use ceramic tile, a high-temperature adhesive, etc.
Wrong Alarm Messages	There are errors in the displayed alarms. One message is displayed when there is really another problem.	Correct software.
Bearings	There has been a bearing and rod problem with two Mark II engines with less than 2,000 operating hours.	The problem was not investigated Could be that bearings are too small or need to install motorized oil pump to eliminate dry starts.
Compressor	Two compressors had to be overhauled before 1,000 hours of operation.	Not presently considered to be a problem.

VIII. SYSTEM PERFORMANCE OF THE STIRLING DISH

- Annual net energy efficiency of 22%
- Levelized energy cost of less than 8 cents per kWh
- Major annual sources of energy losses are basic reflectivity and soiling of mirrors

The energy performance and operating performance from the test data are used in a computer simulation to estimate annual system performance in terms of annual energy output, dollars of generated revenue, and cost of O&M. The architecture of the Stirling dish performance simulation is shown in Figure VIII-1. A description of the different models of this program are:

Solar Energy - The sun's irradiance energy for each day at the SCE Test Site was used to generate a probability distribution function for each month of the year. An example of the probability distribution function is shown in Figure VIII-2 for June and December. The daily energy is generated randomly using the monthly probability distribution function. The probability of rain is included as a function of the month of the year and daily sun-energy level. If the randomly generated daily sun energy is high for that time of the year, then the probability of rain occurring is low.

Wind Speed - The wind speed is generated randomly using the annual wind speed distribution for Barstow shown in Figure VIII-3 (Reference 12). The wind speed is used to estimate receiver energy spillage and determined if the system should go to a wind stow position. If the wind speed is above 35 mph, the system goes to a wind stow position. The time spent at the high wind stow position is randomly selected. This time includes the time at the wind stow position and the time to go to and from this position. At the present time, there is no correlation between wind speed and sun irradiance level.

Concentrator reflectivity - The mean reflectivity measurements for the Huntington Beach test site were used to determine the concentrator reflectivity as a function of the days since the last washing. There were not sufficient SCE Test Site data to define a model. Concentrator washing is performed when the reflectivity decreases to a minimum level.

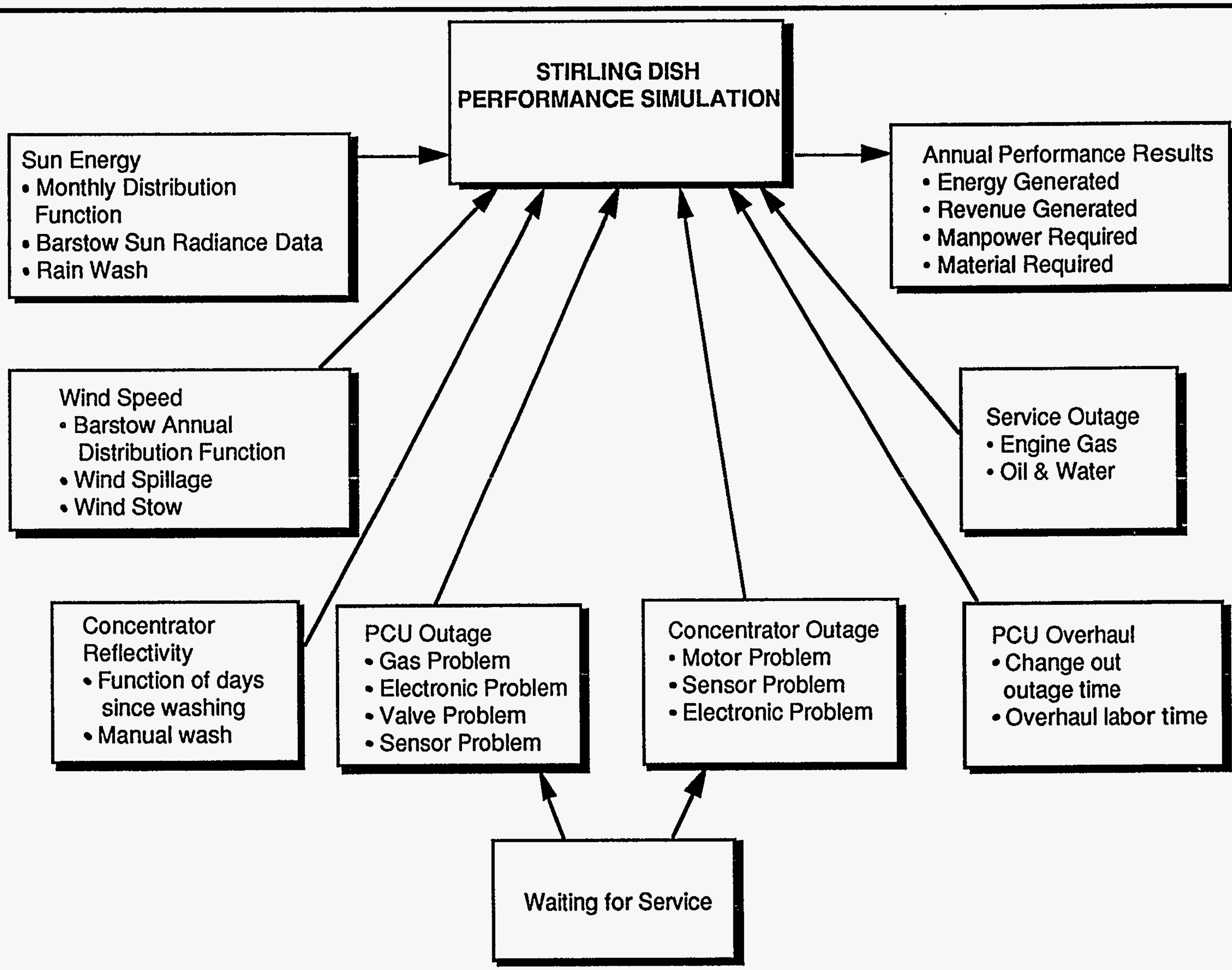


Figure VIII-1. Stirling Dish Annual Performance Simulation.

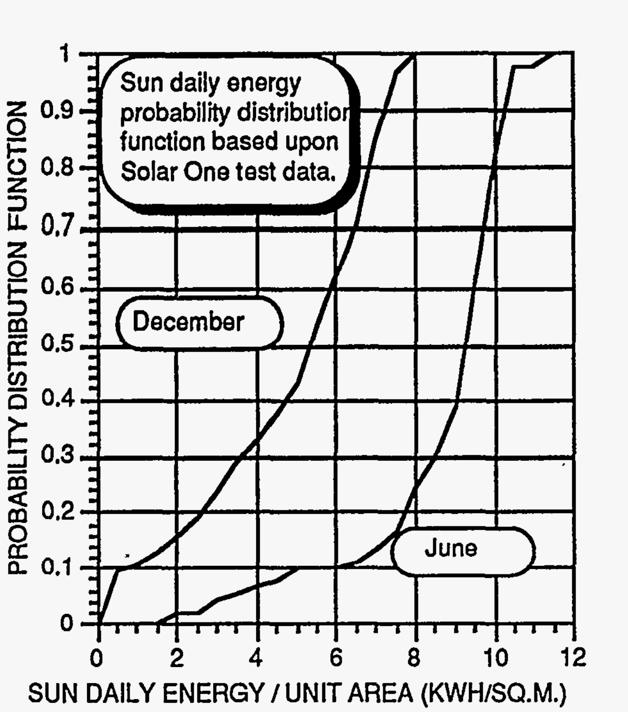


Figure VIII-2. Sun Energy Model Distribution Function for SCE Test Site.

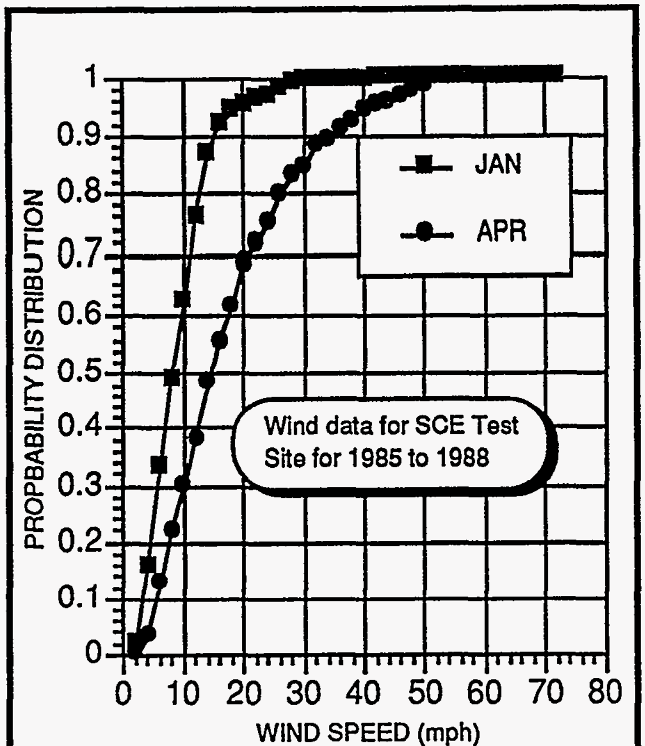


Figure VIII-3. SCE Test Site Annual Wind Speed Density Function.

The reflectivity returns to the nominal level after washing. If it rained, the reflectivity also returns to the nominal value.

PCU problem outage - The mean time between failure is used to determine when a problem outage would occur as a result of a PCU gas valve, electronic, sensor, etc. Associated with the outage is the mean time to correct the problem and the time to put the system back in service. With each outage, there is an estimate of labor and material cost. There is also a non-outage labor and material cost included for repairing the problem with the replaced module, i.e., repair the electronic controller, valve, etc.

Concentrator problem outage - A mean time between failure is used to determine when an outage would occur as a result of an electronic, sensor, motor, etc. problem. Associated with the outage is the mean time to correct the problem and an estimate of labor and material cost. There is also a non-outage labor and material cost included for repairing the problem with the replaced module removed, i.e., repair the electronic controller, sensor, etc.

Waiting for service outage - Since maintenance personnel may not be available because they are working on another project at the time a PCU or concentrator problem occurs, there is a random wait period before the actual repair begins. A Chi-square probability distribution is used to define the waiting for service time.

PCU overhaul - A mean time between major overhauls is used to determine when the PCU should be removed and the rings, seals, etc. are replaced. An overhauled engine replaces the old engine so the system outage time is only the PCU change out time. The engine overhaul labor and material cost associated with each engine replacement is included in the simulation.

Service outage - The USAB 4-95 requires oil, water, and hydrogen gas servicing. The frequency of service time is based upon the number of operating hours on the engine. There is a different service time, labor time, and material cost associated with each of these service outages.

Although it is not the intent in this report to present a detailed discussion of the economic performance of the system, there are economic cost models included in the simulation as well (Reference 13 & 14). These include capital cost, operational and maintenance labor cost, management labor cost, plant overhead cost, inflation, taxes, interest on loan, tax base, etc. The management time and plant overhead cost are modeled as a function of the maintenance time, i.e. the less maintenance labor required to operate the plant, the less management is required. The lower the maintenance activity, the lower the plant overhead, i.e. less replacement material has to be ordered, less inventory, less storage area, less field vehicles to maintain, etc.

The simulation inputs and an example of data base values are shown in Table VIII-1. Two examples of the simulation's generated energy as a function of time for a two-year period using data base parameters based upon the SCE Test site are shown in Figure VIII-4. Also shown are the actual SCE Test Site data presented in Section IV. The long periods that the SCE system was off line waiting for service and spare parts has

Table VIII-1. Example of Simulation Data Base.			
Parameter	Value	Parameter	Value
PCU operating & maintenance cost		Washing cost	
Engine overhaul time		Mean outage time	0.75 h
Mean change outage time	2.00 h	Material cost per wash	$4.00
Overhaul time	5.50 h	System reflectivity	
Mean time between overhaul	6000.00 h	Cleaned mirror reflectivity	0.920%
Overhaul material cost	$200.00	Soiling rate (%/day)	0.005
Hydrogen gas		Wash reflectivity level	0.750
Mean outage time	1.00 h	Rain wash yearly mean	10.000
Gas bottle cost	$38.00	Wind stow level	35 mph
Mean time between service	1500 h	General plant operation parameters	
Oil & water		Field shadowing	0.020
Mean outage time	0.50 h	Hourly labor rate	$15.00
Mean time between service	2200.00 h	Inflation rate	.04%
Oil & coolant material cost	5.00	Management cost	
PCU problem		Labor rate	$28.00
Mean outage time	1.50 h	Percent required of manload	10.00%
Mean time between failure	1,000.00 h	Plant overhead,percent of manload	8.00%
Repair time of unit	2.50 h	Mean time before service	3.00 h
Repair cost of unit	$50.00	Interest rate	5.0 %
Concentrator O&M cost		Length of loan	10 yr
Concentrator problem		Hardware depreciation time	25 yr
Mean outage time	1.00 h	Tax base	20 %
Mean time between failure	2000.00 h		
Repair time of unit	2.50 h		
Repair cost of unit	$50.00		

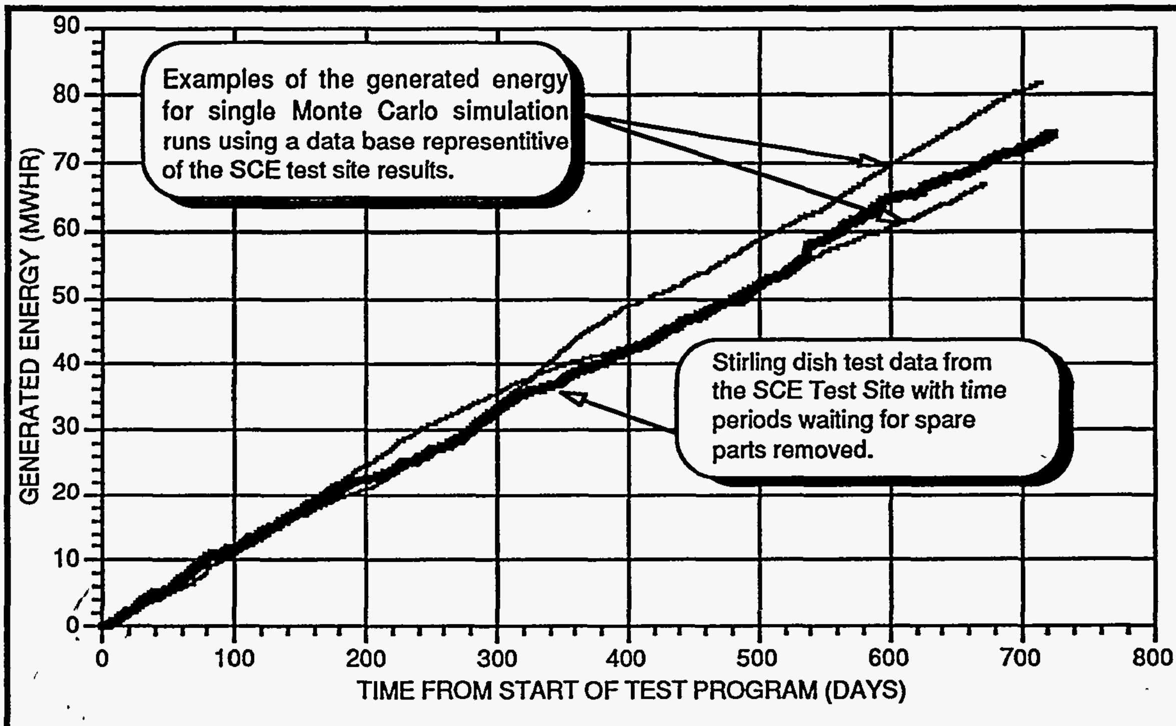


Figure VIII-4. Example of Simulation Accumulated Generated Energy.

been removed from the test data. As shown, the amount of generated energy predicted by the simulation program is very similar to the actual generated electrical energy at the SCE test site. The daily energy normalized by the area for this same two year period is shown in Figure VIII-5. The distribution of data points from the performance line corresponds with the daily energy performance test data for the SCE Test Site shown in Section IV.

The average annual generated electrical energy of the Stirling dish is shown in Table VIII-2, which shows that the system has an average annual efficiency of 22%. The data were generated by averaging the energy over a thirty-year period. A thirty-year period was used because the magnitude of the estimated mean time between failure of the different components precludes many failures in the first few years of operation and higher failure rates towards the end of the operating period as components are subjected to additional wear. For example, the estimated mean time between PCU overhaul is over two years, electronics is over five years and the estimated mean time between concentrator drive failure is over 30 years. The total annual energy that is incident on the aperture area of the concentrator is 217,878 kWhs (Item 1). Of this amount, 154,737 kWhs (Item 2) or 71% of the total incident energy are lost by the PCU

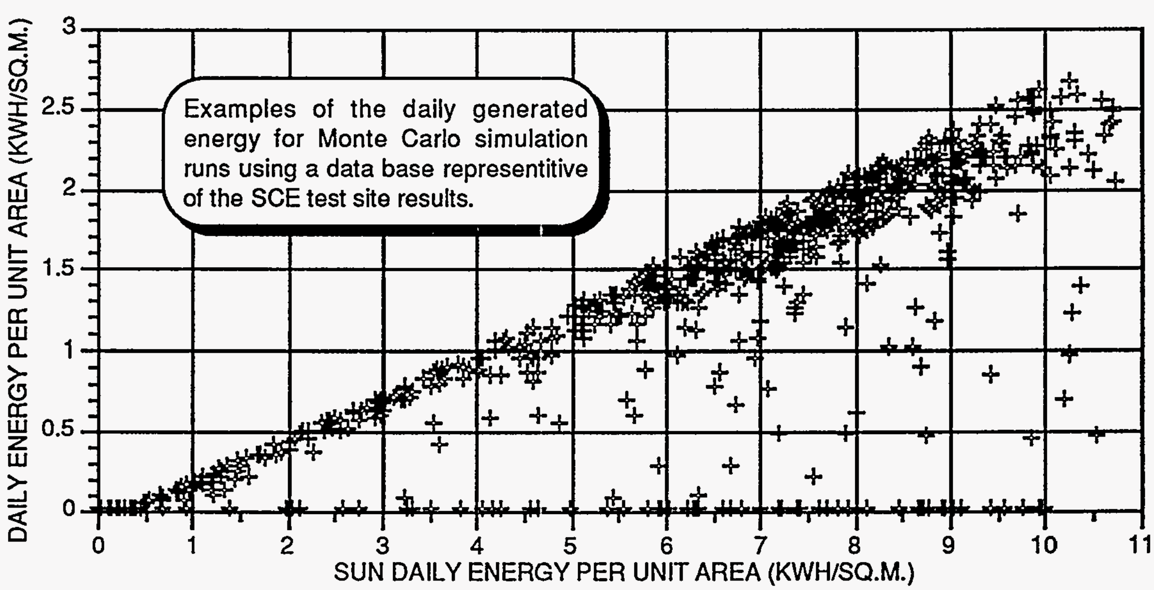


Figure VIII-5. Example of Simulation Daily Energy Performance.

Table VIII-2. Annual Energy Performance.				
Item	Description	Energy	As Percent of Other Losses (excludes PCU)	Percent of Total Aperture Energy
1	Total aperture energy	217,878 kWh		
2	PCU losses	154,737 kWh		71.02 %
	Other system losses			
3	Field shadowing energy loss	1154 kWh	7.6 %	0.50 %
4	Base reflective energy loss	5,292 kWh	34.7 %	2.50 %
5	Mirror soiling energy loss	5,636 kWh	36.9 %	2.60 %
6	Wind spillage energy loss	1,924 kWh	12.6 %	0.90 %
7	Wind stow energy loss	215 kWh	1.4 %	0.10 %
8	Washing outage energy loss	130 kWh	0.9 %	0.05 %
9	Engine gas outage energy loss	22 kWh	0.1 %	0.01 %
10	Oil & water outage loss	10 kWh	0.1 %	0.01 %
11	PCU overhaul outage loss	19 kWh	0.1 %	0.01 %
12	PCU problem outage loss	30 kWh	0.2 %	0.02 %
13	Conc. problem outage loss	12 kWh	0.1 %	0.01 %
14	Waiting for service outage loss	823 kWh	5.4 %	0.37 %
	Average annual grid energy =	50122 kWh		22 %

due to system efficiency and to the PCU's inability to utilize low solar irradiance, i.e., levels of less than 250-300 W/m^2. This leaves a maximum of 63,141 kWhs for other system operating losses (Item 3 to 14) and net power generation.

Other System Losses - Each of the other system losses are shown as a percent of total other system losses in the fourth column and total incident energy in the fifth column of Table VIII-2. The largest of these losses is from the reflectivity of the mirror facets. The average annual loss of electrical energy from the ideal reflectivity (Item 4) and mirror soiling (Item 5) is over 10,000 kWhs which is 70% of the other system losses or over 5 % of total aperture energy. The simulation assumes the mirrors are washed when the reflectivity drops to 0.75%. Based upon the environmental model, there was an average of 10.7 concentrator washings per year and an average number of rain washings of 10.6 per year. The rain washing mainly occurred in the months from December through February which is common for Southern California. The soiling rate in the simulation was based upon the MDAC Test Site data because sufficient data were not available for the SCE Test Site . The soiling rate will vary from site to site, but it is expected to contribute a significant portion of the other system losses. The amount of soiling loss is a function of many site characteristics and operation such as the terrain cover, manual wash frequency, rain frequency, wind frequency, etc. Although soiling loss is a controllable variable, it would require a trade off between increased maintenance cost and improved performance.

The annual wind induced energy loss is a result of spillage out of the receiver due to motion of the concentrator caused by winds and loss out of the receiver from wind currents (Item 6). This loss is in addition to the receiver radiation and convection loss considered in the energy loss diagram presented in Table IV-6. A second wind-related energy loss result from high winds requiring the concentrator to go to a wind stow position (Item 7). The concentrator wind stow limit was set at 35 mph for this analysis (Table VIII-1). The energy loss for maintenance (Item 8 to 13) accounts for less than 2% of the other system losses. This low loss is a result of the maintenance policy of module replacement. Therefore, the system is out of service a very short period of time. The energy lost while waiting for a service person to repair the unit (Item 14) represents over 5% of the other system losses. The waiting for service loss can be decreased by increasing the maintenance manload but the trade-off of this revenue loss verses maintenance cost must be made to find the optimum.

The installed cost of the Stirling dish system is shown in Figure VIII-6 as a function of the manufacturing rate for minimum, best and maximum cost variations. The upper three curves include a 30% profit margin, and the lower curve is the minimum cost variation with no profit margin. This cost is based upon a 1985 production

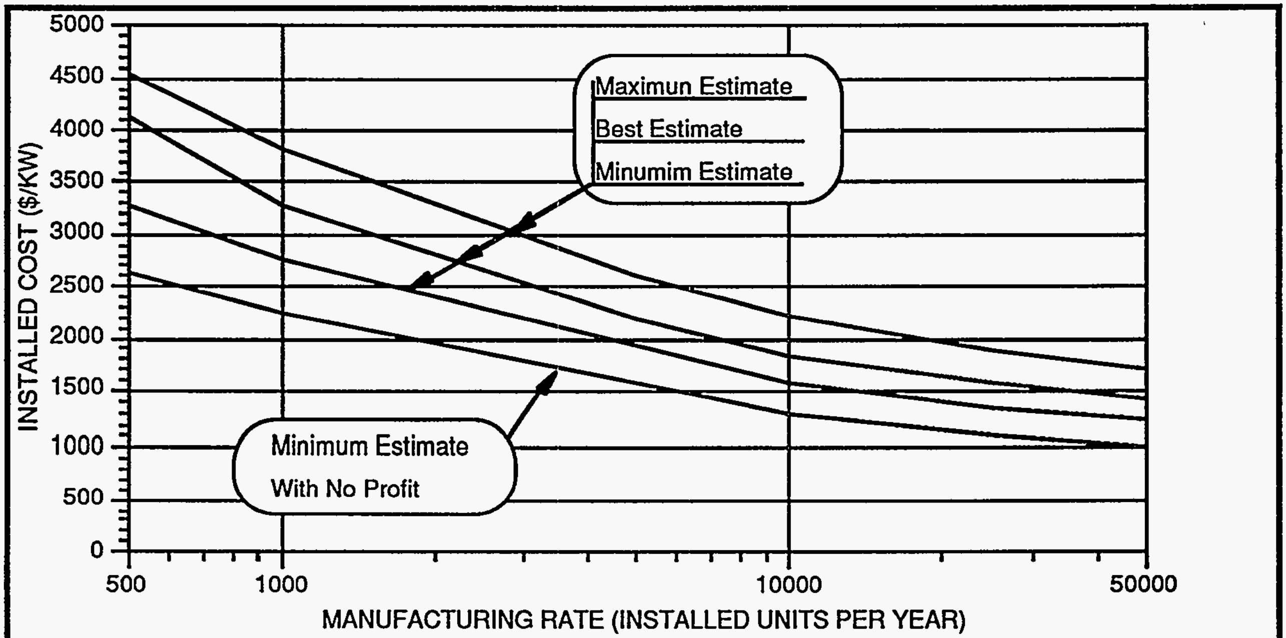


Figure VIII-6. Installed Cost of the Stirling Dish System.

study conducted by MDAC (Reference 15 & 16) and updated to 1992 using a 4% inflation rate. In addition, updated cost numbers were obtained for major components such as the drive, mirror assembly and mirror support structure from Peerless Winsmith, Naugatuck Glass, Mactac, General Electric, EWI, Rohn, Binkely, etc. Using this cost information, an estimate of the levelized energy cost over a 30 year period is shown in Figure VIII-7 as a function of concentrator MTBF. Since the PCU is more complicated that the concentrator (more ICs, more sensors, valves, etc.), the PCU MTBF was assumed to be 0.5 that of the concentrator. The levelized energy cost is the 30-year system cost (installation, manufacturing, O&M, taxes, loan, etc.) divided by the total electrical energy generated over this 30 year period. The data show that a levelized energy cost of less than \$ 0.08 per kWh can be obtained with a concentrator MTBF of 2000 hours and PCU MTBF of 1000 hours. A levelized energy cost of \$0.65 per kWh can be obtained with a further increase in the MTBF. Even lower levelized energy cost can be obtained by increasing the PCU mean time between major overhauls or higher manufacturing rates. An estimate of the O&M cost per kWh as a function of concentrator MTBF is shown in Figure VIII-8. This data show that depending upon the concentrator and PCU MTBF, the O&M costs could be less than 2 cent per kWh. The labor and material cost for a system with a concentrator MTBF of 4000 hours and PCU MTBF of 2000 hours is shown in Table VIII-3. The man loading requirements are shown in Table VIII-4. The major O&M costsresult from the PCU overhaul and other PCU-related problems.

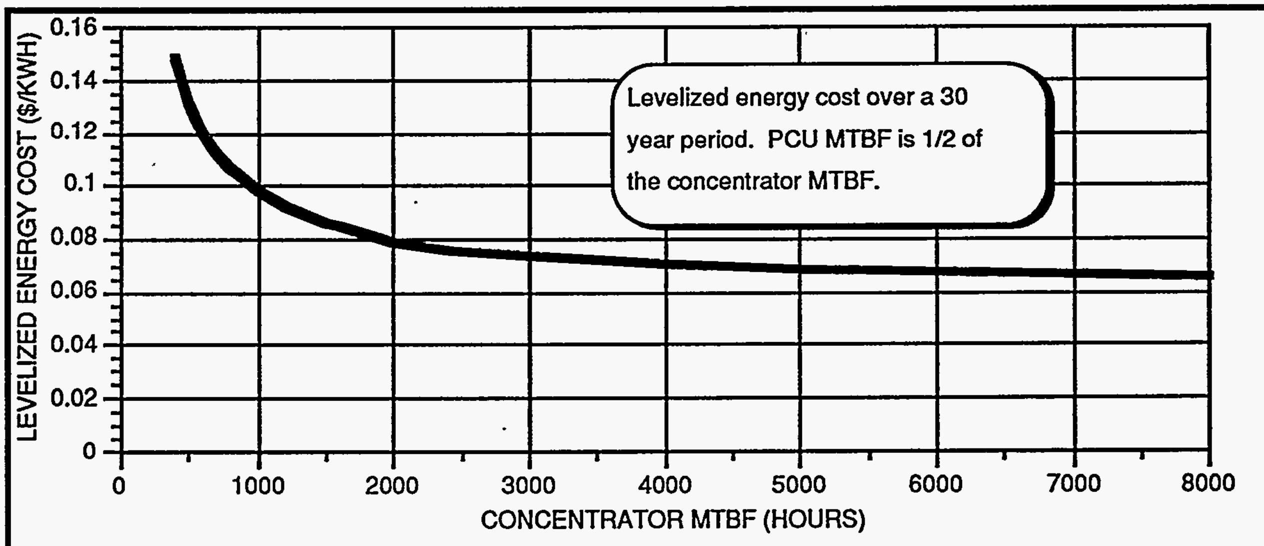


Figure VIII-7. Estimate of Levelized Energy Cost.

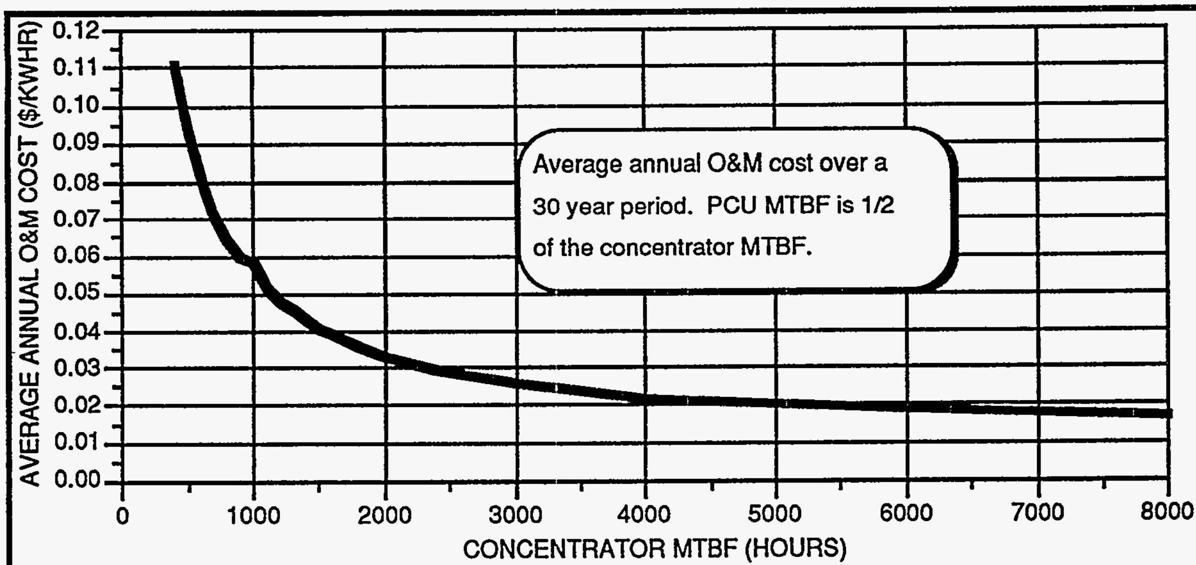


Figure VIII-8. Estimate of System O&M Cost.

Table VIII-3. Estimate of Average Annual Cost Per Concentrator Over a 30 Year Period

Concentrator MTBF = 4000 Hours/PCU MTBF = 2000 Hours

Operating & Maintenance Cost	Labor Cost	Material Cost	Total Cost
Washing labor cost	$ 95.00	$ 68.00	$ 163.00
Hydrogen gas fill labor cost	$ 29.00	$ 72.00	$ 101.00
Oil & water labor cost	$ 9.00	$ 6.00	$ 15.00
PCU overhaul			
Replacement outage labor cost	$ 24.00		$ 24.00
Engine overhaul labor cost	$ 66.00	$ 160.00	$ 226.00
PCU problem repair			
Repair outage labor cost	$ 53.00		$ 53.00
Unit repair labor cost	$ 89.00	$ 119.00	$ 208.00
Concentrator problem repair			
Repair outage labor cost	$ 17.00		$ 17.00
Unit repair labor cost	$ 44.00	$ 58.00	$ 102.00
Management labor cost	$ 79.00		$ 79.00
Plant maintenance overhead	$ 34.00	$ 81.00	$ 115.00
Total cost	$ 539.00	$ 564.00	

Table VIII-4. Estimate of Required Manload Per Concentrator Per Year.

Concentrator MTBF = 4000 Hours/ PCU MTBF = 2000 Hours		
Manpower Load Requirement for	Manload	Percent of Total
Washing manload	0.0021 man	21.9 %
Gas service manload	0.0010 man	11.0 %
Oil and water service manload	0.0004 man	3.7 %
Engine replacement manload	0.0005 man	5.4 %
Engine overhaul manload per Year	0.0014 man	14.9 %
PCU problem outage manload	0.0006 man	6.5 %
PCU hardware repair manload	0.0010 man	10.9 %
Concentrator problem outage manload	0.0003 man	3.3 %
Concentrator hardware repair manload	0.0008 man	8.1 %
Management manload	0.0008 man	7.9 %
Plant overhead manload	0.0006 man	6.3 %
Total manpower requirement	0.0095 man	

IX. LESSONS LEARNED AND RECOMMENDATIONS FOR A CONTINUING TEST PROGRAM

Many important lessons were learned during the five year duration of the MDAC/USAB/SCE Stirling dish demonstration program. This section discusses the lessons whose consideration may be beneficial to future programs in accomplishing their program objectives. This program demonstrated once again that Stirling dish systems have the highest solar-to-electric conversion efficiency of systems under development and should be considered as a viable commercial electrical power generation resource. Since considerable amount of field testing is required prior to mass production of a system and the MDAC/USAB/SCE Stirling dish system has a substantial amount of the required test time, it is conceivable that an organization will continue development of the MDAC/USAB/SCE Stirling dish system. Therefore, recommendations for modifications to the MDAC/USAB/SCE components are discussed at the end of this section for future reference by that organization.

LESSONS LEARNED

The program clearly demonstrated the importance of early interface with the potential customers during the development of system requirements. As was shown in Section VIII, operating and maintenance cost is a major part of the overall system life-cycle cost. MDAC'S early contact with the potential customers enabled the customer to influence the basic design philosophy which resulted in adoption of customer preferred design features which lowered O&M costs, e.g., the concentrator slot which allowed the PCU to be serviceable from ground level to facilitate maintenance and use of modular components to allow repair by replacement to minimize outage time that would otherwise be required to diagnose and correct maintenance problems in place. Modular components also allow for the repair of the components in a controlled environment with the proper test equipment.

Early customer involvement in the test program is very beneficial and the lessons learned during the testing could save considerable developer expense in finalizing the system design prior to start of mass production. Some of the lessons learned during this test period include:

- **The designers are of a different skill level and are more familiar with the technical operation of the system than the customer operating personnel and fail to fully appreciate the difficulty that will be encountered by the customer operating personnel.** What is a very simple operation and easily understood by the designer whose focus may be on the single operation, may not be easily understood by the customer operating personnel.

- **The developer must be aware that the customer will not normally employ operating personnel with the same skill level as the designer to operate the system and the designer needs to recognize the skill level of the potential customer's operating personnel.** The higher the required skill level, the higher the customer cost for the customer to operate the system.

- **The customer is faced with losing trained operating personnel for various reasons and must constantly train new people to operate the system.** The more procedures involved in operating the system, the more training time and expense that the customer must endure.

- **The operating personnel tend to forget certain aspects of the operation when a system operates daily or weekly with out requiring their involvement.** This resulted in more system downtime for the test program and led to confusion in the diagnosis and correction of operating and maintenance problems. The current experience indicates that demonstration programs or commercial plants consisting of a small number of units should provide for the routine training of O&M personnel.

The lessons learned validated the need to keep the system simple, eliminating all operating procedures, command, display, mechanical and electrical hardware, test equipment, etc. that can be eliminated to simplify operation and maintenance and in so doing will improve overall system availability. This will lower the O&M personnel skill level requirement, initial and follow up training cost, inventory cost, etc. On the other hand, there must be sufficient information not only to operate the system but to easily diagnose problems in a timely manner. Customer involvement with testing before commercial production commences, enables the achievement of the delicate balance between complexity and simplicity for the most cost effective system for the customer.

The importance of field testing and field testing at different site locations. The USAB 4-95 PCU had thousands of hours of bench testing during the development of the engine and during checkout of each PCU before shipment to the test site. This allowed for the cost effective detection and solution of many problems. In spite of all of the bench testing, the field testing resulted in identification of additional problems. Interaction of the system with the environment, such as solar insolation, cloud passage, and wind transients, resulted in several modifications to the system design. The PCU rod bearing failures and the engine/generator oil leakage that may have been consequent to frequent daily system starts and stop cycles are examples of problems which occurred in field testing but never occurred during bench testing which had more cumulative hours of operation. In addition, a different set of problems were encountered at the different test site locations. For example, humidity and moisture was one of the main problems encountered at the Georgia Test Site but was not a problem at the SCE Site; dust/sand resulted in problems at the SCE Test Site but was not a problem at the Georgia Test Site.

The PCU bench test program was not adequate. Many of the PCU problems encountered in the field test could have been discovered during the bench testing if the bench testing had been more representative of the field operational conditions. Because field testing is expensive, it is advisable that future test programs consider expanding the bench testing to more closely model the actual real world operating environment. Where cost effective, consideration should be given to include the following operations as part of the PCU bench testing:

- As a result of cloud cover, the PCU may have many starts over the day and idle at low speeds for long periods of time. The high number of starts/stops and idling at low speeds for long periods of time should be included as part of the PCU bench testing.

- Since the concentrator operates at different elevation angles while tracking the sun over the day, the PCU should be operated at various attitude angles. This will ensure proper oil lubrication, water level sensor operation, etc.

- Uneven flux levels over the PCU receiver as a result of gravity bending of the structure and wind movement of the reflective surface and PCU should be included in order to determine the long term life of the receiver.

- Operate the system in a hot and a cold environment.

- Vibration of the PCU resulted in electrical connectors becoming loose, insulation falling off and nuts coming off. The PCU should be mounted in such a way that the vibration will be similar to that encountered on the concentrator.

- Operate the system in a high and low ambient humidity. Simulation of blowing rain should be included.

Lightning is a major problem that must be taken into account in the design of the system. The level of lightning protection for the PCU electrical system and the data acquisition system were not adequate for the lightning environment encountered at both the SCE and Georgia test site. Lightning induced failures resulted in a lot of system downtime. Because of previous experience, the concentrator control electrical system was designed for a lightning environment and did not encounter lightning problems. The PCU, however, had frequent lightning induced problems. During the later part of the system testing at the SCE Test Site, modifications were made the to the PCU control and data acquisition components which reduced their sensitivity to lightning.

Serious consideration must be given to the maturity of the product when setting up a test program performed at potential customer test sites or the developer's remote test site. The MDAC commercialization program provided for early electric utility involvement in the test program. The intent of this program was for early involvement of the utilities in the program to provide first-hand information in the operation and performance of the Stirling dish and aid in further definition of utility specific needs with regards to the Stirling dish system. The development test period was less than one year which was driven by the MDAC/USAB desire to reach the marketplace in the shortest possible time. This Stirling dish system was being designed as an automatic or unattended low-maintenance system, a system with a 6000 hour MTBF, which is approximately 2 years of operation, and would not require significant utility personnel support for operations and maintenance. The demonstration program was therefore designed for a mature system with a high MTBF and did not provide for on-site spare parts, special test equipment, and provided only minimal personnel training. Spare parts, skilled personnel and special test equipment were located at the MDAC test site to service the MDAC and the remote utility test sites. The short development test period did not allow sufficient testing to develop the system maturity to the level that required for the designed test program. Therefore the test program design philosophy did not match the system maturity level and resulted in considerably more system down time than expected. Some of the lessons learned from this experience are:

- **Personnel training must reflect the level of maturity of the product.** The training covered the daily operation and general maintenance of the system but did not cover the basic principles of operation. Based on the lack of maturity of the system, the personnel were not sufficiently trained to the level required to diagnose and identify the source of the problems. Since the units were located across the US, the troubleshooting and analysis of many of the problems were conducted over the phone with the MDAC Test Site personnel. Often pertinent information was not observed, thought not to be important, or misinterpreted by the site personnel. This resulted in longer system outage time and much misdirected correction effort by MDAC and site personnel. The lack of local system knowledge led to frustration by the site personnel and vain attempts to correct the problems on their own. One such incident resulted in system damage when an operator performed the incorrect immediate action required due to the operator's inadequate system knowledge.

- **Each utility test site must have at least one person who is dedicated and is responsible for the daily operation of the system.** For example, at the SCE test site, there was a crew of operators and maintenance personnel whose secondary job was to operate and maintain the Stirling dish system. Because the system normally operated automatically without requiring routine O&M action and because the O&M responsibility was rotated among the crew members, an individual would go a month or more without interacting with the system. When a problem arose, the individual assigned to correct the problem had forgotten much about the system and would thus have to re-familiarize himself prior to resolving the problem. Therefore, it is suggested that future similar demonstration programs designate one person at each site who is responsible for the day-to-day operation of the system.

- **Adequate spare parts and special test equipment should be located at each test site.** The lack of maturity of the system resulted in more hardware problems than anticipated. Since the spare parts and test equipment were not located at the test site, the time to diagnose the problem and ship the spare parts contributed to long downtimes.

In a future program where early customer site testing is desired before the system is very mature, program planning should include one multi-discipline person at each test site. That person must have a general technology background and comprehend the details of the software, controls system, electronics, electrical, thermal, mechanical, PCU fundamentals, etc. The customer (or the developer if within his budget) should identify this person to be responsible for servicing the system as required. One to three months before the delivery of the system to the customer, the customer designee should be assigned to the developer's test site for training in the fundamentals of the operation and to be involved in the development testing of the product. During this period of time, the assigned person should learn the details of the fundamentals of operation and be involved in the day-to-day operational tests performed on the systems. This would include the diagnosing of any problems, general maintenance, servicing, logging of daily activity, data recording, repair, overhauling components, and troubling shooting. In this way, the utility personnel will be familiar with the operation, problem history, and fault diagnosis through hands on experience.

CONTINUATION OF THE MDAC/USAB/SCE PROGRAM

The USAB 4-95 Stirling PCU has demonstrated the highest solar-to-electric conversion efficiency of any system in the world. Successful commercialization will be dependent upon achieving a competitive life-cycle cost in order to establish a market for Stirling dishes. Life-cycle cost include manufacture, installation, operation, and maintenance cost. The demonstration program did not provide the operating and maintenance cost data required for adequate estimates of a Stirling dish power plant operation because of the comparatively short test time. Therefore, the necessary information must be acquired through additional testing of the USAB Stirling 4-95

Mark II PCUs. This system has accumulated more testing time than any other system and would require less testing time and thus a much lower cost to obtain the information with this system than any other present system. Even if newer technology would be later incorporated, much of the information obtained would still be applicable. Therefore there are good reasons for continuing with testing of this system. The test data would be valuable for the following purposes:

- Determination of the maintenance and material cost of the PCU and the mechanical life expectancy of the engine.
- Validation of performance improvements and cost reduction designs.
- Determination of design modifications necessary for low cost production units.
- Evaluation of modifications to extend the MTBF rate.
- Determination of performance improvements for future units.
- Generation of database for performance evaluation of alternate systems.

The Stirling dish components particularly the USAB Mark II PCU experienced problems that could have been corrected by application of relatively simple engineering solutions. At the time the problems were discovered, the program funding had been reduced to that essential for operation only. In the last two years of operation the authors, with the voluntary support of the Intersol Company, kept the SCE PCUs operating through their individual efforts and by cannibalizing parts from PCUs abandoned in Ann Arbor, Michigan. It is recommended that consideration be given to returning the original MDAC/USAB/SCE system to operational level to provide advancement of components as well as upgraded or improved components manufactured by others. Assuming the initial reuse of the original components, it is suggested that the recommendations below be given particular attention.

PCU - Failures such as the connecting rod crank shaft bearing experienced on the two Solar One USAB Mark II engines should be analyzed as to the cause of their failure and corrections made prior to their return to service. Each of the 4-95 engines should also be thoroughly checked out before returning them to service. The engines have been dormant since 1988 and were not subject to remedial preservation when the demonstration program was terminated.

Spare Parts - Obtain spare parts for the solar concentrators and the PCUs. Each test site should have available spare modules to minimize outage time and maximize the cost effectiveness of the demonstration program. In addition a parts storage and repair facility staffed by knowledgeable persons who can expedite problem resolution along with design specific support equipment should be available at each site.

Azimuth Gear Drive - The azimuth gear drives on all of the units should be replaced with the Sumitomo gear drive that was designed to overcome the mechanical weakness of the original drive assembly.

PCU Lightning Protection - This was a problem with the PCU electronics at all test sites. To ensure protection, a complete repackaging of the electronics will be required for a production unit. Modifications that were made at the MDAC Test Site and the SCE Test Site appeared to eliminate or at least greatly reduce the lightning-related problems. At a minimum, the grounding system of the PCU electronics should be modified; the wire shielding should be changed; a fiber optic link should replace the communications line between the PCU controller and the PCU monitor; a lightning-resistant diode should be added to the end of the line to discharge lightning-induced high potential to ground.

Fast Slew System - This emergency system was responsible for removing the concentrated solar energy from the receiver when the unit experienced either an interruption of its electrical grid connection or an emergency detrack condition. A new system needs to be designed to satisfy low-global latitude operation for the production design unit. The direct current motor did not have shaft bearings for radial loading. The belt connection with the main elevation drive motor resulted in a side load on the motor. This load would wear the bearing in a short time and render the motor inoperative. Also, the mechanical connection to the elevation gear drive was dependent on a compression-style coupling that proved to be unreliable. These problems can be easily resolved for future testing.

PCU Alarms/False Detracks - The PCU control system has a limited amount of information available to it for system diagnostics. The PCU control designer used this limited number of measurements to provide an extensive set of diagnostic alarms. These diagnostics were developed and tested in a controlled environment with a bench setup. The real solar environment is considerably different from this environment and as a result, detracks occurred even when there was no apparent problem. The detrack was cleared and the system was placed back in service without further incident. This type of problem occurred most frequently on cloudy days. It is recommended that a review be made of all alarms and that threshold settings be changed to reduce the problem.

PCU Electronics - The electronics should be upgraded to state-of-the-art technology and repackaged. Moisture caused a number of problems with the PCU electronics and related electrical connectors, particularly at the Georgia Power test site. Where possible, the number of connectors should be reduced and components that are not required for solar operation, should be removed.

Oil leakage - The two Mark II PCUs that operated at Barstow experienced oil leakage between the engine and generator. Although the SCE units oil leakage was minor, it needs to be resolved since it reduces concentrator efficiency and increases maintenance costs. The leaking oil collects on the concentrator's reflective surface during the time of day when the concentrator is at a high elevation angle. This oil cause increased soiling of the mirror surface from dust sticking to the oil. This reduced the total reflectivity of the system and resulted in an uneven receiver flux distribution which further reduced the system efficiency. Because the normal low cost washing technique would not remove the oil spot entirely, costly methods such as manual scrubbing had to be employed.

X. CONCLUSIONS

The MDAC/USAB/SCE Stirling dish test program demonstrated the high performance of this solar-to-electric conversion technology and confirmed the performance results of previous DOE Stirling dish systems to include the systems tested in the JPL and Vanguard programs. The system reviewed in this report achieved a peak net power efficiency of 30% at 1000 W/m^2 solar insolation and a daily generated energy efficiency of 27% at daily sun energy levels of 10 kWh/m^2. The system can start and operate at insolation levels as low as 250 W/m^2. Even on cloudy days the unit can produce net power at energy levels as low as 1 kWh/m^2. The Solar One test site Stirling dish was able to produce up to one half of its normal daily net electrical output during days of frequent cloud passage, whereas, the adjacent Solar One and SEGS plants could not operate consequent to the cloud passage frequency. Over 118 MWh of energy was generated and put onto the utility grid line during the test program. Nine USAB 4-95 Stirling PCUs were tested during the four-year program and accumulated over 13,852 hours of on-sun generating time. The first unit operated in late 1984, and PCUs operated on different units until late 1988. Several of the concentrators continue to operate up to the present time in various applications.

The Stirling dish system did not require a full-time operator because the control system had the capability of operating automatically. It would startup in the morning at sunrise and move to the sun position, track the sun all day, and then rotate back to a night stow position at sundown. If any problem occurred during the day, the system would detrack from the sun and return to a night stow position, where it would wait for the problem to be corrected. Following a grid power loss, the system would obtain a new reference position and then return to normal operation.

The power and energy performance of the USAB 4-95 engine was confirmed by this test program. No engine receiver problems were encountered during the test program. It was found during the test program that controlling the receiver quadrature temperature difference was not a problem. It was generally maintained in the 60 to 70 deg C range and often was as low as 20 to 30 deg C. This validated that a uniform flux distribution over the receiver was achieved. The USAB Mark II engine heater heads that under went test operation on the Solar One Site engines did not evidence any degradation after each had 1700+ hours of operation. The small heater head temperature differential that was demonstrated coupled with visual examination of the heater heads confirmed that silvered glass dishes can provide uniform flux distribution and thus operate without thermal buffers, e.g., reflux boilers and heat pipes between the solar irradiance and the working fluid heat exchanger. No hydrogen engine seals or piston ring problems were encountered during the test program. Consumption of hydrogen gas as a result of leakage was not found to be a major problem. Most of the problems experienced with the engine were of a minor nature and could be rectified merely by a repackaging of the electronics and modification of the control diagnostic.

The overall performance of the concentrator was good during the test program and has been improved since the end of the official test program in 1988. After eight years of operation at the different test sites, there has been no change in the structural performance that would indicate that the structure would not meet the 30-year design life. The mirrors in the desert environment withstood the environment without any apparent degradation in performance. After 8 years, the reflectivity was measured at 0.91+, which is the same as the day the dish was manufactured. The surface waviness and radius of curvature were also measured and found to be the same as the day it was manufactured (within the limits of the instrument that is 0.2 mad and ±10 inches out of 700 inches). The surface of the mirror showed no signs of sand erosion. It was also found that the mirror withstood mishaps that might occur during plant operation without requiring their replacement. Because of their method of construction, mirror impact resulting from a falling wrench or other object will generally only break the local area glass and the balance of the reflective area is not affected. In addition, resulting cracks did not induce mirror silver corrosion thus minimal loss of reflectivity resulted from the incidents.

The tracking control system achieved a tracking accuracy of 0.2 mrad rms over the day. Achieving this accuracy did not result in costly control components, costly requirements on the structure and mechanical assembles, or costly installation requirements. This accuracy was achieved by developing a software error model that would adjust the tracking to compensate for these errors.

The alignment of the mirrors was maintained on all units throughout the test program. This included assembling and disassembling the concentrator and their shipment to Barstow, California, Nevada, Georgia, Japan and Switzerland. A mirror alignment method was developed during this program using an instrument called the Digital

Image Radiometer (DIR). With the DIR, alignment of the mirrors to an accuracy of 0.2 mrad rms was achieved with a timely and cost-effective operation. Using the available equipment at the time, the 82 mirrors were aligned by one person in less than four hours. With current state-of-the-art equipment this would be greatly reduced.

The overall MDAC/USAB/SCE Stirling dish program results determined that the system is not faced with technical barriers that would preclude commercialization of this or similar Stirling dish systems. The significant component failures were the concentrator azimuth gear drive and Mark II PCU piston connecting rods bearings. A replacement gear drive was purchased, installed and underwent successful test. The failed bearings were a result of the conscious decision to optimize the performance of the PCU and accept the reduced reliability. Correction of the problem requires the use of larger bearings or the installation of a motor operated oil pump to lubricate the bearings in preparation for mechanically demanding start ups each day or following cloud passages.

A computer model of the energy performance of the Stirling dish system was created which uses actual MDAC/USAB/SCE Stirling dish program system cost, based on a 1985 cost reduction study and demonstrated performance data. The program using Barstow, California environment conditions, and mature system reliability data predicts a Stirling dish system annual energy performance efficiency of 23%. The major sources of controllable energy loss are soiling of the mirrors. The major O&M expenses are PCU overhaul and concentrator wash costs. The simulation model shows that system availability must be in the mid-90 percent range, under the above conditions, to achieve a competitive levelized energy cost. The 1985 cost data were updated in early 1993 in response to a U.S. Department of Energy request for proposal to commercialize distributed generation system. Using this new cost data, the Stirling dish simulation indicates that the system can be manufactured and installed in the $1,500 to $2,000 /kW range and produce power in the $0.08 /kWhr range at production rates as low as 10,000 units per year.

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Test Site	Time Period	Report Number
Georgia Power	Oct. 85-Jan 86	GPC-001
Georgia Power	Feb. 1986	GPC-002
Georgia Power	Mar. 1986	GPC-003
Georgia Power	Apr. 1986	GPC-004
Georgia Power	May 1986	GPC-005
Georgia Power	June 1986	GPC-006
Georgia Power	July 1986	GPC-007
SCE	Oct. 85- Jan. 86	SCE-001
SCE	Feb. 1986	SCE-002
SCE	Mar. 1986	SCE-003
SCE	Apr. 1986	SCE-004
SCE	May 1986	SCE-005
SCE	June 1986	SCE-006
SCE	July 1986	SCE-007

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APPENDIX A

This appendix contains a summary of the
Stirling Dish testing from September 1984 to June 1986
at MDAC test site, Huntington Beach, California.

OPERATING SUMMARY FOR THE MDAC TEST SITE

Date		Description
1984		
12/3	Pad 2	First startup, had to adjust track system.
12/4	Pad 2	First full day operation, numerous clouds. No problems.
12/5	Pad 2	Dedication of Solar Dish.
12/6	Pad 2	No testing. Routing and tie down of concentrator wiring.
12/7	Pad 2	No testing, clouds.
12/10	Pad 2	Cloudy and rain. No testing. Intermittent problem with helicon sensor during reference update. PCU pressure transducer problem, damp connector.
12/12	Pad 2	Partly cloudy, no problem.
12/13	Pad 2	Structure deflection test.
12/18	Pad 2	Cloudy and rained all day, no testing.
12/19	Pad 2	Water in PXU electronic box caused system to be down
12/20	Pad 2	Changed cable routing and change Ptank to Pmin because of water connector problem
12/21	Pad 2	Many detracks in early morning because of clouds - too many starts - oil pressure but not running
12/24	Pad 2	System shut down over holidays.
1985		
1/1 to 1/4	Pad 2	Personnel on vacation.
1/7 to 1/8	Pad 2	No testing because of clouds.
1/9	Pad 2	Started operating at 10:39, no problems.
1/10	Pad 2	No problems.
1/11	Pad 2	Check gas leak, cone insolation fell off.
1/14	Pad 2	Put on flux mapper and camera.
1/15	Pad 2	Operated with no problem.
1/17	Pad 2	8:00 down - Rewire data wires for power meas. 900 track
1/18	Pad 2	Down 7:30 for DAS work, 9:07 track
1/22	Pad 2	Down for site work, started 11:56
1/24	Pad 2	Measure fan & pump power.
1/28	Pad 2	Elevation motor ran into pedestal during night stow.
1/29	Pad 2	Replaced elevation motor.
1/30	Pad 2	Problem with elevation helicon sensor during reference update.
1/31	Pad 2	Operated in automatic, no problem.
2/1	Pad 2	Added oil to PCU.
2/4	Pad 2	Conducted tilt measurement in morning, tested in afternoon with no problem.
2/5	Pad 2	Detrack, found oil in gas system, removed PCU 101.
2/8	Pad 2	Replaced elevation gimbeland helicon sensor.
2/11	Pad 2	Replace PCU generated thermal shield. Rain in afternoon resulted in insolation falling off.
2/14	Pad 2	Detrack-wrong start pressure.
2/21	Pad 2	Detrack, oil pressure but not running.
2/22	Pad 2	PCU water leak.
2/25 to 3/6	Pad 2	Remove PCU 102 and installed fluxmapper.
3/7	Pad 2	Install PCU 101 and checked out, check valve prob. replaced.
3/8 to 3/15	Pad 2	Operated with no problem.
3/19	Pad 2	System controller communication problem.
3/20/3/31	Pad 2	In automatic most of time, no problem.
4/1 to 4/8	Pad 2	No problem, did life cycling when cloudy
4/9	Pad	Software update.
4/16	Pad 2	Filled hydrogen tank, 11:50 in track
4/17	Pad 2	Took reflectivity measurements, 1:10 track.
4/18	Pad 2	Water pump fault, 8:30 track.
4/22	Pad 2	Took photos of system.

4/24	Pad 2	Installed data acquisition wiring.
4/25	Pad 2	Power test
4/27	Pad 2	Detrack - fan fault, 1000 track.
5/1	Pad 2	Problem with PCU control operation.
5/2	Pad 2	Found low voltage on output of PCU dc power supply.
5/3 to 5/8	Pad 2	Cloudy most of time, no problem.
5/9	Pad 2	Sun sensor problem.
5/10	Pad 2	Down 7:00 with waterpump fault, 7:50 track
5/14	Pad 2	Detrack-fan fault.
5/15	Pad 2	Changed aperture cone, 13:00 burned wires on PCU support.
5/16	Pad 2	Replaced burned wires, reflectivity measurements.
5/17 to 5/19	Pad 2	Operated with no problem.
5/20	Pad 2	Detrack -fan fault, reflectivity measurements.
5/23	Pad 2	SC/CC communication problem, did not stop operation.
5/24	Pad 2	Gravity bending test, detrack-generator on/off too fast
5/29	Pad 2	Down 8:00 - Hydrogen gas fill, 11:15 track
5/30	Pad 2	Reflectivity measurements, washed mirrors.
6/4	Pad 2	10:45 Fan fault detrack.
6/7	Pad 2	14:00 Fan fault detrack, cleaned relay.
6/10 to 6/11	Pad 2	Optical bending measurement, 11:15 track
6/14	Pad 2	Down 6:55 - Power consumption test, 9:45 track
6/15 to 6/16	Pad 2	Operated in automatic, no problem.
6/17	Pad 2	Power consumption test, refl. meas.
6/18	Pad 2	Operated in automatic, no problem.
6/19	Pad 2	System Controller CRT communication problem.
6/25	Pad 2	10:00 Low H2, filled tank, 12:50 back in track.
6/26	Pad 2	H2 leak, repaired & filled H2.
6/27 to 6/31	Pad 2	Operated with no problem.
7/2	Pad 2	Removed P101 & installed P102
7/3	Pad 2	Adjusted fan relay.
7/4	Pad 2	Down 9:00 - In auto, app. 9:00 Repaired gas pipe leak, 10:30 track.
7/23	Pad 2	Changed PCU-removed P102 & installed P205
7/24	Pad 3	Installed concentrator on pad 3.
7/29	Pad 2	Down 10:00 - Hydrogen Gas refill, 11:20 track.
7/31	Pad 2	Down 7:00 - Installed new thermal shield.
8/11	Pad 2	Detrack-high temp. & no speed.
8/17	Pad 2	Repair PCU connector
8/18	Pad 2	Grid power loss. Shutters open when power restored because of design problem and receiver burned up.
8/19	Pad 2	Installed new PCU.
8/20	Pad 2	Installed P103.
9/5	Pad 2	Water in PCU connector.
9/11	Pad 2	Down 10:50 - Trouble shooting DAS
9/12	Pad 2	Startup of unit
9/13	Pad 3	Down 8:00 - Water leak in radiator, replaced radiator.
9/15 to 9/16	Pad 2 Pad 3	Oil pressure problem, sensor. A false detrack problem started occurring during this month, continued for several months until a capacitor was added to PCU interface relay.
9/23	Pad 2	Removed PCU 103 & install PCU 205
10/10	Pad 2	PCU dump fault, compressor problem.
10/15	Pad 2	Detrack, too many starts, detrack-fan fault.
10/26	Pad 3	Down 12:22 - Detrack on fan fault, 16:19 track
11/10	Pad 3	Down - Detrack on not running but oil pressure.
11/13 to 11/18	Pad 2	Gas leak problem, found to be bad seal.
11/20	Pad 2	PCU gas leak.
11/21	Pad 3	Fast slew problem.
11/26	Pad 3	Communication problem with PCU.
11/30	Pad 2	Facility power outage.
12/1	Pad 2	Facility power outage.
12/3	Pad 2	PCU breaker prob.
12/4	Pad 3	Problem with cooling fan breaker.
12/11	Pad 2	Concentrator controller had communication problem.
12/12	Pad 2	Gravity bending, measurement.

1986

1/1 to 1/5	Pad 2 & 3	Automatic operation, no problem - clouds most of time
1/6	Pad 2	Automatic operation, no problem
	Pad 3	Water in PCU power connector caused short
1/7 to 1/12	Pad 2 & 3	Automatic operation, no problem - data system down, no data
1/13	Pad 2	Automatic operation, no problem
	Pad 3	Down to fix gas leak
1/14 to 1/15	Pad 2 & 3	Automatic operation, no problem
1/16	Pad 2	Automatic operation, no problem
	Pad 3	Down to investigate gas leak
1/17	Pad 2 & 3	Automatic operation, no problem
1/18	Pad 2	System down to perform work on DAS system.
1/19	Pad 2 & 3	Automatic operation, no problem
1/20	Pad 2	Automatic operation, no problem
	Pad 3	Detrack - wrong start pressure
1/21	Pad 2	Automatic operation, no problem
	Pad 3	Operated part of day, gas leak problem
1/22	Pad 2	Automatic operation, no problem
	Pad 3	9:00 to night stow because of gas leak problem
1/23	Pad 2	Detrack at 15:25, could fine no problem or error message
	Pad 3	System down to investigate gas leak problem
1/24 to 1/30	Pad 3	Internal gas leak, changed PCU., check out of new PCU
1/24	Pad 2	Detrack at 11:44, could fine no problem, returned to track
1/25	Pad 2	Detrack at 11:44, could fine no problem, returned to track
1/26 to 1/30	Pad 2	Automatic operation, no problem, clouds & rain
2/5 to 2/7	Pad 3	Intermittent problem with experimental encoder, replaced.
2/9 to 2/14	Pad 2 & 3	Automatic operation, no problem, clouds most of time
2/18	Pad 2	Low oil pressure detracks, replaced oil sensor.
2/19 to 2/22	Pad 2 & 3	Automatic operation, no problem, clouds part of time
1/23	Pad 2	Automatic operation, no problem
	Pad 3	Automatic operation, Detrack - high tank pressure, dump fault
2/24	Pad 2	Automatic operation, no problem
	Pad 3	Detrack- no PCU error, put back into track
2/25 to 2/28	Pad 2 & 3	Automatic operation, no problem
3/1 to 3/2	Pad 3	Running but no oil pressure, replaced oil sensor.
3/2	Pad 3	Pad 3 down, detrack-running but no oil pressure.
3/9	Pad 3	Detrack-wrong start to pressure.
3/18	Pad 2	Down - radiator fan fault
3/24	Pad 2	Down 13:52 - Detrack water pump fault
3/26	Pad 2	Down 6:59 - Detrack because of too many starts
	Pad 3	Down 6:59 - Detrack for wrong start pressure, 10:19 track.
4/11 to 4/17	Pad 2 & 3	Automatic operation, no problem.
4/18	Pad 2	Gas refill, automatic operation
	Pad 3	Automatic operation, no problem.
4/19 to 4/21	Pad 2 & 3	Automatic operation, no problem.
4/22	Pad 2 & 3	Washed concentrators, reflectivity measurements.
		Trouble during reference update with concentrator 2, went up in elevation and burned wiring on PCU support structure, 13:00 back in service
4/23	Pad 2	Down 12:20 - Detrack for radiator fan fault.
4/24 to 4/25	Pad 2 & 3	Automatic operation, no problem.
4/30	Pad 2	Automatic operation, no problem
	Pad 3	Went into Fast Slew mode in track, no PCU problem
5/1	Pad 2	Automatic operation, no problem
	Pad 3	Investigation of Fast Slew problem, loose connection in PCU box.
5/2 to 5/5	Pad 2 & 3	Automatic operation, no problem
5/6	Pad 2	Night stow to investigate radiator fan fault.
	Pad 3	Automatic operation, no problem
5/7	Pad 2 & 3	Automatic operation, no problem
5/8	Pad 2	Night stow for investigation of fan fault.
	Pad 3	Automatic operation, no problem
5/12 to 5/15	Pad 2	Automatic operation, no problem
	Pad 3	Inactive, too chips for Las Vegas unit.
5/20 to 5/23	Pad 2 & 3	Automatic operation, no problem, DAS problem - no data part of time.

5/27	Pad 2	Automatic operation, no problem
	Pad 3	Detrack - wrong start pressure.
6/3 to 6/4	Pad 2	Automatic operation, no problem
	Pad 3	Fast Slew problem
6/5	Pad 2	Checked mirror pattern in morning, 12:00 in track.
	Pad 3	Checked mirror pattern in morning, inactive because of Fast Slew problem.
6/5 to 6/9	Pad 2	Automatic operation, no problem
6/5 to end	Pad 3	Fast slew problem, bad wire connections.

DATA FOR MONTH 12 AND YEAR 1984 FOR PAD 2 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
2	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
3	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
4	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
5	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
6	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
7	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
8	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
9	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
10	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
11	0.00	0.0	0.0	-0.9	0.115	-9.0	0.00	0.00	0.0
12	15.40	745.9	23.5	17.3	0.905	21.8	0.00	0.00	0.0
13	21.20	927.7	26.1	80.8	4.174	22.1	0.00	0.00	0.0
14	21.20	922.0	26.2	132.5	6.403	23.6	0.00	0.00	0.0
15	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
16	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
17	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
18	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
19	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
20	15.50	850.4	20.8	9.8	0.548	20.4	0.00	0.00	0.0
21	20.50	864.9	27.0	98.7	5.340	21.1	0.00	0.00	0.0
22	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
23	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
24	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
25	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
26	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
27	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
28	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
29	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
30	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
31	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............	0.00	HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M....	0.00	HOURS
TRACK TIME / TIME NIP > 300...........	0.0000	
MAXIMUM DAILY NET POWER	21.20	KW
MAX. DAILY NET POWER EFFIC. FOR MONTH	27.0	%
MAXIMUM DAILY NET ENERGY	132.50	KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH	23.6	%
TOTAL NET POWER PRODUCED FOR MONTH....	3.9	KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........	17.5	KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH ..	22.1	%

DATA FOR MONTH 1 AND YEAR 1985 FOR PAD 2 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
2	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
3	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
4	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
5	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
6	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
7	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
8	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
9	17.00	773.9	25.1	52.4	2.929	20.4	6.30	0.00	0.0
10	19.20	833.4	26.3	40.8	2.293	20.3	0.00	0.00	0.0
11	21.50	952.9	25.7	81.1	4.151	22.3	0.00	0.00	0.0
12	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
13	0.00	0.0	0.0	0.0	0.000	0.0	6.60	0.00	0.0
14	21.80	935.3	26.6	90.0	4.312	23.8	5.30	0.00	0.0
15	19.90	894.6	25.4	113.3	5.590	23.1	0.00	0.00	0.0
16	19.90	865.0	26.2	98.5	4.829	23.3	7.60	0.00	0.0
17	19.60	848.7	26.3	105.5	4.722	25.5	7.90	0.00	0.0
18	19.20	853.3	25.7	109.0	5.394	23.0	7.70	0.00	0.0
19	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
20	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
21	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
22	19.10	880.5	24.7	45.8	2.520	20.7	4.30	0.00	0.0
23	12.20	642.7	21.7	56.7	3.615	17.9	7.80	0.00	0.0
24	18.90	858.0	25.1	76.2	3.938	22.1	5.80	0.00	0.0
25	13.80	755.7	20.8	12.1	0.907	15.2	5.40	0.00	0.0
26	15.00	735.6	23.3	23.6	1.321	20.4	0.00	0.00	0.0
27	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
28	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
29	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
30	15.60	754.3	23.6	36.1	1.966	20.9	6.00	0.00	0.0
31	21.20	847.2	28.5	123.5	5.669	24.8	8.60	0.00	0.0

TOTAL TRACK TIME FOR MONTH............	79.30	HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M....	0.00	HOURS
TRACK TIME / TIME NIP > 300...........	0.0000	
MAXIMUM DAILY NET POWER	21.80	KW
MAX. DAILY NET POWER EFFIC. FOR MONTH	28.5	%
MAXIMUM DAILY NET ENERGY	123.50	KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH	25.5	%
TOTAL NET POWER PRODUCED FOR MONTH....	12.1	KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........	54.2	KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH ..	22.4	%

DATA FOR MONTH 2 AND YEAR 1985 FOR PAD 2 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	22.30	904.6	28.1	114.4	5.093	25.6	0.00	0.00	0.0
2	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
3	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
4	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
5	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
6	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
7	16.60	729.6	26.0	70.7	3.629	22.2	7.00	0.00	0.0
8	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
9	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
10	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
11	20.00	906.1	25.2	106.4	5.226	23.2	7.60	0.00	0.0
12	18.80	884.1	24.3	97.2	4.671	23.7	8.70	0.00	0.0
13	19.30	861.9	25.5	124.9	6.119	23.3	9.00	0.00	0.0
14	21.80	965.6	25.8	168.6	7.847	24.5	9.50	0.00	0.0
15	21.00	913.8	26.2	125.5	5.900	24.3	8.30	0.00	0.0
16	19.80	879.4	25.7	141.4	6.685	24.1	9.20	0.00	0.0
17	14.80	708.8	23.8	12.1	1.016	13.6	7.90	0.00	0.0
18	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
19	8.00	498.2	18.3	9.1	0.718	14.5	2.60	0.00	0.0
20	10.50	529.5	22.6	25.4	1.502	19.3	4.10	0.00	0.0
21	17.60	772.6	26.0	91.3	4.842	21.5	9.60	0.00	0.0
22	19.00	825.7	26.2	95.0	5.145	21.1	8.80	0.00	0.0
23	17.00	768.6	25.2	103.6	5.265	22.4	8.50	0.00	0.0
24	19.00	850.7	25.5	122.0	6.140	22.7	9.10	0.00	0.0
25	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
26	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
27	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
28	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............ 109.90 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY NET POWER .... 22.30 KW
MAX. DAILY NET POWER EFFIC. FOR MONTH 28.1 %
MAXIMUM DAILY NET ENERGY .... 168.60 KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH 25.6 %
TOTAL NET POWER PRODUCED FOR MONTH.... 16.1 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 69.8 KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH .. 23.0 %

DATA FOR MONTH 3 AND YEAR 1985 FOR PAD 2 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
2	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
3	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
4	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
5	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
6	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
7	17.70	760.7	26.5	34.0	1.772	21.9	3.60	0.00	0.0
8	1.00	469.9	2.4	0.0	0.022	0.0	4.50	0.00	0.0
9	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
10	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
11	22.20	915.2	27.7	153.2	7.037	24.8	9.60	0.00	0.0
12	19.90	835.9	27.2	89.7	4.994	20.5	9.60	0.00	0.0
13	18.80	792.1	27.1	130.5	6.427	23.2	10.30	0.00	0.0
14	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
15	15.10	662.7	26.0	45.8	2.995	17.4	8.80	0.00	0.0
16	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
17	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
18	22.20	923.6	27.4	17.3	0.833	23.7	1.50	0.00	0.0
19	21.30	869.9	27.9	153.8	6.955	25.2	11.00	0.00	0.0
20	18.90	772.1	27.9	132.7	6.324	23.9	11.20	0.00	0.0
21	14.10	625.0	25.7	37.2	2.023	21.0	5.00	0.00	0.0
22	16.90	714.7	27.0	88.0	4.157	24.1	8.20	0.00	0.0
23	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
24	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
25	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
26	17.40	765.3	25.9	59.9	3.255	21.0	5.70	0.00	0.0
27	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
28	20.40	918.2	25.3	40.8	2.086	22.3	5.30	0.00	0.0
29	20.50	888.7	26.3	130.2	6.100	24.3	10.30	0.00	0.0
30	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
31	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............ 104.60 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY NET POWER .... 22.20 KW
MAX. DAILY NET POWER EFFIC. FOR MONTH 27.9 %
MAXIMUM DAILY NET ENERGY .... 153.80 KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH 25.2 %
TOTAL NET POWER PRODUCED FOR MONTH.... 12.7 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 55.0 KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH .. 23.1 %

DATA FOR MONTH 4 AND YEAR 1985 FOR PAD 2 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
2	21.10	928.0	25.9	171.3	8.282	23.6	10.70	0.00	0.0
3	19.70	873.7	25.7	153.0	7.732	22.6	11.30	0.00	0.0
4	17.60	778.8	25.8	24.5	1.347	20.7	3.70	0.00	0.0
5	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
6	0.00	0.0	0.0	0.0	0.000	0.0	3.70	0.00	0.0
7	13.00	639.1	23.2	33.5	1.817	21.0	3.70	0.00	0.0
8	12.60	635.5	22.6	20.7	1.336	17.7	4.50	0.00	0.0
9	17.70	795.4	25.4	33.1	1.863	20.3	3.40	0.00	0.0
10	19.80	874.2	25.8	122.2	5.977	23.3	8.50	0.00	0.0
11	15.70	727.8	24.6	89.9	4.733	21.7	8.00	0.00	0.0
12	19.40	871.6	25.4	113.8	5.763	22.5	8.40	0.00	0.0
13	17.00	811.4	23.9	66.1	3.529	21.4	7.30	0.00	0.0
14	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
15	18.40	845.1	24.8	74.7	4.145	20.6	7.40	0.00	0.0
16	18.70	885.4	24.1	54.7	3.236	19.3	6.10	0.00	0.0
17	22.80	716.0	36.3	106.3	4.757	25.5	6.70	0.00	0.0
18	20.90	854.6	27.9	126.8	5.882	24.6	8.90	0.00	0.0
19	18.30	767.2	27.2	50.6	2.513	23.0	5.40	0.00	0.0
20	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
21	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
22	15.80	828.5	21.8	29.1	0.000	0.0	0.00	0.00	0.0
23	20.00	861.4	26.5	167.7	7.990	23.9	11.40	0.00	0.0
24	19.80	866.8	26.1	107.6	6.080	20.2	10.40	0.00	0.0
25	13.70	680.8	23.0	17.4	3.380	5.9	12.10	0.00	0.0
26	20.00	908.3	25.1	172.4	8.470	23.2	11.80	0.00	0.0
27	18.10	847.1	24.4	97.7	0.000	0.0	8.20	0.00	0.0
28	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
29	18.30	863.5	24.2	42.8	2.530	19.3	4.50	0.00	0.0
30	18.50	864.7	24.4	75.0	7.280	11.8	7.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............	173.10	HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M....	0.00	HOURS
TRACK TIME / TIME NIP > 300...........	0.0000	
MAXIMUM DAILY NET POWER	22.80	KW
MAX. DAILY NET POWER EFFIC. FOR MONTH	36.3	%
MAXIMUM DAILY NET ENERGY	172.40	KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH	25.5	%
TOTAL NET POWER PRODUCED FOR MONTH....	20.8	KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........	98.6	KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH ..	21.1	%

DATA FOR MONTH 5 AND YEAR 1985 FOR PAD 2 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	18.30	0.0	0.0	114.8	6.490	20.2	7.40	0.00	0.0
2	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
3	16.00	837.8	21.8	14.0	1.660	9.6	1.80	0.00	0.0
4	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
5	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
6	14.30	725.8	22.5	35.3	2.656	15.2	5.00	0.00	0.0
7	10.70	593.1	20.6	19.9	1.265	17.9	3.00	0.00	0.0
8	14.30	774.3	21.1	15.6	1.516	11.7	9.60	0.00	0.0
9	20.30	866.5	26.7	71.9	3.532	23.2	7.00	0.00	0.0
10	22.20	886.1	28.6	200.2	8.614	26.5	11.50	0.00	0.0
11	21.10	849.6	28.3	90.6	4.329	23.9	8.70	0.00	0.0
12	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
13	19.90	839.3	27.0	186.3	8.609	24.7	12.30	0.00	0.0
14	19.60	838.0	26.7	156.0	7.897	22.5	12.10	0.00	0.0
15	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
16	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
17	19.10	819.6	26.6	58.0	2.762	24.0	4.30	0.00	0.0
18	20.30	854.1	27.1	171.2	8.188	23.8	12.60	0.00	0.0
19	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
20	15.30	691.0	25.3	55.4	3.479	18.2	0.00	0.00	0.0
21	18.40	817.1	25.7	108.7	5.601	22.1	8.80	0.00	0.0
22	16.20	746.3	24.8	78.0	4.478	19.9	9.30	0.00	0.0
23	16.10	735.1	25.0	83.8	4.563	20.9	9.00	0.00	0.0
24	18.20	827.9	25.1	92.5	4.584	23.0	6.40	0.00	0.0
25	18.20	845.5	24.6	69.5	3.634	21.8	8.10	0.00	0.0
26	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
27	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
28	19.60	896.8	24.9	180.9	0.000	0.0	12.50	0.00	0.0
29	17.60	851.3	23.6	64.9	5.112	14.5	10.00	0.00	0.0
30	18.40	874.9	24.0	7.5	1.257	6.8	3.30	0.00	0.0
31	20.60	848.8	27.7	140.9	6.472	24.8	11.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............ 173.70 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY NET POWER .... 22.20 KW
MAX. DAILY NET POWER EFFIC. FOR MONTH 28.6 %
MAXIMUM DAILY NET ENERGY .... 200.20 KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH 26.5 %
TOTAL NET POWER PRODUCED FOR MONTH.... 20.9 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 96.7 KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH .. 21.6 %

DATA FOR MONTH 6 AND YEAR 1985 FOR PAD 2 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	22.50	908.9	28.2	176.0	7.997	25.1	12.80	0.00	0.0
2	20.60	838.0	28.0	122.5	6.088	23.0	11.10	0.00	0.0
3	18.70	805.1	26.5	127.3	6.464	22.5	12.30	0.00	0.0
4	19.90	876.0	25.9	137.8	9.017	17.4	12.00	0.00	0.0
5	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
6	20.40	896.0	26.0	117.6	8.595	15.6	8.00	0.00	0.0
7	18.00	842.0	24.4	122.9	8.117	17.3	9.50	0.00	0.0
8	19.00	882.6	24.6	155.6	8.003	22.2	11.90	0.00	0.0
9	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
10	17.30	840.0	23.5	69.0	4.127	19.1	4.10	0.00	0.0
11	14.70	775.0	21.6	24.4	3.625	7.7	10.60	0.00	0.0
12	12.50	668.0	21.3	60.5	4.036	17.1	8.80	0.00	0.0
13	14.90	753.0	22.6	68.6	3.979	19.7	7.00	0.00	0.0
14	16.40	809.0	23.1	106.5	6.133	19.8	9.40	0.00	0.0
15	17.00	846.0	22.9	114.5	6.687	19.5	10.50	0.00	0.0
16	17.90	878.0	23.3	86.5	5.267	18.7	13.00	0.00	0.0
17	16.30	852.0	21.8	117.6	6.930	19.4	11.10	0.00	0.0
18	14.50	774.0	21.4	84.8	5.315	18.2	10.00	0.00	0.0
19	21.60	882.0	27.9	59.3	2.637	25.7	6.00	0.00	0.0
20	21.50	889.0	27.6	162.1	7.260	25.5	11.30	0.00	0.0
21	21.90	887.0	28.2	138.9	6.560	24.2	0.00	0.00	0.0
22	20.70	840.0	28.1	125.6	5.960	24.0	0.00	0.00	0.0
23	20.00	808.0	28.2	122.3	5.930	23.5	0.00	0.00	0.0
24	21.10	887.0	27.1	116.9	7.370	18.1	0.00	0.00	0.0
25	18.30	787.0	26.5	60.4	3.320	20.8	0.00	0.00	0.0
26	18.60	809.0	26.2	157.4	8.320	21.6	0.00	0.00	0.0
27	17.00	783.0	24.8	99.8	6.120	18.6	0.00	0.00	0.0
28	17.30	808.0	24.4	116.8	6.590	20.2	0.00	0.00	0.0
29	19.00	888.0	24.4	82.6	5.930	15.9	0.00	0.00	0.0
30	17.30	864.0	22.8	148.3	8.950	18.9	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............ 179.40 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY NET POWER .... 22.50 KW
MAX. DAILY NET POWER EFFIC. FOR MONTH 28.2 %
MAXIMUM DAILY NET ENERGY .... 176.00 KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH 25.7 %
TOTAL NET POWER PRODUCED FOR MONTH.... 35.2 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 175.3 KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH .. 20.1 %

DATA FOR MONTH 7 AND YEAR 1985 FOR PAD 2 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	16.70	854.0	22.3	162.8	9.520	19.5	0.00	0.00	0.0
2	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
3	14.90	797.0	21.3	73.3	6.470	12.9	0.00	0.00	0.0
4	13.20	726.0	20.7	71.2	7.470	10.9	0.00	0.00	0.0
5	12.50	707.0	20.2	31.3	4.070	8.8	0.00	0.00	0.0
6	0.00	0.0	0.0	0.0	2.750	0.0	0.00	0.00	0.0
7	13.60	745.0	20.8	37.3	7.110	6.0	0.00	0.00	0.0
8	12.00	691.0	19.8	22.5	3.610	7.1	0.00	0.00	0.0
9	12.00	729.0	18.8	26.5	3.040	9.9	0.00	0.00	0.0
10	12.40	742.0	19.1	54.1	5.590	11.0	0.00	0.00	0.0
11	17.20	754.0	26.0	117.3	7.310	18.3	0.00	0.00	0.0
12	19.30	828.0	26.6	166.2	8.600	22.0	0.00	0.00	0.0
13	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
14	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
15	7.20	558.0	14.7	1.3	0.370	4.0	0.00	0.00	0.0
16	16.00	731.0	25.0	158.9	10.150	17.9	0.00	0.00	0.0
17	14.10	682.0	23.6	84.7	5.320	18.2	0.00	0.00	0.0
18	15.70	769.0	23.3	78.5	5.070	17.7	0.00	0.00	0.0
19	15.00	772.0	22.2	70.4	5.910	13.6	0.00	0.00	0.0
20	15.60	781.0	22.8	117.4	7.850	17.1	0.00	0.00	0.0
21	15.50	805.0	22.0	131.0	0.000	0.0	0.00	0.00	0.0
22	0.00	865.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
23	0.00	856.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
24	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
25	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
26	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
27	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
28	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
29	0.00	0.0	0.0	0.0	1.570	0.0	0.00	0.00	0.0
30	19.60	865.0	25.8	97.6	6.690	16.6	0.00	0.00	0.0
31	18.70	856.0	24.9	80.1	6.530	14.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY NET POWER .... 19.60 KW
MAX. DAILY NET POWER EFFIC. FOR MONTH 26.6 %
MAXIMUM DAILY NET ENERGY .... 166.20 KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH 22.0 %
TOTAL NET POWER PRODUCED FOR MONTH.... 16.6 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 115.0 KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH .. 14.4 %

DATA FOR MONTH 8 AND YEAR 1985 FOR PAD 2 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	20.00	910.0	25.1	133.8	6.760	22.6	0.00	0.00	0.0
2	19.90	924.0	24.6	139.3	7.410	21.4	0.00	0.00	0.0
3	17.80	886.0	22.9	106.9	7.940	15.4	0.00	0.00	0.0
4	19.00	903.0	24.0	132.4	0.000	0.0	0.00	0.00	0.0
5	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
6	16.70	863.0	22.1	150.4	0.000	0.0	0.00	0.00	0.0
7	17.00	902.0	21.5	97.6	6.850	16.3	0.00	0.00	0.0
8	16.40	856.0	21.9	106.9	6.710	18.2	0.00	0.00	0.0
9	20.40	899.0	25.9	143.6	9.160	17.9	0.00	0.00	0.0
10	19.40	869.0	25.5	124.6	6.370	22.3	0.00	0.00	0.0
11	17.30	880.0	22.4	39.9	6.040	7.5	0.00	0.00	0.0
12	19.30	882.0	25.0	111.7	0.000	0.0	0.00	0.00	0.0
13	17.60	825.0	24.3	89.6	4.920	20.8	0.00	0.00	0.0
14	19.60	911.0	24.5	108.2	9.220	13.4	0.00	0.00	0.0
15	19.20	903.0	24.3	61.5	8.620	8.1	0.00	0.00	0.0
16	20.50	844.0	27.7	54.2	3.220	19.2	0.00	0.00	0.0
17	16.40	795.0	23.5	45.3	3.080	16.8	0.00	0.00	0.0
18	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
19	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
20	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
21	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
22	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
23	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
24	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
25	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
26	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
27	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
28	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
29	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
30	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
31	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY NET POWER .... 20.50 KW
MAX. DAILY NET POWER EFFIC. FOR MONTH 27.7 %
MAXIMUM DAILY NET ENERGY .... 150.40 KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH 22.6 %
TOTAL NET POWER PRODUCED FOR MONTH.... 14.3 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 86.3 KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH .. 16.5 %

DATA FOR MONTH 9 AND YEAR 1985 FOR PAD 2 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
2	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
3	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
4	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
5	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
6	14.20	674.0	24.0	0.0	1.150	0.0	0.00	0.00	0.0
7	0.00	771.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
8	0.00	821.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
9	19.80	878.0	25.7	41.9	6.610	7.2	0.00	0.00	0.0
10	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
11	18.60	868.0	24.4	52.2	7.390	8.1	0.00	0.00	0.0
12	23.40	889.0	30.0	119.6	5.660	24.1	0.00	0.00	0.0
13	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
14	20.10	705.0	32.5	154.5	0.000	0.0	0.00	0.00	0.0
15	18.40	839.0	25.0	120.3	7.820	17.5	0.00	0.00	0.0
16	17.60	808.0	24.8	66.8	4.210	18.1	0.00	0.00	0.0
17	18.30	811.0	25.7	48.1	4.810	11.4	0.00	0.00	0.0
18	0.00	832.0	0.0	89.7	0.000	0.0	0.00	0.00	0.0
19	0.00	890.0	0.0	155.0	3.650	48.4	0.00	0.00	0.0
20	0.00	0.0	0.0	0.0	8.060	0.0	0.00	0.00	0.0
21	0.00	0.0	0.0	0.0	7.490	0.0	0.00	0.00	0.0
22	0.00	0.0	0.0	0.0	8.110	0.0	0.00	0.00	0.0
23	0.00	797.0	0.0	0.0	6.210	0.0	0.00	0.00	0.0
24	0.00	878.0	0.0	69.0	7.230	10.9	0.00	0.00	0.0
25	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
26	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
27	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
28	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
29	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
30	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............	0.00	HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M....	0.00	HOURS
TRACK TIME / TIME NIP > 300...........	0.0000	
MAXIMUM DAILY NET POWER	23.40	KW
MAX. DAILY NET POWER EFFIC. FOR MONTH	32.5	%
MAXIMUM DAILY NET ENERGY	155.00	KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH	48.4	%
TOTAL NET POWER PRODUCED FOR MONTH....	7.7	KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........	78.4	KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH ..	9.8	%

DATA FOR MONTH 10 AND YEAR 1985 FOR PAD 2 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	754.0	0.0	109.0	3.820	32.5	0.00	0.00	0.0
2	0.00	829.0	0.0	125.0	0.000	0.0	0.00	0.00	0.0
3	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
4	0.00	794.0	0.0	0.0	1.020	0.0	0.00	0.00	0.0
5	0.00	784.0	0.0	55.0	3.370	18.6	0.00	0.00	0.0
6	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
7	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
8	0.00	775.0	0.0	45.0	2.790	18.4	0.00	0.00	0.0
9	0.00	847.0	0.0	48.0	3.230	17.0	0.00	0.00	0.0
10	0.00	892.0	0.0	0.0	7.330	0.0	0.00	0.00	0.0
11	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
12	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
13	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
14	0.00	911.0	0.0	91.0	7.200	14.4	0.00	0.00	0.0
15	0.00	926.0	0.0	132.0	8.200	18.4	0.00	0.00	0.0
16	0.00	843.0	0.0	30.0	1.970	17.4	0.00	0.00	0.0
17	0.00	0.0	0.0	77.5	3.690	24.0	0.00	0.00	0.0
18	0.00	0.0	0.0	56.4	3.860	16.7	0.00	0.00	0.0
19	0.00	0.0	0.0	169.0	0.000	0.0	0.00	0.00	0.0
20	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
21	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
22	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
23	0.00	0.0	0.0	0.0	5.270	0.0	0.00	0.00	0.0
24	0.00	0.0	0.0	140.5	5.190	30.9	0.00	0.00	0.0
25	0.00	0.0	0.0	134.3	5.490	27.9	0.00	0.00	0.0
26	0.00	0.0	0.0	43.2	3.010	16.4	0.00	0.00	0.0
27	0.00	0.0	0.0	0.0	1.270	0.0	0.00	0.00	0.0
28	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
29	0.00	0.0	0.0	58.8	2.400	27.9	0.00	0.00	0.0
30	0.00	0.0	0.0	0.0	0.560	0.0	0.00	0.00	0.0
31	0.00	0.0	0.0	15.0	4.690	3.6	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............	0.00	HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M....	0.00	HOURS
TRACK TIME / TIME NIP > 300...........	0.0000	
MAXIMUM DAILY NET POWER	0.00	KW
MAX. DAILY NET POWER EFFIC. FOR MONTH	0.0	%
MAXIMUM DAILY NET ENERGY	169.00	KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH	32.5	%
TOTAL NET POWER PRODUCED FOR MONTH....	11.8	KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........	74.4	KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH ..	15.9	%

DATA FOR MONTH 11 AND YEAR 1985 FOR PAD 2 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	54.5	0.000	0.0	0.00	0.00	0.0
2	0.00	0.0	0.0	191.6	0.000	0.0	0.00	0.00	0.0
3	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
4	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
5	0.00	0.0	0.0	84.4	3.750	25.7	0.00	0.00	0.0
6	0.00	0.0	0.0	110.6	0.000	0.0	0.00	0.00	0.0
7	0.00	0.0	0.0	24.3	0.000	0.0	0.00	0.00	0.0
8	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
9	0.00	0.0	0.0	56.0	0.000	0.0	0.00	0.00	0.0
10	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
11	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
12	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
13	0.00	0.0	0.0	11.5	6.800	1.9	0.00	0.00	0.0
14	0.00	0.0	0.0	0.0	6.620	0.0	0.00	0.00	0.0
15	0.00	0.0	0.0	0.0	7.070	0.0	0.00	0.00	0.0
16	0.00	0.0	0.0	0.0	4.460	0.0	0.00	0.00	0.0
17	0.00	0.0	0.0	0.0	5.310	0.0	0.00	0.00	0.0
18	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
19	0.00	0.0	0.0	85.0	5.620	17.3	0.00	0.00	0.0
20	0.00	0.0	0.0	92.4	5.400	19.5	0.00	0.00	0.0
21	0.00	0.0	0.0	120.2	0.000	0.0	0.00	0.00	0.0
22	0.00	0.0	0.0	358.8	0.000	0.0	0.00	0.00	0.0
23	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
24	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
25	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
26	0.00	0.0	0.0	40.6	2.360	19.6	0.00	0.00	0.0
27	0.00	0.0	0.0	40.1	1.900	24.1	0.00	0.00	0.0
28	0.00	0.0	0.0	18.0	1.930	10.6	0.00	0.00	0.0
29	0.00	0.0	0.0	0.0	0.810	0.0	0.00	0.00	0.0
30	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............	0.00	HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M....	0.00	HOURS
TRACK TIME / TIME NIP > 300...........	0.0000	
MAXIMUM DAILY NET POWER	0.00	KW
MAX. DAILY NET POWER EFFIC. FOR MONTH	0.0	%
MAXIMUM DAILY NET ENERGY	358.80	KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH	25.7	%
TOTAL NET POWER PRODUCED FOR MONTH....	4.2	KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........	52.0	KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH ..	8.2	%

DATA FOR MONTH 12 AND YEAR 1985 FOR PAD 2 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	0.0	2.980	0.0	0.00	0.00	0.0
2	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
3	0.00	0.0	0.0	4.6	3.290	1.6	0.00	0.00	0.0
4	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
5	0.00	0.0	0.0	73.1	2.740	30.4	0.00	0.00	0.0
6	0.00	0.0	0.0	23.0	4.100	6.4	0.00	0.00	0.0
7	0.00	0.0	0.0	88.6	2.990	33.8	0.00	0.00	0.0
8	0.00	0.0	0.0	4.1	3.080	1.5	0.00	0.00	0.0
9	0.00	0.0	0.0	9.4	5.940	1.8	0.00	0.00	0.0
10	0.00	0.0	0.0	57.1	3.460	18.8	0.00	0.00	0.0
11	0.00	0.0	0.0	94.1	6.370	16.8	0.00	0.00	0.0
12	0.00	0.0	0.0	133.9	7.080	21.6	0.00	0.00	0.0
13	0.00	0.0	0.0	0.8	1.150	0.8	0.00	0.00	0.0
14	0.00	0.0	0.0	234.8	0.000	0.0	0.00	0.00	0.0
15	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
16	0.00	0.0	0.0	247.1	0.000	0.0	0.00	0.00	0.0
17	0.00	0.0	0.0	280.6	0.000	0.0	0.00	0.00	0.0
18	0.00	0.0	0.0	257.4	0.000	0.0	0.00	0.00	0.0
19	0.00	0.0	0.0	213.2	0.000	0.0	0.00	0.00	0.0
20	0.00	0.0	0.0	236.5	0.000	0.0	0.00	0.00	0.0
21	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
22	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
23	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
24	0.00	0.0	0.0	162.3	0.000	0.0	0.00	0.00	0.0
25	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
26	0.00	0.0	0.0	138.3	0.000	0.0	0.00	0.00	0.0
27	0.00	0.0	0.0	93.1	0.000	0.0	0.00	0.00	0.0
28	0.00	0.0	0.0	18.6	0.000	0.0	0.00	0.00	0.0
29	0.00	0.0	0.0	17.0	0.000	0.0	0.00	0.00	0.0
30	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
31	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY NET POWER .... 0.00 KW
MAX. DAILY NET POWER EFFIC. FOR MONTH 0.0 %
MAXIMUM DAILY NET ENERGY .... 280.60 KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH 33.8 %
TOTAL NET POWER PRODUCED FOR MONTH.... 5.6 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 43.2 KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH .. 12.9 %

DATA FOR MONTH 5 AND YEAR 1986 FOR PAD 2 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	16.50	738.5	25.5	50.2	4.150	13.8	0.00	0.00	0.0
2	20.80	872.3	27.2	195.7	9.160	24.4	0.00	0.00	0.0
3	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
4	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
5	19.30	906.2	24.3	137.9	7.110	22.1	0.00	0.00	0.0
6	16.90	864.1	22.3	68.5	6.790	11.5	0.00	0.00	0.0
7	18.40	908.7	23.1	102.6	9.280	12.6	0.00	0.00	0.0
8	17.70	876.3	23.0	151.9	8.730	19.8	0.00	0.00	0.0
9	0.00	0.0	0.0	0.0	9.210	0.0	0.00	0.00	0.0
10	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
11	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
12	16.00	834.1	21.9	131.2	7.470	20.0	0.00	0.00	0.0
13	14.30	765.9	21.3	72.7	4.620	17.9	0.00	0.00	0.0
14	0.00	0.0	0.0	0.0	2.000	0.0	0.00	0.00	0.0
15	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
16	0.00	0.0	0.0	0.0	4.480	0.0	0.00	0.00	0.0
17	0.00	0.0	0.0	0.0	7.740	0.0	0.00	0.00	0.0
18	0.00	0.0	0.0	0.0	7.750	0.0	0.00	0.00	0.0
19	15.90	872.1	20.8	106.9	6.367	19.2	0.00	0.00	0.0
20	14.20	826.7	19.6	93.4	6.170	17.3	0.00	0.00	0.0
21	12.30	755.8	18.6	21.9	2.320	10.8	0.00	0.00	0.0
22	7.20	547.1	15.0	34.3	3.765	10.4	0.00	0.00	0.0
23	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
24	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
25	13.50	788.6	19.5	107.1	7.220	16.9	0.00	0.00	0.0
26	9.50	631.8	17.2	17.0	1.360	14.3	0.00	0.00	0.0
27	13.10	789.1	18.9	98.2	6.630	16.9	0.00	0.00	0.0
28	0.00	0.0	0.0	0.0	6.420	0.0	0.00	0.00	0.0
29	0.00	0.0	0.0	0.0	2.990	0.0	0.00	0.00	0.0
30	0.00	0.0	0.0	0.0	2.361	0.0	0.00	0.00	0.0
31	0.00	0.0	0.0	0.0	4.965	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............	0.00	HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M....	0.00	HOURS
TRACK TIME / TIME NIP > 300...........	0.0000	
MAXIMUM DAILY NET POWER	20.80	KW
MAX. DAILY NET POWER EFFIC. FOR MONTH	27.2	%
MAXIMUM DAILY NET ENERGY	195.70	KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH	24.4	%
TOTAL NET POWER PRODUCED FOR MONTH....	15.8	KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........	139.1	KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH ..	11.4	%

DATA FOR MONTH 4 AND YEAR 1986 FOR PAD 2 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
2	16.70	823.5	23.1	4.6	8.430	0.6	0.00	0.00	0.0
3	17.40	804.1	24.7	104.1	7.020	16.9	0.00	0.00	0.0
4	17.30	818.6	24.1	116.3	6.890	19.3	0.00	0.00	0.0
5	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
6	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
7	19.90	885.5	25.6	139.9	6.710	23.8	0.00	0.00	0.0
8	19.70	881.1	25.5	149.4	7.310	23.3	0.00	0.00	0.0
9	20.60	913.5	25.7	144.8	8.450	19.5	0.00	0.00	0.0
10	17.10	806.9	24.2	48.2	0.000	0.0	0.00	0.00	0.0
11	13.90	671.4	23.6	23.5	2.120	12.6	0.00	0.00	0.0
12	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
13	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
14	19.00	887.9	24.4	59.5	0.000	0.0	0.00	0.00	0.0
15	18.60	864.2	24.5	106.2	6.120	19.8	0.00	0.00	0.0
16	19.20	895.2	24.5	101.1	7.320	15.8	0.00	0.00	0.0
17	17.80	864.2	23.5	149.6	7.710	22.1	0.00	0.00	0.0
18	17.70	836.4	24.1	165.1	8.660	21.7	0.00	0.00	0.0
19	19.70	909.1	24.7	182.8	0.000	0.0	0.00	0.00	0.0
20	19.60	910.3	24.6	125.8	0.000	0.0	0.00	0.00	0.0
21	19.10	904.4	24.1	169.1	0.000	0.0	0.00	0.00	0.0
22	14.80	694.5	24.3	23.0	0.000	0.0	0.00	0.00	0.0
23	20.90	846.8	28.2	150.1	0.000	0.0	0.00	0.00	0.0
24	19.80	807.3	28.0	154.7	0.000	0.0	0.00	0.00	0.0
25	16.30	683.9	27.2	75.1	4.140	20.7	0.00	0.00	0.0
26	16.50	675.9	27.8	100.4	5.110	22.4	0.00	0.00	0.0
27	20.80	829.8	28.6	201.1	0.000	0.0	0.00	0.00	0.0
28	21.70	879.5	28.1	219.1	0.000	0.0	0.00	0.00	0.0
29	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
30	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY NET POWER .... 21.70 KW
MAX. DAILY NET POWER EFFIC. FOR MONTH 28.6 %
MAXIMUM DAILY NET ENERGY .... 219.10 KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH 23.8 %
TOTAL NET POWER PRODUCED FOR MONTH.... 15.7 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 86.0 KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH .. 18.3 %

DATA FOR MONTH 3 AND YEAR 1986 FOR PAD 2 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
2	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
3	16.40	736.7	25.4	71.0	3.770	21.5	0.00	0.00	0.0
4	0.00	0.0	0.0	39.0	1.290	34.5	0.00	0.00	0.0
5	0.00	0.0	0.0	13.0	1.060	14.0	0.00	0.00	0.0
6	0.00	0.0	0.0	-6.0	0.000	0.0	0.00	0.00	0.0
7	0.00	0.0	0.0	-6.0	0.000	0.0	0.00	0.00	0.0
8	0.00	0.0	0.0	-6.0	0.000	0.0	0.00	0.00	0.0
9	0.00	0.0	0.0	94.0	0.000	0.0	0.00	0.00	0.0
10	0.00	0.0	0.0	-7.0	0.000	0.0	0.00	0.00	0.0
11	0.00	0.0	0.0	-6.0	0.000	0.0	0.00	0.00	0.0
12	0.00	0.0	0.0	107.0	0.000	0.0	0.00	0.00	0.0
13	0.00	0.0	0.0	107.0	0.000	0.0	0.00	0.00	0.0
14	15.30	671.9	26.0	17.7	0.000	0.0	0.00	0.00	0.0
15	21.20	741.0	32.6	63.7	1.840	39.5	0.00	0.00	0.0
16	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
17	22.00	896.4	28.0	161.7	7.450	24.8	0.00	0.00	0.0
18	24.00	970.1	28.2	169.4	8.120	23.8	0.00	0.00	0.0
19	20.70	867.3	27.2	168.5	7.910	24.3	0.00	0.00	0.0
20	0.00	0.0	0.0	178.7	0.000	0.0	0.00	0.00	0.0
21	22.10	906.5	27.8	39.2	8.210	5.4	0.00	0.00	0.0
22	20.60	855.0	27.5	165.2	8.010	23.5	0.00	0.00	0.0
23	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
24	16.30	700.0	26.6	111.7	6.130	20.8	0.00	0.00	0.0
25	17.20	747.0	26.3	107.2	0.000	0.0	0.00	0.00	0.0
26	15.50	714.5	24.7	40.6	4.920	9.4	0.00	0.00	0.0
27	19.00	825.1	26.3	66.7	5.620	13.5	0.00	0.00	0.0
28	0.00	0.0	0.0	54.6	0.000	0.0	0.00	0.00	0.0
29	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
30	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
31	17.30	777.5	25.4	0.0	2.910	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY NET POWER .... 24.00 KW
MAX. DAILY NET POWER EFFIC. FOR MONTH 32.6 %
MAXIMUM DAILY NET ENERGY .... 178.70 KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH 39.5 %
TOTAL NET POWER PRODUCED FOR MONTH.... 12.7 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 67.2 KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH .. 18.8 %

DATA FOR MONTH 2 AND YEAR 1986 FOR PAD 2 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	0.0	1.642	0.0	0.00	0.00	0.0
2	0.00	0.0	0.0	0.0	1.383	0.0	0.00	0.00	0.0
3	0.00	0.0	0.0	0.0	4.978	0.0	0.00	0.00	0.0
4	0.00	0.0	0.0	45.1	6.989	7.4	0.00	0.00	0.0
5	0.00	0.0	0.0	1.9	5.781	0.4	0.00	0.00	0.0
6	0.00	0.0	0.0	24.0	3.850	7.1	0.00	0.00	0.0
7	0.00	0.0	0.0	24.0	1.077	25.4	0.00	0.00	0.0
8	0.00	0.0	0.0	-6.0	0.000	0.0	0.00	0.00	0.0
9	0.00	0.0	0.0	-6.0	6.016	-1.1	0.00	0.00	0.0
10	0.00	0.0	0.0	-6.0	0.143	-47.9	0.00	0.00	0.0
11	0.00	0.0	0.0	-6.0	6.445	-1.1	0.00	0.00	0.0
12	0.00	0.0	0.0	-6.0	0.263	-26.0	0.00	0.00	0.0
13	0.00	0.0	0.0	-6.0	0.000	0.0	0.00	0.00	0.0
14	0.00	0.0	0.0	-6.0	0.000	0.0	0.00	0.00	0.0
15	0.00	0.0	0.0	-6.0	0.000	0.0	0.00	0.00	0.0
16	0.00	0.0	0.0	-6.0	0.000	0.0	0.00	0.00	0.0
17	0.00	0.0	0.0	-6.0	0.000	0.0	0.00	0.00	0.0
18	0.00	0.0	0.0	-6.0	0.000	0.0	0.00	0.00	0.0
19	0.00	0.0	0.0	47.0	0.000	0.0	0.00	0.00	0.0
20	0.00	0.0	0.0	63.0	0.000	0.0	0.00	0.00	0.0
21	0.00	0.0	0.0	104.0	0.000	0.0	0.00	0.00	0.0
22	0.00	0.0	0.0	104.0	0.000	0.0	0.00	0.00	0.0
23	0.00	0.0	0.0	104.0	0.000	0.0	0.00	0.00	0.0
24	0.00	0.0	0.0	119.0	0.000	0.0	0.00	0.00	0.0
25	0.00	0.0	0.0	146.0	0.000	0.0	0.00	0.00	0.0
26	0.00	0.0	0.0	90.0	0.000	0.0	0.00	0.00	0.0
27	0.00	0.0	0.0	-2.0	0.000	0.0	0.00	0.00	0.0
28	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............	0.00	HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M....	0.00	HOURS
TRACK TIME / TIME NIP > 300...........	0.0000	
MAXIMUM DAILY NET POWER	0.00	KW
MAX. DAILY NET POWER EFFIC. FOR MONTH	0.0	%
MAXIMUM DAILY NET ENERGY	146.00	KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH	25.4	%
TOTAL NET POWER PRODUCED FOR MONTH....	0.8	KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........	38.6	KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH ..	2.1	%

DATA FOR MONTH 1 AND YEAR 1986 FOR PAD 2 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	10.7	0.000	0.0	0.00	0.00	0.0
2	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
3	0.00	0.0	0.0	24.1	0.000	0.0	0.00	0.00	0.0
4	0.00	0.0	0.0	1.6	0.000	0.0	0.00	0.00	0.0
5	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
6	0.00	0.0	0.0	113.4	0.000	0.0	0.00	0.00	0.0
7	0.00	0.0	0.0	0.2	1.660	0.1	0.00	0.00	0.0
8	0.00	0.0	0.0	65.5	0.000	0.0	0.00	0.00	0.0
9	0.00	0.0	0.0	272.1	0.000	0.0	0.00	0.00	0.0
10	0.00	0.0	0.0	217.4	6.740	36.8	0.00	0.00	0.0
11	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
12	0.00	0.0	0.0	40.1	0.000	0.0	0.00	0.00	0.0
13	0.00	0.0	0.0	64.1	2.240	32.6	0.00	0.00	0.0
14	0.00	0.0	0.0	6.4	0.330	22.1	0.00	0.00	0.0
15	0.00	0.0	0.0	92.8	3.270	32.4	0.00	0.00	0.0
16	0.00	0.0	0.0	45.0	2.900	17.7	0.00	0.00	0.0
17	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
18	0.00	0.0	0.0	255.0	0.000	0.0	0.00	0.00	0.0
19	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
20	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
21	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
22	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
23	0.00	0.0	0.0	205.0	0.000	0.0	0.00	0.00	0.0
24	0.00	0.0	0.0	38.1	3.300	13.2	0.00	0.00	0.0
25	0.00	0.0	0.0	0.0	6.730	0.0	0.00	0.00	0.0
26	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
27	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
28	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
29	0.00	0.0	0.0	0.0	1.660	0.0	0.00	0.00	0.0
30	0.00	0.0	0.0	0.0	0.170	0.0	0.00	0.00	0.0
31	0.00	0.0	0.0	0.0	0.290	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY NET POWER .... 0.00 KW
MAX. DAILY NET POWER EFFIC. FOR MONTH 0.0 %
MAXIMUM DAILY NET ENERGY .... 272.10 KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH 36.8 %
TOTAL NET POWER PRODUCED FOR MONTH.... 5.3 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 29.3 KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH .. 18.1 %

DATA FOR MONTH 1 AND YEAR 1986 FOR PAD 3 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
2	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
3	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
4	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
5	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
6	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
7	0.00	0.0	0.0	0.0	1.660	0.0	0.00	0.00	0.0
8	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
9	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
10	0.00	0.0	0.0	0.0	6.740	0.0	0.00	0.00	0.0
11	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
12	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
13	0.00	0.0	0.0	0.0	2.240	0.0	0.00	0.00	0.0
14	0.00	0.0	0.0	0.0	0.330	0.0	0.00	0.00	0.0
15	0.00	0.0	0.0	0.0	3.270	0.0	0.00	0.00	0.0
16	0.00	0.0	0.0	0.0	2.900	0.0	0.00	0.00	0.0
17	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
18	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
19	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
20	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
21	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
22	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
23	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
24	0.00	0.0	0.0	0.0	3.300	0.0	0.00	0.00	0.0
25	0.00	0.0	0.0	0.0	6.730	0.0	0.00	0.00	0.0
26	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
27	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
28	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
29	0.00	0.0	0.0	0.0	1.660	0.0	0.00	0.00	0.0
30	0.00	0.0	0.0	0.0	0.170	0.0	0.00	0.00	0.0
31	0.00	0.0	0.0	0.0	0.290	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY NET POWER .... 0.00 KW
MAX. DAILY NET POWER EFFIC. FOR MONTH 0.0 %
MAXIMUM DAILY NET ENERGY .... 0.00 KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH 0.0 %
TOTAL NET POWER PRODUCED FOR MONTH.... 0.0 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 29.3 KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH .. 0.0 %

DATA FOR MONTH 2 AND YEAR 1986 FOR PAD 3 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	0.0	1.642	0.0	0.00	0.00	0.0
2	0.00	0.0	0.0	0.0	1.383	0.0	0.00	0.00	0.0
3	0.00	0.0	0.0	0.0	4.978	0.0	0.00	0.00	0.0
4	0.00	0.0	0.0	0.0	6.989	0.0	0.00	0.00	0.0
5	0.00	0.0	0.0	0.0	5.781	0.0	0.00	0.00	0.0
6	0.00	0.0	0.0	0.0	3.850	0.0	0.00	0.00	0.0
7	0.00	0.0	0.0	0.0	1.077	0.0	0.00	0.00	0.0
8	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
9	0.00	0.0	0.0	0.0	6.016	0.0	0.00	0.00	0.0
10	0.00	0.0	0.0	0.0	0.143	0.0	0.00	0.00	0.0
11	0.00	0.0	0.0	0.0	6.445	0.0	0.00	0.00	0.0
12	0.00	0.0	0.0	0.0	0.263	0.0	0.00	0.00	0.0
13	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
14	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
15	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
16	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
17	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
18	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
19	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
20	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
21	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
22	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
23	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
24	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
25	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
26	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
27	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
28	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............	0.00	HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M....	0.00	HOURS
TRACK TIME / TIME NIP > 300...........	0.0000	
MAXIMUM DAILY NET POWER	0.00	KW
MAX. DAILY NET POWER EFFIC. FOR MONTH	0.0	%
MAXIMUM DAILY NET ENERGY	0.00	KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH	0.0	%
TOTAL NET POWER PRODUCED FOR MONTH....	0.0	KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........	38.6	KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH ..	0.0	%

DATA FOR MONTH 3 AND YEAR 1986 FOR PAD 3 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
2	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
3	15.20	736.7	23.5	0.0	3.770	0.0	0.00	0.00	0.0
4	0.00	0.0	0.0	0.0	1.290	0.0	0.00	0.00	0.0
5	0.00	0.0	0.0	0.0	1.060	0.0	0.00	0.00	0.0
6	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
7	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
8	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
9	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
10	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
11	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
12	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
13	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
14	14.30	671.9	24.3	0.0	0.000	0.0	0.00	0.00	0.0
15	20.20	741.0	31.1	0.0	1.840	0.0	0.00	0.00	0.0
16	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
17	20.20	896.4	25.7	0.0	7.450	0.0	0.00	0.00	0.0
18	22.10	970.1	26.0	0.0	8.120	0.0	0.00	0.00	0.0
19	19.40	867.3	25.5	0.0	7.910	0.0	0.00	0.00	0.0
20	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
21	17.70	906.5	22.3	0.0	8.210	0.0	0.00	0.00	0.0
22	19.40	855.0	25.9	0.0	8.010	0.0	0.00	0.00	0.0
23	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
24	14.90	700.0	24.3	0.0	6.130	0.0	0.00	0.00	0.0
25	15.70	747.0	24.0	0.0	0.000	0.0	0.00	0.00	0.0
26	16.90	714.5	27.0	0.0	4.920	0.0	0.00	0.00	0.0
27	19.70	825.1	27.2	0.0	5.620	0.0	0.00	0.00	0.0
28	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
29	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
30	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
31	17.60	777.5	25.8	0.0	2.910	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............	0.00	HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M....	0.00	HOURS
TRACK TIME / TIME NIP > 300...........	0.0000	
MAXIMUM DAILY NET POWER	22.10	KW
MAX. DAILY NET POWER EFFIC. FOR MONTH	31.1	%
MAXIMUM DAILY NET ENERGY	0.00	KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH	0.0	%
TOTAL NET POWER PRODUCED FOR MONTH....	0.0	KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........	67.2	KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH ..	0.0	%

DATA FOR MONTH 4 AND YEAR 1986 FOR PAD 3 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
2	17.40	823.5	24.1	25.6	8.430	3.5	0.00	0.00	0.0
3	17.10	804.1	24.3	26.7	7.020	4.3	0.00	0.00	0.0
4	16.90	818.6	23.5	80.3	6.890	13.3	0.00	0.00	0.0
5	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
6	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
7	19.60	885.5	25.2	141.8	6.710	24.1	0.00	0.00	0.0
8	19.60	881.1	25.4	149.0	7.310	23.2	0.00	0.00	0.0
9	20.40	913.5	25.5	167.9	8.450	22.7	0.00	0.00	0.0
10	19.20	806.9	27.1	33.2	0.000	0.0	0.00	0.00	0.0
11	13.70	671.4	23.3	29.0	2.120	15.6	0.00	0.00	0.0
12	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
13	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
14	19.00	887.9	24.4	60.6	0.000	0.0	0.00	0.00	0.0
15	18.60	864.2	24.5	107.4	6.120	20.0	0.00	0.00	0.0
16	18.60	895.2	23.7	103.6	7.320	16.1	0.00	0.00	0.0
17	17.60	864.2	23.2	146.2	7.710	21.6	0.00	0.00	0.0
18	17.30	836.4	23.6	114.0	8.660	15.0	0.00	0.00	0.0
19	19.50	909.1	24.5	182.5	0.000	0.0	0.00	0.00	0.0
20	19.30	910.3	24.2	125.5	0.000	0.0	0.00	0.00	0.0
21	18.80	904.4	23.7	170.0	0.000	0.0	0.00	0.00	0.0
22	16.00	694.5	26.3	17.1	0.000	0.0	0.00	0.00	0.0
23	21.50	846.8	29.0	115.0	0.000	0.0	0.00	0.00	0.0
24	20.50	807.3	29.0	144.1	0.000	0.0	0.00	0.00	0.0
25	16.90	683.9	28.2	73.7	4.140	20.3	0.00	0.00	0.0
26	17.00	675.9	28.7	98.1	5.110	21.9	0.00	0.00	0.0
27	21.30	829.8	29.3	195.8	0.000	0.0	0.00	0.00	0.0
28	22.40	879.5	29.1	195.0	0.000	0.0	0.00	0.00	0.0
29	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
30	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY NET POWER .... 22.40 KW
MAX. DAILY NET POWER EFFIC. FOR MONTH 29.3 %
MAXIMUM DAILY NET ENERGY .... 195.80 KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH 24.1 %
TOTAL NET POWER PRODUCED FOR MONTH.... 14.4 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 86.0 KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH .. 16.8 %

DATA FOR MONTH 5 AND YEAR 1986 FOR PAD 3 AT HUNTINGTON BEACH

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	15.60	738.5	24.1	22.7	4.150	6.2	0.00	0.00	0.0
2	20.40	872.3	26.7	198.3	9.160	24.7	0.00	0.00	0.0
3	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
4	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
5	18.90	906.2	23.8	90.6	7.110	14.5	0.00	0.00	0.0
6	16.80	864.1	22.2	45.6	6.790	7.7	0.00	0.00	0.0
7	18.30	908.7	23.0	125.3	9.280	15.4	0.00	0.00	0.0
8	17.50	876.3	22.8	164.3	8.730	21.5	0.00	0.00	0.0
9	16.90	0.0	0.0	134.7	9.210	16.7	0.00	0.00	0.0
10	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
11	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
12	15.70	834.1	21.5	65.0	7.470	9.9	0.00	0.00	0.0
13	0.00	765.9	0.0	0.0	4.620	0.0	0.00	0.00	0.0
14	0.00	0.0	0.0	0.0	2.000	0.0	0.00	0.00	0.0
15	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
16	0.00	0.0	0.0	0.0	4.480	0.0	0.00	0.00	0.0
17	0.00	0.0	0.0	0.0	7.740	0.0	0.00	0.00	0.0
18	0.00	0.0	0.0	0.0	7.750	0.0	0.00	0.00	0.0
19	0.00	872.1	0.0	0.0	6.367	0.0	0.00	0.00	0.0
20	13.50	826.7	18.6	29.2	6.170	5.4	0.00	0.00	0.0
21	12.90	755.8	19.5	23.3	2.320	11.5	0.00	0.00	0.0
22	7.80	547.1	16.3	35.9	3.765	10.9	0.00	0.00	0.0
23	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
24	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
25	13.80	788.6	20.0	111.7	7.220	17.6	0.00	0.00	0.0
26	0.00	631.8	0.0	0.0	1.360	0.0	0.00	0.00	0.0
27	13.60	789.1	19.7	103.6	6.630	17.8	0.00	0.00	0.0
28	13.90	0.0	0.0	81.1	6.420	14.4	0.00	0.00	0.0
29	8.00	0.0	0.0	7.8	2.990	3.0	0.00	0.00	0.0
30	0.00	0.0	0.0	0.0	2.361	0.0	0.00	0.00	0.0
31	0.00	0.0	0.0	0.0	4.965	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY NET POWER .... 20.40 KW
MAX. DAILY NET POWER EFFIC. FOR MONTH 26.7 %
MAXIMUM DAILY NET ENERGY .... 198.30 KWHR
MAX. DAILY NET ENERGY EFFIC. FOR MONTH 24.7 %
TOTAL NET POWER PRODUCED FOR MONTH.... 14.1 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 139.1 KWHR/ SQ.M
SYSTEM NET EFFICIENCY FOR THE MONTH .. 10.2 %

APPENDIX B

This appendix contains a summary of the
Stirling Dish testing from November 1985 to June 1986
at the Georgia Power, Shenandoah, Georgia.

OPERATING SUMMARY FOR THE GEORGIA POWER TEST SITE

Date	Description
1985	
10/7	Concentrator #5 was delivered to Georgia Power.
10/8	Concentrator was unloaded.
10/9	Crane late in showing up to install unit. Installation started at 12:30 pm and erection completed by 4:30 pm. PCU #103 was installed.
10/12	Concentrator reference helicon magnet shattered, design problem.
10/15	Dead fast slew battery because charger not hooked up.
10/25	First positive power from unit occurred at 11:32 am.
10/26	Water pump logic chip failure.
10/27	Moisture in PCU control plug caused PCU control problem.
11/5	Loose wire and broken diode on PCU bypass valve, back in service by 10:30.
11/11	CRT screen blank, reboot DEC.
11/12	Problem with DEC controller time drifting.
11/23	Noise spike on wind data line, caused unit to go to wind stow position during night. Only happened at night so no power production was lost.
	Anomalies with data acquistion system began appearing during the month.
12/2	Protective aperture insulation fell out.
12/5	Ceramic tiles installed in placed of cone insulation.
12/8	New fast slew motor.
12/11	Installed new DC power supply in DEC to correct time drift problem that had estra filters on line to reduce line noise.
12/16	Water pump failure and control relay failure.
12/17	Replaced new contactor & protection relay
12/18	Found burned wiring
12/19	Replaced water pump and relay
12/26	Detrack because of engine stiffness caused by cold morning.
	Continued anomalies with the data acquisition system throughout the month.
1986	
1/2	STEP grid out while in track.
1/18	Lightning strike, blown communication ICs.in PCU monitor & several in PCU controller.
1/19	DEC A/D board blown from previous lightning, did not stop operation of unit.
1/27	Detrack, high engine pressure caused by a valve problem.
1/28	Site power shutdown to install equipment.
1/29	Dish reference/inc. encoder problem.
	Continued anomalies with the data acquisition system throughout the month.
2/5	Thunderstorm and lightning
2/6	Overpressurized engine/DEC A/D lighting problem from lightning on 2/5.
2/7	Water pump failed, foun that water pump had been installed wrong on 12/15.
2/9	System repaired and back in service.
2/12	Oil sensor problem.
3/1	Solenoid hydrogen valve failed and overpressurized engine on 3/1 and 3/2.
3/5	System out because of site work
3/6	Replaced solonoid H2 supply valve.
3/7	DEC monitor failed, unit was replaced. Probable result of lightning.
3/14 to 3/17	Lightning strike damaged the PCU interface board. Moisture in a connector caused a monitor keyswitch problem. DEC A/D failed but did not limit operation. Had to wait for USAB personnel to fix PCU problems.
3/24	Startup, oil transducer problem.
	Minor problems left over from the lightning on the 13th caused delays throughout the month.
4/1	Wash mirrors to remove pollen from trees.

4/3	9:20 site grid loss, 10:45 back in service, 16:00 out of service for software update.
4/4	Disconnected sun sensor because of problems, not required for operation.
4/11	10:30 site grid loss, 12:30 back in service.
4/21	7:30 Receiver center cone fell out, 17:15 back in service.
4/23	Produced 223 kWh of gross power.
4/29	14:50 receiver center cone fell out, bracket bad, 16:20 back in service. Cone hit and cracked a mirror.
5/19	Many detracks, no oil pressure.
5/20 to 5/28	Oil pressure sensor replaced. Later a detrack set the fast slew and because of a design problem in the fast slew, it would not deactivate and was cycling. In an attempt to stop the system, the power was cycled, a manual controller was used and a motor wire was broken while changing which resulted in the elevation motor burning up. The unit was left at an elevation angle that resulted in the reflecting beam burning the PCU wiring. All repairs were made by the end of the month.
6/1	A Mark II engine was mounted and checked out. The large reserve hydrogen bottle was added to the PCU 208 support structure. Design changes were made to the fast slew system.
6/10 to 6/14	Checkout continued, most of day PCU monitor problem. Gravity bending measurement taken, PCU monitor false alarm buzzer. Tested Fast Slew track checkout. Trouble shoot ref. update problem.
6/15 to 6/23	Down waiting for parts and service personnel.
6/24	Checkout continued on ref. update problem.
6/25	Modified Fast Slew system, system put back in automatic service.
6/26	Operation started.
7/2	Detrack caused by water in connectors, cleaned and dried
7/8	Detrack cause by loose thermocouple wire on terminal strip.
7/20	Lightning damage to PCU monitor and A/D DEC board.
7/23	Repaired PCU monitor IC damaged by lightning. DEC A/D board bad but did not stop operation.
7/25	Repaired DEC A/D board damaged by lightning.

DATA FOR MONTH 11 AND YEAR 1985

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
2	0.00	23.8	0.0	0.0	0.518	0.0	0.00	0.00	0.0
3	0.00	23.9	0.0	0.0	0.511	0.0	0.00	0.00	0.0
4	0.00	571.7	0.0	0.0	0.831	0.0	0.00	0.00	0.0
5	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
6	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
7	18.70	851.5	25.0	0.0	0.000	0.0	0.00	0.00	0.0
8	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
9	22.30	971.5	26.2	0.0	0.000	0.0	0.00	0.00	0.0
10	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
11	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
12	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
13	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
14	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
15	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
16	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
17	19.10	865.5	25.2	0.0	0.000	0.0	0.00	0.00	0.0
18	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
19	0.00	768.1	0.0	0.0	1.660	0.0	0.00	0.00	0.0
20	0.00	61.5	0.0	0.0	0.496	0.0	0.00	0.00	0.0
21	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
22	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
23	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
24	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
25	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
26	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
27	0.00	249.5	0.0	0.0	0.613	0.0	0.00	0.00	0.0
28	0.00	261.5	0.0	0.0	0.590	0.0	0.00	0.00	0.0
29	0.00	20.6	0.0	0.0	0.461	0.0	0.00	0.00	0.0
30	0.00	158.0	0.0	0.0	0.509	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............	0.00	HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M....	0.00	HOURS
TRACK TIME / TIME NIP > 300...........	0.0000	
MAXIMUM DAILY POWER...................	22.30	KW
MAX. DAILY POWER EFFIC. FOR MONTH.....	26.2	%
MAXIMUM DAILY NET ENERGY..............	0.00	KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ...	0.0	%
TOTAL POWER PRODUCED FOR MONTH........	0.0	KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........	6.2	KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH.......	0.0	%

DATA FOR MONTH 12 AND YEAR 1985

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
2	21.50	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
3	21.50	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
4	19.40	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
5	19.40	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
6	20.50	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
7	21.30	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
8	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
9	13.40	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
10	17.10	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
11	2.70	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
12	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
13	0.00	87.7	0.0	0.0	1.155	0.0	0.00	0.00	0.0
14	0.00	984.3	0.0	0.0	7.505	0.0	0.00	0.00	0.0
15	24.98	996.1	28.6	0.0	7.866	0.0	0.00	0.00	0.0
16	23.10	949.8	27.7	0.0	7.777	0.0	0.00	0.00	0.0
17	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
18	0.00	906.4	0.0	0.0	3.142	0.0	0.00	0.00	0.0
19	20.78	974.4	24.3	0.0	7.796	0.0	0.00	0.00	0.0
20	23.27	919.8	28.9	0.0	5.809	0.0	0.00	0.00	0.0
21	23.62	926.7	29.1	0.0	6.387	0.0	0.00	0.00	0.0
22	17.20	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
23	17.20	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
24	19.70	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
25	20.90	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
26	21.60	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
27	20.30	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
28	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
29	20.70	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
30	25.00	973.0	29.3	0.0	8.418	0.0	0.00	0.00	0.0
31	6.70	0.0	0.0	0.0	0.272	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 25.00 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 29.3 %
MAXIMUM DAILY NET ENERGY.............. 0.00 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 0.0 %
TOTAL POWER PRODUCED FOR MONTH........ 0.0 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 56.1 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 0.0 %

DATA FOR MONTH 1 AND YEAR 1986

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	21.90	0.0	0.0	117.0	7.071	18.9	0.00	0.00	0.0
2	17.50	0.0	0.0	56.0	3.990	16.0	0.00	0.00	0.0
3	12.50	0.0	0.0	32.0	5.534	6.6	0.00	0.00	0.0
4	0.00	0.0	0.0	-4.0	0.230	-19.8	0.00	0.00	0.0
5	21.60	0.0	0.0	150.0	8.215	20.8	0.00	0.00	0.0
6	19.40	0.0	0.0	74.0	5.170	16.3	0.00	0.00	0.0
7	19.50	0.0	0.0	87.0	4.830	20.5	0.00	0.00	0.0
8	23.96	937.8	29.1	104.0	5.995	19.8	0.00	0.00	0.0
9	18.72	794.4	26.9	25.0	2.467	11.6	0.00	0.00	0.0
10	0.20	72.6	3.1	-4.0	1.077	-4.2	0.00	0.00	0.0
11	23.79	934.0	29.1	150.0	7.988	21.4	0.00	0.00	0.0
12	23.37	919.3	29.0	151.0	8.812	19.5	0.00	0.00	0.0
13	20.80	0.0	0.0	116.0	7.068	18.7	0.00	0.00	0.0
14	20.20	0.0	0.0	139.0	8.267	19.2	0.00	0.00	0.0
15	20.50	0.0	0.0	145.0	7.213	22.9	0.00	0.00	0.0
16	19.60	0.0	0.0	87.0	5.551	17.9	0.00	0.00	0.0
17	2.90	0.0	0.0	-5.0	0.000	0.0	0.00	0.00	0.0
18	0.00	517.6	0.0	-4.0	2.747	-1.7	0.00	0.00	0.0
19	0.00	0.0	0.0	-7.0	3.002	-2.7	0.00	0.00	0.0
20	0.00	1029.4	0.0	-8.0	10.032	-0.9	0.00	0.00	0.0
21	0.00	998.8	0.0	-8.0	8.541	-1.1	0.00	0.00	0.0
22	0.00	206.4	0.0	-5.0	0.591	-9.7	0.00	0.00	0.0
23	0.00	0.0	0.0	4.0	7.392	0.6	0.00	0.00	0.0
24	23.73	922.6	29.3	155.0	8.806	20.1	0.00	0.00	0.0
25	0.00	172.8	0.0	-5.0	6.970	-0.8	0.00	0.00	0.0
26	7.50	0.0	0.0	20.0	1.762	12.9	0.00	0.00	0.0
27	0.00	0.0	0.0	-7.0	4.416	-1.8	0.00	0.00	0.0
28	18.50	0.0	0.0	61.0	4.341	16.0	0.00	0.00	0.0
29	0.00	0.0	0.0	-11.0	0.072	-174.3	0.00	0.00	0.0
30	25.40	990.0	29.3	159.0	8.697	20.9	0.00	0.00	0.0
31	21.20	0.0	0.0	159.0	8.412	21.6	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............	0.00	HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M....	0.00	HOURS
TRACK TIME / TIME NIP > 300...........	0.0000	
MAXIMUM DAILY POWER...................	25.40	KW
MAX. DAILY POWER EFFIC. FOR MONTH.....	29.3	%
MAXIMUM DAILY NET ENERGY..............	159.00	KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ...	22.9	%
TOTAL POWER PRODUCED FOR MONTH........	22.0	KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........	165.3	KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH.......	13.3	%

DATA FOR MONTH 2 AND YEAR 1986

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	19.00	0.0	0.0	77.0	0.000	0.0	0.00	0.00	0.0
2	17.60	0.0	0.0	95.0	0.000	0.0	0.00	0.00	0.0
3	18.50	0.0	0.0	97.0	0.000	0.0	0.00	0.00	0.0
4	0.00	0.0	0.0	-7.0	0.000	0.0	0.00	0.00	0.0
5	0.00	0.0	0.0	-8.0	0.000	0.0	0.00	0.00	0.0
6	2.20	0.0	0.0	-8.0	0.000	0.0	0.00	0.00	0.0
7	0.00	0.0	0.0	-2.0	0.000	0.0	0.00	0.00	0.0
8	0.00	0.0	0.0	-4.0	0.000	0.0	0.00	0.00	0.0
9	16.30	0.0	0.0	29.0	0.000	0.0	0.00	0.00	0.0
10	0.00	0.0	0.0	-11.0	0.000	0.0	0.00	0.00	0.0
11	0.00	0.0	0.0	-7.0	0.000	0.0	0.00	0.00	0.0
12	22.40	0.0	0.0	159.0	0.000	0.0	0.00	0.00	0.0
13	26.30	0.0	0.0	189.0	0.000	0.0	0.00	0.00	0.0
14	0.00	0.0	0.0	-9.0	0.000	0.0	0.00	0.00	0.0
15	21.30	0.0	0.0	132.0	0.000	0.0	0.00	0.00	0.0
16	22.00	0.0	0.0	157.0	0.000	0.0	0.00	0.00	0.0
17	14.00	0.0	0.0	13.0	0.000	0.0	0.00	0.00	0.0
18	18.00	0.0	0.0	79.0	0.000	0.0	0.00	0.00	0.0
19	7.80	0.0	0.0	-2.0	0.000	0.0	0.00	0.00	0.0
20	20.60	0.0	0.0	111.0	0.000	0.0	0.00	0.00	0.0
21	0.00	0.0	0.0	-8.0	0.000	0.0	0.00	0.00	0.0
22	0.00	0.0	0.0	-8.0	0.000	0.0	0.00	0.00	0.0
23	22.60	0.0	0.0	186.0	0.000	0.0	0.00	0.00	0.0
24	17.30	0.0	0.0	36.0	0.000	0.0	0.00	0.00	0.0
25	21.80	0.0	0.0	177.0	0.000	0.0	0.00	0.00	0.0
26	17.50	0.0	0.0	65.0	0.000	0.0	0.00	0.00	0.0
27	10.70	0.0	0.0	22.0	0.000	0.0	0.00	0.00	0.0
28	1.80	0.0	0.0	-2.0	0.000	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............	0.00	HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M....	0.00	HOURS
TRACK TIME / TIME NIP > 300...........	0.0000	
MAXIMUM DAILY POWER...................	26.30	KW
MAX. DAILY POWER EFFIC. FOR MONTH.....	0.0	%
MAXIMUM DAILY NET ENERGY..............	189.00	KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ...	0.0	%
TOTAL POWER PRODUCED FOR MONTH........	0.0	KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........	0.0	KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH.......	0.0	%

DATA FOR MONTH 3 AND YEAR 1986

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	24.97	915.6	31.1	174.8	8.353	23.9	0.00	0.00	0.0
2	24.89	906.0	31.3	167.0	8.252	23.1	0.00	0.00	0.0
3	23.28	818.0	32.5	98.2	5.599	20.0	0.00	0.00	0.0
4	21.58	807.0	30.5	68.2	4.924	15.8	0.00	0.00	0.0
5	22.68	859.0	30.1	48.0	8.140	6.7	0.00	0.00	0.0
6	0.00	1132.0	0.0	0.0	10.012	0.0	0.00	0.00	0.0
7	16.30	1050.0	17.7	23.0	8.622	3.0	0.00	0.00	0.0
8	21.04	824.0	29.1	122.9	7.276	19.3	0.00	0.00	0.0
9	20.70	856.0	27.6	40.3	3.704	12.4	0.00	0.00	0.0
10	10.69	773.0	15.8	4.8	2.676	2.0	0.00	0.00	0.0
11	11.49	562.0	23.3	8.6	1.819	5.4	0.00	0.00	0.0
12	20.43	852.0	27.4	11.5	2.470	5.3	0.00	0.00	0.0
13	0.00	83.0	0.0	-2.9	0.576	-5.7	0.00	0.00	0.0
14	0.00	73.4	0.0	0.0	0.000	0.0	0.00	0.00	0.0
15	0.00	431.6	0.0	0.0	0.000	0.0	0.00	0.00	0.0
16	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
17	0.00	1021.0	0.0	0.0	4.878	0.0	0.00	0.00	0.0
18	0.00	860.0	0.0	-5.3	6.861	-0.9	0.00	0.00	0.0
19	0.00	56.4	0.0	-7.7	1.043	-8.4	0.00	0.00	0.0
20	0.00	621.9	0.0	-7.7	1.431	-6.1	0.00	0.00	0.0
21	0.00	981.7	0.0	-5.8	9.901	-0.7	0.00	0.00	0.0
22	0.00	952.1	0.0	-4.8	9.472	-0.6	0.00	0.00	0.0
23	0.00	951.0	0.0	-4.8	9.594	-0.6	0.00	0.00	0.0
24	0.00	883.0	0.0	-3.8	7.364	-0.6	0.00	0.00	0.0
25	20.65	886.0	26.6	109.4	8.290	15.1	0.00	0.00	0.0
26	17.07	777.5	25.0	42.2	4.125	11.7	0.00	0.00	0.0
27	19.74	892.4	25.2	146.9	8.875	18.9	0.00	0.00	0.0
28	21.21	994.8	24.3	180.5	9.987	20.6	0.00	0.00	0.0
29	20.92	959.5	24.9	167.1	9.246	20.6	0.00	0.00	0.0
30	18.98	868.0	24.9	119.0	7.729	17.6	0.00	0.00	0.0
31	17.90	808.0	25.3	124.7	7.129	19.9	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............	0.00	HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M....	0.00	HOURS
TRACK TIME / TIME NIP > 300...........	0.0000	
MAXIMUM DAILY POWER...................	24.97	KW
MAX. DAILY POWER EFFIC. FOR MONTH.....	32.5	%
MAXIMUM DAILY NET ENERGY..............	180.48	KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ...	23.9	%
TOTAL POWER PRODUCED FOR MONTH........	18.4	KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........	178.3	KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH.......	10.3	%

DATA FOR MONTH 4 AND YEAR 1986 .

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	16.97	0.0	0.0	78.7	8.036	11.2	0.00	0.00	0.0
2	21.29	835.2	29.1	128.6	4.788	30.6	0.00	0.00	0.0
3	18.05	734.5	28.0	36.5	5.085	8.2	0.00	0.00	0.0
4	14.64	745.2	22.4	30.7	5.883	6.0	0.00	0.00	0.0
5	12.73	725.1	20.0	40.3	7.074	6.5	0.00	0.00	0.0
6	18.12	831.4	24.9	80.6	4.810	19.1	0.00	0.00	0.0
7	14.93	755.1	22.6	18.2	1.670	12.5	0.00	0.00	0.0
8	0.00	194.5	0.0	-8.6	10.719	-0.9	0.00	0.00	0.0
9	23.88	995.5	27.4	195.8	0.000	0.0	0.00	0.00	0.0
10	24.22	953.7	29.0	162.0	9.527	19.4	0.00	0.00	0.0
11	24.08	985.7	27.9	143.0	1.449	112.6	0.00	0.00	0.0
12	0.00	109.1	0.0	-11.5	9.950	-1.3	0.00	0.00	0.0
13	22.56	951.8	27.0	164.2	7.005	26.7	0.00	0.00	0.0
14	20.78	892.3	26.6	79.7	8.464	10.7	0.00	0.00	0.0
15	24.56	1000.5	28.0	131.5	8.004	18.7	0.00	0.00	0.0
16	23.41	935.9	28.5	129.6	7.166	20.6	0.00	0.00	0.0
17	22.28	894.2	28.4	97.0	9.934	11.1	0.00	0.00	0.0
18	22.88	929.4	28.1	185.7	9.206	23.0	0.00	0.00	0.0
19	21.90	917.9	27.2	153.6	0.000	0.0	0.00	0.00	0.0
20	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
21	0.00	0.0	0.0	21.0	0.000	0.0	0.00	0.00	0.0
22	0.00	0.0	0.0	154.0	0.000	0.0	0.00	0.00	0.0
23	0.00	0.0	0.0	219.0	0.000	0.0	0.00	0.00	0.0
24	0.00	0.0	0.0	208.0	0.000	0.0	0.00	0.00	0.0
25	0.00	0.0	0.0	166.0	0.000	0.0	0.00	0.00	0.0
26	0.00	0.0	0.0	166.0	0.000	0.0	0.00	0.00	0.0
27	0.00	0.0	0.0	166.0	0.000	0.0	0.00	0.00	0.0
28	0.00	0.0	0.0	39.0	0.000	0.0	0.00	0.00	0.0
29	24.36	976.0	28.5	122.9	10.100	13.9	0.00	0.00	0.0
30	19.75	984.2	22.9	32.6	10.942	3.4	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 24.56 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 29.1 %
MAXIMUM DAILY NET ENERGY.............. 219.00 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 112.6 %
TOTAL POWER PRODUCED FOR MONTH........ 18.7 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 139.8 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 13.4 %

DATA FOR MONTH 5 AND YEAR 1986

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	21.35	883.1	27.6	68.2	5.967	13.0	0.00	0.00	0.0
2	22.12	912.6	27.6	131.5	9.029	16.6	0.00	0.00	0.0
3	25.49	959.6	30.3	195.8	10.640	21.0	0.00	0.00	0.0
4	23.52	930.4	28.8	193.9	10.596	20.9	0.00	0.00	0.0
5	22.86	893.6	29.2	104.6	6.945	17.2	0.00	0.00	0.0
6	15.05	728.1	23.6	9.6	3.704	3.0	0.00	0.00	0.0
7	17.75	793.5	25.5	34.6	4.908	8.0	0.00	0.00	0.0
8	20.57	887.5	26.4	123.8	8.517	16.6	0.00	0.00	0.0
9	20.04	836.7	27.3	102.7	7.629	15.4	0.00	0.00	0.0
10	16.95	743.1	26.0	32.6	4.378	8.5	0.00	0.00	0.0
11	5.63	439.0	14.6	-6.7	2.355	-3.3	0.00	0.00	0.0
12	1.94	498.3	4.4	-7.7	1.656	-5.3	0.00	0.00	0.0
13	16.15	710.3	25.9	25.0	3.793	7.5	0.00	0.00	0.0
14	13.81	652.9	24.1	43.2	5.476	9.0	0.00	0.00	0.0
15	17.37	767.0	25.8	25.0	2.768	10.3	0.00	0.00	0.0
16	15.29	726.4	24.0	23.0	2.864	9.2	0.00	0.00	0.0
17	20.55	869.0	27.0	97.9	7.327	15.2	0.00	0.00	0.0
18	0.44	197.4	2.5	-6.7	1.555	-4.9	0.00	0.00	0.0
19	0.44	294.2	1.7	-7.7	1.506	-5.8	0.00	0.00	0.0
20	20.43	847.2	27.5	10.7	6.498	1.9	0.00	0.00	0.0
21	0.00	908.0	0.0	-1.0	3.735	-0.3	0.00	0.00	0.0
22	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
23	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
24	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
25	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
26	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
27	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
28	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
29	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
30	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
31	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............	0.00	HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M....	0.00	HOURS
TRACK TIME / TIME NIP > 300...........	0.0000	
MAXIMUM DAILY POWER..................	25.49	KW
MAX. DAILY POWER EFFIC. FOR MONTH.....	30.3	%
MAXIMUM DAILY NET ENERGY..............	195.84	KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ...	21.0	%
TOTAL POWER PRODUCED FOR MONTH........	13.6	KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........	111.8	KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH.......	12.2	%

DATA FOR MONTH 6 AND YEAR 1986

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
2	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
3	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
4	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
5	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
6	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
7	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
8	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
9	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
10	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
11	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
12	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
13	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
14	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
15	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
16	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
17	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
18	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
19	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
20	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
21	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
22	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
23	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
24	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
25	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
26	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
27	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
28	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
29	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
30	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 0.00 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 0.0 %
MAXIMUM DAILY NET ENERGY.............. 0.00 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 0.0 %
TOTAL POWER PRODUCED FOR MONTH........ 0.0 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 0.0 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 0.0 %

DATA FOR MONTH 7 AND YEAR 1986

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH
1	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
2	1.22	0.0	0.0	-7.7	6.688	-1.3	0.00	0.00	0.0
3	21.61	0.0	0.0	148.8	5.125	33.1	0.00	0.00	0.0
4	18.76	0.0	0.0	101.8	3.419	33.9	0.00	0.00	0.0
5	16.66	0.0	0.0	62.4	3.542	20.1	0.00	0.00	0.0
6	19.35	0.0	0.0	38.4	2.228	19.7	0.00	0.00	0.0
7	18.02	0.0	0.0	53.8	4.169	14.7	0.00	0.00	0.0
8	18.39	0.0	0.0	69.1	3.819	20.6	0.00	0.00	0.0
9	17.01	0.0	0.0	27.8	6.642	4.8	0.00	0.00	0.0
10	16.94	0.0	0.0	79.7	4.558	19.9	0.00	0.00	0.0
11	21.12	0.0	0.0	78.7	5.219	17.2	0.00	0.00	0.0
12	18.21	0.0	0.0	36.5	4.627	9.0	0.00	0.00	0.0
13	20.77	0.0	0.0	72.0	4.489	18.3	0.00	0.00	0.0
14	19.55	706.9	31.5	79.7	2.393	38.0	0.00	0.00	0.0
15	19.34	711.9	31.0	25.9	6.122	4.8	0.00	0.00	0.0
16	21.17	756.9	31.9	126.7	3.617	40.0	0.00	0.00	0.0
17	16.47	615.9	30.5	62.4	4.724	15.1	0.00	0.00	0.0
18	17.69	620.0	32.5	76.8	1.557	56.3	0.00	0.00	0.0
19	13.32	497.4	30.5	23.0	0.000	0.0	0.00	0.00	0.0
20	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
21	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
22	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
23	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
24	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
25	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
26	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
27	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0
28	16.17	616.0	29.9	41.3	5.315	8.9	0.00	0.00	0.0
29	18.70	694.4	30.7	104.6	5.324	22.4	0.00	0.00	0.0
30	21.06	765.5	31.4	146.9	7.167	23.4	0.00	0.00	0.0
31	19.55	702.2	31.8	90.2	4.552	22.6	0.00	0.00	0.0

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 21.61 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 32.5 %
MAXIMUM DAILY NET ENERGY.............. 148.80 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 56.3 %
TOTAL POWER PRODUCED FOR MONTH........ 17.3 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 95.3 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 18.1 %

APPENDIX C

This appendix contains a summary of the
Stirling Dish testing from August 1985 to Sept. 1988
at SCE test site, Barstow, California.

DATA FOR MONTH 9 AND YEAR 1985

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	
2	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	
3	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	
4	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	
5	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	
6	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	
7	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	
8	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	
9	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	
10	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	
11	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	
12	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	
13	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	
14	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	
15	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	
16	0.00	953.0	0.0	-6.0	8.158	-0.8	0.00	0.00	0.0	STARTUP TESTS
17	0.00	964.0	0.0	25.0	8.351	3.4	0.00	0.00	25.0	N.P., STARTUP TESTS
18	0.00	740.0	0.0	5.0	0.303	18.8	0.00	0.00	0.0	"
19	0.00	893.0	0.0	-6.0	1.039	-6.6	0.00	0.00	11.0	
20	0.00	932.0	0.0	80.0	8.657	10.5	0.00	0.00	10.0	"
21	0.00	970.0	0.0	202.0	9.165	25.1	0.00	0.00	16.0	"
22	0.00	955.0	0.0	190.0	9.010	24.0	0.00	0.00	15.0	"
23	0.00	812.0	0.0	63.0	4.096	17.5	0.00	0.00	14.0	"
24	21.30	940.0	25.8	167.6	8.575	22.3	0.00	0.00	16.0	N.P., STARTUP TESTS, NEW METER
25	0.00	923.0	0.0	2.0	8.253	0.3	0.00	0.00	0.0	DISH MECHANICAL TEST, JACK
26	0.00	880.0	0.0	104.8	5.902	20.2	0.00	0.00	25.0	N.P.
27	0.00	760.0	0.0	81.6	4.566	20.4	0.00	0.00	17.0	N.P.
28	0.00	875.0	0.0	140.2	6.966	23.0	0.00	0.00	14.0	N.P.
29	0.00	876.0	0.0	139.8	6.911	23.1	0.00	0.00	5.0	N.P.
30	0.00	876.0	0.0	161.8	7.600	24.3	0.00	0.00	8.0	N.P.

TOTAL TRACK TIME FOR MONTH............. 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 21.30 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 25.8 %
MAXIMUM DAILY ENERGY.................. 202.00 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 25.1 %
TOTAL POWER PRODUCED FOR MONTH........ 15.4 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 97.6 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 15.8 %

DATA FOR MONTH 11 AND YEAR 1985

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	0.0	0.0	-1.0	8.099	-0.1	0.00	0.00	0.0	P.
2	0.00	0.0	0.0	0.0	8.228	0.0	0.00	0.00	0.0	"
3	0.00	0.0	0.0	0.0	7.883	0.0	0.00	0.00	0.0	"
4	0.00	964.0	0.0	-4.0	1.537	-3.0	0.00	0.00	0.0	"
5	0.00	0.0	0.0	-6.0	6.578	-1.0	0.00	0.00	0.0	"
6	0.00	0.0	0.0	-7.0	7.654	-1.0	0.00	0.00	0.0	"
7	16.09	936.0	19.6	94.2	7.364	14.6	0.00	0.00	0.0	ALIGNMENT TEST
8	0.00	941.0	0.0	-12.0	6.063	-2.3	0.00	0.00	0.0	AZ DR REPLACEMENT
9	0.00	860.0	0.0	-9.0	4.091	-2.5	0.00	0.00	0.0	"
10	0.00	972.0	0.0	-11.0	6.442	-1.9	0.00	0.00	0.0	"
11	0.00	973.0	0.0	-14.0	0.393	-40.6	0.00	0.00	0.0	TRACK ALGNMENT, TILT TEST
12	17.32	938.0	21.1	-11.0	5.249	-2.4	0.00	0.00	0.0	TRACK ALGNMENT TEST
13	0.00	0.0	0.0	28.0	6.727	4.7	0.00	0.00	0.0	"
14	22.88	972.0	26.8	165.0	7.558	24.9	0.00	0.00	0.0	"
15	22.73	972.0	26.7	149.6	7.635	22.3	0.00	0.00	10.0	N.P.
16	20.10	910.0	25.2	52.6	4.322	13.9	0.00	0.00	12.0	
17	-6.00	921.0	-7.4	-6.0	6.588	-1.0	0.00	0.00	38.0	WINDS ALL DAY
18	0.00	948.0	0.0	-7.0	7.371	-1.1	0.00	0.00	39.0	WINDS ALL DAY
19	20.79	972.0	24.4	156.4	7.609	23.4	0.00	0.00	15.0	N.P.
20	18.90	920.0	23.4	114.6	6.453	20.3	0.00	0.00	12.0	N.P.
21	19.98	942.0	24.2	140.8	7.082	22.7	0.00	0.00	12.0	N.P.
22	19.87	907.0	25.0	75.0	6.982	12.2	0.00	0.00	26.0	WINDS
23	19.80	897.0	25.2	57.2	4.024	16.2	0.00	0.00	7.0	N.P.
24	0.00	208.0	0.0	-9.0	0.045	-228.1	0.00	0.00	13.0	N.P.
25	21.56	890.0	27.6	7.2	1.196	6.9	0.00	0.00	15.0	N.P.
26	24.48	898.0	31.1	13.0	6.228	2.4	0.00	0.00	14.0	DET., DEC PM
27	0.00	452.0	0.0	-5.0	2.381	-2.4	0.00	0.00	16.0	FAST SLEW PROBLEM
28	12.06	910.0	15.1	-4.6	3.780	-1.4	0.00	0.00	32.0	WINDS
29	16.38	934.0	20.0	15.6	4.368	4.1	0.00	0.00	39.0	WINDS-7HR
30	3.42	962.0	4.1	-8.2	5.669	-1.6	0.00	0.00	25.0	WINDS-3HR

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 24.48 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 31.1 %
MAXIMUM DAILY ENERGY.................. 165.00 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 24.9 %
TOTAL POWER PRODUCED FOR MONTH........ 10.9 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 165.6 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 6.6 %

DATA FOR MONTH 1 AND YEAR 1986

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	0.0	0.0	124.0	6.572	21.5	0.00	0.00	0.0	S.N.P.
2	0.00	0.0	0.0	20.8	2.127	11.2	0.00	0.00	0.0	
3	18.54	881.0	24.0	93.2	5.047	21.1	0.00	0.00	14.0	N.P.
4	0.00	0.0	0.0	-7.0	0.013	-614.1	0.00	0.00	4.0	GRID LOSS
5	17.64	840.0	23.9	10.0	4.099	2.8	0.00	0.00	12.0	DET.-7HR,RAD.FAN FAULT, TECH.A
6	20.52	931.0	25.1	148.2	6.943	24.3	0.00	0.00	15.0	N.P.
7	22.32	1001.0	25.4	165.2	7.652	24.6	0.00	0.00	11.0	N.P.
8	22.07	1026.0	24.5	131.0	7.169	20.8	0.00	0.00	11.0	ADD H2
9	22.32	984.0	25.9	162.6	7.627	24.3	0.00	0.00	12.0	N.P.
10	21.44	967.0	25.3	136.2	7.476	20.8	0.00	0.00	12.0	N.P.
11	0.00	0.0	0.0	155.4	7.339	24.1	0.00	0.00	0.0	
12	21.62	874.0	28.2	156.0	7.492	23.7	0.00	0.00	13.0	N.P.
13	18.38	964.0	21.7	24.8	3.952	7.2	0.00	0.00	10.0	DET.,FAN FAULT
14	0.00	330.0	0.0	-8.0	0.065	-140.4	0.00	0.00	16.0	/
15	14.56	760.0	21.9	29.8	3.572	9.5	0.00	0.00	17.0	7
16	17.21	805.0	24.4	71.6	4.261	19.2	0.00	0.00	6.0	Ow
17	19.53	890.0	25.0	108.4	5.787	21.4	0.00	0.00	4.0	Ow
18	20.16	928.0	24.8	147.4	7.139	23.5	0.00	0.00	15.0	Ow
19	20.88	949.0	25.1	130.0	6.571	22.6	0.00	0.00	13.0	Ow
20	18.00	850.0	24.1	35.4	4.886	8.3	0.00	0.00	27.0	Ow
21	13.34	750.0	20.3	10.8	2.924	4.2	0.00	0.00	10.0	Ow
22	16.11	650.0	28.3	78.0	4.714	18.9	0.00	0.00	7.0	Ow
23	18.72	944.0	22.6	35.2	5.872	6.8	0.00	0.00	28.0	Ow
24	20.70	940.0	25.1	145.4	7.281	22.8	0.00	0.00	14.0	Ow
25	21.60	994.0	24.8	167.8	8.059	23.7	0.00	0.00	10.0	Ow
26	19.44	979.0	22.6	106.8	6.044	20.2	0.00	0.00	8.0	Ow
27	21.60	993.0	24.8	164.2	8.072	23.2	0.00	0.00	12.0	Ow
28	20.88	969.0	24.6	130.0	7.575	19.6	0.00	0.00	10.0	Ow
29	0.00	420.0	0.0	-8.0	0.496	-18.4	0.00	0.00	10.0	Ow
30	8.40	925.0	10.4	-5.2	2.828	-2.1	0.00	0.00	29.0	Ox
31	6.30	600.0	12.0	0.6	0.447	1.5	0.00	0.00	0.0	Ou

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 22.32 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 28.3 %
MAXIMUM DAILY ENERGY.................. 167.80 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 24.6 %
TOTAL POWER PRODUCED FOR MONTH........ 30.3 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 160.1 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 19.0 %

DATA FOR MONTH 2 AND YEAR 1986

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	21.09	964.0	24.9	149.4	7.450	22.9	0.00	0.00	0.0	N.P.
2	21.10	956.0	25.2	45.0	7.541	6.8	0.00	0.00	0.0	WIND-5HR
3	21.15	933.0	25.9	7.2	6.661	1.2	0.00	0.00	0.0	WIND
4	20.90	963.0	24.7	94.0	7.820	13.7	0.00	0.00	0.0	WIND ST SEVERAL TIMES
5	20.43	972.0	24.0	91.0	6.284	16.5	0.00	0.00	0.0	WIND ST MOST OF DAY
6	13.30	730.0	20.8	-1.0	0.755	-1.5	0.00	0.00	0.0	N.P. BUT CLOUDY
7	13.30	25.0	606.7	-3.6	0.873	-4.7	0.00	0.00	0.0	N.P.
8	19.19	937.0	23.4	57.0	3.313	19.6	0.00	0.00	0.0	N.P.
9	20.34	1018.0	22.8	56.0	8.549	7.5	0.00	0.00	0.0	
10	21.06	971.0	24.7	93.0	5.404	19.6	0.00	0.00	0.0	N.P.
11	12.33	670.0	21.0	13.0	1.687	8.8	0.00	0.00	0.0	N.P.
12	9.00	650.0	15.8	1.8	0.905	2.3	0.00	0.00	0.0	N.P.
13	19.44	950.0	23.3	7.4	2.501	3.4	0.00	0.00	0.0	N.P.
14	9.54	697.0	15.6	-3.6	1.419	-2.9	0.00	0.00	0.0	
15	11.70	825.0	16.2	-8.2	1.874	-5.0	0.00	0.00	0.0	
16	0.00	775.0	0.0	-10.0	2.469	-4.6	0.00	0.00	0.0	
17	16.02	950.0	19.2	7.0	6.007	1.3	0.00	0.00	0.0	WIND
18	19.04	950.0	22.9	30.8	4.250	8.3	0.00	0.00	0.0	N.P.
19	0.72	950.0	0.9	-3.2	3.128	-1.2	0.00	0.00	35.0	WINDS/CLOUDY
20	0.00	858.0	0.0	-7.0	6.670	-1.2	0.00	0.00	35.0	PCU CHANGE OUT
21	0.00	965.0	0.0	-3.0	8.792	-0.4	0.00	0.00	18.0	PCU CHANGE OUT
22	0.00	1021.0	0.0	-6.0	6.203	-1.1	0.00	0.00	20.0	PCU CHANGE OUT
23	0.00	970.0	0.0	-4.0	8.681	-0.5	0.00	0.00	15.0	NEW PCU INSTALLATION/CHECKOUT
24	0.00	988.0	0.0	-7.0	8.925	-0.9	0.00	0.00	15.0	NEW PCU INSTALLATION/CHECKOUT
25	0.00	994.0	0.0	-4.0	8.991	-0.5	0.00	0.00	14.0	NEW PCU INSTALLATION/CHECKOUT
26	0.00	997.0	0.0	-6.0	8.683	-0.8	0.00	0.00	16.0	NEW PCU INSTALLATION/CHECKOUT
27	0.00	1010.0	0.0	-5.0	8.742	-0.7	0.00	0.00	15.0	NEW PCU INSTALLATION/CHECKOUT
28	20.25	975.0	23.7	130.0	8.452	17.5	0.00	0.00	14.0	NEW PCU FUNCTIONAL TEST

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 21.15 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 606.7 %
MAXIMUM DAILY ENERGY.................. 149.40 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 22.9 %
TOTAL POWER PRODUCED FOR MONTH........ 8.1 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 153.0 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 5.3 %

DATA FOR MONTH 3 AND YEAR 1986

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	15.88	897.0	20.2	49.8	8.353	6.8	0.00	0.00	24.0	P.N.P.
2	18.86	922.0	23.3	130.0	7.060	21.0	0.00	0.00	15.0	N.P.
3	19.69	930.0	24.1	169.0	8.183	23.6	0.00	0.00	12.0	N.P.
4	19.33	939.0	23.5	164.4	8.301	22.6	0.00	0.00	13.0	N.P.
5	19.42	953.0	23.2	169.6	8.418	23.0	0.00	0.00	12.0	N.P.
6	17.84	939.0	21.7	93.2	6.714	15.8	0.00	0.00	25.0	N.P.
7	0.00	845.0	0.0	-7.0	2.425	-3.3	0.00	0.00	0.0	
8	0.00	780.0	0.0	-8.2	0.296	-31.6	0.00	0.00	0.0	
9	16.69	910.0	20.9	0.0	3.149	0.0	0.00	0.00	0.0	DET,TO MANY STARTS
10	0.00	880.0	0.0	9.0	1.323	7.8	0.00	0.00	0.0	N.P.
11	10.80	830.0	14.8	-4.2	6.498	-0.7	0.00	0.00	36.0	N.P., ????
12	13.50	880.0	17.5	-1.8	5.065	-0.4	0.00	0.00	52.0	WIND STOW MOST OF DAY
13	1.62	188.0	9.8	-9.0	0.195	-52.6	0.00	0.00	20.0	N.P., WINDS & RAINS
14	21.78	1002.0	24.8	132.6	8.892	17.0	0.00	0.00	26.0	N.P.
15	20.16	895.0	25.7	102.2	5.667	20.6	0.00	0.00	33.0	WIND
16	13.14	920.0	16.3	-2.0	0.559	-4.1	0.00	0.00	20.0	N.P., BAD WEATHER
17	15.66	970.0	18.4	3.8	4.557	1.0	0.00	0.00	22.0	N.P.
18	0.00	1001.0	0.0	-8.0	9.415	-1.0	0.00	0.00	12.0	REPAIR, COMP. VALVE PROBLEM
19	24.66	998.0	28.2	232.0	9.484	27.9	0.00	0.00	8.0	N.P.
20	24.12	992.0	27.7	227.4	9.534	27.2	0.00	0.00	11.0	N.P.
21	24.12	986.0	27.9	216.4	9.393	26.3	0.00	0.00	12.0	N.P.
22	23.40	985.0	27.1	181.6	9.374	22.1	0.00	0.00	12.0	N.P.
23	19.26	735.0	29.9	61.4	3.801	18.4	0.00	0.00	12.0	N.P.
24	22.50	979.0	26.2	104.0	6.707	17.7	0.00	0.00	32.0	N.P.
25	21.92	920.0	27.2	190.4	8.200	26.5	0.00	0.00	18.0	N.P.
26	21.70	926.0	26.7	194.0	8.344	26.5	0.00	0.00	16.0	N.P.
27	20.88	886.0	26.9	179.8	7.852	26.1	0.00	0.00	15.0	N.P.
28	18.52	815.0	25.9	83.0	4.680	20.2	0.00	0.00	26.0	N.P.
29	21.31	950.0	25.6	185.2	8.250	25.6	0.00	0.00	22.0	N.P.
30	18.52	841.0	25.1	104.0	5.500	21.6	0.00	0.00	26.0	N.P.
31	19.58	723.0	30.9	58.8	3.410	19.7	0.00	0.00	26.0	N.P.

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 24.66 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 30.9 %
MAXIMUM DAILY ENERGY.................. 232.00 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 27.9 %
TOTAL POWER PRODUCED FOR MONTH........ 34.2 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 189.6 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 18.1 %

DATA FOR MONTH 4 AND YEAR 1986

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	19.19	892.0	24.5	45.0	6.581	7.8	0.00	0.00	40.0	WIND-5HR
2	14.08	520.0	30.9	-2.0	3.571	-0.6	0.00	0.00	39.0	N.P.,WINDS
3	20.34	962.0	24.1	112.0	9.325	13.7	0.00	0.00	15.0	N.P.
4	18.72	892.0	23.9	134.6	7.104	21.6	0.00	0.00	10.0	N.P.
5	14.04	820.0	19.5	25.4	3.182	9.1	0.00	0.00	26.0	N.P.
6	21.60	931.0	26.5	31.6	2.099	17.2	0.00	0.00	16.0	N.P.
7	23.20	965.0	27.4	155.2	7.410	23.9	0.00	0.00	10.0	N.P.
8	21.87	965.0	25.8	214.0	9.455	25.8	0.00	0.00	15.0	N.P.
9	23.40	985.0	27.1	225.6	9.619	26.7	0.00	0.00	13.0	N.P.
10	12.96	690.0	21.4	29.0	2.531	13.1	0.00	0.00	10.0	N.P.
11	11.52	702.0	18.7	30.0	3.120	11.0	0.00	0.00	13.0	N.P.
12	14.76	886.0	19.0	7.2	7.608	1.1	0.00	0.00	48.0	WIND-ALL DAY
13	22.86	995.0	26.2	193.0	9.131	24.0	0.00	0.00	15.0	N.P.
14	19.62	985.0	22.7	93.0	5.155	20.6	0.00	0.00	20.0	N.P.
15	21.06	985.0	24.4	110.8	6.757	18.7	0.00	0.00	32.0	N.P.
16	12.24	901.0	15.5	-8.4	6.433	-1.5	0.00	0.00	50.0	N.P.,WIND STOW MOST OF DAY
17	21.60	938.0	26.3	199.6	9.340	24.4	0.00	0.00	25.0	N.P.
18	20.88	927.0	25.7	171.4	8.705	22.5	0.00	0.00	26.0	N.P.
19	22.32	982.0	25.9	227.4	10.130	25.6	0.00	0.00	11.0	N.P.
20	21.00	971.0	24.7	217.6	10.199	24.3	0.00	0.00	0.0	N.P.
21	21.96	965.0	26.0	210.2	9.841	24.4	0.00	0.00	18.0	N.P.
22	20.52	952.0	24.6	98.4	8.485	13.2	0.00	0.00	25.0	N.P.
23	21.08	925.0	26.0	103.6	8.587	13.8	0.00	0.00	27.0	N.P.
24	14.96	916.0	18.6	2.6	8.034	0.4	0.00	0.00	31.0	N.P.,WIND STOW
25	9.00	810.0	12.7	-2.4	4.595	-0.6	0.00	0.00	49.0	N.P.,WIND STOW
26	20.30	942.0	24.6	149.0	7.915	21.5	0.00	0.00	14.0	N.P.
27	21.37	980.0	24.9	215.8	10.229	24.1	0.00	0.00	8.0	N.P.
28	21.37	989.0	24.6	90.0	10.460	9.8	0.00	0.00	29.0	WIND-6HR
29	18.31	914.0	22.8	68.4	8.950	8.7	0.00	0.00	34.0	N.P.,WINDS
30	16.40	909.0	20.6	39.8	6.169	7.4	0.00	0.00	0.0	DEC PM-3HR

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 23.40 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 30.9 %
MAXIMUM DAILY ENERGY.................. 227.40 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 26.7 %
TOTAL POWER PRODUCED FOR MONTH........ 36.3 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 220.7 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 16.5 %

DATA FOR MONTH 5 AND YEAR 1986

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	21.27	950.0	25.5	58.0	4.377	15.1	0.00	0.00	0.0	ND-5HR
2	19.75	950.0	23.7	192.2	9.741	22.5	0.00	0.00	0.0	N.P.
3	18.47	968.0	21.8	90.2	9.659	10.6	0.00	0.00	0.0	WIND-3HR
4	0.00	1001.0	0.0	-8.0	10.558	-0.9	0.00	0.00	0.0	WIND ALL DAY
5	19.33	991.0	22.2	128.8	9.752	15.1	0.00	0.00	0.0	WIND-3HR
6	0.00	920.0	0.0	-10.0	8.717	-1.3	0.00	0.00	0.0	WIND ALL DAY
7	18.00	938.0	21.9	117.2	9.752	13.7	0.00	0.00	0.0	WIND-1HR
8	19.71	962.0	23.4	156.2	8.509	20.9	0.00	0.00	0.0	N.P.
9	19.62	973.0	23.0	203.2	10.369	22.3	0.00	0.00	0.0	N.P.
10	18.00	972.0	21.1	96.4	10.030	11.0	0.00	0.00	0.0	WIND-3HR
11	18.61	972.0	21.8	158.0	10.044	17.9	0.00	0.00	0.0	WIND-1HR
12	18.76	952.0	22.5	190.4	10.034	21.6	0.00	0.00	0.0	N.P.
13	21.96	950.0	26.4	58.0	9.474	7.0	0.00	0.00	0.0	WASH-2HR,PM-6HR
14	21.96	938.0	26.7	133.4	7.996	19.0	0.00	0.00	0.0	WIND-1635 TO END OF DAY
15	20.52	980.0	23.9	112.6	8.542	15.0	0.00	0.00	0.0	WIND-1730 TO END OF DAY
16	21.42	952.0	25.7	222.0	9.823	25.8	0.00	0.00	0.0	N.P.
17	21.60	961.0	25.6	203.0	9.551	24.2	0.00	0.00	0.0	N.P.
18	22.14	987.0	25.6	234.6	10.739	24.9	0.00	0.00	0.0	N.P.
19	19.98	963.0	23.7	173.4	8.824	22.4	0.00	0.00	0.0	N.P.
20	20.52	945.0	24.8	138.8	8.980	17.6	0.00	0.00	0.0	WIND-4HR
21	13.18	912.0	16.5	1.8	6.398	0.3	0.00	0.00	0.0	WIND-11HR
22	18.88	902.0	23.9	76.0	5.106	17.0	0.00	0.00	0.0	N.P.
23	17.33	835.0	23.7	95.0	5.691	19.0	0.00	0.00	0.0	WIND-2HR
24	16.04	798.0	22.9	136.4	7.350	21.2	0.00	0.00	0.0	N.P.
25	17.42	901.0	22.1	157.2	8.181	21.9	0.00	0.00	0.0	N.P.
26	19.71	916.0	24.5	191.4	9.302	23.5	0.00	0.00	0.0	N.P.
27	17.37	875.0	22.6	159.8	8.153	22.4	0.00	0.00	0.0	N.P.
28	17.28	870.0	22.7	95.0	8.311	13.0	0.00	0.00	0.0	N.P.
29	16.67	868.0	21.9	141.8	8.112	19.9	0.00	0.00	0.0	N.P.
30	19.80	850.0	26.6	-5.0	5.607	-1.0	0.00	0.00	0.0	
31	0.00	871.0	0.0	-5.0	7.705	-0.7	0.00	0.00	0.0	WAITING FOR TECH. SER.

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 22.14 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 26.7 %
MAXIMUM DAILY ENERGY.................. 234.60 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 25.8 %
TOTAL POWER PRODUCED FOR MONTH........ 42.1 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 265.4 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 15.9 %

DATA FOR MONTH 6 AND YEAR 1986

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1.	0.00	824.0	0.0	-6.0	7.266	-0.9	0.00	0.00	0.0	P.WAITING FOR REPAIRS
2	19.32	760.0	29.0	61.4	7.935	8.8	0.00	0.00	0.0	WASH-2HR,FAST SLEW REPAIR
3	20.45	885.0	26.3	181.2	9.202	22.5	0.00	0.00	0.0	CHECKOUT BY T LEWIS
4	21.43	910.0	26.9	129.6	7.469	19.8	0.00	0.00	0.0	N.P.
5	19.80	920.0	24.5	113.8	9.758	13.3	0.00	0.00	0.0	N.P.
6	19.80	1000.0	22.6	195.6	9.553	23.3	0.00	0.00	0.0	N.P.
7	18.00	1000.0	20.5	35.4	9.334	4.3	0.00	0.00	0.0	WIND-7HR
8	20.16	934.0	24.6	199.2	9.456	24.0	0.00	0.00	0.0	N.P.
9	20.52	1000.0	23.4	219.4	10.051	24.9	0.00	0.00	0.0	N.P.
10	19.98	1005.0	22.7	213.8	9.990	24.4	0.00	0.00	0.0	N.P.
11	18.90	909.0	23.7	191.4	9.505	23.0	0.00	0.00	0.0	N.P.
12	21.24	964.0	25.1	195.0	9.966	22.3	0.00	0.00	0.0	N.P.
13	18.90	933.0	23.1	73.2	9.750	8.6	0.00	0.00	0.0	N.P.???
14	19.62	968.0	23.1	177.0	9.550	21.1	0.00	0.00	0.0	N.P.
15	18.00	911.0	22.5	118.2	8.679	15.5	0.00	0.00	0.0	N.P.
16	22.50	939.0	27.3	101.4	8.124	14.2	0.00	0.00	0.0	WASH-2HR
17	23.96	961.0	28.4	229.0	10.497	24.9	0.00	0.00	0.0	N.P.
18	3.55	957.0	4.2	9.8	9.863	1.1	0.00	0.00	0.0	WIND-11HR
19	22.59	943.0	27.3	231.8	10.136	26.1	0.00	0.00	0.0	N.P.
20	22.97	966.0	27.1	228.4	10.113	25.8	0.00	0.00	0.0	N.P.
21	22.41	932.0	27.4	232.0	9.946	26.6	0.00	0.00	0.0	N.P.
22	22.43	932.0	27.4	233.6	10.041	26.5	0.00	0.00	0.0	N.P.
23	18.02	848.0	24.2	29.2	2.552	13.0	0.00	0.00	0.0	N.P.,CLOUDS
24	19.62	860.0	26.0	164.2	10.440	17.9	0.00	0.00	0.0	N.P.,CLOUDS
25	20.61	940.0	25.0	137.2	9.800	16.0	0.00	0.00	0.0	WIND-2HR
26	20.18	930.0	24.7	100.0	8.938	12.8	0.00	0.00	0.0	RAETZ PM
27	7.13	920.0	8.8	-6.2	9.251	-0.8	0.00	0.00	0.0	SUN SENSOR FAILED
28	0.00	847.0	0.0	0.0	3.760	0.0	0.00	0.00	0.0	WAITING SUN SENSOR REPAIR
29	0.00	876.0	0.0	0.0	6.796	0.0	0.00	0.00	0.0	WAITING FOR TECH. SER.
30	7.16	926.0	8.8	-10.2	9.422	-1.2	0.00	0.00	0.0	FAST SLEW/DISH CON.MALFUNCTION

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER.................. 23.96 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 29.0 %
MAXIMUM DAILY ENERGY.................. 233.60 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 26.6 %
TOTAL POWER PRODUCED FOR MONTH........ 43.1 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 267.1 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 16.1 %

DATA FOR MONTH 7 AND YEAR 1986

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	927.0	0.0	-3.0	10.120	-0.3	0.00	0.00	0.0	WAWAITING FOR PCU REPAIR
2	0.00	907.0	0.0	-6.0	6.896	-1.0	0.00	0.00	0.0	ON FAST SLEW & PCU
3	0.00	850.0	0.0	-10.0	6.766	-1.7	0.00	0.00	0.0	"
4	0.00	795.0	0.0	-7.0	5.769	-1.4	0.00	0.00	0.0	"
5	0.00	910.0	0.0	-7.0	8.454	-0.9	0.00	0.00	0.0	"
6	0.00	942.0	0.0	-9.0	7.835	-1.3	0.00	0.00	0.0	"
7	0.00	950.0	0.0	-7.0	10.150	-0.8	0.00	0.00	0.0	"
8	0.00	934.0	0.0	-5.0	9.815	-0.6	0.00	0.00	0.0	BURNED OUT RECEIVER
9	0.00	991.0	0.0	0.0	10.499	0.0	0.00	0.00	0.0	REMOVING PCU
10	0.00	938.0	0.0	0.0	9.153	0.0	0.00	0.00	0.0	INSTALLED NEW PCU
11	0.00	896.0	0.0	0.0	9.217	0.0	0.00	0.00	0.0	WAITING FOR CHECKOUT
12	0.00	883.0	0.0	0.0	9.085	0.0	0.00	0.00	0.0	"
13	0.00	918.0	0.0	0.0	9.822	0.0	0.00	0.00	0.0	"
14	0.00	676.0	0.0	0.0	2.637	0.0	0.00	0.00	0.0	TESTING DISH
15	0.00	190.0	0.0	-4.0	0.607	-7.5	0.00	0.00	0.0	WAITING FOR FURTHER TESTS
16	0.00	951.0	0.0	-3.0	9.555	-0.4	0.00	0.00	0.0	"
17	0.00	966.0	0.0	-7.0	10.110	-0.8	0.00	0.00	0.0	WAITING FOR CHECKOUT
18	0.00	970.0	0.0	-4.0	10.717	-0.4	0.00	0.00	0.0	"
19	0.00	999.0	0.0	-6.0	10.746	-0.6	0.00	0.00	0.0	"
20	0.00	926.0	0.0	-4.0	8.587	-0.5	0.00	0.00	0.0	"
21	0.00	747.0	0.0	-6.0	2.486	-2.8	0.00	0.00	0.0	"
22	0.00	878.0	0.0	-2.0	4.308	-0.5	0.00	0.00	0.0	WORK ON DISH DRIVES,WAITING ON
23	0.00	880.0	0.0	-2.0	4.899	-0.5	0.00	0.00	0.0	KS PM, FAST SLEW
24	0.00	971.0	0.0	-1.0	8.946	-0.1	0.00	0.00	0.0	WAITING FOR CCHECKOUT
25	0.00	967.0	0.0	0.0	10.226	0.0	0.00	0.00	0.0	"
26	0.00	936.0	0.0	0.0	9.151	0.0	0.00	0.00	0.0	"
27	0.00	940.0	0.0	0.0	8.720	0.0	0.00	0.00	0.0	NEED RADIATOR PEPLACEMENT
28	0.00	979.0	0.0	-2.0	10.425	-0.2	0.00	0.00	0.0	WAITING FOR REPAIR
29	0.00	988.0	0.0	-5.0	10.315	-0.6	0.00	0.00	0.0	"
30	0.00	977.0	0.0	-4.0	10.150	-0.4	0.00	0.00	0.0	CHECKOUR PCU FAN, PUMP,ETC
31	0.00	970.0	0.0	-6.0	10.173	-0.7	0.00	0.00	0.0	CHECHOUT OF SYSTEM

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 0.00 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 0.0 %
MAXIMUM DAILY ENERGY.................. 0.00 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 0.0 %
TOTAL POWER PRODUCED FOR MONTH........ -1.3 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 256.3 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... -0.5 %

DATA FOR MONTH 8 AND YEAR 1986

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	941.0	0.0	-5.0	9.581	-0.6	0.00	0.00	0.0	WAITING FOR PCU REPAIR
2	0.00	927.0	0.0	-5.0	8.326	-0.7	0.00	0.00	0.0	"
3	0.00	878.0	0.0	-6.0	7.954	-0.9	0.00	0.00	0.0	"
4	0.00	868.0	0.0	-4.0	6.967	-0.7	0.00	0.00	0.0	/
5	0.00	832.0	0.0	-7.0	7.929	-1.0	0.00	0.00	0.0	KS PM
6	0.00	889.0	0.0	0.8	7.469	0.1	0.00	0.00	0.0	PCU BURN IN PROB, KS PM
7	0.00	878.0	0.0	-4.0	8.213	-0.6	0.00	0.00	0.0	SOLENOID PROB, NO SPARE
8	0.00	857.0	0.0	-5.0	7.150	-0.8	0.00	0.00	0.0	WAITING FOR REPAIR
9	0.00	826.0	0.0	-5.0	4.075	-1.4	0.00	0.00	0.0	"
10	0.00	822.0	0.0	-4.0	6.727	-0.7	0.00	0.00	0.0	"
11	0.00	860.0	0.0	-5.0	7.355	-0.8	0.00	0.00	0.0	"
12	0.00	860.0	0.0	-6.0	8.060	-0.8	0.00	0.00	0.0	"
13	0.00	865.0	0.0	-5.0	8.298	-0.7	0.00	0.00	0.0	"
14	0.00	930.0	0.0	-6.0	9.153	-0.7	0.00	0.00	0.0	"
15	0.00	953.0	0.0	-4.0	9.855	-0.5	0.00	0.00	0.0	"
16	0.00	968.0	0.0	-6.0	9.890	-0.7	0.00	0.00	0.0	"
17	0.00	956.0	0.0	-2.2	9.080	-0.3	0.00	0.00	0.0	"
18	0.00	870.0	0.0	-5.0	1.740	-3.3	0.00	0.00	0.0	"
19	0.00	860.0	0.0	-5.0	7.228	-0.8	0.00	0.00	0.0	KS PM, REPLACE VALVE
20	16.92	828.0	23.3	102.2	5.899	19.8	0.00	0.00	0.0	KS PM
21	18.63	858.0	24.8	145.2	7.162	23.1	0.00	0.00	0.0	REC.BURN IN CONTINUED
22	0.00	930.0	0.0	-9.0	8.648	-1.2	0.00	0.00	0.0	WAITING FOR NEW PCU
23	0.00	918.0	0.0	-11.0	9.132	-1.4	0.00	0.00	0.0	"
24	0.00	875.0	0.0	-10.0	8.142	-1.4	0.00	0.00	0.0	"
25	0.00	850.0	0.0	-11.0	7.951	-1.6	0.00	0.00	0.0	WAITING FOR FAST SLEW MODS.
26	0.00	836.0	0.0	-8.0	3.071	-3.0	0.00	0.00	0.0	"
27	0.00	983.0	0.0	-5.0	6.028	-0.9	0.00	0.00	0.0	
28	0.00	985.0	0.0	-5.0	7.450	-0.8	0.00	0.00	0.0	
29	19.44	0.0	0.0	37.0	8.236	5.1	0.00	0.00	0.0	KS PM
30	0.00	900.0	0.0	-11.0	8.498	-1.5	0.00	0.00	0.0	
31	0.00	0.0	0.0	-9.0	7.893	-1.3	0.00	0.00	0.0	

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 19.44 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 24.8 %
MAXIMUM DAILY ENERGY.................. 145.20 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 23.1 %
TOTAL POWER PRODUCED FOR MONTH........ 1.3 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 233.2 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 0.6 %

DATA FOR MONTH 9 AND YEAR 1986

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	0.0	0.0	-11.0	7.187	-1.7	0.00	0.00	0.0	ITING FOR PCU REPAIR
2	19.44	948.0	23.4	67.6	8.966	8.6	0.00	0.00	0.0	KS PM-7HR
3	19.18	928.0	23.6	184.2	8.748	24.0	0.00	0.00	0.0	N.P.
4	19.80	928.0	24.3	183.4	8.459	24.7	0.00	0.00	0.0	N.P.
5	19.08	918.0	23.7	102.8	8.873	13.2	0.00	0.00	0.0	DEC MAINT-3HR
6	19.08	911.0	23.9	155.4	8.173	21.7	0.00	0.00	0.0	N.P.
7	20.34	978.0	23.7	178.4	9.004	22.6	0.00	0.00	0.0	N.P.
8	19.80	988.0	22.9	100.2	8.752	13.1	0.00	0.00	0.0	WIND-1HR
9	17.90	957.0	21.3	27.8	8.949	3.5	0.00	0.00	0.0	WIND-6HR
10	20.34	961.0	24.1	182.2	8.858	23.5	0.00	0.00	0.0	N.P.
11	20.08	941.0	24.3	101.2	7.707	15.0	0.00	0.00	0.0	PM-2HR
12	19.89	927.0	24.5	167.0	8.322	22.9	0.00	0.00	0.0	N.P.
13	17.37	918.0	21.6	75.2	6.579	13.0	0.00	0.00	0.0	OPER.OPERATIONAL PROB.
14	18.72	947.0	22.5	152.4	8.305	20.9	0.00	0.00	0.0	N.P.
15	14.04	922.0	17.4	34.2	6.257	6.2	0.00	0.00	0.0	WIND-7HR
16	18.83	965.0	22.3	59.6	8.810	7.7	0.00	0.00	0.0	WIND-6HR
17	0.00	943.0	0.0	-8.0	6.215	-1.5	0.00	0.00	0.0	WASH-2HR,PCU INSOLATION PROB
18	0.00	985.0	0.0	-8.0	6.423	-1.4	0.00	0.00	0.0	REPAIR OF INSULATION
19	0.00	948.0	0.0	-9.0	7.988	-1.3	0.00	0.00	0.0	WIND
20	0.00	972.0	0.0	-4.0	6.600	-0.7	0.00	0.00	0.0	N.P.
21	17.95	966.0	21.2	18.2	8.026	2.6	0.00	0.00	0.0	DET,OIL PRESSURE PROB
22	9.54	985.0	11.0	10.2	7.390	1.6	0.00	0.00	0.0	TRACK ALGN PROB?
23	0.00	999.0	0.0	-5.0	7.605	-0.7	0.00	0.00	0.0	"
24	0.00	882.0	0.0	-7.0	2.336	-3.4	0.00	0.00	0.0	WAITING FOR ALGNMENT
25	0.00	930.0	0.0	-4.0	5.637	-0.8	0.00	0.00	0.0	"
26	0.00	938.0	0.0	-7.0	8.527	-0.9	0.00	0.00	0.0	"
27	0.00	196.0	0.0	-5.0	0.150	-38.0	0.00	0.00	0.0	"
28	0.00	838.0	0.0	-6.0	4.821	-1.4	0.00	0.00	0.0	"
29	0.00	0.0	0.0	-5.0	8.937	-0.6	0.00	0.00	0.0	"
30	0.00	992.0	0.0	-5.0	8.720	-0.7	0.00	0.00	0.0	WAITING FOR REPAIR

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 20.34 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 24.5 %
MAXIMUM DAILY ENERGY.................. 184.20 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 24.7 %
TOTAL POWER PRODUCED FOR MONTH........ 19.6 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 221.3 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 8.8 %

DATA FOR MONTH 10 AND YEAR 1986

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	953.0	0.0	-5.0	7.625	-0.7	0.00	0.00	0.0	PMN.P.
2	17.64	928.0	21.7	20.0	4.106	5.6	0.00	0.00	0.0	RPM ADJUSTMENT
3	18.36	965.0	21.7	36.2	8.088	5.1	0.00	0.00	0.0	DET GAS PROBLEMS
4	0.00	972.0	0.0	-4.0	8.752	-0.5	0.00	0.00	0.0	WAITING FOR TECH. SERVICE
5	0.00	948.0	0.0	-7.0	8.442	-0.9	0.00	0.00	0.0	"
6	0.00	905.0	0.0	-3.0	6.893	-0.5	0.00	0.00	0.0	WAITING TECH SERVICE
7	0.00	950.0	0.0	-8.0	7.413	-1.2	0.00	0.00	0.0	DUMP FAULT, TROUBLINGSHOOTING
8	0.00	916.0	0.0	-3.0	6.740	-0.5	0.00	0.00	0.0	WAITING FOR SPS
9	0.00	908.0	0.0	-5.0	0.128	-44.5	0.00	0.00	0.0	"
10	0.00	918.0	0.0	-4.0	7.017	-0.7	0.00	0.00	0.0	"
11	0.00	830.0	0.0	-7.0	4.767	-1.7	0.00	0.00	0.0	"
12	0.00	1003.0	0.0	-4.0	9.096	-0.5	0.00	0.00	0.0	"
13	0.00	1013.0	0.0	-7.0	9.194	-0.9	0.00	0.00	0.0	REPAIR H2 COMPRESSOR
14	18.34	1012.0	20.7	21.4	9.174	2.7	0.00	0.00	0.0	REPLACE COMP.PISTON
15	4.23	748.0	6.4	18.0	3.232	6.4	0.00	0.00	0.0	STILL GAS PROB.
16	22.41	972.0	26.3	58.8	8.360	8.0	0.00	0.00	0.0	"
17	0.00	887.0	0.0	-5.0	5.152	-1.1	0.00	0.00	0.0	STILL GAS PROB
18	0.00	923.0	0.0	-7.0	7.818	-1.0	0.00	0.00	0.0	"
19	0.00	921.0	0.0	-4.0	7.743	-0.6	0.00	0.00	0.0	"
20	0.00	9.3	0.0	-6.0	7.773	-0.9	0.00	0.00	0.0	"
21	0.00	924.0	0.0	-4.0	6.562	-0.7	0.00	0.00	0.0	"
22	0.00	915.0	0.0	-6.0	5.335	-1.3	0.00	0.00	0.0	"
23	0.00	920.0	0.0	-5.0	6.342	-0.9	0.00	0.00	0.0	"
24	0.00	885.0	0.0	-5.0	7.118	-0.8	0.00	0.00	0.0	REM.RADIATOR
25	0.00	949.0	0.0	0.0	7.950	0.0	0.00	0.00	0.0	SPS REPAIR, VALVE PROB
26	0.00	520.0	0.0	0.0	2.810	0.0	0.00	0.00	0.0	"
27	15.30	926.0	18.8	10.6	7.505	1.6	0.00	0.00	0.0	SPS REPAIR
28	9.18	841.0	12.4	-4.4	2.602	-1.9	0.00	0.00	0.0	REP.BYPASS VALVE#13 HOUSING
29	20.43	931.0	25.0	143.8	7.172	22.9	0.00	0.00	0.0	N.P.
30	8.44	858.0	11.2	2.8	6.051	0.5	0.00	0.00	0.0	REPLACED POWER METER
31	18.23	900.0	23.1	112.0	6.645	19.2	0.00	0.00	0.0	N.P.

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 22.41 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 26.3 %
MAXIMUM DAILY ENERGY.................. 143.80 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 22.9 %
TOTAL POWER PRODUCED FOR MONTH........ 3.7 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 203.6 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 1.8 %

DATA FOR MONTH 11 AND YEAR 1986

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	19.75	954.0	23.6	135.0	7.079	21.7	0.00	0.00	0.0	N.P.
2	18.33	765.0	27.3	78.0	4.500	19.8	0.00	0.00	0.0	N.P.
3	19.97	963.0	23.6	117.0	6.274	21.3	0.00	0.00	0.0	N.P.
4	20.13	965.0	23.8	163.0	8.098	23.0	0.00	0.00	0.0	N.P.
5	20.12	971.0	23.6	160.8	8.065	22.7	0.00	0.00	0.0	N.P.
6	14.71	755.0	22.2	34.6	4.339	9.1	0.00	0.00	0.0	HAZE
7	16.51	852.0	22.1	102.8	5.319	22.0	0.00	0.00	0.0	N.P.
8	19.12	933.0	23.4	138.8	7.207	22.0	0.00	0.00	0.0	N.P.
9	20.13	986.0	23.3	156.4	8.006	22.3	0.00	0.00	0.0	DET-1HR,WR START PRESS
10	20.01	960.0	23.8	157.0	7.876	22.7	0.00	0.00	0.0	N.P.
11	20.36	960.0	24.2	161.6	8.023	23.0	0.00	0.00	0.0	N.P.
12	20.24	985.0	23.4	160.8	7.943	23.1	0.00	0.00	0.0	N.P.
13	19.98	969.0	23.5	153.4	5.910	29.6	0.00	0.00	0.0	N.P.
14	18.02	867.0	23.7	112.2	6.553	19.5	0.00	0.00	0.0	N.P.
15	17.20	910.0	21.6	84.2	5.068	18.9	0.00	0.00	0.0	N.P.
16	0.00	850.0	0.0	23.6	2.666	10.1	0.00	0.00	0.0	N.P.
17	13.10	456.0	32.8	9.0	1.466	7.0	0.00	0.00	0.0	PM-3HR
18	12.08	969.0	14.2	19.8	1.778	12.7	0.00	0.00	0.0	DET,WR START PRESS
19	19.33	890.0	24.8	143.8	6.891	23.8	0.00	0.00	0.0	N.P.
20	19.74	909.0	24.8	108.4	7.055	17.5	0.00	0.00	0.0	N.P.
21	18.00	914.0	22.5	77.6	6.132	14.4	0.00	0.00	0.0	WIND-2HR
22	19.81	927.0	24.4	137.2	7.140	21.9	0.00	0.00	0.0	N.P.
23	21.05	938.0	25.6	163.4	7.705	24.2	0.00	0.00	0.0	N.P.
24	20.92	963.0	24.8	160.6	7.517	24.4	0.00	0.00	0.0	N.P.
25	18.19	910.0	22.8	131.0	6.488	23.0	0.00	0.00	0.0	N.P.
26	21.08	960.0	25.0	155.4	7.343	24.1	0.00	0.00	0.0	N.P.
27	21.31	977.0	24.9	153.4	7.310	23.9	0.00	0.00	0.0	N.P.
28	20.88	950.0	25.1	80.6	4.450	20.7	0.00	0.00	0.0	N.P.
29	0.00	900.0	0.0	-5.0	5.700	-1.0	0.00	0.00	0.0	KS PM,INSTAL NEW FAST SLEW
30	19.75	970.0	23.2	215.8	7.112	34.6	0.00	0.00	0.0	KS PM

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 21.31 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 32.8 %
MAXIMUM DAILY ENERGY.................. 215.80 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 34.6 %
TOTAL POWER PRODUCED FOR MONTH........ 39.8 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 187.0 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 21.3 %

DATA FOR MONTH 12 AND YEAR 1986

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	21.35	1010.0	24.1	152.2	7.489	23.2	0.00	0.00	0.0	P.
2	19.49	920.0	24.2	66.0	4.093	18.4	0.00	0.00	0.0	CLOUDY
3	20.52	951.0	24.6	119.6	7.168	19.0	0.00	0.00	0.0	1356 DOWN INST.INSULATION
4	0.00	180.0	0.0	-3.0	0.065	-52.6	0.00	0.00	0.0	GRID LOSS,WIND,FAST SLEW PM
5	0.00	200.0	0.0	-8.0	0.403	-22.6	0.00	0.00	0.0	N.P.,LOOKING FOR OIL LEAK
6	0.00	440.0	0.0	-3.0	0.053	-64.5	0.00	0.00	0.0	RAIN WASH STOW
7	1.42	320.0	5.1	-9.0	0.093	-110.4	0.00	0.00	0.0	N.P.
8	20.47	930.0	25.1	110.2	7.600	16.5	0.00	0.00	0.0	1341 NST FOR PM INSPECTION
9	18.70	935.0	22.8	30.2	7.273	4.7	0.00	0.00	0.0	PM-6HR,TORQUE GEN.BOLTS,OIL LE
10	22.50	994.0	25.8	114.6	7.521	17.4	0.00	0.00	0.0	INSOL TO HIGH-3HR
11	21.13	977.0	24.7	95.8	7.357	14.8	0.00	0.00	0.0	N.P.
12	21.64	962.0	25.7	91.8	7.239	14.5	0.00	0.00	0.0	N.P.
13	19.81	953.0	23.7	64.0	5.113	14.3	0.00	0.00	0.0	N.P.
14	2.80	640.0	5.0	-6.4	1.054	-6.9	0.00	0.00	0.0	N.P.
15	19.09	905.0	24.1	29.0	3.776	8.8	0.00	0.00	0.0	N.P.
16	19.32	870.0	25.3	41.8	2.982	16.0	0.00	0.00	0.0	N.P.
17	19.72	901.0	25.0	103.8	5.060	23.4	0.00	0.00	0.0	N.P.
18	18.28	870.0	24.0	107.8	5.380	22.9	0.00	0.00	0.0	N.P.
19	11.93	981.0	13.9	29.8	2.264	15.0	0.00	0.00	0.0	N.P.
20	15.65	825.0	21.6	50.0	2.952	19.3	0.00	0.00	0.0	N.P.
21	20.05	907.0	25.2	142.6	6.818	23.9	0.00	0.00	0.0	N.P.
22	20.05	998.0	22.9	54.4	3.715	16.7	0.00	0.00	0.0	N.P.
23	19.35	992.0	22.2	53.4	2.982	20.4	0.00	0.00	0.0	N.P.
24	19.41	906.0	24.4	104.0	5.231	22.7	0.00	0.00	0.0	N.P.
25	19.75	928.0	24.3	86.6	4.991	19.8	0.00	0.00	0.0	N.P.
26	0.00	961.0	0.0	-5.0	6.765	-0.8	0.00	0.00	0.0	DET DUMP FAULT SEV.TIMES,STOWE
27	0.00	960.0	0.0	-4.0	6.285	-0.7	0.00	0.00	0.0	WAITING FOR PCU TECH.DIRECTION
28	0.00	949.0	0.0	-4.6	7.073	-0.7	0.00	0.00	0.0	WAITING FOR TECH DIRECTION
29	0.00	860.0	0.0	-5.0	2.403	-2.4	0.00	0.00	0.0	"
30	0.00	950.0	0.0	-8.0	5.930	-1.5	0.00	0.00	0.0	"
31	0.00	720.0	0.0	-4.0	1.710	-2.7	0.00	0.00	0.0	"

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 22.50 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 25.8 %
MAXIMUM DAILY ENERGY.................. 152.20 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 23.9 %
TOTAL POWER PRODUCED FOR MONTH........ 18.1 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 138.8 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 13.0 %

DATA FOR MONTH 1 AND YEAR 1987

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	597.0	0.0	-6.0	2.489	-2.7	0.00	0.00	0.0	P.
2	0.00	956.0	0.0	-5.0	4.516	-1.3	0.00	0.00	0.0	"
3	0.00	928.0	0.0	-6.0	3.546	-1.9	0.00	0.00	0.0	"
4	0.00	0.0	0.0	-5.0	0.566	-10.1	0.00	0.00	0.0	"
5	0.00	920.0	0.0	-3.0	6.772	-0.5	0.00	0.00	0.0	"
6	0.00	372.0	0.0	-8.0	1.551	-5.9	0.00	0.00	0.0	"
7	0.00	750.0	0.0	-5.0	0.793	-7.2	0.00	0.00	0.0	"
8	0.00	850.0	0.0	-6.0	6.687	-1.0	0.00	0.00	0.0	"
9	22.26	961.0	26.4	171.6	7.496	26.1	0.00	0.00	0.0	N.P.
10	22.32	1006.0	25.3	167.2	7.835	24.3	0.00	0.00	0.0	N.P.
11	22.91	1016.0	25.7	172.2	8.050	24.4	0.00	0.00	0.0	N.P.
12	22.57	1006.0	25.6	171.6	7.896	24.8	0.00	0.00	0.0	N.P.
13	0.00	875.0	0.0	80.4	4.609	19.9	0.00	0.00	0.0	N.P.
14	22.60	998.0	25.8	165.4	7.519	25.1	0.00	0.00	0.0	WASH-2HR
15	0.00	740.0	0.0	-5.0	-1.000	0.0	0.00	0.00	0.0	CLOUDS
16	0.00	937.0	0.0	-6.0	7.680	-0.9	0.00	0.00	0.0	PCU & FLUKE COM, WAIT TECH SER
17	0.00	1006.0	0.0	-9.0	7.711	-1.3	0.00	0.00	0.0	"
18	0.00	971.0	0.0	-8.0	6.268	-1.5	0.00	0.00	0.0	"
19	0.00	967.0	0.0	-4.0	6.836	-0.7	0.00	0.00	0.0	CABLE PROBLEM
20	0.00	1007.0	0.0	-7.0	7.925	-1.0	0.00	0.00	0.0	PLICE CABLES, DISH CONTROL PRO
21	0.00	1020.0	0.0	-4.0	8.046	-0.6	0.00	0.00	0.0	WAITING FOR KS PM
22	0.00	963.0	0.0	-3.0	4.881	-0.7	0.00	0.00	0.0	"
23	0.00	908.0	0.0	0.0	6.648	0.0	0.00	0.00	0.0	"
24	0.00	877.0	0.0	-3.0	3.696	-0.9	0.00	0.00	0.0	REPAIR CABLES
25	0.00	904.0	0.0	-5.0	6.179	-0.9	0.00	0.00	0.0	"
26	21.77	989.0	25.1	112.0	7.173	17.8	0.00	0.00	0.0	CKECKOUT
27	0.00	250.0	0.0	-8.0	0.412	-22.1	0.00	0.00	0.0	DET-WR START PRESS/CLOUDS
28	0.00	952.0	0.0	-5.0	5.660	-1.0	0.00	0.00	0.0	WIND-ALL DAY
29	12.91	650.0	22.6	23.6	3.013	8.9	0.00	0.00	0.0	GRID LOSS-4HR
30	16.00	795.0	23.0	66.2	4.200	18.0	0.00	0.00	0.0	DET-1.5HR
31	20.21	912.0	25.3	130.0	6.692	22.2	0.00	0.00	0.0	N.P.

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER.................... 22.91 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 26.4 %
MAXIMUM DAILY ENERGY................... 172.20 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 26.1 %
TOTAL POWER PRODUCED FOR MONTH........ 13.2 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 163.3 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 8.1 %

DATA FOR MONTH 2 AND YEAR 1987

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	20.73	967.0	24.4	126.6	7.357	19.6	0.00	0.00	0.0	ITING FOR TECH.DIRECTION
2	9.57	548.0	19.9	9.0	1.660	6.2	0.00	0.00	0.0	N.P., CLOUDS
3	17.65	675.0	29.8	35.6	3.209	12.7	0.00	0.00	0.0	DET-2HR/WR.STAR.PRESS/OP.MISTA
4	21.64	1001.0	24.7	168.6	8.315	23.1	0.00	0.00	0.0	N.P.
5	21.97	1023.0	24.5	183.4	8.485	24.6	0.00	0.00	0.0	N.P.
6	21.16	1005.0	24.0	125.4	7.539	19.0	0.00	0.00	0.0	WINDS-1303 REST OF DAY
7	21.16	982.0	24.6	26.4	3.118	9.7	0.00	0.00	0.0	N.P., CLOUDS
8	20.44	965.0	24.2	63.2	3.697	19.5	0.00	0.00	0.0	N.P.
9	20.44	878.0	26.5	67.8	3.725	20.8	0.00	0.00	0.0	N.P., WARNING PRESS COMP CIR
10	19.25	931.0	23.6	113.0	6.213	20.7	0.00	0.00	0.0	N.P., SAME WARNING
11	14.73	742.0	22.6	36.4	2.707	15.3	0.00	0.00	0.0	N.P.
12	17.81	856.0	23.7	48.0	3.642	15.0	0.00	0.00	0.0	N.P.
13	7.70	623.0	14.1	-7.2	0.931	-8.8	0.00	0.00	0.0	WIND-953 ALL DAY
14	20.01	984.0	23.2	154.0	7.962	22.1	0.00	0.00	0.0	N.P.
15	0.00	961.0	0.0	3.8	5.514	0.8	0.00	0.00	0.0	WIND
16	19.05	1018.0	21.3	165.2	8.694	21.7	0.00	0.00	0.0	N.P.
17	19.54	985.0	22.6	145.4	7.956	20.8	0.00	0.00	0.0	N.P.
18	16.87	650.0	29.6	31.8	2.631	13.8	0.00	0.00	0.0	N.P.
19	18.10	985.0	21.0	105.6	7.628	15.8	0.00	0.00	0.0	N.P.
20	19.16	987.0	22.1	140.8	7.638	21.0	0.00	0.00	0.0	N.P.
21	18.51	940.0	22.5	133.0	7.196	21.1	0.00	0.00	0.0	N.P.
22	15.09	820.0	21.0	36.2	3.102	13.3	0.00	0.00	0.0	N.P.
23	0.00	785.0	0.0	-6.0	2.403	-2.8	0.00	0.00	0.0	WIND ALL DAY
24	0.00	964.0	0.0	-8.0	4.056	-2.2	0.00	0.00	0.0	DET SEVERAL TIMES, DIRTY MIRRO
25	0.00	500.0	0.0	-4.2	1.266	-3.8	0.00	0.00	0.0	FACEUP ST FOR RAIN WASH
26	16.50	940.0	20.0	4.2	4.260	1.1	0.00	0.00	0.0	WASH-3HR,PM REST OF DAY
27	23.27	1006.0	26.4	190.2	8.570	25.3	0.00	0.00	0.0	N.P.
28	0.00	826.0	0.0	90.6	5.221	19.8	0.00	0.00	0.0	CLOUDS, OPERATOR STOWED

TOTAL TRACK TIME FOR MONTH............. 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M..... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 23.27 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 29.8 %
MAXIMUM DAILY ENERGY.................. 190.20 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 25.3 %
TOTAL POWER PRODUCED FOR MONTH........ 24.8 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 144.7 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 17.2 %

DATA FOR MONTH 3 AND YEAR 1987

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	16.50	1003.0	18.8	190.2	8.030	27.0	0.00	0.00	0.0	T-4HR
2	18.10	850.0	24.3	92.2	6.523	16.1	0.00	0.00	0.0	REFLECTIVITY-2HR
3	0.00	973.0	0.0	57.2	8.230	7.9	0.00	0.00	0.0	DET-2HR,PCU FAN FAULT,CH.RELAY
4	14.67	734.0	22.8	3.0	2.096	1.6	0.00	0.00	0.0	CH 12V FAN RELAY-2HR
5	0.00	0.0	0.0	-9.0	0.000	0.0	0.00	0.00	0.0	OPERATOR PUT IN RAIN WASH STOW
6	0.00	0.0	0.0	-11.0	0.000	0.0	0.00	0.00	0.0	BAD WEATHER
7	8.02	725.0	12.6	2.2	1.957	1.3	0.00	0.00	0.0	N.P., BAD WEATHER
8	5.86	940.0	7.1	-6.2	7.279	-1.0	0.00	0.00	0.0	N.P., BAD WEATHER
9	15.48	720.0	24.5	17.2	1.623	12.1	0.00	0.00	0.0	N.P.
10	18.48	738.0	28.6	48.8	3.056	18.2	0.00	0.00	0.0	N.P.
11	19.91	948.0	24.0	157.2	7.591	23.6	0.00	0.00	0.0	N.P.
12	20.75	950.0	24.9	164.4	7.784	24.1	0.00	0.00	0.0	N.P.
13	14.99	965.0	17.7	8.2	8.014	1.2	0.00	0.00	0.0	WIND-8AM ALL DAY
14	17.51	960.0	20.8	20.8	5.153	4.6	0.00	0.00	0.0	WIND-8:00 REST OF DAY
15	0.00	0.0	0.0	-1.0	3.214	-0.4	0.00	0.00	0.0	WIND ALL DAY
16	0.00	0.0	0.0	87.4	8.099	12.3	0.00	0.00	0.0	WIND-6HR
17	21.47	990.0	24.7	199.0	9.339	24.3	0.00	0.00	0.0	N.P.
18	0.00	968.0	0.0	-9.0	8.399	-1.2	0.00	0.00	0.0	WIND-ALL DAY
19	0.00	0.0	0.0	-10.0	9.158	-1.2	0.00	0.00	0.0	WINDS
20	21.61	1012.0	24.4	141.4	7.259	22.2	0.00	0.00	0.0	N.P.
21	0.00	927.0	0.0	-8.0	3.271	-2.8	0.00	0.00	0.0	DET-2HR,OPERATOR NOT AVAILABLE
22	17.95	989.0	20.7	28.2	8.532	3.8	0.00	0.00	0.0	WINDS-UNTIL 1350
23	10.72	962.0	12.7	-4.6	6.214	-0.8	0.00	0.00	0.0	WIND-9:00 REST OF DAY
24	0.00	927.0	0.0	29.8	2.293	14.8	0.00	0.00	0.0	CLOUDS
25	20.76	992.0	23.9	187.8	8.603	24.9	0.00	0.00	0.0	N.P.
26	21.00	980.0	24.4	196.6	9.045	24.8	0.00	0.00	0.0	N.P.
27	20.59	970.0	24.2	122.0	8.857	15.7	0.00	0.00	0.0	DET-6HR,THERMOCOUCLE FAILED
28	22.01	1028.0	24.4	194.2	9.199	24.1	0.00	0.00	0.0	N.P., WARNING PRESS PROB. COMP
29	22.47	1017.0	25.2	216.4	10.059	24.5	0.00	0.00	0.0	N.P.
30	22.30	0.0	0.0	203.2	9.401	24.6	0.00	0.00	0.0	N.P.
31	21.19	0.0	0.0	117.6	8.692	15.4	0.00	0.00	0.0	PCU THERMOCOUPLE BRIDGED CHANG

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 22.47 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 28.6 %
MAXIMUM DAILY ENERGY.................. 216.40 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 27.0 %
TOTAL POWER PRODUCED FOR MONTH........ 27.9 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 197.0 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 14.2 %

DATA FOR MONTH 4 AND YEAR 1987

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	22.19	1007.0	25.1	211.0	9.792	24.6	0.00	0.00	0.0	N.WIND-ALL DAY
2	20.46	966.0	24.2	179.8	7.962	25.8	0.00	0.00	0.0	N.P.
3	0.00	850.0	0.0	75.8	5.027	17.2	0.00	0.00	0.0	WIND-ALL DAY?
4	15.94	916.0	19.8	122.8	5.409	25.9	0.00	0.00	0.0	DET-1HR
5	19.16	929.0	23.5	137.2	7.383	21.2	0.00	0.00	0.0	N.P.
6	19.44	934.0	23.7	128.4	6.233	23.5	0.00	0.00	0.0	N.P.
7	18.79	944.0	22.7	146.4	7.538	22.1	0.00	0.00	0.0	N.P.
8	19.67	968.0	23.2	151.6	7.817	22.1	0.00	0.00	0.0	N.P.
9	19.77	964.0	23.4	182.4	9.042	23.0	0.00	0.00	0.0	N.P.
10	17.95	934.0	21.9	165.4	8.326	22.7	0.00	0.00	0.0	N.P.
11	0.00	832.0	0.0	-2.0	3.171	-0.7	0.00	0.00	0.0	WIND ALL DAY
12	17.62	929.0	21.6	148.8	9.611	17.7	0.00	0.00	0.0	N.P.
13	18.79	967.0	22.2	110.4	9.501	13.3	0.00	0.00	0.0	WASH- ALL DAY?
14	21.21	929.0	26.0	117.8	6.618	20.3	0.00	0.00	0.0	WASH-ALL DAY?
15	20.07	888.0	25.8	143.6	6.932	23.6	0.00	0.00	0.0	
16	19.15	895.0	24.4	109.4	5.794	21.5	0.00	0.00	0.0	N.P.
17	19.16	915.0	23.9	56.8	8.230	7.9	0.00	0.00	0.0	N.P.
18	17.65	872.0	23.1	11.8	7.103	1.9	0.00	0.00	0.0	WIND-5HR
19	20.88	992.0	24.0	194.8	9.233	24.1	0.00	0.00	0.0	N.P.
20	20.96	985.0	24.3	213.0	9.926	24.5	0.00	0.00	0.0	N.P.
21	20.10	988.0	23.2	206.6	9.872	23.9	0.00	0.00	0.0	N.P.
22	20.07	958.0	23.9	197.8	9.589	23.5	0.00	0.00	0.0	N.P.
23	17.65	911.0	22.1	109.2	6.802	18.3	0.00	0.00	0.0	N.P.
24	17.02	810.0	24.0	41.6	3.810	12.5	0.00	0.00	0.0	N.P.
25	18.28	917.0	22.7	133.6	7.069	21.6	0.00	0.00	0.0	N.P.
26	17.53	911.0	21.9	52.6	5.991	10.0	0.00	0.00	0.0	N.P.
27	17.75	903.0	22.4	164.2	6.469	28.9	0.00	0.00	0.0	WIND-3HR
28	15.78	852.0	21.1	57.8	3.736	17.6	0.00	0.00	0.0	WIND-3HR, WARNING LOW GAS REF
29	15.69	843.0	21.2	32.8	2.722	13.7	0.00	0.00	0.0	WIND-2HR
30	14.97	931.0	18.3	25.4	8.559	3.4	0.00	0.00	0.0	WIND-8HR

TOTAL TRACK TIME FOR MONTH............. 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 22.19 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 26.0 %
MAXIMUM DAILY ENERGY.................. 213.00 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 28.9 %
TOTAL POWER PRODUCED FOR MONTH........ 41.4 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 215.3 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 19.2 %

DATA FOR MONTH 5 AND YEAR 1987

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	942.0	0.0	-4.0	7.099	-0.6	0.00	0.00	0.0	WIND-ALL DAY
2	15.76	932.0	19.3	109.4	7.443	16.8	0.00	0.00	0.0	N.P.
3	17.12	967.0	20.2	175.2	9.497	21.0	0.00	0.00	0.0	N.P.
4	16.47	935.0	20.1	161.8	9.413	19.6	0.00	0.00	0.0	N.P.
5	0.00	936.0	0.0	158.0	8.780	20.5	0.00	0.00	0.0	WASH-3HR
6	0.00	936.0	0.0	-3.0	8.249	-0.4	0.00	0.00	0.0	DISH COM/CONTROL PROB
7	0.00	884.0	0.0	-4.0	2.469	-1.8	0.00	0.00	0.0	DISH COM/CONTROL PROB
8	0.00	902.0	0.0	-5.0	4.437	-1.3	0.00	0.00	0.0	LIGHTNING ST/WIND SENSOR PROB
9	0.00	913.0	0.0	-6.0	7.965	-0.9	0.00	0.00	0.0	DISH TROUBLESHOOTING
10	0.00	907.0	0.0	-5.0	7.905	-0.7	0.00	0.00	0.0	"
11	0.00	898.0	0.0	-5.0	7.198	-0.8	0.00	0.00	0.0	"
12	0.00	865.0	0.0	-6.0	4.941	-1.4	0.00	0.00	0.0	"
13	0.00	905.0	0.0	-2.0	8.081	-0.3	0.00	0.00	0.0	"
14	0.00	890.0	0.0	-5.0	6.984	-0.8	0.00	0.00	0.0	"
15	0.00	0.0	0.0	-5.0	0.000	0.0	0.00	0.00	0.0	"
16	0.00	894.0	0.0	1.0	5.158	0.2	0.00	0.00	0.0	"
17	0.00	878.0	0.0	-10.0	8.336	-1.4	0.00	0.00	0.0	"
18	0.00	924.0	0.0	-6.0	9.367	-0.7	0.00	0.00	0.0	"
19	0.00	862.0	0.0	-4.0	5.821	-0.8	0.00	0.00	0.0	"
20	0.00	888.0	0.0	-6.0	8.142	-0.8	0.00	0.00	0.0	"
21	0.00	909.0	0.0	-3.0	9.095	-0.4	0.00	0.00	0.0	"
22	0.00	924.0	0.0	-7.0	8.838	-0.9	0.00	0.00	0.0	"
23	0.00	887.0	0.0	-4.0	8.592	-0.5	0.00	0.00	0.0	"
24	0.00	838.0	0.0	-5.0	7.292	-0.8	0.00	0.00	0.0	"
25	0.00	885.0	0.0	-4.0	5.855	-0.8	0.00	0.00	0.0	"
26	0.00	822.0	0.0	-6.0	5.466	-1.3	0.00	0.00	0.0	"
27	0.00	870.0	0.0	-5.0	8.288	-0.7	0.00	0.00	0.0	"
28	0.00	872.0	0.0	-2.0	7.387	-0.3	0.00	0.00	0.0	"
29	0.00	861.0	0.0	-7.0	5.905	-1.4	0.00	0.00	0.0	"
30	0.00	914.0	0.0	-3.0	8.407	-0.4	0.00	0.00	0.0	"
31	0.00	931.0	0.0	-6.0	8.721	-0.8	0.00	0.00	0.0	"

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 17.12 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 20.2 %
MAXIMUM DAILY ENERGY.................. 175.20 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 21.0 %
TOTAL POWER PRODUCED FOR MONTH........ 5.5 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 221.1 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 2.5 %

DATA FOR MONTH 6 AND YEAR 1987

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	906.0	0.0	-4.0	8.870	-0.5	0.00	0.00	0.0	ND-ALL DAY
2	0.00	925.0	0.0	-6.0	9.071	-0.8	0.00	0.00	0.0	REP. PCU CARD, LIGHTNING PROB
3	0.00	890.0	0.0	-4.0	8.690	-0.5	0.00	0.00	0.0	"
4	0.00	845.0	0.0	-5.0	6.138	-0.9	0.00	0.00	0.0	"
5	0.00	830.0	0.0	-4.0	4.111	-1.1	0.00	0.00	0.0	"
6	0.00	760.0	0.0	-3.0	2.822	-1.2	0.00	0.00	0.0	LIGHTNING STOW
7	0.00	901.0	0.0	-1.0	8.629	-0.1	0.00	0.00	0.0	"
8	0.00	900.0	0.0	-2.0	8.453	-0.3	0.00	0.00	0.0	"
9	0.00	904.0	0.0	-5.0	8.827	-0.6	0.00	0.00	0.0	"
10	0.00	891.0	0.0	-5.0	9.192	-0.6	0.00	0.00	0.0	"
11	0.00	902.0	0.0	-4.0	9.033	-0.5	0.00	0.00	0.0	"
12	0.00	859.0	0.0	-6.0	7.778	-0.9	0.00	0.00	0.0	PCU PROB, SENSORS
13	0.00	880.0	0.0	-4.0	9.043	-0.5	0.00	0.00	0.0	"
14	0.00	930.0	0.0	-6.0	9.076	-0.8	0.00	0.00	0.0	"
15	0.00	973.0	0.0	-4.0	11.114	-0.4	0.00	0.00	0.0	WAITING PCU PARTS
16	0.00	961.0	0.0	-6.0	9.985	-0.7	0.00	0.00	0.0	"
17	0.00	968.0	0.0	-4.0	10.444	-0.4	0.00	0.00	0.0	"
18	0.00	975.0	0.0	-7.0	9.981	-0.8	0.00	0.00	0.0	"
19	0.00	925.0	0.0	-3.0	7.811	-0.4	0.00	0.00	0.0	"
20	0.00	921.0	0.0	-7.0	9.477	-0.8	0.00	0.00	0.0	"
21	0.00	950.0	0.0	-3.0	10.109	-0.3	0.00	0.00	0.0	"
22	0.00	909.0	0.0	-7.0	9.423	-0.8	0.00	0.00	0.0	"
23	0.00	909.0	0.0	-4.0	8.882	-0.5	0.00	0.00	0.0	"
24	0.00	897.0	0.0	-5.0	9.260	-0.6	0.00	0.00	0.0	"
25	0.00	936.0	0.0	-5.0	9.734	-0.6	0.00	0.00	0.0	"
26	0.00	863.0	0.0	-5.0	8.108	-0.7	0.00	0.00	0.0	"
27	0.00	875.0	0.0	-5.0	8.307	-0.7	0.00	0.00	0.0	"
28	0.00	868.0	0.0	-6.0	8.308	-0.8	0.00	0.00	0.0	"
29	0.00	885.0	0.0	-5.0	8.578	-0.7	0.00	0.00	0.0	"
30	0.00	938.0	0.0	-6.0	9.580	-0.7	0.00	0.00	0.0	"

TOTAL TRACK TIME FOR MONTH............. 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 0.00 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 0.0 %
MAXIMUM DAILY ENERGY.................. 0.00 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 0.0 %
TOTAL POWER PRODUCED FOR MONTH........ -1.6 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 258.8 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... -0.6 %

DATA FOR MONTH 7 AND YEAR 1987

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	934.0	0.0	-3.0	9.654	-0.4	0.00	0.00	0.0	PCU PROB, WAITING PARTS, SC WI
2	0.00	980.0	0.0	-6.0	10.712	-0.6	0.00	0.00	0.0	"
3	0.00	989.0	0.0	-4.0	10.626	-0.4	0.00	0.00	0.0	"
4	0.00	970.0	0.0	-7.0	9.215	-0.9	0.00	0.00	0.0	"
5	0.00	958.0	0.0	-3.0	10.217	-0.3	0.00	0.00	0.0	"
6	0.00	952.0	0.0	-7.0	9.964	-0.8	0.00	0.00	0.0	"
7	0.00	940.0	0.0	-3.0	9.141	-0.4	0.00	0.00	0.0	"
8	0.00	877.0	0.0	-6.0	9.306	-0.7	0.00	0.00	0.0	"
9	0.00	840.0	0.0	-6.0	7.335	-0.9	0.00	0.00	0.0	"
10	0.00	853.0	0.0	-4.0	8.973	-0.5	0.00	0.00	0.0	"
11	0.00	935.0	0.0	-5.0	10.167	-0.6	0.00	0.00	0.0	"
12	0.00	974.0	0.0	-5.0	10.360	-0.6	0.00	0.00	0.0	"
13	0.00	928.0	0.0	-5.0	9.737	-0.6	0.00	0.00	0.0	"
14	0.00	925.0	0.0	-6.0	9.265	-0.7	0.00	0.00	0.0	"
15	0.00	416.0	0.0	-2.0	0.488	-4.7	0.00	0.00	0.0	"
16	0.00	710.0	0.0	0.0	3.014	0.0	0.00	0.00	0.0	"
17	0.00	976.0	0.0	0.0	9.915	0.0	0.00	0.00	0.0	"
18	0.00	982.0	0.0	0.0	9.144	0.0	0.00	0.00	0.0	"
19	0.00	942.0	0.0	0.0	9.183	0.0	0.00	0.00	0.0	"
20	0.00	0.0	0.0	0.0	1.002	0.0	0.00	0.00	0.0	"
21	0.00	939.0	0.0	0.0	9.821	0.0	0.00	0.00	0.0	"
22	0.00	976.0	0.0	0.0	10.584	0.0	0.00	0.00	0.0	"
23	0.00	976.0	0.0	0.0	10.465	0.0	0.00	0.00	0.0	"
24	0.00	958.0	0.0	0.0	8.767	0.0	0.00	0.00	0.0	"
25	0.00	988.0	0.0	0.0	10.537	0.0	0.00	0.00	0.0	"
26	0.00	893.0	0.0	0.0	8.511	0.0	0.00	0.00	0.0	"
27	0.00	803.0	0.0	0.0	3.557	0.0	0.00	0.00	0.0	"
28	0.00	794.0	0.0	0.0	4.623	0.0	0.00	0.00	0.0	"
29	0.00	895.0	0.0	0.0	9.249	0.0	0.00	0.00	0.0	"
30	0.00	934.0	0.0	0.0	9.952	0.0	0.00	0.00	0.0	"
31	0.00	935.0	0.0	0.0	9.830	0.0	0.00	0.00	0.0	"

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 0.00 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 0.0 %
MAXIMUM DAILY ENERGY.................. 0.00 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 0.0 %
TOTAL POWER PRODUCED FOR MONTH........ -0.8 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 263.3 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... -0.3 %

DATA FOR MONTH 8 AND YEAR 1987

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	930.0	0.0	0.0	8.913	0.0	0.00	0.00	0.0	PCU PROB, WAITING PARTS
2	0.00	846.0	0.0	0.0	7.767	0.0	0.00	0.00	0.0	"
3	0.00	870.0	0.0	0.0	8.149	0.0	0.00	0.00	0.0	"
4	0.00	880.0	0.0	0.0	8.223	0.0	0.00	0.00	0.0	"
5	0.00	750.0	0.0	-35.0	5.824	-6.9	0.00	0.00	0.0	"
6	0.00	792.0	0.0	0.0	7.365	0.0	0.00	0.00	0.0	"
7	0.00	875.0	0.0	-2.0	8.993	-0.3	0.00	0.00	0.0	"
8	14.90	920.0	18.5	80.2	8.518	10.7	0.00	0.00	0.0	KS MAINTENANCE,RPM ADJUSTMENT
9	22.56	954.0	27.0	161.6	9.704	19.0	0.00	0.00	0.0	KS MAINTENANCE
10	20.41	915.0	25.4	169.6	8.543	22.6	0.00	0.00	0.0	NO PROBLEM
11	0.00	914.0	0.0	-2.0	9.374	-0.2	0.00	0.00	0.0	DISH CONTROL PROB.?????
12	20.17	932.0	24.7	112.2	9.707	13.2	0.00	0.00	0.0	GAS LEAK-4HR
13	0.00	975.0	0.0	-4.0	9.863	-0.5	0.00	0.00	0.0	WINDS & PROBLEMS???????
14	0.00	952.0	0.0	12.0	9.537	1.4	1.27	0.00	30.0	WIND
15	21.00	930.0	25.8	218.2	9.683	25.7	12.67	0.00	19.0	NO PROBLEM
16	21.13	935.0	25.8	216.6	9.341	26.4	12.64	0.00	17.0	NO PROBLEM
17	20.69	931.0	25.3	138.4	9.522	16.6	8.09	0.00	14.0	CONE INSOLATION REPLACED-3HR
18	19.87	936.0	24.2	193.0	8.707	25.3	12.57	0.00	11.0	NO PROBLEM
19	20.17	928.0	24.8	181.6	8.869	23.4	12.55	0.00	17.0	NO PROBLEM
20	20.73	884.0	26.7	110.4	6.026	20.9	9.31	0.00	26.0	WASH-3HR
21	20.73	928.0	25.5	48.0	8.689	6.3	0.00	0.00	0.0	KS MAINTENANCE
22	21.65	925.0	26.7	212.2	8.237	29.4	0.00	0.00	0.0	KS MAINTENANCE
23	23.28	948.0	28.0	216.6	7.814	31.6	0.00	0.00	0.0	KS MAINTENANCE
24	23.63	953.0	28.3	224.6	9.816	26.1	0.00	0.00	0.0	PLANT FUSE/BREAKER REPAIR
25	23.65	954.0	28.3	221.0	9.582	26.3	0.00	0.00	0.0	NO PROBLEM
26	23.65	917.0	29.4	202.2	8.894	25.9	0.00	0.00	0.0	NO PROBLEM
27	20.86	919.0	25.9	185.0	8.615	24.5	0.00	0.00	0.0	NO PROBLEM
28	20.36	907.0	25.6	190.6	8.506	25.6	0.00	0.00	0.0	NO PROBLEM
29	19.90	905.0	25.1	189.4	7.434	29.1	0.00	0.00	0.0	NO PROBLEM
30	19.35	904.0	24.4	133.6	7.488	20.3	0.00	0.00	0.0	NO PROBLEM
31	18.38	904.0	23.2	82.6	4.724	19.9	0.00	0.00	0.0	WINDS & LIGHTNING

TOTAL TRACK TIME FOR MONTH............ 69.10 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 23.65 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 29.4 %
MAXIMUM DAILY ENERGY.................. 224.60 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 31.6 %
TOTAL POWER PRODUCED FOR MONTH........ 39.4 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 262.4 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 15.0 %

DATA FOR MONTH 9 AND YEAR 1987

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	6.49	480.0	15.4	-2.6	0.194	-15.3	0.00	0.00	0.0	LIFHTNING,WATER SENSOR,ETC
2	0.00	883.0	0.0	-5.0	5.537	-1.0	0.00	0.00	0.0	H2 LEAKING INTO COOLING SYSTEM
3	0.00	753.0	0.0	0.0	4.991	0.0	0.00	0.00	0.0	WAITING FOR SPARE PARTS/REPAIR
4	0.00	878.0	0.0	-4.0	7.002	-0.7	0.00	0.00	0.0	"
5	0.00	903.0	0.0	0.0	8.097	0.0	0.00	0.00	0.0	"
6	0.00	926.0	0.0	0.0	6.677	0.0	0.00	0.00	0.0	"
7	0.00	830.0	0.0	0.0	7.740	0.0	0.00	0.00	0.0	"
8	0.00	930.0	0.0	0.0	8.574	0.0	0.00	0.00	0.0	"
9	0.00	963.0	0.0	0.0	5.801	0.0	0.00	10.72	0.0	"
10	0.00	600.0	0.0	0.0	2.900	0.0	0.00	9.38	0.0	"
11	0.00	916.0	0.0	0.0	8.197	0.0	0.00	0.00	0.0	"
12	0.00	510.0	0.0	0.0	4.236	0.0	0.00	0.00	0.0	"
13	0.00	760.0	0.0	0.0	6.268	0.0	0.00	0.00	0.0	"
14	0.00	796.0	0.0	0.0	6.975	0.0	0.00	12.33	0.0	"
15	0.00	883.0	0.0	0.0	7.123	0.0	0.00	12.56	0.0	"
16	0.00	911.0	0.0	0.0	7.235	0.0	0.00	12.52	0.0	"
17	5.34	858.0	7.1	-0.2	7.629	0.0	0.00	8.47	0.0	REPAIRED SYSTEM, ADDED H2
18	10.49	840.0	14.2	14.6	7.085	2.3	3.24	12.15	16.0	DET-6HR, LOW WATER LEVEL
19	14.55	865.0	19.2	112.2	7.450	17.2	11.48	11.52	13.0	NO PROBLEM
20	14.77	850.0	19.8	120.2	7.882	17.4	11.45	8.86	13.0	NO PROBLEM
21	15.76	925.0	19.4	103.0	7.095	16.6	11.41	8.86	15.0	NO PROBLEM
22	0.00	720.0	0.0	-5.0	3.405	-1.7	0.52	5.30	21.0	DET, WATER SENSOR PROBLEM
23	0.00	821.0	0.0	0.0	6.322	0.0	0.00	7.70	33.0	
24	0.00	932.0	0.0	0.0	8.762	0.0	0.00	11.04	13.0	
25	0.00	845.0	0.0	0.0	7.402	0.0	0.00	10.22	15.0	
26	0.00	880.0	0.0	-5.4	7.502	-0.8	0.00	10.48	12.0	
27	0.00	896.0	0.0	5.4	7.633	0.8	0.00	10.37	11.0	
28	0.00	910.0	0.0	-14.3	7.740	-2.1	0.00	10.52	13.0	
29	0.00	892.0	0.0	-11.6	7.519	-1.8	0.00	10.44	12.0	
30	0.00	772.0	0.0	-12.0	8.089	-1.7	0.00	10.67	14.0	

TOTAL TRACK TIME FOR MONTH.............	38.10	HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M....	194.11	HOURS
TRACK TIME / TIME NIP > 300............	0.1963	
MAXIMUM DAILY POWER....................	15.76	KW
MAX. DAILY POWER EFFIC. FOR MONTH......	19.8	%
MAXIMUM DAILY ENERGY...................	120.20	KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH	17.4	%
TOTAL POWER PRODUCED FOR MONTH.........	3.4	KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH.........	199.1	KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH.......	1.7	%

DATA FOR MONTH 10 AND YEAR 1987

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	930.0	0.0	23.6	7.499	3.6	0.00	10.55	13.0	FHTNING,WATER SENSOR,ETC
2	0.00	920.0	0.0	-1.2	7.952	-0.2	0.00	10.60	12.0	WAITING FOR PARTS
3	0.00	930.0	0.0	-8.0	7.598	-1.2	0.00	10.53	14.0	WAITING FOR PARTS
4	0.00	942.0	0.0	-5.0	8.238	-0.7	-1.00	-1.00	-1.0	WAITING FOR PARTS
5	18.14	963.0	21.5	19.1	9.667	2.3	2.02	10.76	13.0	REPLACED WATER LEVEL SENSOR.
6	22.66	980.0	26.4	119.8	6.329	21.6	10.85	8.51	15.0	NO PROBLEM
7	21.77	942.0	26.4	150.7	7.261	23.7	10.33	9.35	20.0	NO PROBLEM
8	21.98	933.0	26.9	177.8	8.126	25.0	10.78	10.44	14.0	NO PROBLEM
9	0.00	867.0	0.0	124.2	6.399	22.1	10.74	9.11	14.0	NO PROBLEM
10	18.96	849.0	25.5	146.1	6.963	23.9	10.70	9.89	18.0	NO PROBLEM
11	0.00	658.0	0.0	-8.8	1.131	-8.9	0.80	1.44	22.0	NO PROBLEM
12	0.00	0.0	0.0	-1.0	0.440	-2.6	-1.00	-1.00	-1.0	NO PROBLEM
13	20.05	893.0	25.6	141.0	6.977	23.0	9.44	9.41	16.0	NO PROBLEM
14	20.72	885.0	26.7	150.1	7.071	24.2	10.56	10.03	13.0	NO PROBLEM
15	21.77	922.0	26.9	162.9	7.467	24.9	10.53	10.07	14.0	NO PROBLEM
16	21.35	920.0	26.5	161.3	7.577	24.3	10.49	10.17	15.0	NO PROBLEM
17	0.00	930.0	0.0	167.8	7.462	25.6	10.45	10.26	11.0	NO PROBLEM
18	0.00	942.0	0.0	168.0	7.717	24.8	10.42	10.11	12.0	NO PROBLEM
19	21.47	934.0	26.2	161.0	7.745	23.7	10.38	9.98	12.0	NO PROBLEM
20	21.47	924.0	26.5	106.1	5.803	20.9	10.34	8.12	15.0	NO PROBLEM
21	0.00	699.0	0.0	0.0	2.099	0.0	0.00	2.81	12.0	WASH-2HR, 7HR OPER. NOT AVAIL.
22	0.00	492.0	0.0	0.0	1.439	0.0	-1.00	-1.00	-1.0	LIGHTNING-7HR
23	20.80	729.0	32.5	69.8	3.782	21.0	9.52	5.62	14.0	LIGHTNING ST-2HR
24	0.00	216.0	0.0	1.4	0.048	33.3	0.00	0.00	0.0	K.S. MAINTENANCE
25	13.14	883.0	17.0	10.4	1.941	6.1	0.00	0.00	0.0	K.S. MAINTENANCE
26	21.87	942.0	26.5	135.2	6.151	25.1	0.00	0.00	0.0	NO PROBLEM
27	0.00	934.0	0.0	-10.0	2.021	-5.6	0.00	0.00	0.0	FACEUP FOR RAIN WASH
28	19.29	920.0	23.9	68.8	3.516	22.3	0.00	0.00	0.0	DET-1HR,WRONG START PRESS.
29	0.00	878.0	0.0	37.0	3.139	13.4	0.00	0.00	0.0	NO PROBLEM
30	21.15	979.0	24.6	88.4	4.930	20.4	0.00	0.00	0.0	NO PROBLEM
31	0.00	0.0	0.0	-6.0	0.000	0.0	0.00	0.00	0.0	DET,LOW PRES./LOSS GRID

TOTAL TRACK TIME FOR MONTH............ 145.35 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 174.76 HOURS
TRACK TIME / TIME NIP > 300........... 0.8317
MAXIMUM DAILY POWER................... 22.66 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 32.5 %
MAXIMUM DAILY ENERGY.................. 177.80 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 33.3 %
TOTAL POWER PRODUCED FOR MONTH........ 26.9 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 164.5 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 16.3 %

DATA FOR MONTH 11 AND YEAR 1987

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	382.0	0.0	-4.0	1.740	-2.6	0.00	0.00	0.0	COLLANT SENSOR PROBLEM
2	0.00	850.0	0.0	-3.0	3.395	-1.0	0.00	0.00	0.0	WIND-4HR/LOW H2-6HR
3	20.26	906.0	25.5	65.0	6.375	11.6	0.00	0.00	0.0	DET.-5HR,LOW H2
4	15.06	830.0	20.7	21.0	1.669	14.3	0.00	0.00	0.0	LIGHTNING STOW-2HR
5	0.00	510.0	0.0	0.0	3.147	0.0	0.00	0.00	0.0	LIGHTNING STOW
6	0.00	940.0	0.0	131.0	6.480	23.1	0.00	0.00	0.0	NO PROBLEM
7	0.00	893.0	0.0	6.2	6.704	1.1	0.00	0.00	0.0	FAST SLEW BELT BROKE
8	0.00	920.0	0.0	-11.0	7.239	-1.7	0.00	0.00	0.0	WAITING FOR F.S. PARTS
9	0.00	943.0	0.0	-11.0	6.488	-1.9	0.00	0.00	0.0	WAITING FOR F.S. PARTS
10	0.00	885.0	0.0	-4.0	6.239	-0.7	0.00	0.00	0.0	WAITING FOR F.S. PARTS
11	0.00	965.0	0.0	0.0	7.623	0.0	0.00	0.00	0.0	WAITING FOR F.S. PARTS
12	0.00	970.0	0.0	0.0	7.029	0.0	0.00	0.00	0.0	FOUND BAD F.S. MOTOR
13	0.00	157.0	0.0	0.0	1.406	0.0	0.00	0.00	0.0	CHANGED OUT MOTOR
14	0.00	941.0	0.0	0.0	6.223	0.0	0.00	0.00	0.0	WINDS
15	22.47	910.0	28.2	166.8	5.194	36.6	0.00	0.00	0.0	NO PROBLEM
16	0.00	820.0	0.0	86.9	5.113	19.4	0.00	0.00	0.0	NO PROBLEM
17	8.91	354.0	28.7	0.1	0.492	0.2	0.00	0.00	0.0	REPLACED H2 BOTTLE-2HR,NO OPER
18	21.67	970.0	25.5	165.3	7.748	24.3	0.00	0.00	0.0	NO PROBLEM
19	22.50	1007.0	25.5	154.1	8.003	22.0	0.00	0.00	0.0	NO PROBLEM
20	21.29	880.0	27.6	112.4	6.080	21.1	0.00	0.00	0.0	NO PROBLEM
21	22.04	972.0	25.9	158.7	7.550	24.0	0.00	0.00	0.0	NO PROBLEM
22	20.89	952.0	25.0	134.2	6.743	22.7	0.00	0.00	0.0	NO PROBLEM
23	20.63	944.0	24.9	142.2	7.152	22.7	0.00	0.00	0.0	NO PROBLEM
24	21.48	972.0	25.2	149.9	7.097	24.1	0.00	0.00	0.0	NO PROBLEM
25	21.31	954.0	25.5	129.1	6.772	21.7	0.00	0.00	0.0	NO PROBLEM
26	22.16	992.0	25.5	159.3	7.645	23.8	0.00	0.00	0.0	NO PROBLEM
27	21.87	979.0	25.5	149.0	7.560	22.5	0.00	0.00	0.0	NO PROBLEM
28	17.12	945.0	20.7	30.7	6.602	5.3	0.00	0.00	0.0	DET-7HR, DELAYED STARTUP
29	20.20	935.0	24.6	130.5	6.603	22.5	0.00	0.00	0.0	NO PROBLEM
30	0.00	540.0	0.0	-6.9	1.683	-4.7	0.00	0.00	0.0	DET, WRONG START PRESS.

TOTAL TRACK TIME FOR MONTH............. 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 0.00 HOURS
TRACK TIME / TIME NIP > 300........... 0.8317
MAXIMUM DAILY POWER.................. 22.50 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 28.7 %
MAXIMUM DAILY ENERGY.................. 166.80 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 36.6 %
TOTAL POWER PRODUCED FOR MONTH........ 23.4 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 169.8 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 13.8 %

DATA FOR MONTH 12 AND YEAR 1987

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	17.66	832.0	24.2	51.7	3.521	16.7	0.00	0.00	0.0	LLANT SENSOR PROBLEM
2	19.22	907.0	24.2	117.9	6.345	21.2	0.00	0.00	0.0	WASH-1.5HR
3	22.26	918.0	27.7	117.8	5.721	23.5	0.00	0.00	0.0	NO PROBLEM
4	0.00	860.0	0.0	91.3	4.207	24.7	0.00	0.00	0.0	NO PROBLEM
5	0.00	460.0	0.0	-7.2	1.480	-5.5	0.00	0.00	0.0	NO PROBLEM
6	0.00	794.0	0.0	88.2	5.650	17.8	0.00	0.00	0.0	DET,WR.START PRESS(2),KEYFAULT
7	0.00	950.0	0.0	-0.2	6.692	0.0	0.00	0.00	0.0	DEC-1HR,MAIN.SERV.,NO OPER-3HR
8	0.00	927.0	0.0	70.8	4.847	16.7	0.00	0.00	0.0	DET,WRONG START PRESSURE
9	0.00	678.0	0.0	30.8	3.014	11.7	0.00	0.00	0.0	DET,NOT RUN BUT OIL PRESS.
10	21.96	931.0	26.9	150.8	6.805	25.3	0.00	0.00	0.0	DET,NOT RUN BUT OIL PRES,KEYF.
11	18.00	921.0	22.3	-4.9	5.785	-1.0	0.00	0.00	0.0	KEYFAULT
12	0.00	960.0	0.0	90.4	6.548	15.7	0.00	0.00	0.0	KEYFAULT
13	0.00	875.0	0.0	-8.6	5.669	-1.7	0.00	0.00	0.0	KEYFAULT
14	0.00	810.0	0.0	-10.6	3.485	-3.5	0.00	0.00	0.0	KEYFAULT
15	0.00	175.0	0.0	-7.3	0.156	-53.4	0.00	0.00	0.0	KEYFAULT
16	0.00	816.0	0.0	2.2	0.735	3.4	0.00	0.00	0.0	WINDS,KEYFAULT
17	0.00	0.0	0.0	-8.0	0.000	0.0	0.00	0.00	0.0	KEYFAULT
18	0.00	920.0	0.0	-14.2	6.362	-2.5	0.00	0.00	0.0	KEYFAULT
19	0.00	0.0	0.0	-8.0	0.000	0.0	0.00	0.00	0.0	K.S.MAINTENANCE
20	10.98	872.0	14.4	7.1	6.946	1.2	0.00	1.68	9.0	K.S.MAIN, BEARING PROB.
21	0.00	934.0	0.0	-11.6	6.136	-2.2	0.00	8.74	11.0	BEARING/ROD PROB.
22	0.00	961.0	0.0	6.6	6.442	1.2	0.00	8.56	35.0	BEARING/ROD PROB.
23	0.00	1004.0	0.0	-4.6	5.991	-0.9	0.00	7.67	15.0	BEARING/ROD PROB.
24	0.00	976.0	0.0	-4.4	4.159	-1.2	0.00	5.56	21.0	BEARING/ROD PROB.
25	0.00	971.0	0.0	4.2	6.755	0.7	0.00	8.74	26.0	BEARING/ROD PROB.
26	0.00	993.0	0.0	-2.0	7.104	-0.3	0.00	8.85	13.0	BEARING/ROD PROB.
27	0.00	983.0	0.0	-7.7	4.531	-1.9	0.00	6.07	11.0	BEARING/ROD PROB.
28	0.00	964.0	0.0	-3.6	2.829	-1.5	0.00	4.11	8.0	BEARING/ROD PROB.
29	0.00	922.0	0.0	4.1	4.531	1.0	0.00	5.26	33.0	BEARING/ROD PROB.
30	0.00	976.0	0.0	-4.1	4.300	-1.1	0.00	6.22	24.0	BEARING/ROD PROB.
31	0.00	995.0	0.0	-2.4	5.237	-0.5	0.00	7.22	11.0	BEARING/ROD PROB.

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 78.68 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 22.26 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 27.7 %
MAXIMUM DAILY ENERGY.................. 150.80 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 25.3 %
TOTAL POWER PRODUCED FOR MONTH........ 8.4 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 142.0 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 5.9 %

DATA FOR MONTH 1 AND YEAR 1988

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	992.0	0.0	-1.0	4.766	-0.2	0.00	6.67	11.0	BEARING/ROD PROBLEM
2	0.00	911.0	0.0	0.6	1.627	0.4	0.00	2.56	11.0	"
3	0.00	348.0	0.0	-3.0	0.055	-62.2	0.00	0.04	10.0	"
4	0.00	873.0	0.0	-2.6	1.326	-2.2	0.00	2.22	12.0	"
5	0.00	91.0	0.0	0.0	0.000	0.0	0.00	0.00	9.0	"
6	0.00	964.0	0.0	-1.0	6.800	-0.2	0.00	8.89	12.0	"
7	0.00	964.0	0.0	-1.1	5.627	-0.2	0.00	7.74	12.0	"
8	0.00	938.0	0.0	-1.7	4.442	-0.4	0.00	6.66	14.0	"
9	0.00	940.0	0.0	1.8	6.673	0.3	0.00	8.81	13.0	"
10	0.00	883.0	0.0	0.0	4.361	0.0	0.00	7.63	0.0	"
11	0.00	957.0	0.0	0.0	6.565	0.0	0.00	0.00	0.0	"
12	0.00	954.0	0.0	-9.0	5.581	-1.8	0.00	0.00	0.0	"
13	0.00	972.0	0.0	0.0	6.431	0.0	0.00	0.00	0.0	"
14	0.00	967.0	0.0	-2.0	6.390	-0.4	0.00	0.00	0.0	"
15	0.00	360.0	0.0	-1.8	0.755	-2.7	0.00	0.00	0.0	"
16	0.00	954.0	0.0	-6.9	5.824	-1.4	0.00	0.00	0.0	"
17	0.00	33.0	0.0	0.0	0.103	0.0	0.00	0.00	0.0	"
18	0.00	974.0	0.0	-11.9	6.928	-2.0	0.00	0.00	0.0	"
19	0.00	1015.0	0.0	-12.3	7.610	-1.8	0.00	0.00	0.0	"
20	0.00	1001.0	0.0	23.9	7.407	3.7	0.00	0.00	0.0	"
21	0.00	977.0	0.0	-11.0	6.459	-1.9	0.00	0.00	0.0	"
22	0.00	990.0	0.0	-12.5	7.711	-1.8	0.00	0.00	0.0	"
23	0.00	977.0	0.0	-10.5	4.163	-2.9	0.00	0.00	0.0	"
24	0.00	984.0	0.0	-12.5	6.282	-2.3	0.00	0.00	0.0	"
25	0.00	975.0	0.0	-10.2	5.930	-2.0	0.00	0.00	0.0	"
26	0.00	942.0	0.0	-9.2	5.139	-2.0	0.00	0.00	0.0	"
27	0.00	840.0	0.0	0.0	1.176	0.0	0.00	0.00	0.0	"
28	0.00	896.0	0.0	47.1	3.884	13.8	0.00	0.00	0.0	"
29	0.00	903.0	0.0	-1.3	5.018	-0.3	0.00	0.00	0.0	"
30	0.00	930.0	0.0	-2.2	6.621	-0.4	0.00	0.00	0.0	"
31	0.00	796.0	0.0	-1.6	4.259	-0.4	0.00	0.00	0.0	"

TOTAL TRACK TIME FOR MONTH............ 0.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 51.22 HOURS
TRACK TIME / TIME NIP > 300........... 0.0000
MAXIMUM DAILY POWER................... 0.00 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 0.0 %
MAXIMUM DAILY ENERGY.................. 47.10 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 13.8 %
TOTAL POWER PRODUCED FOR MONTH........ -0.6 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 145.9 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... -0.4 %

DATA FOR MONTH 2 AND YEAR 1988

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	936.0	0.0	-3.5	4.260	-0.9	0.00	5.50	19.0	ARING/ROD PROBLEM
2	0.00	987.0	0.0	-2.0	-1.000	0.0	-1.00	-1.00	-1.0	PCU BEARING/ROD PROBLEM
3	0.00	1025.0	0.0	-3.3	6.758	-0.6	0.00	9.11	12.0	PCU BEARING/ROD PROBLEM
4	0.00	1027.0	0.0	-2.3	8.015	-0.3	0.00	9.78	12.0	PCU BEARING/ROD PROBLEM
5	0.00	1038.0	0.0	-2.7	8.535	-0.4	0.00	9.85	11.0	PCU BEARING/ROD PROBLEM
6	0.00	1014.0	0.0	-2.4	7.445	-0.4	0.00	9.81	11.0	PCU BEARING/ROD PROBLEM
7	0.00	982.0	0.0	-0.5	7.492	-0.1	0.00	9.85	13.0	PCU BEARING/ROD PROBLEM
8	0.00	979.0	0.0	-4.0	8.035	-0.6	0.00	9.93	13.0	PCU BEARING/ROD PROBLEM
9	0.00	940.0	0.0	-1.1	7.957	-0.2	0.00	9.85	13.0	PCU BEARING/ROD PROBLEM
10	0.00	997.0	0.0	-6.4	7.304	-1.0	0.00	9.64	21.0	PCU BEARING/ROD PROBLEM
11	0.00	979.0	0.0	-6.9	8.016	-1.0	-1.00	-1.00	-1.0	PCU REPLACEMENT & CHECKOUT
12	0.00	997.0	0.0	-5.5	7.921	-0.8	0.00	9.98	14.0	REPLACE COOLING PUMP
13	18.63	976.0	21.8	6.3	7.704	0.9	0.88	6.32	18.0	PCU CHECKOUT, SPEED SENSOR ADJ
14	18.27	815.0	25.6	108.2	5.223	23.6	10.06	8.83	13.0	
15	13.83	717.0	22.0	33.4	3.889	9.8	5.68	8.54	17.0	DET.WRONG START PRESSURE
16	20.93	906.0	26.3	144.0	6.700	24.5	10.14	9.59	21.0	
17	25.20	1048.0	27.4	114.8	7.667	17.1	6.35	10.30	26.0	WIND, DET.HIGH INSOLATION
18	25.20	1003.0	28.7	106.1	6.642	18.2	6.25	9.31	36.0	WIND
19	23.93	1012.0	27.0	204.3	8.377	27.8	10.24	10.29	18.0	WIND-24MIN
20	24.89	1019.0	27.9	177.3	8.520	23.7	10.28	10.14	15.0	
21	0.00	750.0	0.0	-6.0	2.584	-2.6	1.78	4.75	15.0	DET.8HR, OPER. NOT AVAILABLE
22	23.16	1027.0	25.7	173.8	8.254	24.0	10.35	9.87	15.0	
23	13.87	940.0	16.8	69.6	4.570	17.4	5.62	6.45	16.0	
24	18.18	923.0	22.5	25.4	4.922	5.9	0.00	0.00	0.0	DEC DID MAINTENANCE CHECK ON
25	0.00	946.0	0.0	-14.0	5.835	-2.7	0.00	0.00	0.0	COMPUTER, ERASED OPERATING
26	0.00	955.0	0.0	-13.0	1.540	-9.6	0.00	0.00	0.0	SYSTEM
27	0.00	830.0	0.0	13.3	2.027	7.5	0.00	0.00	0.0	KS INSTALLED DEC OPERATING
28	21.06	893.0	26.9	129.3	5.465	27.0	4.52	3.05	15.0	SYSTEM & MAINT. CK
29	16.20	987.0	18.7	32.2	3.959	9.3	3.24	3.83	27.0	WIND-3HR, DET.WRONG STR.PRES.

TOTAL TRACK TIME FOR MONTH............ 83.39 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 192.47 HOURS
TRACK TIME / TIME NIP > 300........... 0.4333
MAXIMUM DAILY POWER.................... 25.20 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 28.7 %
MAXIMUM DAILY ENERGY................... 204.30 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 27.8 %
TOTAL POWER PRODUCED FOR MONTH........ 14.4 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 175.6 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 8.2 %

DATA FOR MONTH 3 AND YEAR 1988

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	19.74	889.0	25.3	50.2	6.417	8.9	3.03	5.42	29.0	U N.P.
2	23.28	980.0	27.1	88.7	7.133	14.2	7.89	8.26	16.0	WASH-2HR FOR FILM CREW, DET.
3	22.88	943.0	27.7	153.8	8.092	21.7	10.72	10.07	15.0	
4	23.31	954.0	27.9	174.7	6.646	30.0	9.71	10.57	15.0	WASH, DET.-45MIN OPER.BUSY
5	23.31	937.0	28.4	175.3	4.970	40.2	10.80	10.50	16.0	PEAK POWER METER NOT RESET
6	19.92	933.0	24.3	23.4	8.255	3.2	2.59	6.97	28.0	WIND-5HR, DET.-GEN ON/OFF
7	23.12	959.0	27.5	179.8	9.009	22.8	10.87	10.51	19.0	
8	23.83	1014.0	26.8	126.2	7.288	19.7	7.51	10.64	14.0	DET.-HIGH INSOLATION
9	1.26	968.0	1.5	-8.8	8.975	-1.1	0.00	0.00	46.0	WIND, LOSS OF GRID POWER
10	23.41	1040.0	25.7	145.7	9.750	17.0	8.57	0.00	15.0	INSPECTION
11	23.78	1053.0	25.8	141.1	9.465	17.0	7.85	0.00	15.0	ALIGNED PCU
12	23.71	1051.0	25.7	99.6	9.717	11.7	0.00	0.00	0.0	WASH, KS MAINTENANCE
13	25.79	863.0	34.5	179.6	9.398	22.1	1.29	1.40	13.0	KS MAINTENANCE, COV. #57
14	26.29	1064.0	29.2	167.6	8.586	23.1	9.02	11.37	15.0	COV. #70 & 71 MIRRORS
15	17.62	1010.0	21.2	9.2	8.579	1.3	0.00	0.00	0.0	WIND
16	22.73	988.0	27.9	170.6	9.230	22.4	9.72	9.89	17.0	COV. #11 & #62 MIRRORS
17	23.42	1034.0	27.5	205.6	8.879	28.1	11.26	11.50	16.0	N.P.
18	22.27	1017.0	26.6	189.7	9.372	24.6	11.23	11.27	13.0	N.P.
19	22.66	1049.0	26.2	185.5	8.592	26.2	11.33	11.52	18.0	N.P.
20	22.53	1040.0	26.3	197.5	7.740	31.0	11.24	11.29	15.0	N.P.
21	19.42	961.0	24.5	53.3	6.586	9.8	4.76	10.58	30.0	WIND
22	20.37	942.0	26.3	157.0	8.272	23.0	0.00	0.00	0.0	WIND
23	9.93	651.0	18.5	-6.9	8.662	-1.0	0.00	0.85	30.0	WIND
24	21.21	989.0	26.0	171.4	9.585	21.7	11.35	11.38	14.0	N.P.
25	21.48	1015.0	25.7	184.5	9.764	22.9	11.55	11.61	17.0	N.P.
26	21.16	1019.0	25.2	188.8	8.272	27.7	11.59	11.68	14.0	N.P.
27	21.16	1005.0	25.6	-6.9	8.845	-0.9	0.52	11.21	33.0	WIND
28	15.79	942.0	20.4	23.7	8.969	3.2	0.00	11.28	0.0	WASH, WIND
29	22.91	992.0	28.0	142.0	7.978	21.6	8.36	11.48	11.0	DET.SEVERAL ALARMS,(DC PROB.)
30	20.44	930.0	26.7	160.5	9.708	20.1	0.00	0.00	0.0	N.P.
31	22.62	1028.0	26.7	160.5	9.708	20.1	0.00	0.00	0.0	DET. SEVERAL ALARMS,(DC PROB.)

TOTAL TRACK TIME FOR MONTH............ 192.76 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 221.25 HOURS
TRACK TIME / TIME NIP > 300........... 0.8712
MAXIMUM DAILY POWER................... 26.29 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 34.5 %
MAXIMUM DAILY ENERGY.................. 205.60 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 40.2 %
TOTAL POWER PRODUCED FOR MONTH........ 46.0 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 262.4 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 17.5 %

DATA FOR MONTH 4 AND YEAR 1988

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	1013.0	0.0	213.2	9.690	26.7	0.00	0.00	0.0	N.P.
2	20.75	951.0	26.5	161.1	8.129	24.1	10.48	11.41	19.0	KS PM
3	20.80	975.0	25.9	125.3	7.459	20.4	0.00	0.00	0.0	KS PM, WIND-3HR
4	17.95	920.0	23.7	30.4	5.438	6.8	1.71	2.61	32.0	WIND-4HR,KS PM
5	21.03	975.0	26.2	172.7	8.834	23.7	11.43	11.51	15.0	N.P.
6	21.86	973.0	27.3	161.7	8.628	22.8	11.10	11.15	14.0	N.P.
7	19.87	915.0	26.4	70.9	6.109	14.1	5.64	9.28	30.0	WIND-5HR
8	18.66	857.0	26.4	136.5	7.778	21.3	11.36	11.37	15.0	N.P.
9	20.99	972.0	26.2	187.0	9.276	24.5	11.82	11.83	21.0	N.P.
10	20.05	915.0	26.6	114.4	5.728	24.3	9.41	9.49	15.0	N.P.
11	0.00	768.0	0.0	-5.4	5.057	-1.3	0.19	9.33	14.0	DET, WR START PRESSURE, GEN. P
12	8.40	781.0	13.1	-1.1	1.697	-0.8	2.45	3.16	27.0	CLOUDS, OPER. LEFT AT NIGHT ST
13	0.00	0.0	0.0	-10.0	0.000	0.0	0.00	0.00	21.0	CLOUDS
14	0.00	0.0	0.0	-5.7	0.232	-29.8	0.00	0.00	0.0	CLOUDS
15	0.00	995.0	0.0	5.1	2.605	2.4	0.74	3.05	11.0	LIGHTNING PROB.
16	0.00	978.0	0.0	-4.3	1.685	-3.1	0.30	2.57	23.0	PCU COM. PROB.
17	0.00	951.0	0.0	-16.2	8.547	-2.3	0.00	11.51	40.0	PCU COM. PROB.
18	0.00	906.0	0.0	10.4	7.627	1.7	0.00	10.45	25.0	PCU COM. PROB.
19	0.00	869.0	0.0	-0.6	4.063	-0.2	0.00	7.79	31.0	PCU COM. PROB.
20	0.00	820.0	0.0	1.8	1.218	1.8	0.00	0.00	0.0	PCU COM. PROB.
21	0.00	690.0	0.0	-4.8	3.467	-1.7	0.00	0.00	0.0	PCU COM. PROB., AZ, ENC. PROB.
22	0.00	898.0	0.0	-4.4	4.091	-1.3	0.00	0.00	0.0	PCU & DISH PROB.
23	7.15	636.0	13.7	-6.7	3.750	-2.2	1.10	0.80	18.0	KS PM, FIX PCU COM & AZ ENC.
24	21.65	982.0	26.8	178.1	9.830	22.0	5.36	5.28	18.0	KS PM
25	21.98	1003.0	26.6	206.4	9.868	25.4	12.56	12.58	15.0	N.P.
26	12.35	922.0	16.3	3.1	7.934	0.5	1.24	10.89	17.0	PCU WIRE REPAIR
27	16.12	808.0	24.2	33.4	3.199	12.7	5.21	5.42	21.0	WARNING MESSAGE
28	18.90	974.0	23.6	36.5	8.785	5.0	3.32	11.80	27.0	WIND
29	13.80	930.0	18.0	-6.4	8.834	-0.9	0.38	12.02	29.0	REPAIR WIRING, GROUNDING
30	0.00	1023.0	0.0	-10.0	7.111	-1.7	0.00	9.12	48.0	PCU COM. LOSS

TOTAL TRACK TIME FOR MONTH............. 105.80 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 194.42 HOURS
TRACK TIME / TIME NIP > 300........... 0.5442
MAXIMUM DAILY POWER................... 21.98 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 27.3 %
MAXIMUM DAILY ENERGY.................. 213.20 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 26.7 %
TOTAL POWER PRODUCED FOR MONTH........ 21.6 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 176.7 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 12.3 %

DATA FOR MONTH 5 AND YEAR 1988

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	939.0	0.0	-14.3	8.678	-2.0	0.00	12.67	27.0	P.DET-1HR, POWER SUPPLY PROB.
2	21.02	915.0	27.9	101.2	9.819	12.5	6.39	12.74	15.0	PCU COM. LOSS
3	12.02	879.0	16.6	1.1	9.221	0.1	1.22	11.29	20.0	DET-3HR,TRUOBLE SHOOTING
4	0.00	813.0	0.0	-2.2	2.120	-1.3	0.00	2.61	32.0	MAINTENANCE REPAIR
5	0.00	848.0	0.0	-9.3	7.633	-1.5	0.00	10.40	41.0	MAINTENANCE REPAIR
6	0.00	973.0	0.0	-16.2	9.712	-2.0	0.00	12.37	34.0	WINDS
7	0.00	923.0	0.0	-14.3	6.422	-2.7	0.00	8.73	31.0	WAITING PCU INTERFACE BOARD
8	0.00	962.0	0.0	-9.4	8.748	-1.3	0.00	12.88	18.0	WAITING PCU INTERFACE BOARD
9	3.39	982.0	4.2	-6.7	10.305	-0.8	0.37	13.06	15.0	REP. INTER. BD, ADJ. SPEED SEN
10	0.00	974.0	0.0	-8.6	9.785	-1.1	0.03	12.97	14.0	GRID LOSS, WASH, ADD H2, TRACK
11	0.00	966.0	0.0	-7.0	9.950	-0.9	0.00	12.99	14.0	WAITING FOR TRACK ALIGNMENT
12	0.00	983.0	0.0	-1.9	9.985	-0.2	0.00	12.97	31.0	WAITING FOR TRACK ALIGNMENT
13	0.00	971.0	0.0	-9.6	10.145	-1.1	0.00	0.00	0.0	WAITING FOR TRACK ALIGNMENT
14	17.29	957.0	21.9	8.8	7.571	1.4	0.00	0.00	0.0	TROUBLESHOOTING TRCK PROB.
15	19.88	918.0	26.3	119.3	7.908	18.3	0.00	0.00	0.0	N.P.
16	9.28	958.0	11.8	-4.4	8.616	-0.6	0.21	11.53	35.0	GRID LOSS-4HR,DET-LOW H2
17	0.00	965.0	0.0	-11.0	6.510	-2.1	0.00	8.50	33.0	N.P.
18	20.59	984.0	25.4	195.9	10.234	23.2	13.04	13.05	22.0	N.P.
19	0.00	1010.0	0.0	201.1	10.762	22.7	12.80	13.22	19.0	DET-1HR
20	21.21	1013.0	25.1	179.9	10.752	20.1	11.33	13.29	15.0	REM #70 COVER, DET-2HR
21	20.76	1002.0	24.8	191.8	8.019	28.7	11.42	13.24	17.0	DET-1HR
22	18.76	951.0	23.7	106.1	6.587	19.3	9.45	10.09	23.0	N.P.
23	18.40	952.0	23.2	27.4	6.601	5.0	2.77	10.33	26.0	PCU TROUB. SHOOTING
24	16.27	940.0	20.8	24.2	7.551	3.8	3.18	10.49	21.0	PCU TROUBLE SHOOTING
25	19.90	956.0	25.0	183.7	9.370	23.5	12.81	12.84	23.0	N.P.
26	21.80	951.0	27.5	129.3	9.796	15.8	7.95	12.95	29.0	EASH-3HR
27	20.40	961.0	25.5	65.3	8.349	9.4	3.92	10.76	32.0	WIND-7HR
28	20.00	970.0	24.7	123.5	9.321	15.9	8.41	12.28	28.0	WIND-3HR
29	15.30	970.0	18.9	-9.4	7.380	-1.5	0.00	12.17	44.0	WIND
30	21.68	998.0	26.0	130.0	9.095	17.1	8.18	13.44	29.0	WIND-4HR
31	21.60	980.0	26.4	76.0	9.500	9.6	0.00	0.00	0.0	

TOTAL TRACK TIME FOR MONTH............ 113.48 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 313.86 HOURS
TRACK TIME / TIME NIP > 300........... 0.3616
MAXIMUM DAILY POWER.................... 21.80 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 27.9 %
MAXIMUM DAILY ENERGY.................. 201.10 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 28.7 %
TOTAL POWER PRODUCED FOR MONTH........ 20.9 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 266.4 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 7.9 %

DATA FOR MONTH 6 AND YEAR 1988

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	15.88	923.0	20.6	31.4	4.734	8.0	4.96	8.93	16.0	DET-1HR, POWER SUPPLY PROB.
2	20.93	980.0	25.6	181.3	10.314	21.1	11.80	13.21	15.0	DET-2HR, INVESTIGATION POW. SU
3	20.52	980.0	25.1	162.3	10.136	19.2	10.32	13.16	27.0	DET-1HR
4	20.52	983.0	25.0	72.2	10.264	8.4	5.13	12.51	33.0	DET-2HR,WIND5HR
5	0.00	963.0	0.0	-11.8	7.837	-1.8	0.00	0.00	0.0	WIND ALL DAY
6	19.41	1005.0	23.2	34.7	9.738	4.3	2.91	12.76	28.0	DET-4HR, UNKNOWN POW.SUP. PROB
7	18.08	1045.0	20.7	27.3	11.202	2.9	2.58	13.49	28.0	DET-1HR, PCU TROUBLESHOOTING-5
8	18.00	1015.0	21.3	44.4	9.474	5.6	4.08	12.60	16.0	PCU TROUBLE SHOOTING-5HR,H23HR
9	0.00	978.0	0.0	-5.1	10.137	-0.6	0.00	13.42	22.0	PCU TROUBLESHOOTING ALL DAY
10	0.00	977.0	0.0	-7.2	10.112	-0.9	0.00	13.33	22.0	PCU TROUBLESHOOTING
11	19.23	838.0	27.5	75.7	9.306	9.8	0.00	0.00	0.0	KS PM, CHANGED PCU POWER SUPPL
12	18.84	946.0	23.9	139.4	9.123	18.3	4.44	6.25	26.0	KS PM
13	19.12	962.0	23.8	160.7	9.192	21.0	17.72	11.78	15.0	N.P.
14	17.92	937.0	22.9	119.1	7.806	18.3	10.33	10.88	25.0	N.P.
15	18.07	973.0	22.3	159.6	9.577	20.0	12.98	12.97	20.0	N.P.
16	17.38	916.0	22.7	124.5	7.680	19.4	10.58	10.73	27.0	N.P.
17	15.84	924.0	20.6	37.7	4.652	9.7	5.50	5.50	18.0	CLOUDS, PLACED IN NST
18	3.51	826.0	5.1	-5.2	1.689	-3.7	1.29	3.30	28.0	CLOUDS, PLACED IN NST
19	15.27	874.0	20.9	119.2	7.488	19.1	10.42	10.57	23.0	N.P.
20	15.72	1006.0	18.7	46.4	9.922	5.6	5.49	13.20	36.0	N.P.
21	18.90	987.0	23.0	131.6	10.271	15.4	10.02	13.41	25.0	WIND-4HR
22	0.00	978.0	0.0	-4.8	3.280	-1.8	0.00	5.26	22.0	LIGHTNING STOW-5HR
23	0.00	908.0	0.0	-1.0	1.504	-0.8	0.00	0.00	0.0	LIGHTNING STOW, NO OPERATOR
24	0.00	868.0	0.0	0.1	9.476	0.0	0.00	2.07	23.0	PM&WASH, MANLIFT BROKE
25	22.20	960.0	27.7	204.6	6.640	36.9	13.04	13.04	21.0	N.P.
26	21.74	921.0	28.3	196.4	7.501	31.4	12.93	12.90	19.0	N.P.
27	22.13	947.0	28.0	217.0	9.942	26.2	13.33	13.33	26.0	N.P.
28	21.29	897.0	28.5	193.7	9.326	24.9	12.91	12.91	26.0	N.P.
29	20.73	905.0	27.5	192.4	9.191	25.1	12.66	13.05	25.0	N.P.
30	21.54	914.0	28.3	205.6	9.540	25.8	12.93	12.93	23.0	N.P.

TOTAL TRACK TIME FOR MONTH............. 208.35 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 297.49 HOURS
TRACK TIME / TIME NIP > 300........... 0.7004
MAXIMUM DAILY POWER................... 22.20 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 28.5 %
MAXIMUM DAILY ENERGY.................. 217.00 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 36.9 %
TOTAL POWER PRODUCED FOR MONTH........ 34.1 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 247.1 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 13.8 %

DATA FOR MONTH 7 AND YEAR 1988

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	21.22	941.0	27.0	194.2	9.385	24.8	12.16	13.03	27.0	DET-1HR, NO OIL PRES, FAST SLE
2	19.52	912.0	25.7	140.6	6.308	26.7	9.71	11.91	26.0	WIND-3HR
3	19.38	912.0	25.5	96.0	6.578	17.5	7.00	12.73	31.0	DET-NO OIL PRESSURE
4	22.03	1009.0	26.2	218.4	8.527	30.7	13.35	13.36	24.0	N.P.
5	21.84	1019.0	25.7	212.5	10.560	24.1	13.22	13.38	24.0	N.P.
6	20.88	982.0	25.5	171.3	10.538	19.5	11.06	13.33	25.0	DET-1HR
7	20.83	977.0	25.6	155.5	10.301	18.1	9.83	13.37	28.0	DET-1HR,COMP. PROB,WIND-2HR
8	20.69	1001.0	24.8	210.0	10.391	24.2	13.25	13.24	21.0	N.P.
9	21.67	945.0	26.8	169.7	8.259	24.0	0.00	0.00	0.0	KS MAINT.,WASH-3HR
10	20.89	948.0	25.8	184.4	6.786	31.8	4.85	6.47	26.0	
11	21.28	940.0	26.5	169.5	8.042	24.6	0.00	0.00	-1.0	DET. FAST SLEW SET
12	20.88	982.0	24.8	172.4	9.519	21.2	10.82	12.41	21.0	2 DET.-1.5HR,LOW OIL PRES. & ?
13	16.58	835.0	23.2	30.1	2.725	12.9	3.27	4.58	22.0	3 DET.2HR, NO OIL PRES & ?
14	21.06	965.0	25.5	190.9	10.016	22.3	10.34	13.16	25.0	FAST SLEW SET-.5HR, NO REASON
15	20.66	963.0	25.1	202.2	9.910	23.8	13.29	13.29	14.0	N.P.
16	20.73	974.0	24.9	201.8	9.502	24.8	13.23	13.22	19.0	N.P.
17	20.73	921.0	26.3	189.1	8.308	26.6	13.01	13.03	22.0	WIND-1HR
18	19.94	936.0	24.9	191.6	9.301	24.1	12.88	12.90	25.0	N.P.
19	18.74	912.0	24.0	179.7	9.341	22.5	12.77	12.78	15.0	N.P.
20	0.00	880.0	0.0	186.6	8.682	25.1	12.45	12.51	18.0	WASH-2HR
21	20.93	925.0	26.4	83.2	3.662	26.6	6.77	7.48	20.0	DET-1.2HR,WRONG START PRESSURE
22	20.24	936.0	25.3	89.3	4.667	22.4	6.67	6.46	31.0	LIGHTNING SHUTDOWN
23	19.49	928.0	24.5	88.4	5.152	20.1	7.23	7.85	23.0	LIGHTNING ST-2HR
24	20.17	898.0	26.2	159.7	7.265	25.7	11.77	11.68	24.0	N.P.
25	20.23	911.0	26.0	176.9	8.767	23.6	12.51	12.55	22.0	N.P.
26	20.33	921.0	25.8	147.6	9.069	19.0	10.10	12.64	27.0	POWER LOSS-2.5HR,NO OP.AVAIL.
27	20.40	933.0	25.6	179.5	9.145	22.9	11.34	12.60	29.0	WIND-2HR
28	20.34	924.0	25.7	138.9	7.892	20.6	9.67	10.82	21.0	N.P.
29	19.54	901.0	25.3	169.5	8.699	22.8	12.29	12.30	20.0	N.P.
30	17.15	821.0	24.4	95.9	4.873	23.0	9.84	9.67	20.0	N.P.
31	15.92	785.0	23.7	39.0	3.563	12.8	4.78	6.51	26.0	WIND-1HR, DET.-2HR, REASON ?

TOTAL TRACK TIME FOR MONTH............ 299.46 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M..... 329.26 HOURS
TRACK TIME / TIME NIP > 300........... 0.9095
MAXIMUM DAILY POWER.................... 22.03 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 27.0 %
MAXIMUM DAILY ENERGY.................. 218.40 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 31.8 %
TOTAL POWER PRODUCED FOR MONTH........ 56.9 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 245.7 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 23.2 %

DATA FOR MONTH 8 AND YEAR 1988

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	17.62	828.0	24.9	129.9	7.800	19.5	10.58	10.75	27.0	T-N DOWN-LIGHTNING & WINDS
2	0.97	857.0	1.3	-3.2	8.510	-0.4	0.00	12.02	27.0	OPERATOR N.A., FACEUP STOW,NO
3	19.85	966.0	24.0	128.7	10.170	14.8	10.04	12.49	22.0	PM-3HR
4	12.60	916.0	16.1	14.0	6.990	2.3	1.57	8.58	33.0	WASH & CHANGED H2 BOTTLE
5	20.53	903.0	26.6	80.0	6.920	13.5	6.98	8.99	26.0	WINDS-2HR
6	21.98	1016.0	25.3	135.6	11.200	14.1	7.85	12.96	26.0	WINDS-1HR
7	22.52	1004.0	26.2	207.6	11.150	21.8	12.87	12.97	17.0	N.P.
8	21.64	982.0	25.8	191.5	10.580	21.2	12.64	12.65	19.0	N.P.
9	21.64	958.0	26.4	186.0	10.190	21.3	12.52	12.51	19.0	N.P.
10	21.22	978.0	25.4	180.2	10.520	20.0	11.94	12.43	24.0	N.P.
11	20.36	969.0	24.6	158.4	10.630	17.4	9.61	12.50	25.0	WINDS-1HR
12	21.47	997.0	25.2	191.3	9.857	22.7	12.52	12.53	23.0	N.P.
13	20.69	963.0	24.5	117.0	8.115	16.4	0.00	0.00	0.0	KS PM
14	21.18	1022.0	23.6	203.6	10.446	22.2	6.01	5.09	22.0	KS PM
15	19.91	1028.0	22.1	199.4	10.346	22.0	12.53	12.66	23.0	N.P.,WHILE AT NST, FS SET
16	20.20	980.0	23.5	190.8	7.695	28.3	11.81	12.57	15.0	DET-1HR,NO OIL PRESSURE
17	18.41	977.0	21.5	39.2	9.334	4.8	3.76	12.48	15.0	WASH-4HR, BIMONTHLY-4HR
18	21.75	939.0	26.4	162.7	8.685	21.4	10.68	11.80	19.0	N.P.,REFLECTIVITY READINGS-2HR
19	20.33	915.0	25.3	127.1	6.480	22.4	9.26	9.98	19.0	CLOUDS
20	16.96	841.0	23.0	33.4	4.383	8.7	3.92	7.67	39.0	WIND-6HR
21	18.43	861.0	24.4	129.3	6.735	21.9	9.84	10.36	35.0	N.P.
22	17.51	868.0	23.0	121.0	5.783	23.9	8.81	8.96	16.0	LIGHTNING-1HR, WIND-1HR
23	16.77	882.0	21.7	95.0	6.528	16.6	7.39	8.24	24.0	LIGHTNING-3HR
24	0.00	888.0	0.0	0.0	0.719	0.0	0.00	1.01	16.0	N.P.
25	5.32	872.0	7.0	0.6	1.676	0.4	1.78	4.38	14.0	LIGHTNING-4HR
26	14.90	845.0	20.1	33.6	3.505	10.9	4.88	5.80	16.0	LIGHTNING-1HR
27	15.78	857.0	21.0	59.8	4.271	16.0	7.33	7.70	13.0	LIGHTNING-1HR
28	15.82	860.0	21.0	62.4	3.539	20.1	6.88	6.85	15.0	N.P.
29	16.44	880.0	21.3	91.4	5.380	19.4	0.00	0.00	0.0	LIGHTNING-3HR
30	0.00	915.0	0.0	-5.0	8.453	-0.7	0.00	5.12	9.0	PROB.-REF SENSOR, T.S.
31	0.00	913.0	0.0	-4.0	8.446	-0.5	0.00	11.53	12.0	PROB.REF SENSOR, T.S.

TOTAL TRACK TIME FOR MONTH............ 214.00 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M.... 283.58 HOURS
TRACK TIME / TIME NIP > 300........... 0.7546
MAXIMUM DAILY POWER................... 22.52 KW
MAX. DAILY POWER EFFIC. FOR MONTH..... 26.6 %
MAXIMUM DAILY ENERGY.................. 207.60 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 28.3 %
TOTAL POWER PRODUCED FOR MONTH........ 37.6 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH........ 235.0 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH....... 16.0 %

DATA FOR MONTH 9 AND YEAR 1988

DATE	PEAK POWER KW	PEAK INSOL KW/M/M	PEAK POW EF %	DAILY ENERGY KWHR	SUN ENERGY KWHR	DAILY EFFIC. %	TRACK TIME HR	NIP> 300 HR	MAX WIND MPH	COMMENTS
1	0.00	889.0	0.0	0.0	0.000	0.0	0.00	8.49	11.0	TRACK PROB, AZ. REF SENSOR
2	0.00	881.0	0.0	0.0	0.000	0.0	0.00	11.59	12.0	WAITING FOR TECH. SERVICE
3	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	KS PM & REPAIR
4	0.00	886.0	0.0	0.0	0.000	0.0	10.93	11.29	22.0	KS, ALIGN NEW SENSOR
5	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	KS PM
6	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	N.P.
7	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	N.P.
8	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	DET & FAST SLEW-2HR, NO REASON
9	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	DET-1HR,NO REAS/NST READ METER
10	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	
11	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	N.P.
12	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	N.P.
13	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	N.P.
14	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	N.P.
15	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	N.P.
16	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	N.P.
17	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	N.P.
18	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	N.P.
19	0.00	0.0	0.0	0.0	0.000	0.0	0.00	0.00	0.0	DET-1HR,NO OIL PRESSURE

TOTAL TRACK TIME FOR MONTH............. 10.93 HOURS
TIME THAT NIP WAS ABOVE 300 W/SQ.M..... 31.37 HOURS
TRACK TIME / TIME NIP > 300........... 0.3484
MAXIMUM DAILY POWER.................... 0.00 KW
MAX. DAILY POWER EFFIC. FOR MONTH...... 0.0 %
MAXIMUM DAILY ENERGY................... 0.00 KWHR
MAX. DAILY ENERGY EFFIC. FOR MONTH ... 0.0 %
TOTAL POWER PRODUCED FOR MONTH......... 0.0 KWHR/ SQ.M
TOTAL SUN ENERGY FOR THE MONTH......... 0.0 KWHR/ SQ.M
SYSTEM EFFICIENCY FOR THE MONTH........ 0.0 %

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