DOE/SF/10501-233
(STMPO - 233)

SOLAR ONE
OPERATION & MAINTENANCE REPORT #33
DECEMBER 1984

THIS REPORT SUMMARIZES THE OPERATIONAL ACTIVITIES AND HIGHLIGHTS MAINTENANCE WORK THAT WAS PERFORMED DURING THE MONTH. IN ADDITION, IT PRESENTS PLANT STATISTICS AND A MONTHLY OPERATION AND MAINTENANCE COST SUMMARY.

ABSTRACT

- The gross energy production for the month was 309.1 MWH and the net energy production was -41.3 MWH. Power production was limited by 142.5 hours of inclement weather.

OPERATIONAL HIGHLIGHTS

- Sandia Labs conducted an on site meeting for the FY85 McDonnel Douglas Support Contract. The efforts agreed to include:

  - Summary Data Tapes

    This provides for data reduction of plant data acquisition tapes into a monthly summary data tape which is sent to Sandia for further analysis.

  - Plant hardware and software support

    This is primarily for major problems. It is expected that SCE will be able to run the plant without much technical assistance from contractors.

  - Plant Evaluation Support

    This covers all aspects of the plant performance evaluation but the major effort will be in the receiver area. Methods will be investigated to further reduce the receiver edge tube temperatures using shields, receiver tube orifice removal and control and instrumentation changes. Control and instrumentation changes are being considered to reduce the plant start-up time and to provide better control throughout the year.

  - Receiver Tube Crack Laboratory Simulation & Modeling

    This is an effort to simulate the receiver edge tube crack initiation and propagation in the laboratory and to develop a finite element model of the tube section for evaluating the crack propagation under cyclic loads and temperatures. Work has started on this effort and actual model testing should start early next year.

- Rain, snow, and frost in the last few weeks has cleaned the heliostats and the reflectivity has reached a new 1984 high of 95.8% clean. Frost on the heliostats in the morning has delayed start-up on several days.

- The plant experienced frequent auxiliary power voltage excursions. Barstow Customer Service was later scheduled to inspect the voltage regulator at Gale Substation in an effort to resolve the problem.

- The condenser experienced a vacuum problem. A ruptured diaphragm was found to be leaking when a morning vacuum was initiated on the condenser. The defective condenser rupture disk was replaced.

- The Operational Control System (OCS) failed at 0630 hours on Sunday, December 9. Communications Maintenance Inc. (CMI) was later on station to work on the OCS hardware problem. A RAM card on the CPU board was replaced and the system was returned to service.

- We have been receiving daily SCE weather forecast information (Monday - Friday) which has proven to be more accurate than that provided by other weather services. Larry Bergman, SCE R&D, will modify the desert section of the SCE weather forecast with a solar plant specific forecast for Solar One and SEGS I. In the revised format, SCE will predict weather for the following day with a telephonic update at 1500 hours on an exception basis. This updated information will be called in as required to the Control room. The combined weather information should be useful in determining our next day's operating plan.

- On Christmas morning, start-up was delayed when the generator breaker would not close. The breaker closing coil contacts were found stuck open with the closing springs fully discharged. The closing springs were recharged (motor driven rewind) and exercised with no further problems.

MAINTENANCE HIGHLIGHTS

- Miscellaneous steam leaks on the receiver and thermal storage system were repaired.

- The historic trend processor was repaired on the receiver system to allow the chart drive trend recorders to function properly.

- A new line was installed on the make-up demineralizer inlet to the storage tank to allow proper rinsing of the demineralizer.

- A new load module has been installed in the heliostat array control field processor to monitor and evaluate the cause of communication line failovers.

- Van Winkle Construction Company completed installation of an auxiliary bay enclosure. This is to help freeze protect all instrumentation in the auxiliary bay area.

- The northeast receiver tower aircraft warning light was returned to service after replacing a blown capacitor.

- A Plant Outage Meeting was held on December 18. The outage is tentatively scheduled for the month of February 1985. Subjects discussed were: a turbine generator overhaul, painting of receiver panels, installation of receiver panel edge tube shields and the removal of selected panel tube orifices, to return the receiver operating temperature 850°F, plans to fix panel warpage problems, and the repair of the spare receiver panel.

- The blowdown line at Evaporation Pond #1 was modified to discharge above the pond water level and preclude the potential drain back of evaporation pond water.

- The east service and instrument air compressor was returned to service after being down for cleaning, inspection of valves, and after having the Cooling Water System repaired.

- Diversified Builders continue to work on the new chemical and oil storage buildings. The new storage buildings will provide a containment area and will also provide a protected environment for chemicals and oils.

- Electricians and technicians are working to reduce the number of out-of-service heliostats. The current number of heliostats out-of-service is 100. The major problems with heliostats are related to motor seals wear and malfunctions of azimuth and elevation encoders.

- Miscellaneous maintenance work accomplished during the month of December 1984 is as follows:

  - Replaced a bad turbine lube oil temperature transmitter on the turbine lube oil reservoir.

  - Checked caustic storage tank heating element.

  - Replaced the air solenoid gaskets on drain valves to Panels 8 and 10.

  - Replaced a defective closing coil on the first point extraction steam drain valve.

  - Daily routines on the Beckman MV-8000 System were accomplished.

  - Routines were completed on the Data Acquisition System.

  - Replaced prefilter gaskets on Receiver Panels 8 and 9.

  - Replaced a flange gasket on desuperheater DS-301.

  - Installed permanent wiring for the Maintenance Shop drill press and bench grinder.

  - Replaced cracked for turbine journal bearing oil flow sight glass.

  - Replaced mirror facets on Heliostats 1035, 2804, 2703, 2350, and 0236.

Plant Statistics	Dec. 83	Dec. 84	Turbine Roll To Date
Net Energy Production MWH	-357.3	-41.3	2403.9
Energy Production (MWH net while connected to the grid)	49.0	268.8	15181.5
Hourly Peak Mw (Net)	7.7*	9.2*	10.4*
On-Line Hours	9.1	44.6	2817.9
Test Hours	8.0	0.0	1621.7
Total Plant Outage Hours	135.0	7.0	2025.8
Scheduled	130.0	0.0	841.3
Unscheduled	5.0	7.0	1184.5
Weather Outage Hours	109.5	142.5	3251.9

*Receiver Generated Steam Only

Attachments:

- Solar One Statistics: weather outage hours, plant outage hours, test hours, and on-line hours (Attachment 1).
- December was a negative output month, -41.3 MWH (Attachment 2). Power production was limited by 142.5 hours of weather outage.
- The daily and cumulative energy production while Solar One was on-line for the three previous months and the year-to-date are shown on Attachments 3 and 4, respectively.

SOLAR ONE PERFORMANCE SUMMARY

1. Station Availability = $\frac{H \times kw}{Hp \times kw}$

H = Hours On-Line
kw = Rated Output
Hp = Period Hours

Receiver Availabiltiy	99.3%
Discharging Availability	100.0%
Charging Availability	100.0%
Turbine Availability	99.7%
Collector Availability	100.0%

NOTE: For the purpose of availability, weather outage hours are considered available operating hours.

2. Output Factor = $\frac{\text{Net Transmitted Power}}{\text{On-Line Hours} \times \text{Maximum Rated Capacity}}$

Output Factor	-2.4%

3. Capacity Factor = $\frac{\text{Net Transmitted Power}}{\text{Period Hours} \times \text{Maximum Rated Capacity}}$

Capacity Factor	-0.5%

4. Solar Capacity Factor =

$\frac{\text{Net Transmitted Power}}{\text{Integrated Insolation w-HR/M}^2 \times \text{Collector Field Surface Area}}$

Solar Capacity Factor	-0.7%

- A summary of the O&M labor, material, contract, and other costs for the month of December 1984 is shown on the following table. Expenses are categorized as follows:

Field Office	- Includes plant supervision, engineering, accounting, clerical, office supplies, and miscellaneous indirect expenses.
Operations	- Includes total cost of operating staff and expenses.
Miscellaneous Support	- Includes station supplies and rentals, safety and job training, and site security.
Maintenance	- Includes total cost of maintenance staff and expenses allocated to major plant subsystems.
Overheads	- Includes costs associated with direct labor plus company administrative and general expenses.

SOLAR ONE

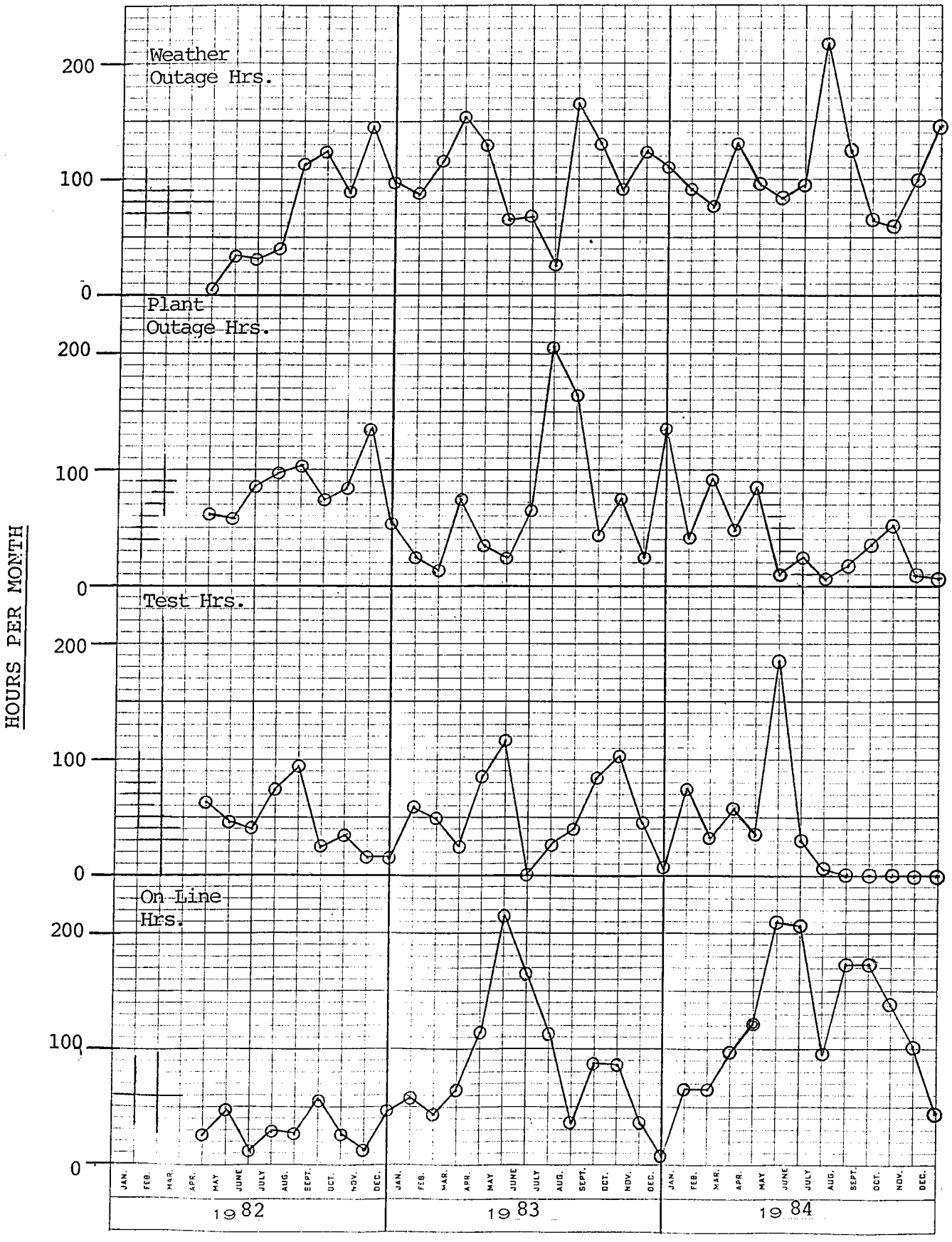
MONTHLY O&M COST SUMMARY
($ x 1000)

MONTH OF DECEMBER 1984

	LABOR	MATERIAL	CONTRACT	OTHER	TOTAL
FIELD OFFICE	30.0	.5	0.0	1.5	32.0
OPERATIONS	45.4	11.1	0.0	.4	56.9
MISC. SUPPORT	3.4	.4	5.7	.2	9.7
MAINTENANCE					
Supervision/Indirects	12.1	(.6)	.2	.1	11.8
Control System	5.1	2.8	14.6	3.2	25.7
Receiver System	1.2	.1	2.2	0.0	3.5
Thermal Storage System	.9	.1	1.0	0.0	2.0
Collector System	7.9	1.0	1.3	0.0	10.2
EPGS System	4.6	1.6	.1	0.0	6.3
Miscellaneous	3.5	(.5)	4.8	0.0	7.8
Total Maintenance	35.3	4.5	24.2	3.3	67.3
SUB TOTAL	114.1	16.5	29.9	5.4	165.9
Division O.H.					23.2
TOTAL DIRECT					189.1
Workman's Compensation					.8
Payroll Tax					8.5
Pension & Benefits					25.4
Administrative & General					35.0
GRAND TOTAL					258.8

Attachment 1

SOLAR ONE STATISTICS



DIETZGEN CORPORATION
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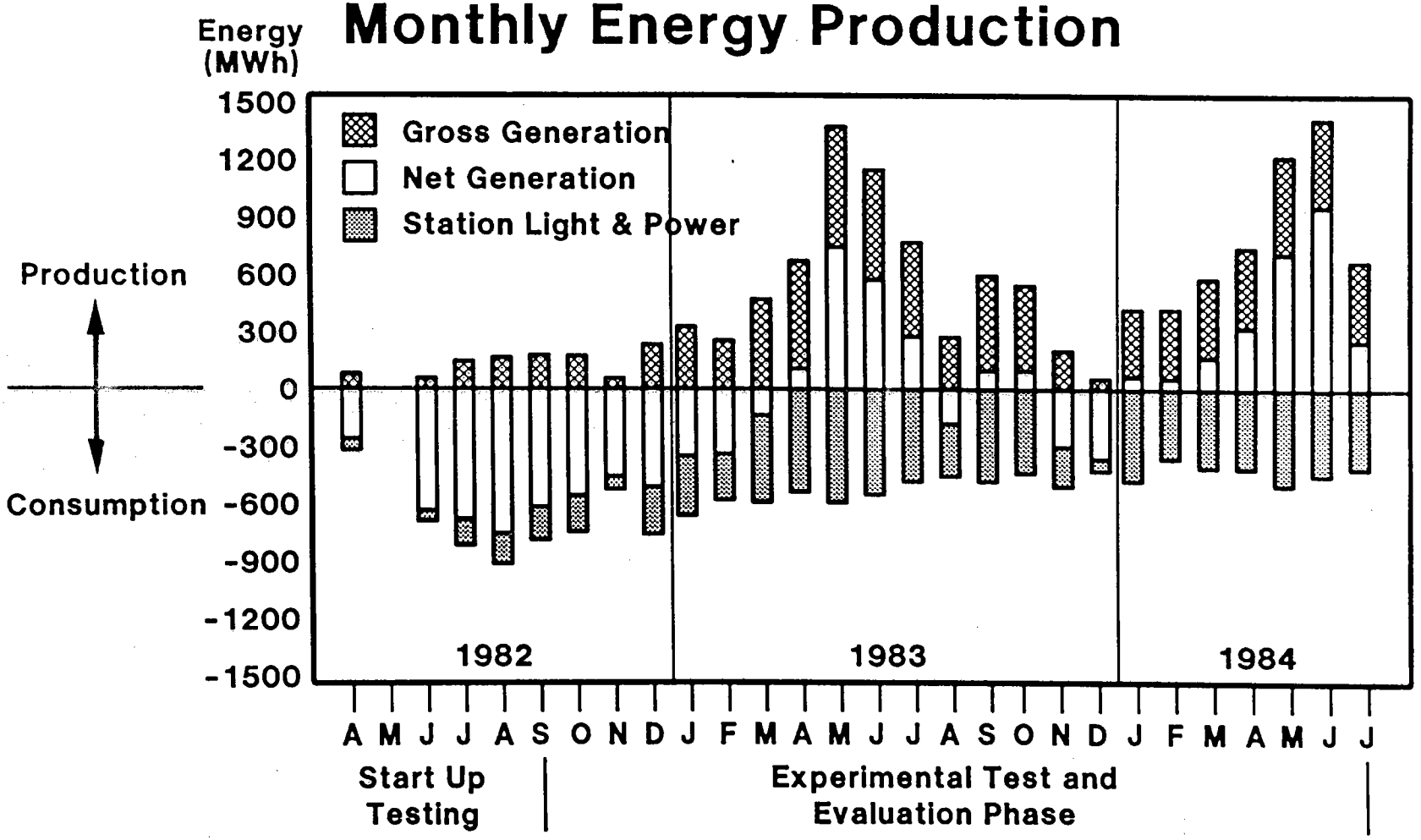
NO. 340-T3D DIETZGEN GRAPH PAPER
3 YEARS BY MONTHS

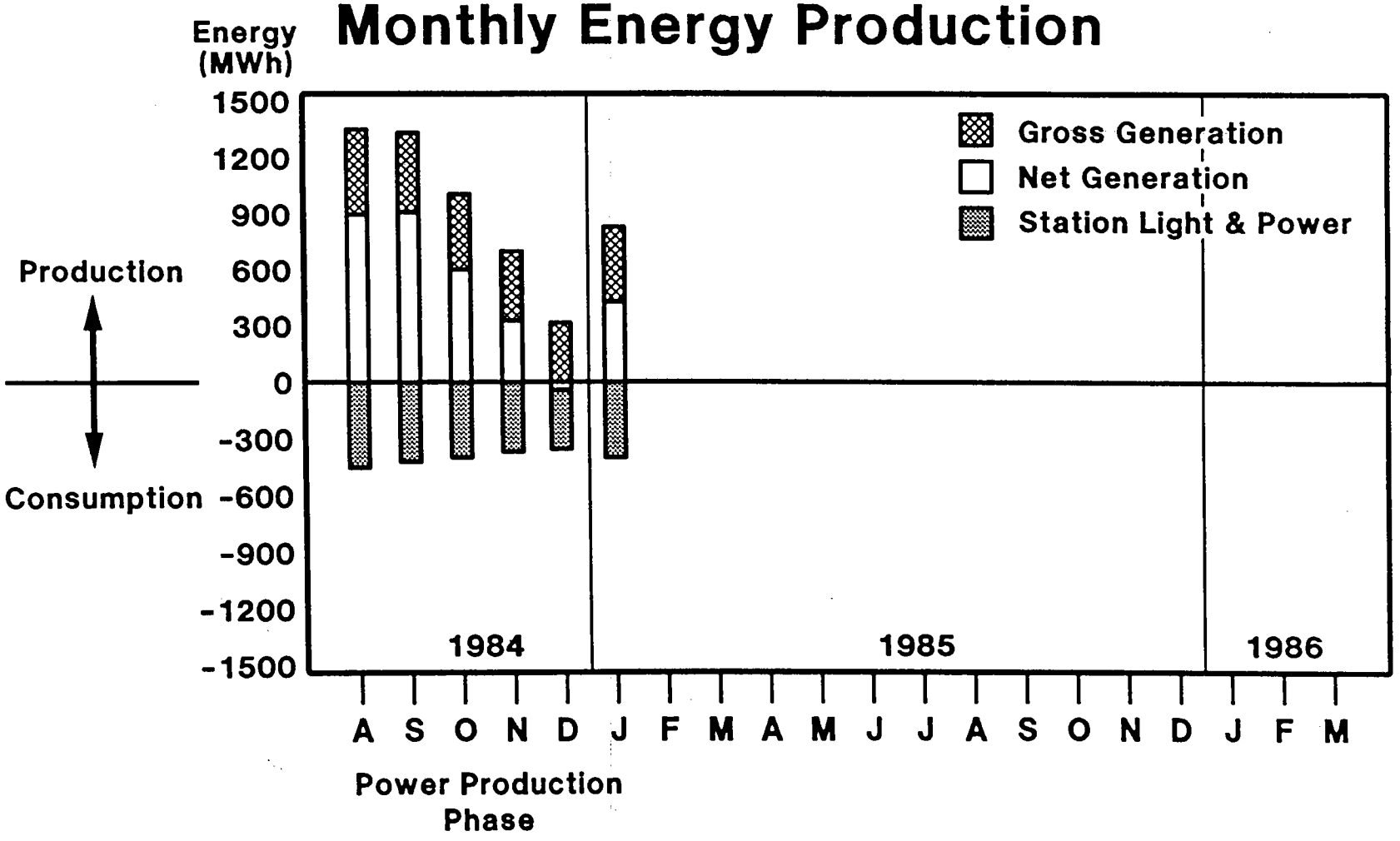
RMA 03/07/84

Solar One
Monthly Energy Production



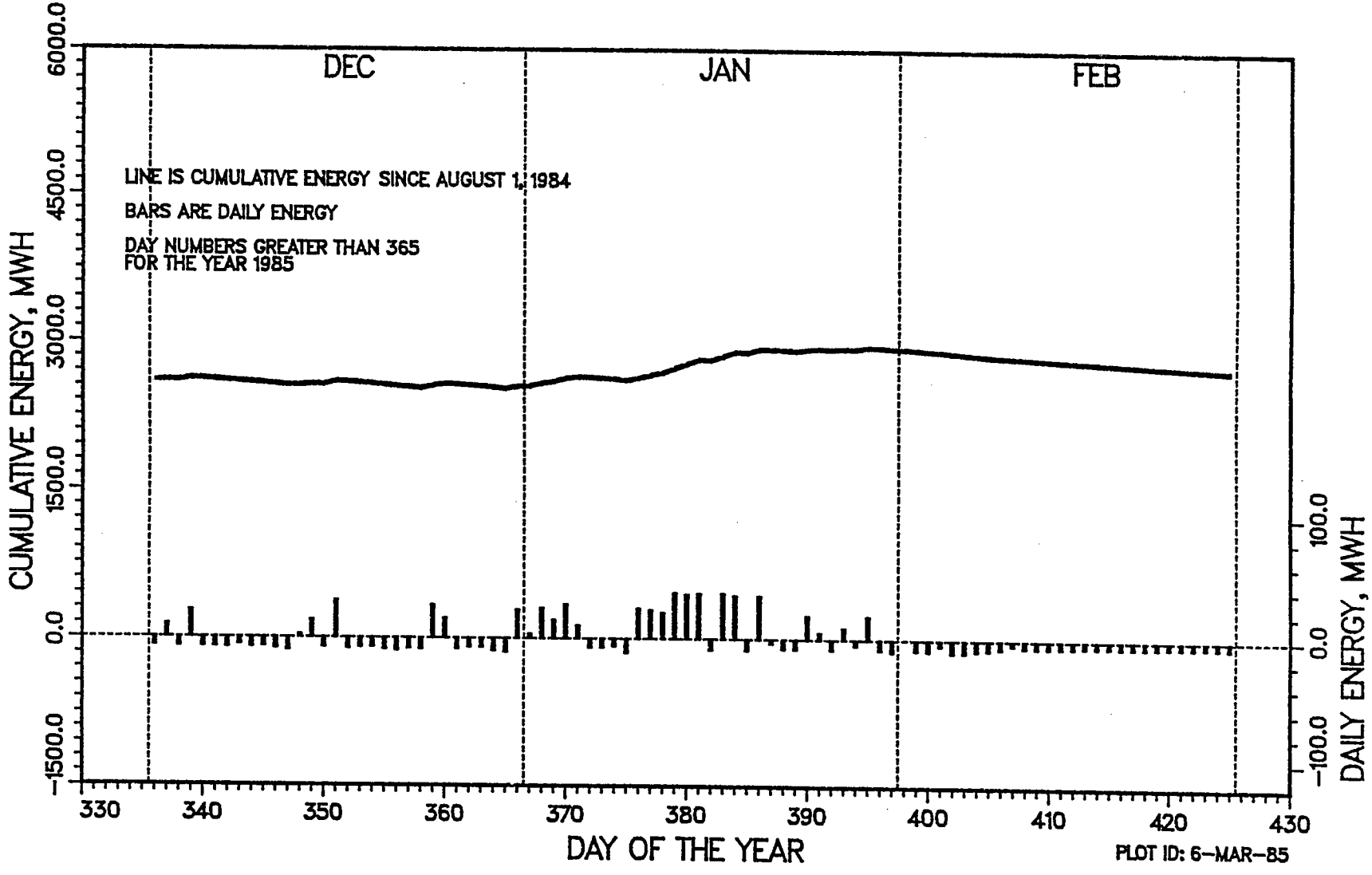
Attachment 2

Solar One
Monthly Energy Production



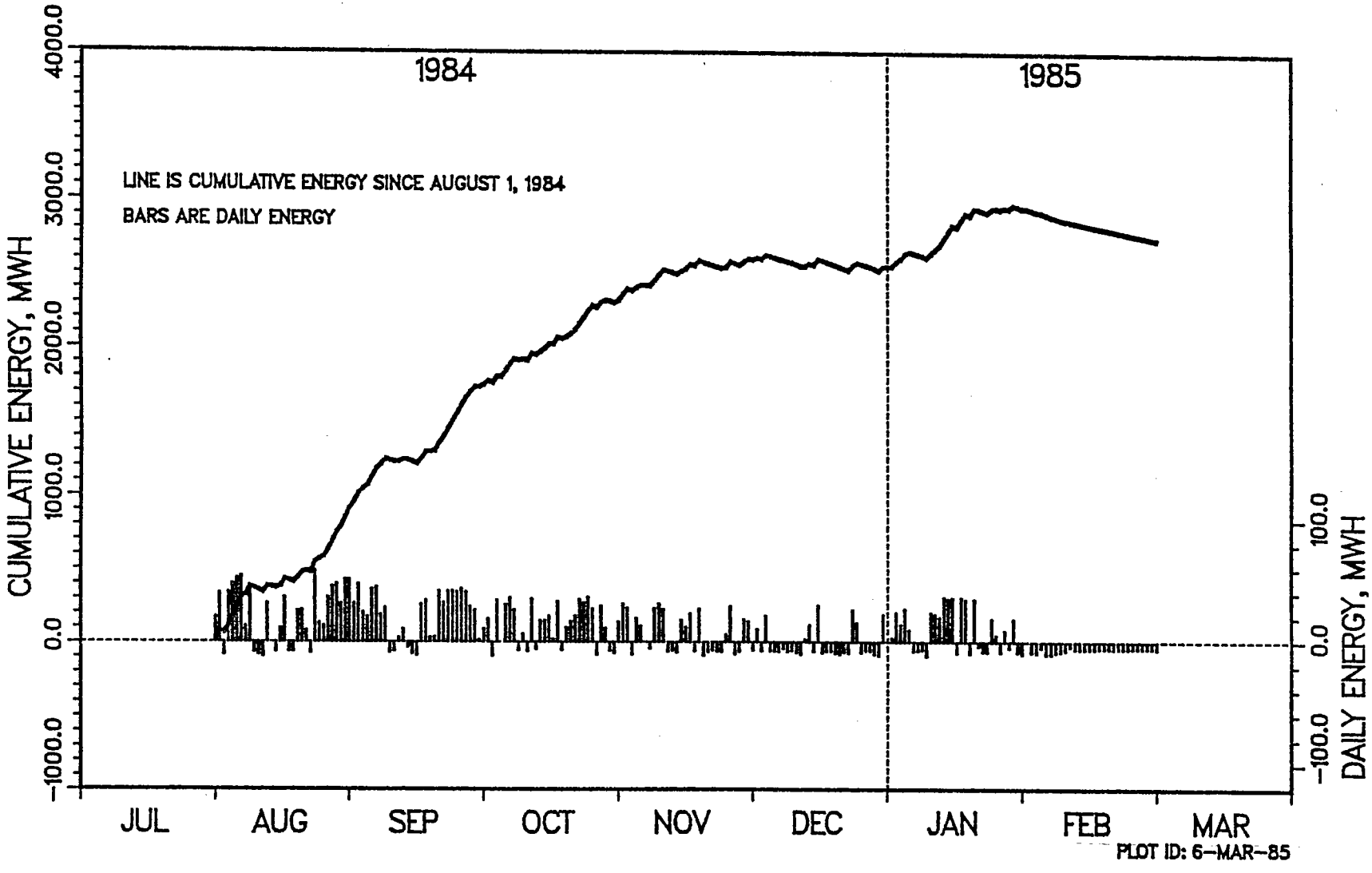
Attachment 3

SOLAR ONE NET ELECTRICAL PRODUCTION



Attachment 4

SOLAR ONE NET ELECTRICAL PRODUCTION



Attachment 5

DOE/SF/10501-232
(STMPO-232)
8

SOLAR ONE
OPERATION AND MAINTENANCE REPORT #32

NOVEMBER 1984

THIS REPORT SUMMARIZES THE OPERATIONAL ACTIVITIES AND HIGHLIGHTS MAINTENANCE WORK THAT WAS PERFORMED DURING THE MONTH. IN ADDITION, IT PRESENTS PLANT STATISTICS AND A MONTHLY OPERATION AND MAINTENANCE COST SUMMARY.

Abstract

- The gross energy production for the month of November was 687.4 MWH, and the net energy production was 322.5 MWH. Power production was limited by 100.0 hours of inclement weather.

Operational Highlights

- Moon tracking was successful Friday night, November 9. The procedure to track moonlight is fundamentally correct, but will be rewritten with assistance from the operators to provide a more precise procedure. Moon tracking is conducted to identify heliostats requiring pointing error corrections and, thereby, decreasing spillage on the top and bottom of the receiver.

- Communication failure between the Operational Control System (OCS) and the Heliostat Array Controller (HAC) has been identified. The data acquisition system ties up the communication between the OCS and the HAC under certain circumstances and causes a loss of communication between the OCS and the HAC. MDAC is presently investigating a software modification to eliminate this condition.

- On November 15, a problem with the Operational Control System (OCS) not controlling the heliostat field for start-up was experienced during the morning. The heliostat field had to be manually controlled during start-up. A follow-up test of the OCS collector field start-up task was successful later in the day.

- Solar One personnel participated in training classes for fire fighting, held at the Coal Gasification Plant. R. Reid, SCE Fire Equipment Inspector, conducted the training classes.

- On November 16, start-up was delayed due to problems encountered with receiver panel #21 temperature control valve. Valve would not initially increase panel temperature to allow panel to go into the temperature control mode. Control valve was placed in manual control to allow a plant start-up on that day.

- On November 19, the Data Acquisition System (DAS), shutdown for no apparent reason during the plant's operation. DAS was reinitiated and operated properly for the remainder of the day.

- On November 20, charging operation on train #1 was terminated at 1411 hours due to a receiver Red Line Unit (RLU) trip on low voltage. Concurrently, the thermal storage system tripped on loss of the receiver. The voltage dip occurred when the Montara 33 KV line was removed from service.

- A Resource Conservation and Recovery Act (RCRA) training meeting was conducted. The training provides the necessary background to enable personnel to perform their duties in a manner which protects human health and the environment.

Maintenance Highlights

- On Wednesday, November 7, an oil leak estimated to be around one to five gallons per minute was discovered by an SCE plant equipment operator in the thermal storage charging train Number 2 condensor. The leak occurred in the gasket forming the seal between the shell and the oil-side tubesheet. No fire occurred and the train was quickly isolated and drained to the oil sump. Charging train #2 was not in service at the time of failure. The gasket that failed was of the new type installed in June 1983, which at that time and up until this event had effectively eliminated all leaks in the heat exchanger shell and channel flanged gasket weld area. The thermal storage charging train #2 condenser oil side head gasket was repaired, and the charging train operated with no oil leaks.

- Quality Sprayers, was on site to manually remove weeds within the collector field and to spray the collector field area to preclude weed regrowth.

- Part of the parking lot perimeter fence was blown down by wind. Repairs were made by an outside contractor.

- Van Winkle Construction completed the work on the auxiliary bay wall enclosure. This wall enclosure will help freeze protect instrumentation and other equipment located in the auxiliary bay aea.

- Two leaky valves (drain pots) on the receiver tower mezzanine deck were repacked. Suspect leaks were caused by internal mechanical wear.

- Water and steam leaks on various valves and fittings were repaired on charging train #2.

- The collector field was 60% washed by using a borrowed insulator wash truck from SCE,s Division Maintenance Organization. The washed mirrors had an average reflectivity reading of 93.6% after the wash.

- Three leaks on the waste water blowdown line were repaired. The PVC couplings failed at midpoint due to compressive or tensile stresses from thermally induced temperature transients.

- Electricians and technicians are working to reduce the number of heliostats out-of-service. The current number of heliostats out-of-service is 86. The major problems with heliostats are related to motor seal wear and malfunction of azimuth and elevation encoders.

- Diversified Builders Co, started building new chemical and oil storage buildings. The new storage buildings will provide a containment area for better control of various chemicals and oils, and will also provide a safer environment for chemicals and oils.

- A leak on the four inch service water line to the administration building was repaired. Suspect fiberglass water line failed due to surging (water hammer).

- Miscellaneous maintenance work accomplished during the month of November, is as follows:

  - Replaced sight glass on 4th point heater.

  - Serviced oily waste water separator sump pumps.

  - Installed support bracket on the east demineralizer sump pump discharge line.

  - Cleaned and lubricated the generator field breaker.

  - Replaced and calibrated the turbine speed/load controller assembly.

  - Replaced the spindle assembly on the Beam Characterization System computer disk drive.

  - Replaced fan belt on remote station #2 air-conditioner.

  - Repaired pre-filter leaks on receiver panels 5 and 11.

  - Repaired temperature control valve leaks on receiver panel 5 and 21.

  - Repaired control system on temperature contorl valve of Receiver Panel #21.

  - Replaced ammonia pump motor pump bearings.

- Replaced hydrazine pump motor due to a damaged commutator.
- Replaced heat flux transducer on receiver panel 16.

Plant Statistics	Nov.'83	Nov.'84	Turbine Roll To Date
Net Energy Production MWH	-295.0	322.5	2,445.2
Energy Production (MWH net while connected to the grid)	166.7	596.9	14,912.7
Hourly Peak Mw (Net)	7.8 *	8.9*	10.4*
On-Line Hours	38.8	101.9	2,773.3
Test Hours	47.4	0.0	1,621.7
Total Plant Outage Hours	23.1	8.7	2,018.8
Scheduled	9.0	4.0	841.3
Unscheduled	14.1	4.7	1177.5
Weather Outage Hours	121.6	100.0	3,109.4

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*Receiver Generated Steam Only

Attachments:

- Chronological Summary of Receiver Tube Defects (Attachment 1).
- Solar One Statistics: weather outage hours, plant outage hours, test hours, and on-line hours (Attachment 2).
- Power production and plant testing were limited by 100.0 hours of weather outage. November was a positive output month, 322.5 MWH (net) (Attachment 3).
- The daily and cumulative energy production while Solar One was on-line for the three previous months and the year-to-date are shown Attachments 4 and 5.

SOLAR ONE PERFORMANCE SUMMARY

1) Station Availability = $\frac{H \times kw}{Hp \times kw}$

H = Hours On-Line

kw = Rated Output

Hp = Period Hours

Receiver Availability	100.0%
Discharging Availability	100.0%
Charging Availability	100.0%
Turbine Availability	99.3%
Collector Availability	99.7%

NOTE: For the purpose of availability, weather outage hours are considered available operating hours.

2) Output Factor = $\frac{\text{Net Transmitted Power}}{\text{On-Line Hours} \times \text{Maximum Rated Capacity}}$

Output Factor ---------- 26.5%

3) Capacity Factor = $\frac{\text{Net Transmitted Power}}{\text{Period Hours} \times \text{Maximum Rated Capacity}}$

Capacity Factor ---------- 3.7%

4) Solar Capacity Factor =

$\frac{\text{Net Transmitted Power}}{\text{Integrated Insolation w-HR/m}^2 \times \text{Collector Field Surface Area}}$

Solar Capacity Factor ---------- 3.2%

Operation and Maintenance Costs

- A summary of the O&M labor, material, contract, and other costs for the month of November 1984 is shown on the attached table. Expenses are categorized as follows:

Field Office	-	Includes plant supervision, engineering, accounting, clerical, office supplies, and miscellaneous indirect expenses.
Operations	-	Includes total cost of operating staff and expenses.
Miscellaneous Support	-	Includes station supplies and rentals, safety and job training, and site security.
Maintenance	-	Includes total cost of maintenance staff and expenses allocated to major plant subsystems.
Overheads	-	Includes costs associated with direct labor plus company administrative and general expenses.

SOLAR ONE

MONTHLY O&M COST SUMMARY
($ X 1000)

MONTH OF NOVEMBER 1984

	LABOR	MATERIAL	CONTRACT	OTHER	TOTAL
FIELD OFFICE	10.6	0.2	0.0	1.7	12.5
OPERATIONS	53.4	2.8	0.0	1.2	57.4
MISC. SUPPORT	3.3	1.0	1.5	0.7	6.5
MAINTENANCE					
Supv./Indirects	12.8	3.1	0.1	0.5	16.5
Control Sys.	6.3	2.4	21.7	0.1	30.5
Receiver Sys.	0.4	0.0	0.0	0.0	0.4
Thermal Sys.	0.8	0.0	0.0	0.0	0.8
Collector Sys.	5.2	0.1	1.5	0.0	6.8
EPG Sys.	2.1	8.8	0.0	0.0	10.9
Misc.	3.6	3.8	0.8	0.0	8.2
Total Maintenance	31.2	18.2	24.1	0.6	74.1
SUB TOTAL	98.5	22.2	25.6	4.2	150.5
Division O. H.					17.9
TOTAL DIRECT					168.4
Workman's Comp.					0.7
Payroll Tax					7.2
Pension & Benefits					21.5
Admin. & Gen.					31.2
GRAND TOTAL					229.0

O&MCOST.RMA

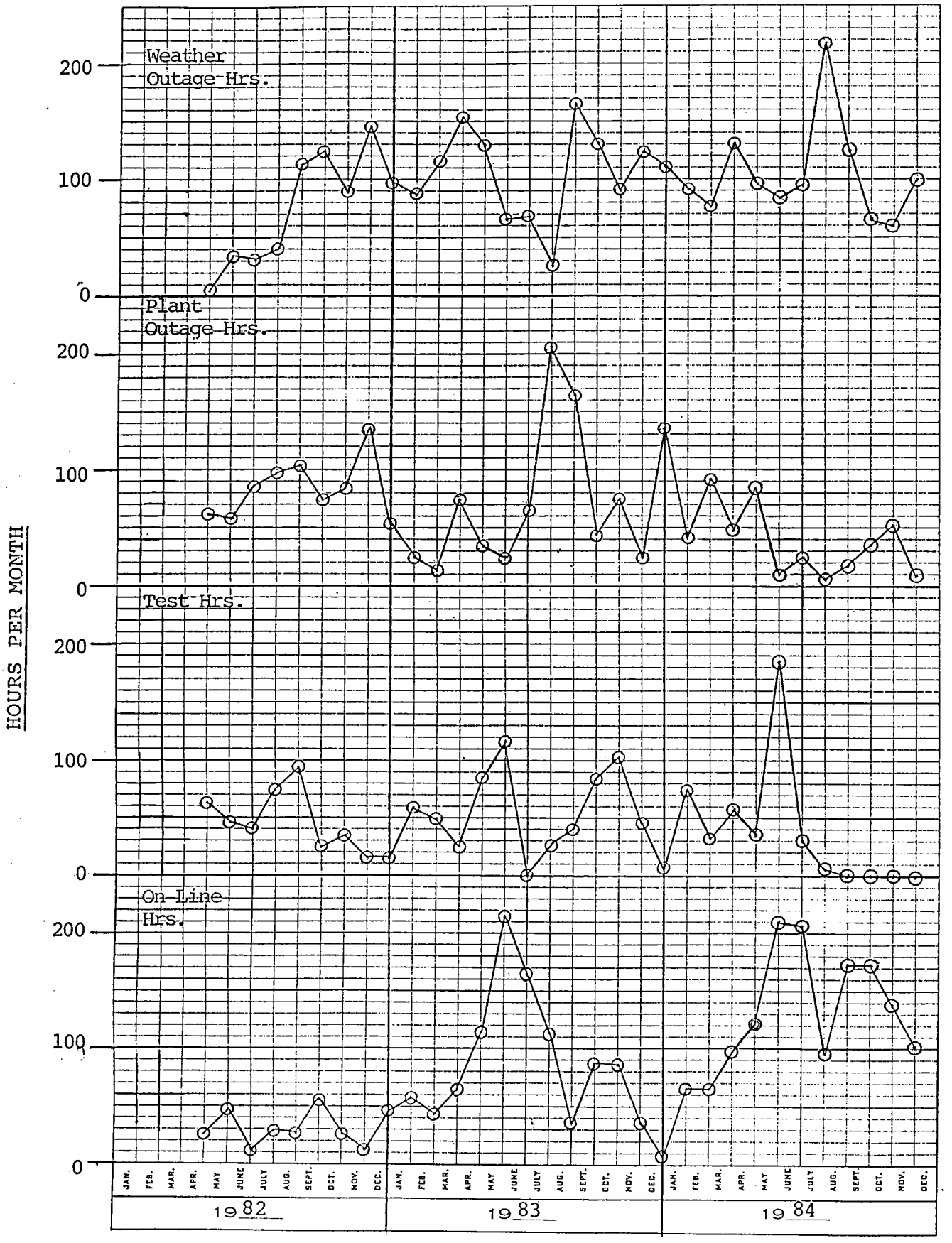
Attachment 1

SOLAR ONE GENERATING STATION

Chronological Summary of Receiver Tube Defects

DATE	DESCRIPTION OF TUBE DEFECT	LOCATION
Jul 15, 1983	Interstitial weld leak	tube 30, panel 18
Jul 26, 1983	Interstitial weld leak	tube 41, panel 18
Aug 2, 1983	Bend leak	tube 70, panel 11
Aug 18, 1983	Repair/removal of sample	tube 30, panel 18
	Repair, grind & fill	tube 41, panel 18
Aug 19, 1983	Replaced cracked tube section	tube 70, panel 11
Sep 8, 1983	Crack indication	tube 30, panel 19
Oct 26, 1983	Crack indication	tube 1, panel 18
	Interstitial weld leak found & repaired	tube 41, panel 12
	Interstitial weld crack	tube 41, panel 13
Nov 1, 1983	Interstitial weld crack on:	tube 41, panel 4
		tube 41, panel 6
		tube 30, panel 7
		tube 41, panel 8
		tube 41, panel 9
		tube 30, panel 17
	Surface irregularity	tube 41, panel 10
Nov 16, 1983	Bend leak	tube 1, panel 15
	Bend crack	tube 1, panel 16
	Bend crack	tube 3, panel 16
	Bend crack	tube 1, panel 17
Dec 1983	Outage - Removal of sample	tube 1, panel 4
		tube 1, panel 6
	Repair of cracks	tube 1, panel 15
		tube 1, panel 16
		tube 2, panel 16
		tube 3, panel 16
Jan 1984	Outage - Interstitial weld crack repair	tube 41, panel 13
Feb 1984	Outage - Interstitial weld crack repair	tube 41, panel 8
	Interstitial weld crack repair	tube 41, panel 9
	Bend crack	tube 70, panel 9
	Bend crack	tube 70, panel 10
	Bend crack	tube 70, panel 11
	Bend crack	tube 70, panel 12
	Surface polished	tube 41, panel 10
Sept 1984	Outage - Bend Crack	tube 70, panel 8

SOLAR ONE STATISTICS

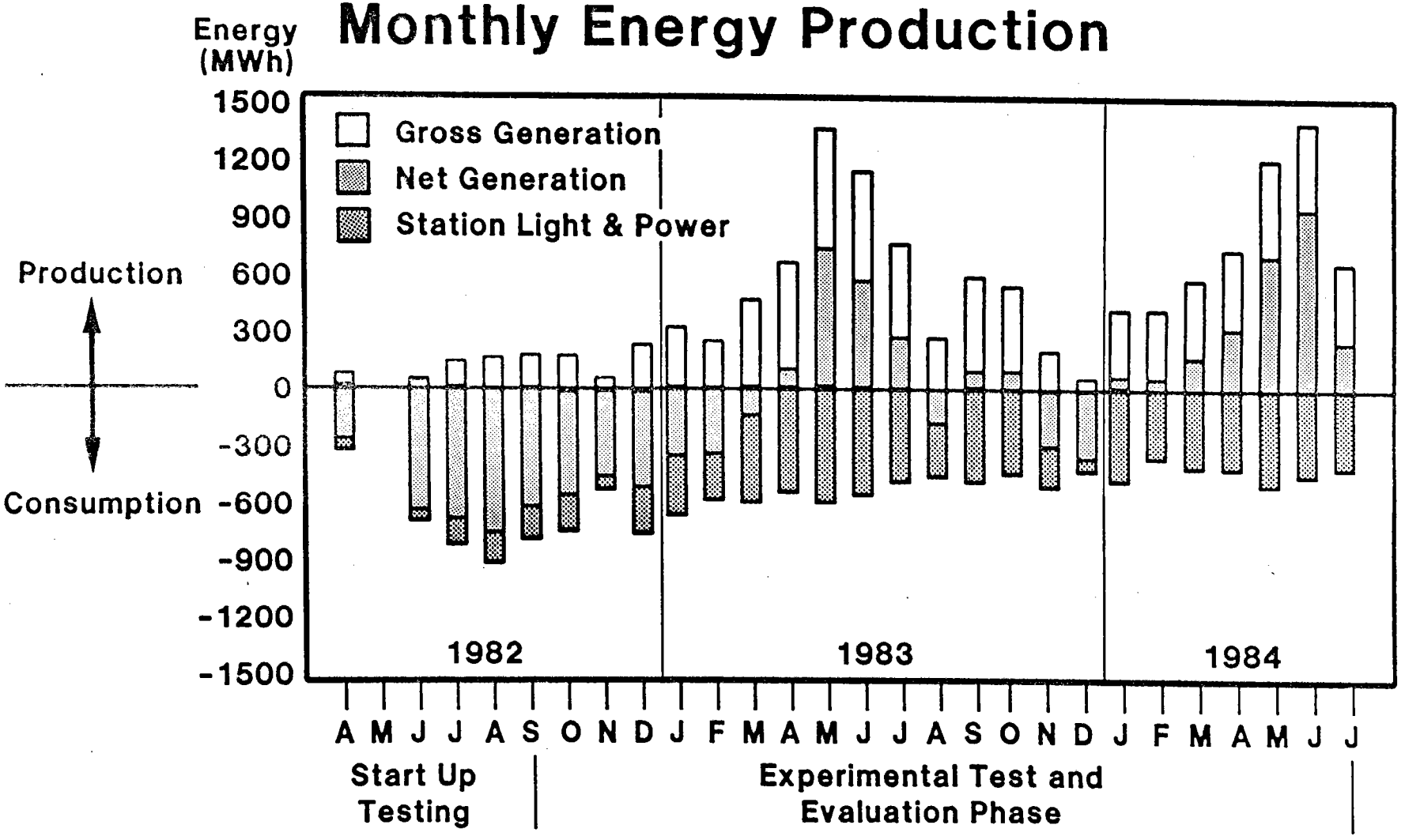


DIETZGEN CORPORATION MADE IN U.S.A.

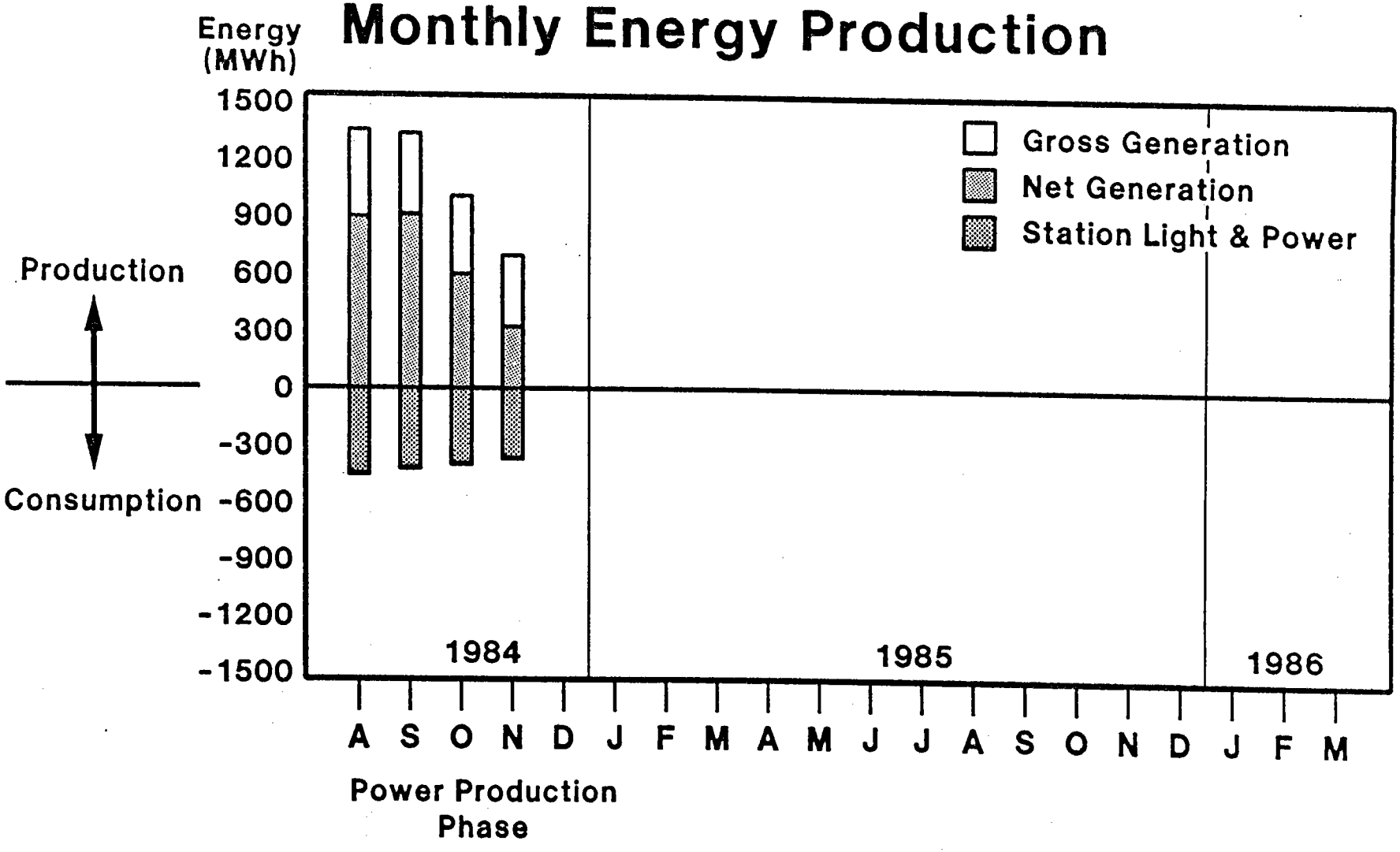
NO. 340-T30 DIETZGEN GRAPH PAPER 3 YEARS BY MONTHS

RMA 03/07/84

Solar One
Monthly Energy Production

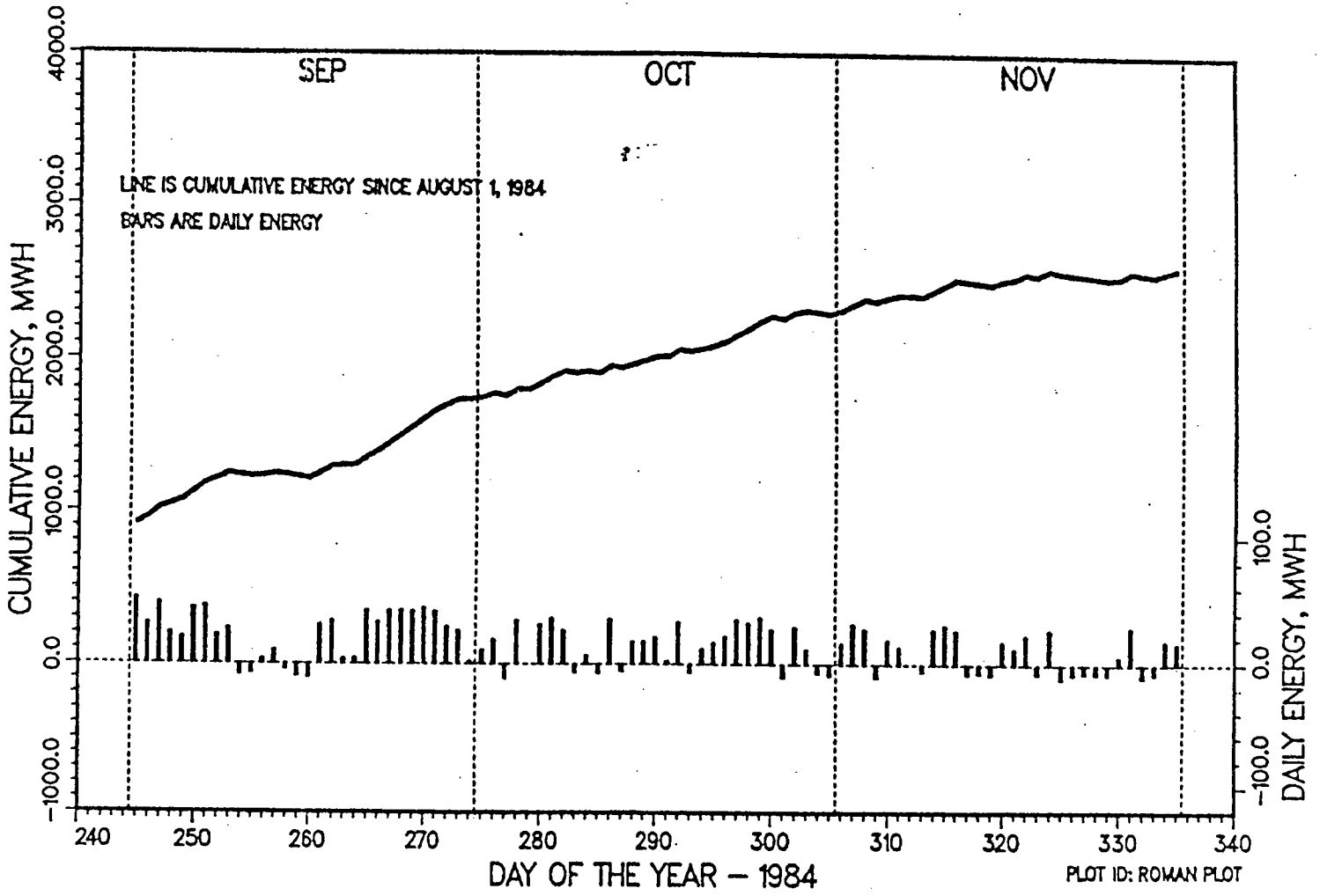


Solar One
Monthly Energy Production

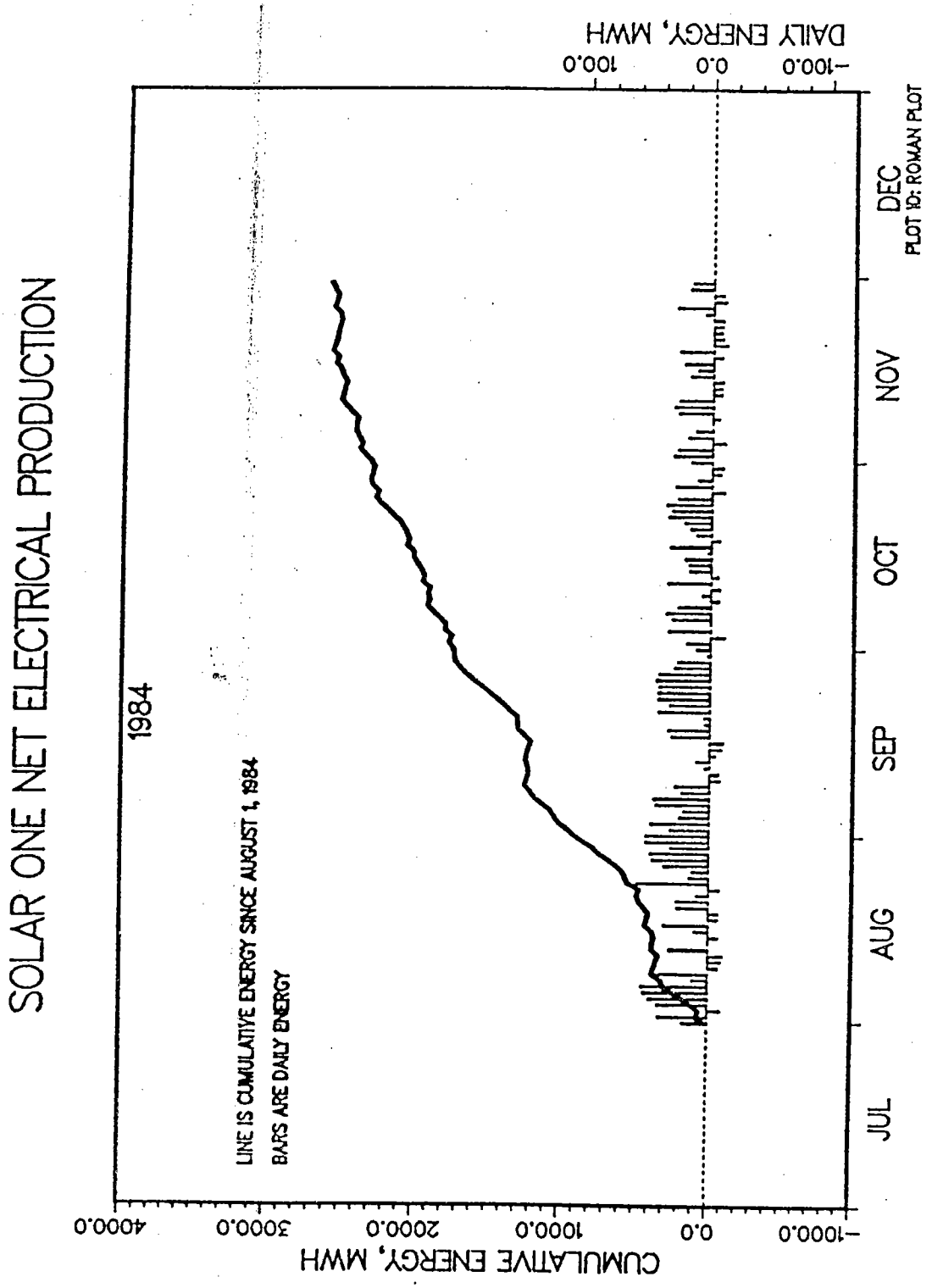


Attachment 3

SOLAR ONE NET ELECTRICAL PRODUCTION



Attachment 4


SOLAR ONE NET ELECTRICAL PRODUCTION
1984
LINE IS CUMULATIVE ENERGY SINCE AUGUST 1, 1984
BARS ARE DAILY ENERGY
CUMULATIVE ENERGY, MWH
4000.0
3000.0
2000.0
1000.0
0.0
-1000.0
DAILY ENERGY, MWH
100.0
0.0
-100.0
JUL
AUG
SEP
OCT
NOV
DEC
PLOT ID: ROMAN PLOT

DOE/SF/10501-231
(STMPO-231)
8

SOLAR ONE
OPERATION AND MAINTENANCE REPORT #31

OCTOBER 1984

THIS REPORT SUMMARIZES THE OPERATIONAL ACTIVITIES AND HIGHLIGHTS MAINTENANCE WORK THAT WAS PERFORMED DURING THE MONTH. IN ADDITION, IT PRESENTS PLANT STATISTICS AND A MONTHLY OPERATION AND MAINTENANCE COST SUMMARY.

Abstract

- The gross energy production for the month of October was 985.0 MWH, and the net energy production was 591.1 MWH. Power production was partially limited by 59.8 hours of inclement weather.

Operational Highlights

- On October 8, the well water line ruptured consequent to agricultural work near the plant. The well water outage prevented power production on one day.

- A new procedure for doing silica testing of the plant's water system was implemented. This new procedure reduces the old testing time by ten minutes and should contribute to a more efficient start-up.

- On October 10, plant start-up was delayed due to a failed drain solenoid valve on receiver preheat panel #3. The solenoid valve was replaced and a start-up was accomplihsed.

- Operators from Arizona Public Service and personnel from McDonnell Douglas, Stearns Catalytic, and Sandia were on site Friday morning, October 12, to observe a plant start-up as a a follow-up to their molten salt electric experiment participation.

- On October 14, a caustic spill occurred when the caustic day tank overflowed, due to operator error while being filled. The spill was contained and clean-up was accomplished the following four days. Clean up consisted of removing eighty-four cubic yards of soil which had a pH greater than 12 (hazardous waste). The excavated soil was transported to a Class I dump site.

- On October 14, a plant start-up was delayed two hours to allow gasket replacement of receiver vent valve (AOV 2902).

- On October 17, start-up was aborted after a water box vent line on the east side of the condenser broke off during water box venting. The water box vent valve was repaired and the unit was placed on-line.

- Found facet #3 on heliostat 2079 on the ground. Suspect facet fell off during high wind period.

- Representatives from 3M Energy Control Products were on site to install a reflective film product onto the four facets of heliostat 2901. The reflective film has a reflective index of 93 to 94 percent as compared to our existing low iron glass heliostats which have an index of 91 percent. This reflective film will be evaluated for possible future applications on stress membrane heliostats.

- T. Barnette and J. Low, of SCE Safety Division, were on site to conduct a safety audit. The receiver tower walked down to check for safety discrepancies.

- Tom Skelly, SCE, was on site to conduct a plant noise survey in the vicinity of the proposed parabolic dish test site.

- The Heliostat wire walks have been changed from summer wire to winter wire walks. Personnel are cautioned that as a consequence, heliostat beams in transition from the ground points to the receiver standby points will now cross the southeast, and west core access roads.

Maintenance Highlightse

- Martin Marietta and McDonnell Douglas, continue to work on Heliostat Array Controller (HAC) and Beam Characterization System (BCS) software and documentation. Major efforts is BCS operation and HAC failover debugging. A problem with the BCS task in the HAC was found and corrected. It is believed this was causing the recent failovers. Auto BCS is running better now as a result of these changes. More operating time is required to establish confidence in the system.

- Routine lubrication of turbine generation slide racks, cooling water pumps, demineralizer sump pumps, oil separator sump pumps, sluice pumps, and the thermal storage feedwater pump were accomplished.

- Van Winkle Construction continues to work on the auxiliary bay wall enclosure. This wall enclosure will help freeze protect instrumentation and other equipment located in the auxiliary bay area.

- A failed coil was replaced on the emergency trip test solenoid on the turbine hydraulic system and contacts were cleaned on the generator voltage/hertz alarm relay.

- A receiver expansion guide (roller) inspection was conducted. No broken or damaged roller hardware was observed.

- Air filters on the control building air conditioners were checked and replaced as necessary.

- Clutches on the turbine speed load control potentiometer and turbine inlet pressure level control potentionmeter were tightened.

- High level alarms were installed on the in-line demineralizer caustic and acid day tanks. This is to help prevent any overfill on the day tanks.

- Inspections were conducted on the station uninterruptible power supply (UPS) battery systems. Cell 43 on the UPS was bad and was replaced.

- T & S construction continued work on the installation of the service jockey pump. The purpose of the jockey pump is to help reduce the plant's parasitic load.

- Leaky valves were replaced on the thermal storage extraction train #2 feedwater supply line vent valve and extraction train #1 feedwater heater tube side vent valve.

- Steam leak under the lagging on the main stop valve was detected. Upper flange bolts on the main steam stop valve were tightened.

- Electricians and technicians are working to reduce the number of out-of-service heliostats. The current number of heliostats out-of service is 76. The major problems with heliostats are related to motor seal wear and malfunction of azimuth and elevation encoders.

- Two leaks on the waste water blowdown line were repaired. The PVC couplings failed at their midpoint due to compressive or tensile stresses from thermally induced temperature transients.

- Miscellaneous maintenance work accomplished during the month of October, is as follows:

  - Calibrated service water tank level indicator.

- Repaired leak on the receiver downcomer valve (2905).
- Adjusted the set point on the east lube oil cooler safety valve.
- Replaced solenoid drain valve on preheat panel #3.
- Replaced air leak on the cooling tower blowdown regulator.
- Repaired the gear box on the main gate.
- Installed a new phone on the northeast corner of the guard building.
- Calibrated feedback signal on charging steam desuperheater valve TV-3105.
- Raised wind meter on the control room roof to allow more accurate wind speed measurements.
- Replaced gasket and calibrated temperature control valve on receiver panels 21 and 18.
- Repaired pre-filter pinhole leak on receiver panel #11.
- Repaired flange leaks on receiver flowmeters 4 and 5.
- Replaced cooling tower make-up bypass valve.
- Replaced diaphragm on level control valve of in-line demineralizer caustic day tank.
- Replaced and calibrated flowmeter on receiver panel #7.
- Replaced the faulty ammonia hand pump.

Plant Statistics	Oct. 83	Oct.84	Turbine Rol To Date
Net Energy Production MWH	98.2	591.1	2,122.7
Energy Production (MWH net while connected to the grid)	453.7	861.0	14,315.8
Hourly Peak Mw (Net)	9.8 *	9.2*	10.4*
On-Line Hours	87.4	138.5	2,671.4
Test Hours	101.6	0.0	1,621.7
Total Plant Outage Hours	74.7	50.5	2,010.1
Scheduled	12.0	3.8	837.3
Unscheduled	62.7	46.7	1,172.8
Weather Outage Hours	91.5	59.8	3,009.4

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*Receiver Generated Steam Only

Attachments:

- Chronological Summary of Receiver Tube Defects (Attachment 1).
- Solar One Statistics: weather outage hours, plant outage hours, test hours, and on-line hours (Attachment 2).
- Power production and plant testing were limited by 59.8 hours of weather outage. October was a positive output month, 591.1 MWH (Attachment 3).
- The daily and cumulative energy production while Solar One was on-line, for the three previous months and the year-to-date are shown on Attachments 4 and 5.

SOLAR ONE PERFORMANCE SUMMARY

1) Station Availability = $\frac{H \times kw}{Hp \times kw}$

H = Hours On-Line

kw = Rated Output

Hp = Period Hours

Receiver Availability	96.4%
Discharging Availability	100.0%
Charging Availability	100.0%
Turbine Availability	99.2%
Collector Availability	98.8%

NOTE: For the purpose of availability, weather outage hours are considered available operating hours.

2) Output Factor = $\frac{\text{Net Transmitted Power}}{\text{On-Line Hours} \times \text{Maximum Rated Capacity}}$

Output Factor ---------- 35.7%

3) Capacity Factor = $\frac{\text{Net Transmitted Power}}{\text{Period Hours} \times \text{Maximum Rated Capacity}}$

Capacity Factor ---------- 6.6%

4) Solar Capacity Factor =

$\frac{\text{Net Transmitted Power}}{\text{Integrated Insolation w-HR/m}^2 \times \text{Collector Field Surface Area}}$

Solar Capacity Factor ---------- 4.4%

Operation and Maintenance Costs

- A summary of the O&M labor, material, contract, and other costs for the month of October 1984 is shown on the attached table. Expenses are categorized as follows:

Field Office	-	Includes plant supervision, engineering, accounting, clerical, office supplies, and miscellaneous indirect expenses.
Operations	-	Includes total cost of operating staff and expenses.
Miscellaneous Support	-	Includes station supplies and rentals, safety and job training, and site security.
Maintenance	-	Includes total cost of maintenance staff and expenses allocated to major plant subsystems.
Overheads	-	Includes costs associated with direct labor plus company administrative and general expenses.

SOLAR ONE

MONTHLY O&M COST SUMMARY

($ X 1000)

MONTH OF OCTOBER, 1984

	LABOR	MATERIAL	CONTRACT	OTHER	TOTAL
FIELD OFFICE	19.1	0.0	0.0	1.4	20.5
OPERATIONS_	76.7	17.6	0.0	1.2	95.4
MISC. SUPPORT	13.7	3.4	4.4	1.4	23.0
MAINTENANCE					
Supervision/Indirects	14.8	2.9	0.1	0.1	17.8
Control System	6.3	1.3	7.0	0.2	14.8
Receiver System	2.3	3.7	0.0	0.0	6.0
Thermal Storage System	1.7	0.1	0.8	0.1	2.5
Collector System	7.5	5.1	1.5	.0	14.2
EPGS System	10.0	1.8	.0	0.1	
Misc.	4.3	1.0	1.0	.0	6.3
Total Maintenance	4.7	1.6	10.5	0.2	73.5
SUB TOTAL	156.3	36.9	15.0	4.2	212.4

Division O.H.	26.4
TOTAL DIRECT	238.8
Workman's Compensation	01.1
Payroll Tax	11.2
Pension & Benefits	33.4
Administrative & General	44.1
GRAND TOTAL	328.6

* $ 4.7 Polymetrics
5.9
2.3 Big Three
3.7 LA/Water Trea
$ 16.6

* * 5.1 BEI ELECTRONICS

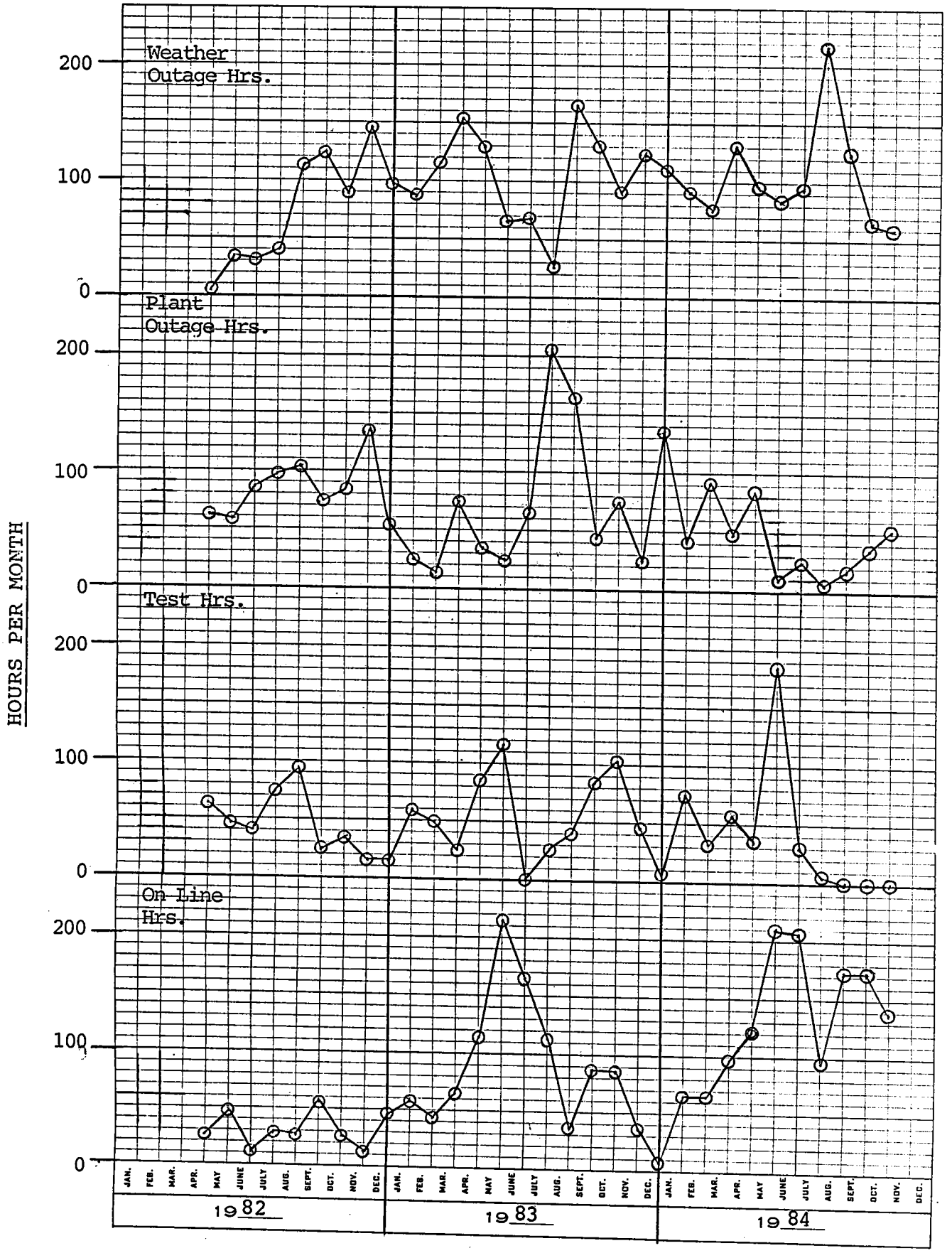
Attachment 1

SOLAR ONE GENERATING STATION

Chronological Summary of Receiver Tube Defects

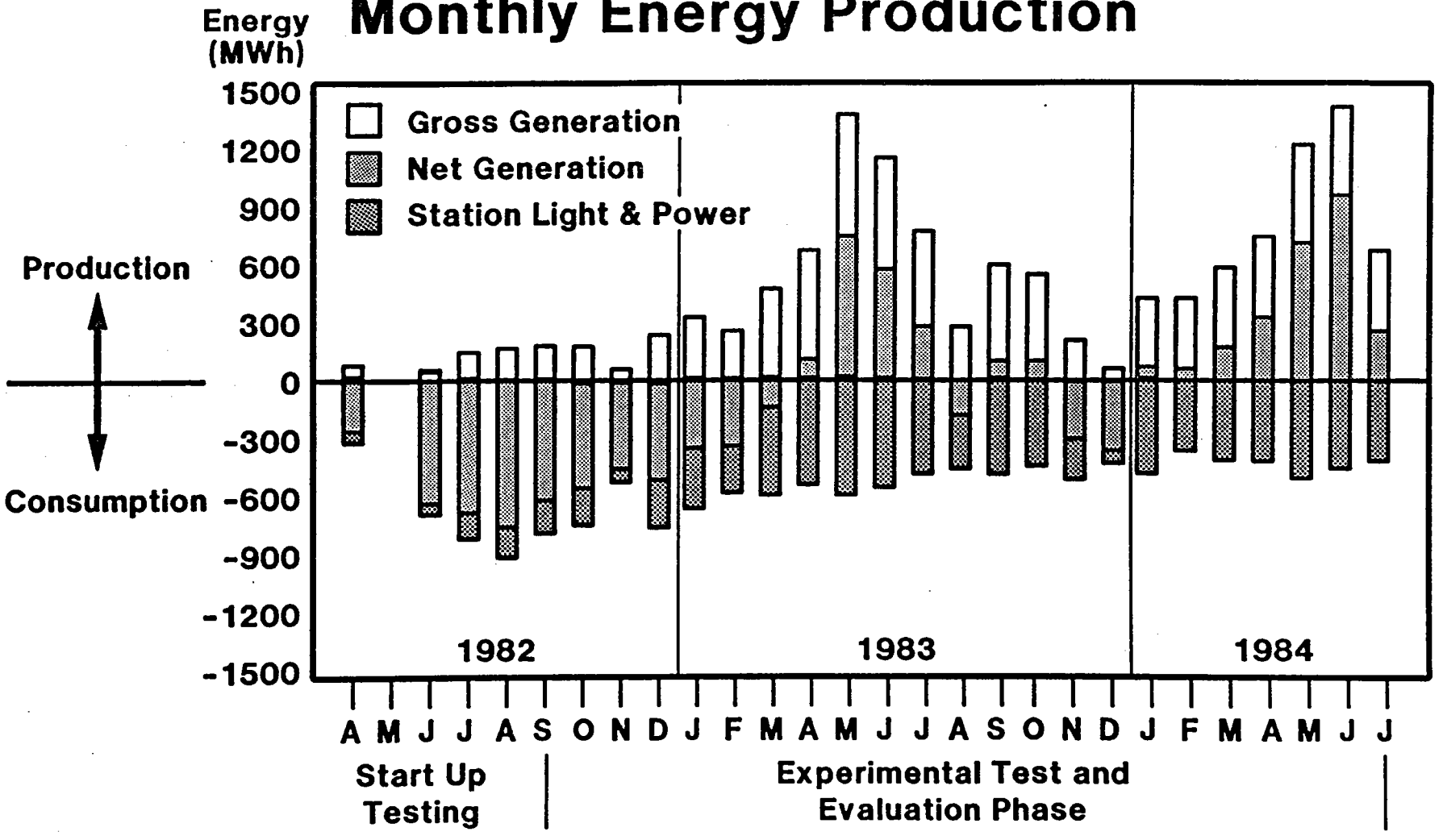
DATE	DESCRIPTION OF TUBE DEFECT	LOCATION
Jul 15, 1983	Interstitial weld leak	tube 30, panel 18
Jul 26, 1983	Interstitial weld leak	tube 41, panel 18
Aug 2, 1983	Bend leak	tube 70, panel 11
Aug 18, 1983	Repair/removal of sample	tube 30, panel 18
	Repair, grind & fill	tube 41, panel 18
Aug 19, 1983	Replaced cracked tube section	tube 70, panel 11
Sep 8, 1983	Crack indication	tube 30, panel 19
Oct 26, 1983	Crack indication	tube 1, panel 18
	Interstitial weld leak found & repaired	tube 41, panel 12
	Interstitial weld crack	tube 41, panel 13
Nov 1, 1983	Interstitial weld crack on:	tube 41, panel 4
		tube 41, panel 6
		tube 30, panel 7
		tube 41, panel 8
		tube 41, panel 9
		tube 30, panel 17
	Surface irregularity	tube 41, panel 10
Nov 16, 1983	Bend leak	tube 1, panel 15
	Bend crack	tube 1, panel 16
	Bend crack	tube 3, panel 16
	Bend crack	tube 1, panel 17
Dec 1983	Outage - Removal of sample	tube 1, panel 4
		tube 1, panel 6
	Repair of cracks	tube 1, panel 15
		tube 1, panel 16
		tube 2, panel 16
		tube 3, panel 16
Jan 1984	Outage - Interstitial weld crack repair	tube 41, panel 13
Feb 1984	Outage - Interstitial weld crack repair	tube 41, panel 8
	Interstitial weld crack repair	tube 41, panel 9
	Bend crack	tube 70, panel 9
	Bend crack	tube 70, panel 10
	Bend crack	tube 70, panel 11
	Bend crack	tube 70, panel 12
	Surface polished	tube 41, panel 10
Sept 1984	Outage - Bend Crack	tube 70, panel 8

SOLAR ONE STATISTICS



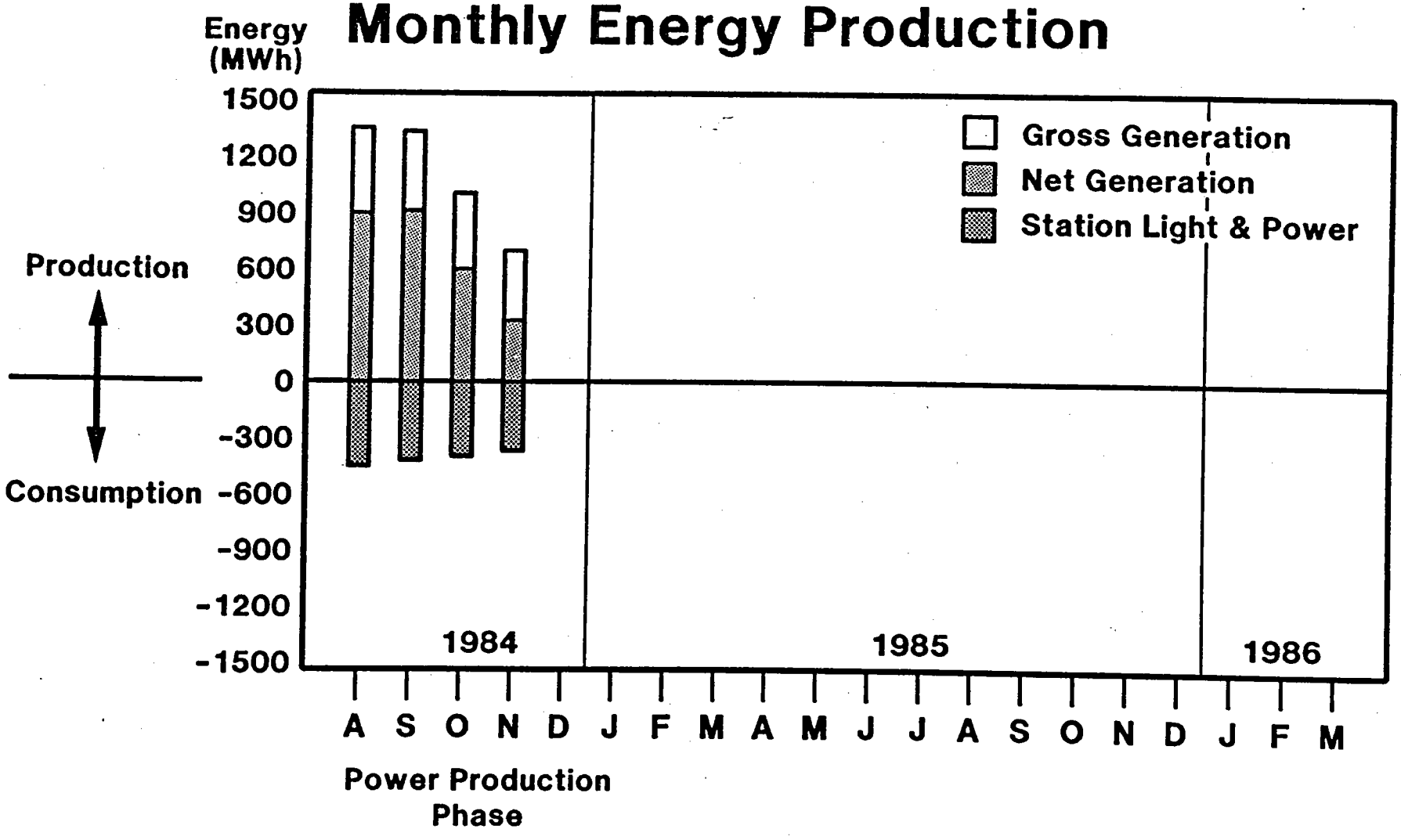
RMA 03/07/84

Solar One
Monthly Energy Production



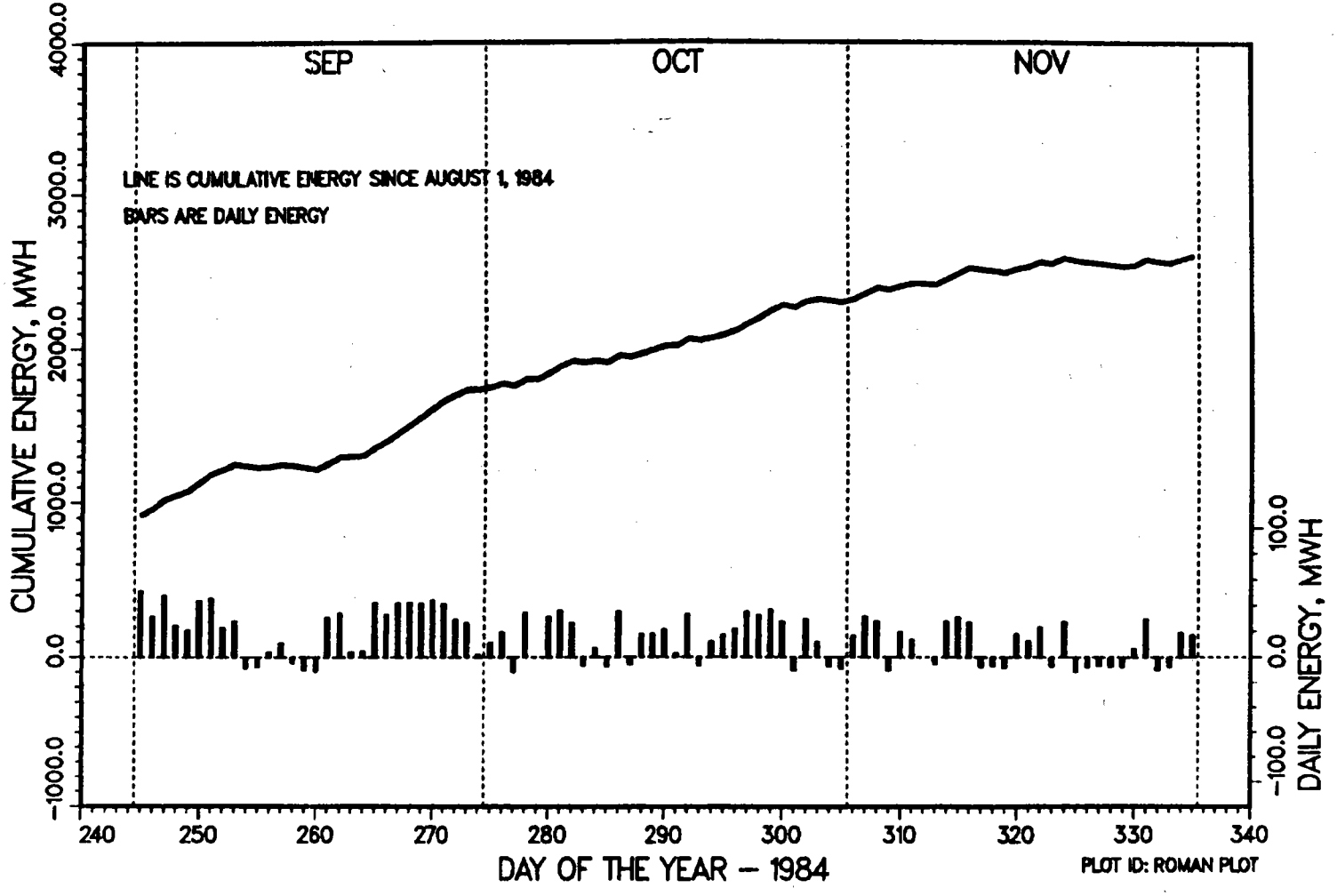
Attachment 3

Solar One
Monthly Energy Production

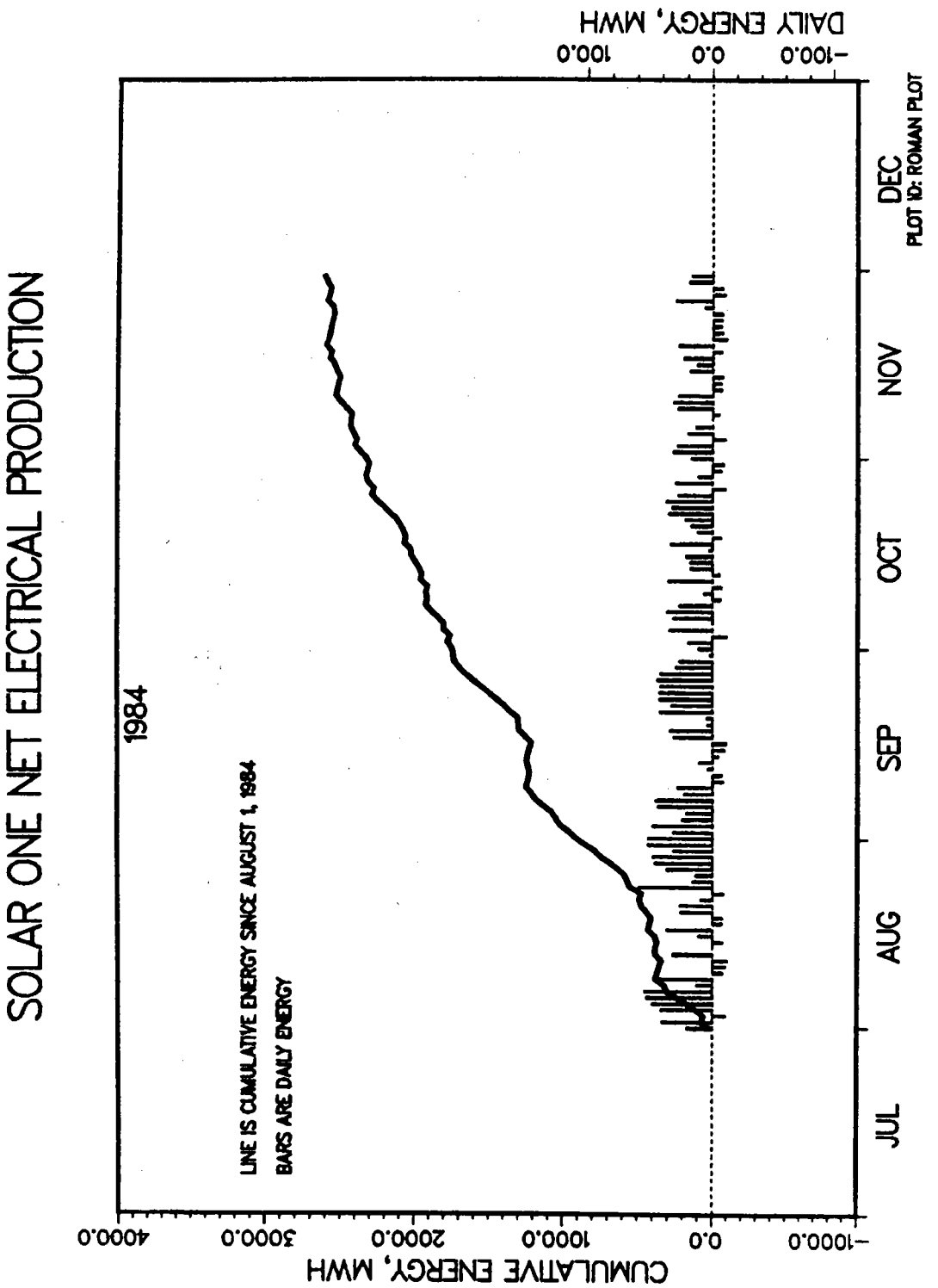


Attachment 3

SOLAR ONE NET ELECTRICAL PRODUCTION



Attachment 4


SOLAR ONE NET ELECTRICAL PRODUCTION
1984
LINE IS CUMULATIVE ENERGY SINCE AUGUST 1, 1984
BARS ARE DAILY ENERGY
CUMULATIVE ENERGY, MWH
4000.0
3000.0
2000.0
1000.0
0.0
-1000.0
DAILY ENERGY, MWH
100.0
0.0
-100.0
JUL
AUG
SEP
OCT
NOV
DEC
PLOT ID: ROMAN PLOT

DOE/SF/10501-230
(STMPO-230)

SOLAR ONE
OPERATION AND MAINTENANCE REPORT #30
SEPTEMBER 1984

THIS REPORT SUMMARIZES THE OPERATIONAL ACTIVITIES AND HIGHLIGHTS MAINTENANCE WORK THAT WAS PERFORMED DURING THE MONTH. IN ADDITION, IT PRESENTS PLANT STATISTICS AND A MONTHLY OPERATION AND MAINTENANCE COST SUMMARY.

Abstract

- Power production was limited by 66.6 hours of inclement weather and a scheduled five-day plant outage. The gross energy production for the month was 1,311.4 MWH and the net energy production was 895.9 MWH.

  A scheduled plant outage took place September 10 through September 14, to allow for dye penetrant inspection of receiver panel interestial welds, ulstrasonic inspection of receiver tube bends and inspection of all receiver panel expansion guides (rollers). Also, 4 KV breaker routines and computer programming was accomplished.

Operational Highlights

- Preliminary indications from the receiver absorbtivity measurements are that there is some further reduction in absorbtivity. A quantitative number will be available after the data is analyzed.

- Panel 16 has developed a warp over the last few months and an expansion guide (roller) inspection was performed by SCE. Level four expansion guides appear to be failing. If level one is hanging up in anyway, it could have caused the panel 16 warp. The expansion guides from other levels appear to be rolling. SCE is waiting for recommendations from Sandia and MCDAC to help resolve the expansion guide (roller) problem.

- There was a status review of the MDAC documentation activities and most of the asbuilt documents will be delivered during the month of October and a few in November.

- On Wednesday, September 5, SCE system peak in power demand set a new all time record of 15,189 MW. It should be noted that one of the key parameters in evaluating a power plant's value is its ability to perform during critical power generation demand periods. Solar One produced 26.4 MWH net during the system's peak.

- Mirror module #11 on Heliostat No. 0236 was found to have an approximate two inch diameter crack.

- Heliostat reflectivity readings were obtained on Friday, September 7. Average collector field reflectivity was 87.8%.

- On September 20, a problem with the receiver feedwater pump hydraulic coupling (scoop tube speed controller) was experienced during startup and caused the unit to be removed off-line. The receiver feed pump scoop tube drive motor "lower" position limit switch was repaired and a plant startup was accomplished.

- On September 26, low voltage was noticed on the generator 13.8 KV, on the 4 KV, and the 480 V systems. This low voltage situation was also noticed at Gale Sub in Daggett by an area operator from Lugo Sub. The cause of the low voltage was not determined. Suspect this caused a Heliostat Array Controller failover while running the Auto Beam Characterization System program.

Maintenance Highlights

- During the outage, dye penetrant inspection of interstice weld areas on the receiver was completed. No tube cracks were found. The root of the notch made in the interstice weld earlier this year shows some axial cracking up to 7mm long, (panel 13, between tubes 40 and 41), indicating that the fix continues to work.

  Also, ultrasonic inspection of receiver edge tubes was completed. The six known cracks were reconfirmed and one new crack, panel 8, tube 70, was found. The crack has reached the outer surface. There are now three tubes which show visable cracks on the surface. There are no indications of significant leakage from the cracks.

- Martin Marietta (MMC) personnel returned to the site to resume Collector System software work. The emphasis will be on the Beam Characterization System, Heliostat Array Controller, and technical documentation. Martin Marietta will investigate the cause of the failovers which occur infrequently. The Heliostat Array Controller software documentation will be updated, this activity will continue through November.

- There was a review of the Heliostat Controller problems and the studies which SCE has been conducting to isolate the causes. Several good ideas have come from this effort and they are being implemented by SCE maintenance. There are 80 Heliostat Controllers which are out of service and many of them fail repeatedly. Encoder failures may account for up to 40 of these bad controllers.

- A new ammonia storage shed was constructed outside the auxiliary bay area. This will minimize the level of ammonia

vapors that were previously present in the auxiliary bay area.

- Service contractor, Communications Maintenance, Inc., will continue troubleshooting and repairing Modcomp hardware problems on the Heliostat Array Controllers, Beam Characterization System, Data Acquisition System, and Operational Control System.

- McDonnell Douglas worked on software changes in the measurement validation area of the Data Acquisition System, and also worked on software for the Auto Beam Characterization System Program.

- Van Winkle Construction Company started installing an auxiliary bay enclosure for winterization. This is to help freeze protect all instrumentation in the auxiliary bay area.

- Four leaks on the waste water blowdown line were repaired. The pvc couplings failed at its midpoint due to compressive or tensile stresses from thermally induced temperature transients.

- The make-up four inch water line to the cooling tower was repaired. Suspect a glue joint on the fiberglass water line failed due to surging (water hammer).

- Heater and cooler units were installed in the warehouse to make a better working environment.

- Miscellaneous maintenance work accomplished during the month of September, including work performed during the outage period, is as follows:

  - Repaired broken water level guage strap on the service water tank.

  - A representative of Clark Pest Control was on station to spray for black widow spiders.

  - Repaired prefilter leaks on receiver panels 11, 12, 17, 18, and 19.

  - Replaced flowmeters on receiver panels 4, 9, 16, and 21.

  - Replaced stud on expansion guide assembly on receiver panel 13, level 5.

  - Replaced heat flux transducers on receiver panels 9, 14, 15, and 19.

  - Replaced two warehouse fire detectors.

  - Replaced drain valve on charging train #1.

- Repaired vent orifice leak on charging train #2.
- Replaced control switch on make-up demineralizer transfer pump.
- Performed routines on data acquisition system.
- Repaired a broken roller on the plant's main gate.

Plant Statistics	Sept. 83	Sept. 84	Turbine Rol To Date
Net Energy Production MWH	99.9	895.9	1,531.6
Energy Production (MWH net while connected to the grid)	496.4	1,159.3	13,454.8
Hourly Peak Mw (Net)	9.7*	9.6*	10.4*
On-Line Hours	88.9	172.9	2,532.9
Test Hours	83.3	0.0	1,621.7
Total Plant Outage Hours	46.2	36.3	1,956.6
Scheduled	22.0	29.5	833.5
Unscheduled	24.2	6.8	1,126.1
Weather Outage Hours	131.0	66.6	2,949.6

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*Receiver Generated Steam Only

Attachments:

- Chronological Summary of Receiver Tube Defects (Attachment 1).
- Solar One Statistics: weather outage hours, plant outage hours, test hours, and on-line hours (Attachment 2).
- Power production was limited by 66.6 hours of weather outage. September was a positive output month, 895.9 MWH (Attachment 3).
- The daily and cumulative energy production while Solar One was on-line for the two previous months during the power production phase is shown on Attachment 4.

SOLAR ONE PERFORMANCE SUMMARY

1) Station Availability = $\frac{H \times kw}{Hp \times kw}$

H = Hours On-Line

kw = Rated Output

Hp = Period Hours

Receiver Availability	95.0%
Discharging Availability	100.0%
Charging Availability	100.0%
Turbine Availability	100.0%
Collector Availability	100.0%

NOTE: For the purpose of availability, weather outage hours are considered available operating hours.

2) Output Factor = $\frac{\text{Net Transmitted Power}}{\text{On-Line Hours} \times \text{Maximum Rated Capacity}}$

Output Factor ---------- 43.4%

3) Capacity Factor = $\frac{\text{Net Transmitted Power}}{\text{Period Hours} \times \text{Maximum Rated Capacity}}$

Capacity Factor ---------- 10.4%

4) Solar Capacity Factor =

$\frac{\text{Net Transmitted Power}}{\text{Integrated Insolation w-HR/m}^2 \times \text{Collector Field Surface Area}}$

Solar Capacity Factor ---------- 7.0%

- A summary of the O&M labor, material, contract, and other costs for the month of September 1984 is shown on the attached table. Expenses are categorized as follows:

Field Office	-	Includes plant supervision, engineering, accounting, clerical, office supplies, and miscellaneous indirect expenses.
Operations	-	Includes total cost of operating staff and expenses.
Miscellaneous Support	-	Includes station supplies and rentals, safety and job training, and site security.
Maintenance	-	Includes total cost of maintenance staff and expenses allocated to major plant subsystems.
Overheads	-	Includes costs associated with direct labor plus company administrative and general expenses.

SOLAR ONE

MONTHLY O&M COST SUMMARY

(X 1000)

MONTH OF SEPTEMBER 1984

	LABOR	MATERIAL	CONTRACT	OTHER	TOTAL
FIELD OFFICE	12.3	.2	.0	2.9	15.4
OPERATIONS	50.9	3.5	.0	1.2	55.6
MISC. SUPPORT	4.5	1.7	2.1	.7	9.0
MAINTENANCE					
Supervision/Indirects	11.1	4.3	.0	.3	15.7
Control System	6.8	(.3)	10.7	2.1	19.3
Receiver System	4.7	2.4	.0	.3	7.4
Thermal Storage System	.3	1.1	.2	.2	1.8
Collector System	3.9	.0	.8	.0	4.7
EPGS System	5.3	6.9	.0	.3	12.5
Misc.	5.7	1.1	5.5	.0	12.3
Total Maintenance	37.8	15.5	17.2	3.2	73.7
SUB TOTAL	105.5	20.9	19.3	8.0	153.7
Division O.H.					19.6
TOTAL DIRECT					173.3
Workman's Compensation					.8
Payroll Tax					7.8
Pension & Benefits					23.3
Administrative & General					32.1
GRAND TOTAL					237.3

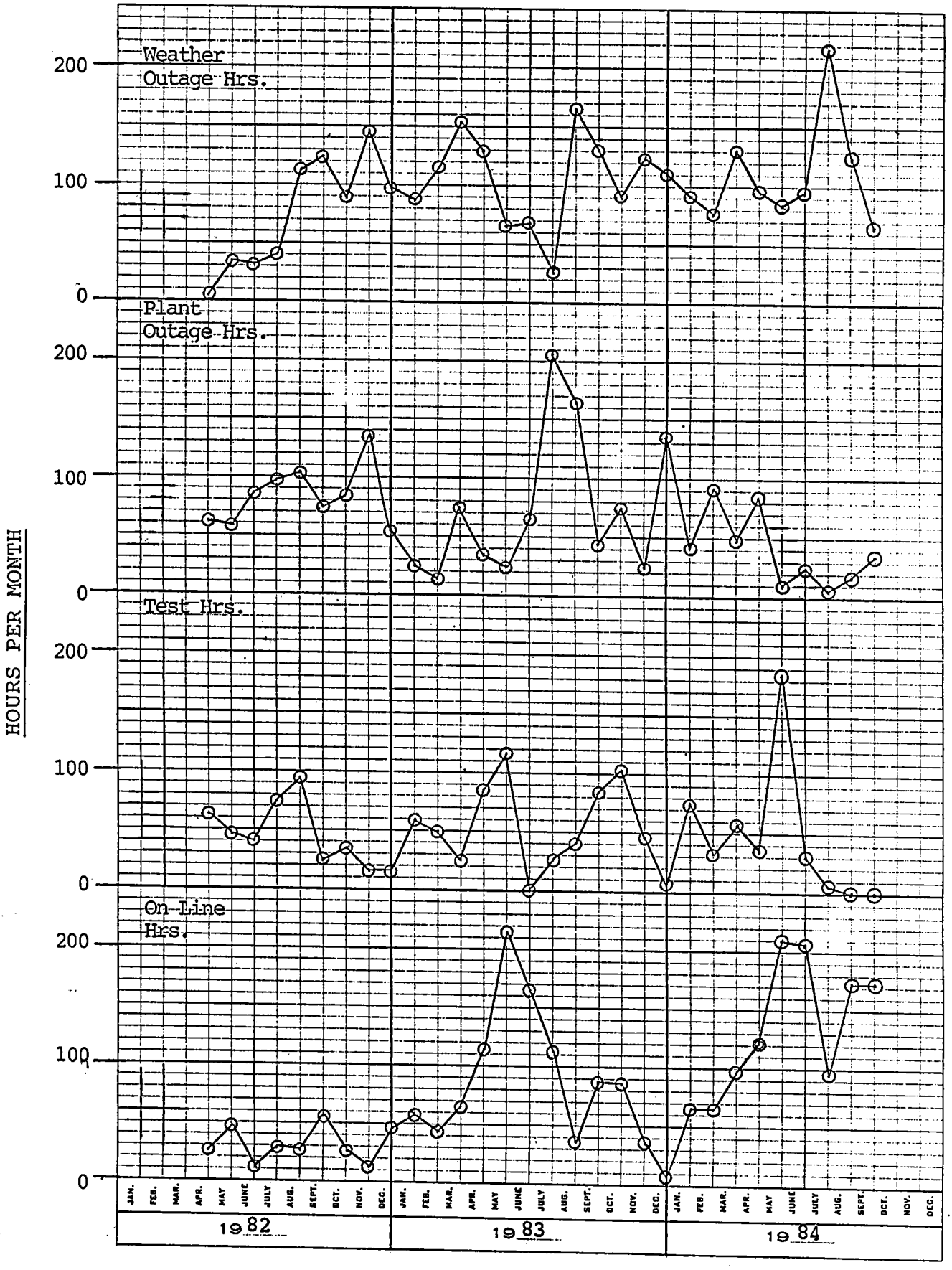
Attachment 1

SOLAR ONE GENERATING STATION

Chronological Summary of Receiver Tube Defects

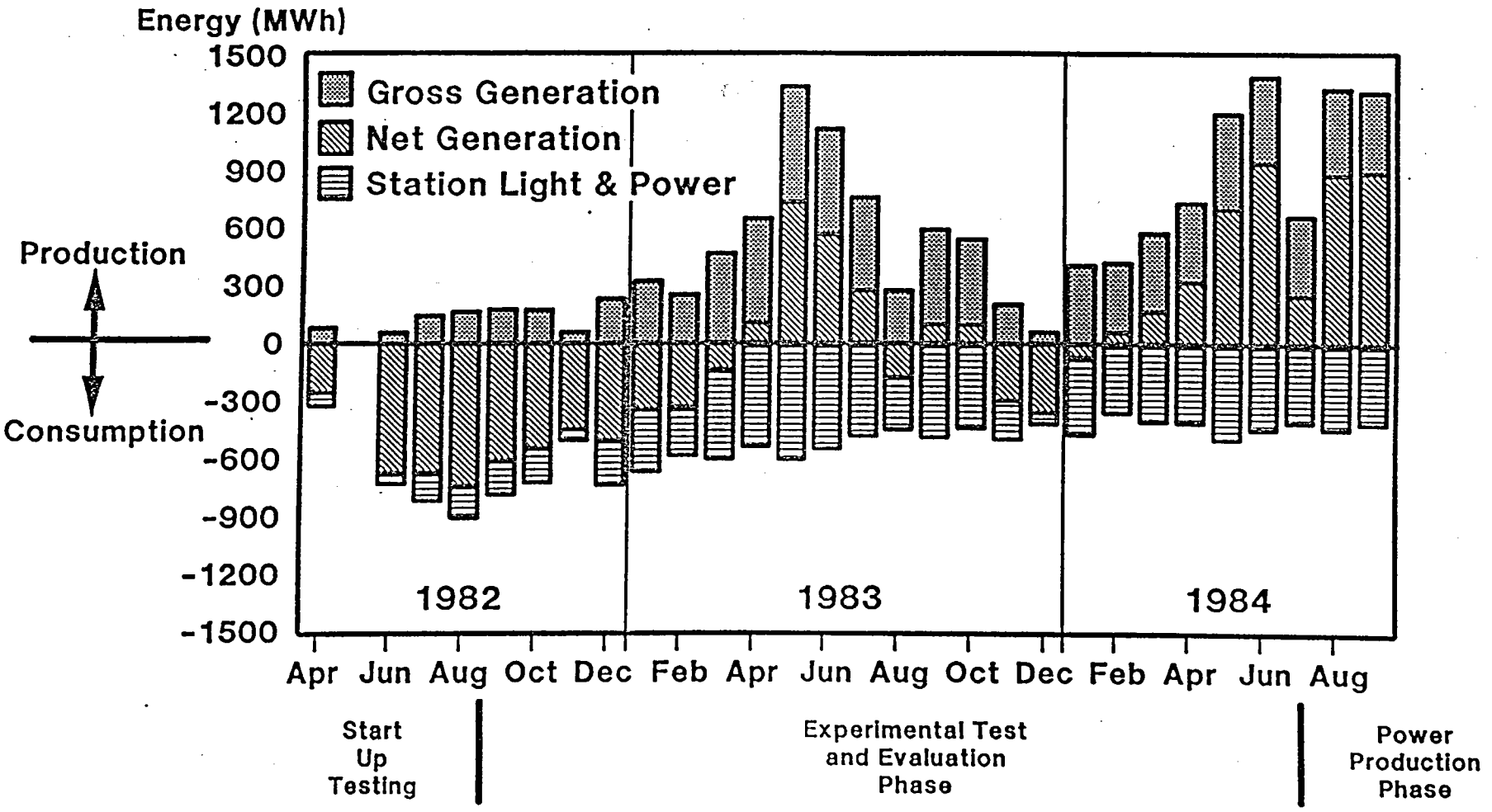
DATE	DESCRIPTION OF TUBE DEFECT	LOCATION
Jul 15, 1983	Interstitial weld leak	tube 30, panel 18
Jul 26, 1983	Interstitial weld leak	tube 41, panel 18
Aug 2, 1983	Bend leak	tube 70, panel 11
Aug 18, 1983	Repair/removal of sample	tube 30, panel 18
	Repair, grind & fill	tube 41, panel 18
Aug 19, 1983	Replaced cracked tube section	tube 70, panel 11
Sep 8, 1983	Crack indication	tube 30, panel 19
Oct 26, 1983	Crack indication	tube 1, panel 18
	Interstitial weld leak found & repaired	tube 41, panel 12
	Interstitial weld crack	tube 41, panel 13
Nov 1, 1983	Interstitial weld crack on:	tube 41, panel 4
		tube 41, panel 6
		tube 30, panel 7
		tube 41, panel 8
		tube 41, panel 9
		tube 30, panel 17
	Surface irregularity	tube 41, panel 10
Nov 16, 1983	Bend leak	tube 1, panel 15
	Bend crack	tube 1, panel 16
	Bend crack	tube 3, panel 16
	Bend crack	tube 1, panel 17
Dec 1983	Outage - Removal of sample	tube 1, panel 4
		tube 1, panel 6
	Repair of cracks	tube 1, panel 15
		tube 1, panel 16
		tube 2, panel 16
		tube 3, panel 16
Jan 1984	Outage - Interstitial weld crack repair	tube 41, panel 13
Feb 1984	Outage - Interstitial weld crack repair	tube 41, panel 8
	Interstitial weld crack repair	tube 41, panel 9
	Bend crack	tube 70, panel 9
	Bend crack	tube 70, panel 10
	Bend crack	tube 70, panel 11
	Bend crack	tube 70, panel 12
	Surface polished	tube 41, panel 10
Sept 1984	Outage - Bend Crack	tube 70, panel 8

SOLAR ONE STATISTICS



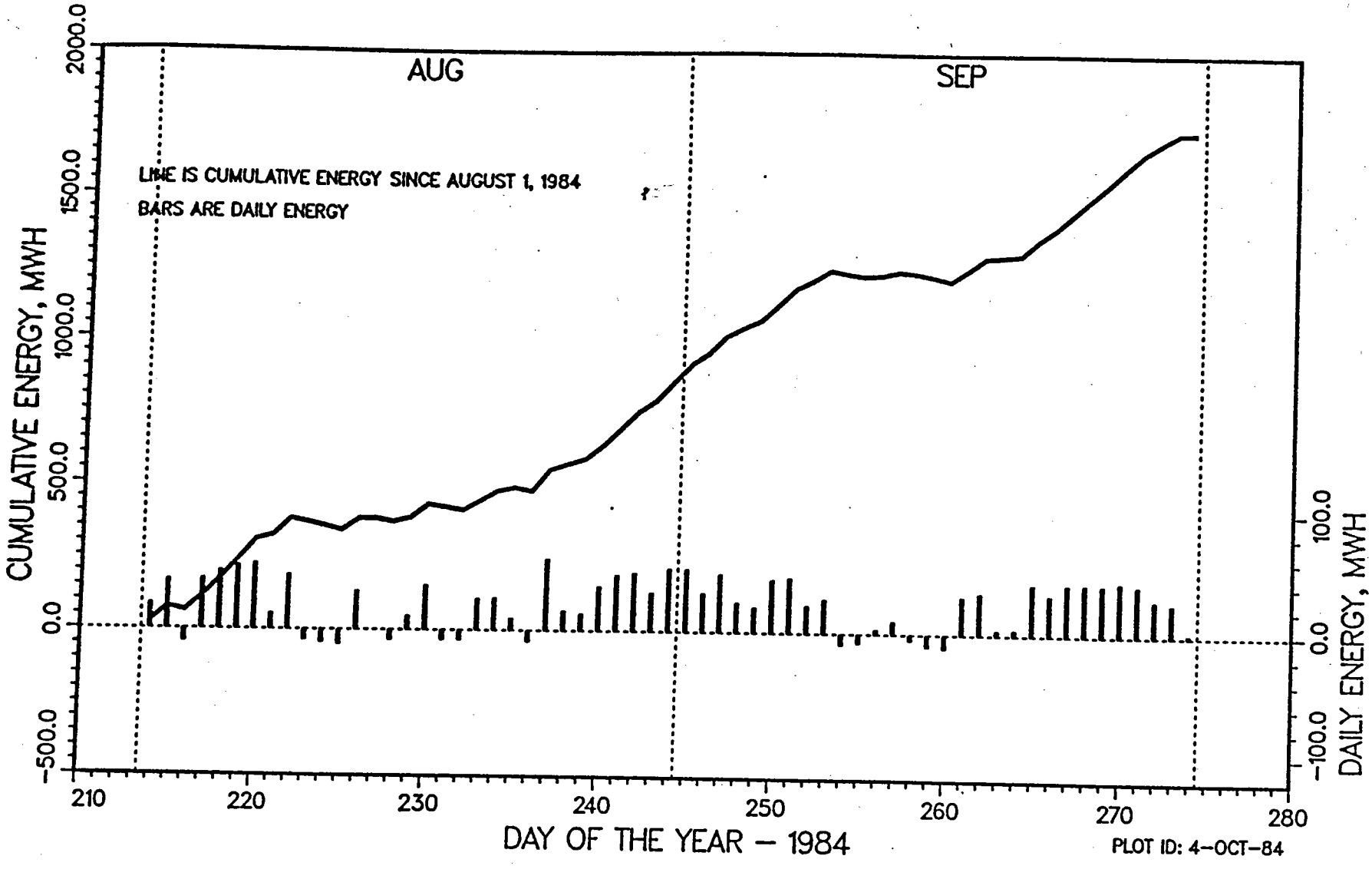
RMA 03/07/84

Solar One
Monthly Energy Production



ATTACHMENT 3

SOLAR ONE NET ELECTRICAL PRODUCTION



ATTACHMENT 4

84-RD-144

DOE/SF/10501-229
(STMPO-829)
8

SOLAR ONE
OPERATION AND MAINTENANCE REPORT #29
AUGUST 1984

THIS REPORT SUMMARIZES THE OPERATIONAL ACTIVITIES AND HIGHLIGHTS MAINTENANCE WORK THAT WAS PERFORMED DURING THE MONTH. IN ADDITION, IT PRESENTS PLANT STATISTICS AND A MONTHLY OPERATION AND MAINTENANCE COST SUMMARY.

Abstract

August 1, 1984 marks the beginning of a three-year power production phase. Power production during the month of August was limited by 124.9 hours of inclement weather. The gross energy production for the month of August was 1,328.6 MWH and the net energy production was 883.0 MWH.

Operational Highlights

- On August 7 peak gross generation reached 10.7 MWe, this was not a record but was the highest observed this year.

- Receiver flow oscillations on panels 4 and 21 have been observed on high insolation days when the plant is operating at a steam temperature of 775 degrees F. The oscillations occur when the flow in a panel reaches or exceeds the limit of the flowmeter and the control system attempts to regulate the temperature.

  The short term solution is to operate the plant at 850 degrees F when required to prevent oscillations. The long term solution is to re-range the flowmeters. A recommendation will be developed by Sandia and MDAC.

- On August 15 the collector field received a good rain wash during day shift. Readings indicated the collector field to be about 93.5 percent clean following the rainwash.

- On August 19 the plant experienced power interruptions during storm passage causing a Heliostat Array Controller (HAC) failover and loss of communications to over 1100 heliostats. Swing and graveyard shift spent the remainder of the shifts preparing the plant for power production.

- A formal gathering was held on August 21 to commemorate the official transition from testing to power generation phase II. Officials present included Mr. Gould, Dr. Papay, Mr. Head, Mr. McCarthy, Mr. Currie, SCE; Mr. Hodel, Mr. Cherian, Department of Energy and other participating organizations.

- On August 24 a new twenty-four hour record for receiver steam only was set. Unit was on-line for ten hours and twenty-five

minutes. Gross generation was 90.24 MW and total transmitted was 73.72 MW.

- A problem with the receiver feedwater pump not toggling into speed control automatically was experienced during early morning startup. The feed pump had to be manually placed in speed control. The problem is under investigation.

- On August 25 a low voltage dip was experienced at 1406 hours due to lightning in the area. Communication was lost to 699 heliostats. Power cycled to the heliostat field and restored communication.

Maintenance Highlights

- The administration building service water line leak was repaired. Suspect a glue joint on the fiberglass water line failed due to surging (water hammer).

- General Paving was on station to repave the section of roadway east of the thermal storage trains that was initially removed during the acid spill clean-up.

- McDonnell Douglas was on site to repair a cable on the sunshape camera and reconnect the Beam Characterization System camera monitor.

- The hydrazine pump motor was repaired. Motor bearings and brushes were replaced, and the commutator was cleaned. Normal mechanical wear seem to be the problem.

- Power receptacle outlets (115 volt) were installed in the Thermal Storage System area for easier access of electrical power.

- Electricians and technicians are working to reduce the number of out-of-service heliostats. The current number of heliostats out-of-service is 49. The major problems with heliostats are related to motor seal wear and malfunction of azimuth and elevation encoders.

- New resin was added to the regeneration vessel for inline demineralizer bed #2. The old resin was completely exhausted and therefore could no longer be regenerated to its natural stage for further use.

- Replaced a leaky root valve bonnet associated with the admission steam header pressure switch PS-1024 sensing line.

- Repaired leaky valve seats on the circulating water inlet and outlet valves to the cooling water heat exchanger.

- Sandia, was on site to remove and inspect the extensiometers on Thermal Storage System train #2.

- Quality Sprayers was on station and removed weeds from the collector field.

- Communications Maintenance Inc. worked on the Operational Control System (OCS) and Beam Characterization System (BCS) computer problems. The memory board on OCS was replaced and the peripheral switch problem on BCS was corrected.

- During a subsequent power cycle, A01-7 (4kV west field electrical breaker) would not close. Breaker was found to be mechanically bound and was replaced with a spare breaker.

- The lab conductivity meter was repaired after adjusting the slide-wire mechanism within the meter.

- Miscellaneous maintenance work accomplished during the month of August, is as follows:

  - Replaced flowmeter flange gasket on receiver panel 16.

  - Replaced pre-filter leak gasket on receiver panel 5.

  - Added 2 cubic feet of cation resin on inline demineralizer mixed-bed #1.

  - Recalibrated caustic and acid introduction solumeters on the inline demineralizer.

  - Repaired plug leak on the bottom of the receiver feed pump.

  - Cleaned internals on service water regulator to the make-up demineralizer.

  - Repaired temperature control valve bonnet leak on receiver panel 13.

  - Repaired oil pressure sensing line leak on the east air compressor 901.

  - Inspected and calibrated level switches on the oily waste water separator sump pump.

  - Beam Characterization System (BCS) cameras were inspected and cleaned.

  - Replaced float and guide tube assembly on level indicator of cooling tower acid tank 904.

  - Obtained resin sample on inline demineralizer bed #1 for analysis.

Plant Statistics	August'83	August'84	Turbine Roll To Date
Net Energy Production MWH	-177.0	883.0	635.7
Energy Production (MWH net while connected to the grid)	234.7	1,169.6	12,295.5
Hourly Peak MW (Net)	9.9*	10.2*	10.4*
On-Line Hours	38.3	170.9	2,360.0
Test Hours	41.0	0.0	1,621.7
Total Plant Outage Hours	165.0	19.5	1,923.3
Scheduled	0.0	0.0	804.0
Unscheduled	165.0	19.5	1,119.3
Weather Outage Hours	166.0	124.9	2,883.0

---

*Receiver Generated Steam Only

Attachments:

- Chronological Summary of Receiver Tube Defects (Attachment 1).
- Solar One Statistics: Weather outage hours, plant outage hours, test hours, and on-line hours (Attachment 2).
- Power production and plant testing were limited by 124.9 hours of weather outage. August was a positive output month, 883.0 MWH (Attachment 3).
- The daily and cumulative energy production while Solar One was on-line for the two previous months during the power production phase is shown on Attachment 4.

Solar One Performance Summary

1) Station Availability = $\frac{H \times kw}{Hp \times kw}$

H = Hours On-Line

kw = Rated Output

Hp = Period Hours

Receiver Availability	97.4%
Discharging Availability	100.0%
Charging Availability	100.0%
Turbine Availability	100.0%
Collector Availability	100.0%

Note: For the purpose of availability, weather outage hours are considered available operating hours.

2) Output Factor = $\frac{\text{Net Transmitted Power}}{\text{On-Line Hours x Maximum Rated Capacity}}$

Output Factor	40.8%

3) Capacity Factor = $\frac{\text{Net Transmitted Power}}{\text{Period Hours x Maximum Rated Capacity}}$

Capacity Factor	9.4%

4) Solar Capacity Factor =

$$\frac{\text{Net Transmitted Power}}{\text{Integrated Insolation W-HR/m}^2 \text{ x Collector Field Surface Area}}$$

Solar Capacity Factor	6.7%

Operation and Maintenance Costs

- A summary of the O&M labor, material, contract, and other costs for the month of August 1984 is shown on the attached table. Expenses are categorized as follows:

Field Office	-	Includes plant supervision, engineering, accounting, clerical, office supplies, and miscellaneous indirect expenses.
Operations	-	Includes total cost of operating staff and expenses.
Miscellaneous Support	-	Includes station supplies and rentals, safety and job training, and site security.
Maintenance	-	Includes total cost of maintenance staff and expenses allocated to major plant subsystems.
Overheads	-	Includes costs associated with direct labor plus company administrative and general expenses.

SOLAR ONE

MONTHLY O&M COST SUMMARY
($ X 1000)

MONTH OF AUGUST 1984

	LABOR	MATERIAL	CONTRACT	OTHER	TOTAL
FIELD OFFICE	15.5	.5	-	3.7	19.7
OPERATIONS	50.8	30.6 *	-	.3	81.7
MISC. SUPPORT	4.1	.1	4.4	.1	8.7
MAINTENANCE					
Supervision/Indirects	11.0	2.0	.1	.1	13.2
Control System	6.0	3.6	5.1	-	14.7
Receiver System	2.1	.1	-	-	2.2
Thermal Storage System	.9	-	.1	-	1.0
Collector System	5.5	-	3.2	-	8.7
EPGS System	4.5	(.6)	3.4	-	7.3
Misc.	5.6	7.6	4.4	-	17.6
Total Maintenance	35.6	12.7	16.3	.1	64.7
SUB TOTAL	106.0	43.9	20.7	4.2	174.8
Division O. H.					21.7
TOTAL DIRECT					196.5
Workman's Compensation					.8
Payroll Tax					8.0
Pension & Benefits					23.9
Administrative & General					36.1
GRAND TOTAL					265.3

* Turbine Generator Operations

Demineralizer Resin	$13,767.81
Big Three	2,470.94
Polymetrics	4,783.95
Polymetrics	7,025.83

Attachment 1

SOLAR ONE GENERATING STATION

Chronological Summary of Receiver Tube Defects

DATE	DESCRIPTION OF TUBE DEFECT	LOCATION
Jul 15, 1983	Interstitial weld leak	tube 30, panel 18
Jul 26, 1983	Interstitial weld leak	tube 41, panel 18
Aug 2, 1983	Bend leak	tube 70, panel 11
Aug 18, 1983	Repair/removal of sample	tube 30, panel 18
	Repair, grind & fill	tube 41, panel 18
Aug 19, 1983	Replaced cracked tube section	tube 70, panel 11
Sep 8, 1983	Crack indication	tube 30, panel 19
Oct 26, 1983	Crack indication	tube 1, panel 18
	Interstitial weld leak found & repaired	tube 41, panel 12
	Interstitial weld crack	tube 41, panel 13
Nov 1, 1983	Interstitial weld crack on:	tube 41, panel 4
		tube 41, panel 6
		tube 30, panel 7
		tube 41, panel 8
		tube 41, panel 9
	Surface irregularity	tube 30, panel 17
		tube 41, panel 10
Nov 16, 1983	Bend leak	tube 1, panel 15
	Bend crack	tube 1, panel 16
	Bend crack	tube 3, panel 16
	Bend crack	tube 1, panel 17
Dec 1983	Outage - Removal of sample	tube 1, panel 4
		tube 1, panel 6
	Repair of cracks	tube 1, panel 15
		tube 1, panel 16
		tube 2, panel 16
		tube 3, panel 16
Jan 1984	Outage - Interstitial weld crack repair	tube 41, panel 13
Feb 1984	Outage - Interstitial weld crack repair	tube 41, panel 8
	Interstitial weld crack repair	tube 41, panel 9
	Bend crack	tube 70, panel 9
	Bend crack	tube 70, panel 10
	Bend crack	tube 70, panel 11
	Bend crack	tube 70, panel 12
	Surface polished	tube 41, panel 10

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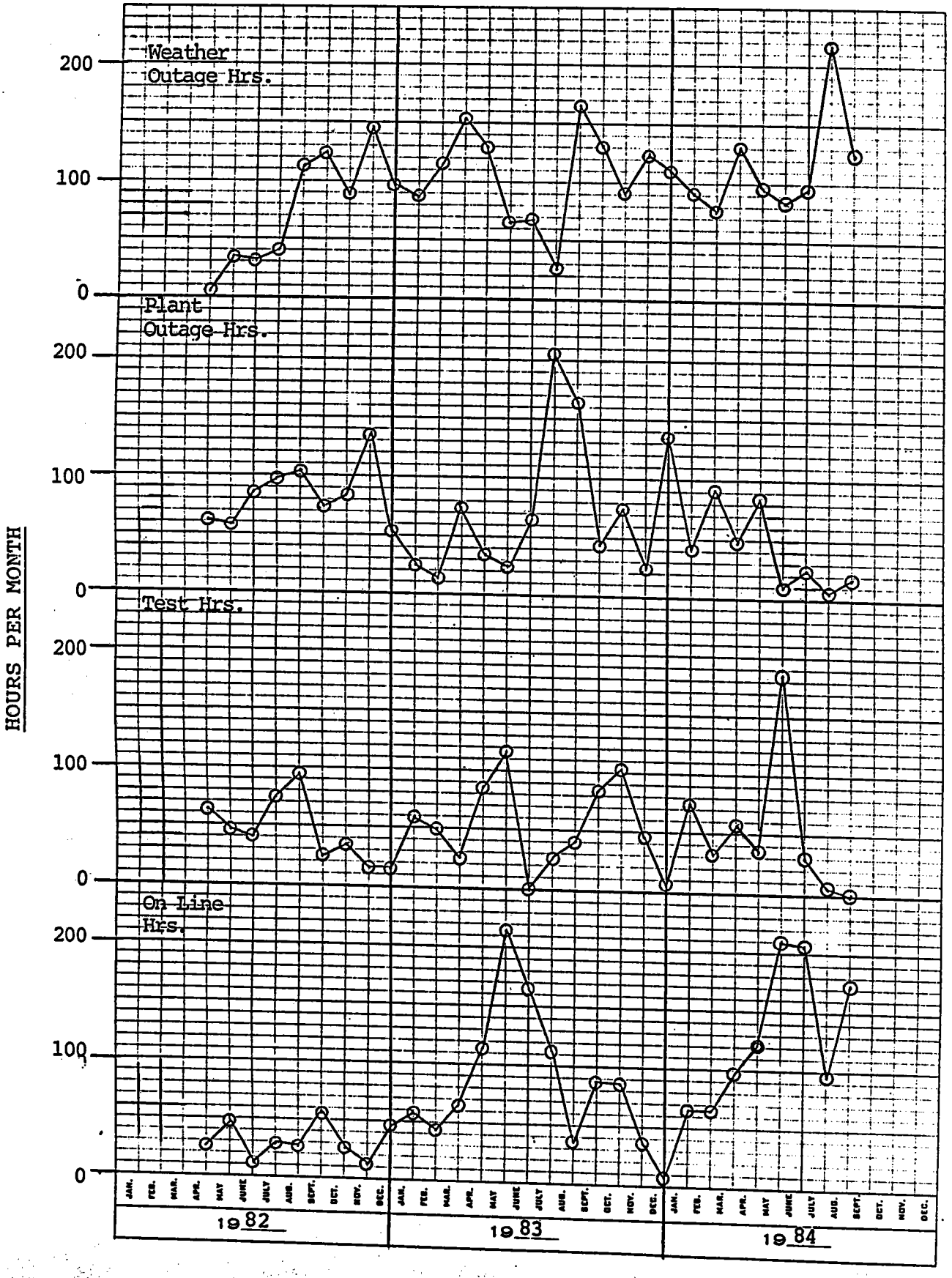
leaks.rno

Attachment 2

SOLAR ONE STATISTICS



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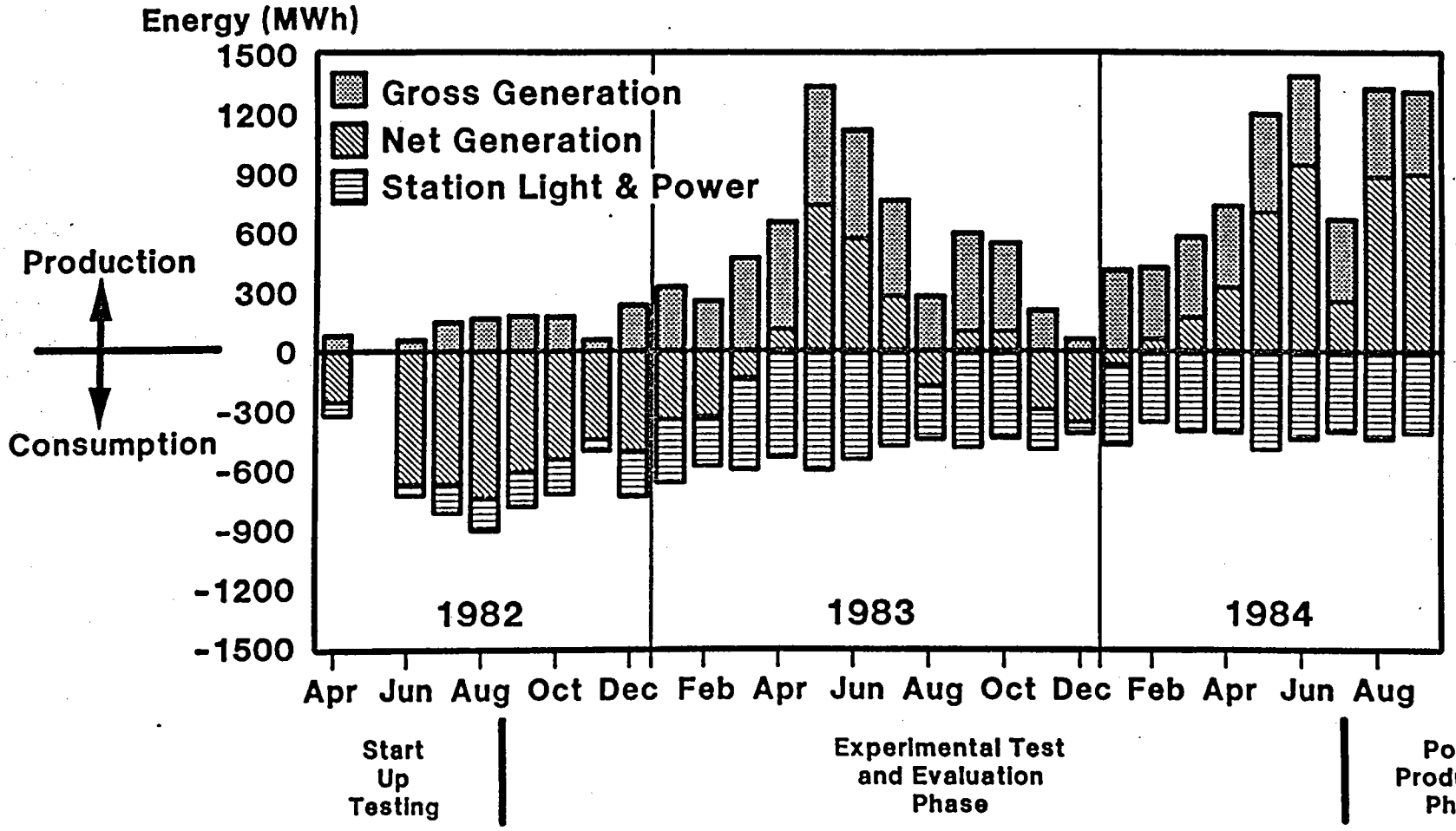
NO. 340-T3D DIETZGEN GRAPH PAPER 3 YEARS BY MONTHS

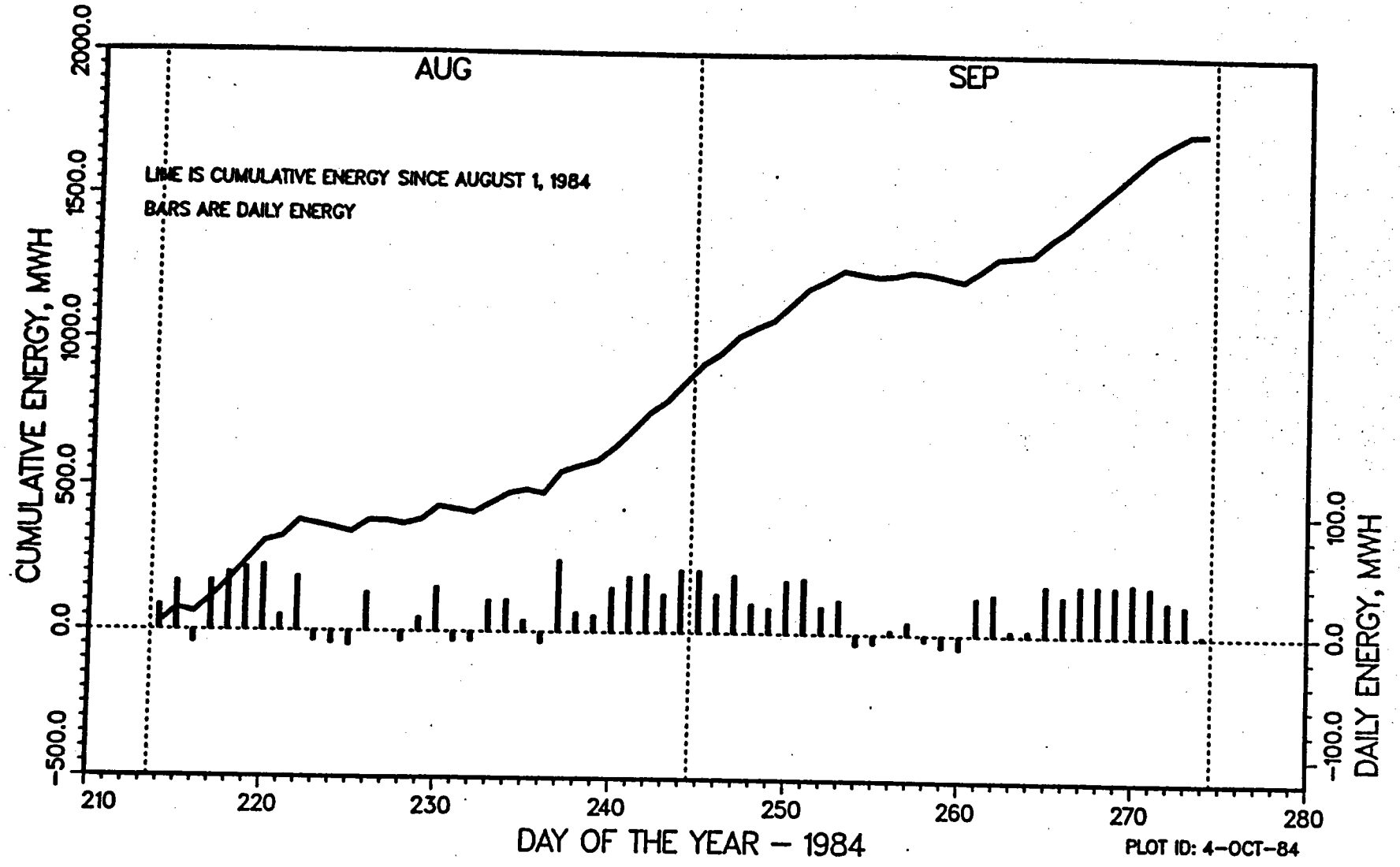
RMA 03/07/84

Solar One
Monthly Energy Production



Attachment 3

SOLAR ONE NET ELECTRICAL PRODUCTION



Attachment 4

DOE/SF/10501-228
(STMPO-828)

SOLAR ONE
OPERATION AND MAINTENANCE REPORT #28
JULY 1984

THIS REPORT SUMMARIZES THE OPERATIONAL ACTIVITIES AND HIGHLIGHTS MAINTENANCE WORK THAT WAS PERFORMED DURING THE MONTH. IN ADDITION, IT PRESENTS PLANT STATISTICS AND A MONTHLY OPERATION AND MAINTENANCE COST SUMMARY.

Abstract

July 31, 1984 marks the end of the project's two-year test and evaluation phase and the start of the three-year power production phase. Power production and plant testing were limited by 218.0 hours of inclement weather. The gross energy production for the month of July was 662.4 MWH and the net energy production was 252.8 MWH.

Operational Highlights

- Testing activities have been reduced and the plant has been operating using the Operational Control System (OCS) automation software. The main purpose is to exercise the OCS and to identify and correct any remaining problems with the software.

  On site engineering personnel are available for consulting but are staying out of the daily operations as much as possible. This is all part of transition activities to the power production phase.

- SCE Operators were given instruction on the Operational Control System (OCS). Emphasis has been on problem diagnosis and the subtleties of OCS operation.

- A turbine-generator to automatic synchronization test was conducted to provide additional data for General Electric's use in analyzing the turbine speed control problem. Presently the unit is being manually synchronized due to incompatibility between the automatic synchronizer and the turbine-generator's speed controller.

- Dave Ege and Herman Lehman, Burns & McDonnell, completed their Electric Power Research Institute (EPRI) - sponsored reassessment of plant parasitic power consumption (July 17-18). The resulting report will be published by EPRI and entered into the plant's bibliography.

- The rain storm on Wednesday, July 18, increased the heliostat cleanliness by about 11 percent to 91 percent of clean. Additional rain on Sunday and Monday, July 22 and 23, increased the cleanliness to 92 percent of clean. This

confirms that rain washing is no longer sufficient to restore design reflectivity and a manual heliostat wash is now required.

- Power generated during the plant start-up and Test and Evaluation Phase was 11,085.3 MWe-hrs while connected to the grid. The plant gross generation for this period was 12,917.6 MWe-hrs and is only 245.1 MWe-hrs below total power usage on a 24 hour basis. Such a high power generation was not expected at the onset of the Test and Evaluation Phase because much of the testing did not emphasize power production. The station's effort in reducing plant parasitic power consumption was a major contributor to achieving the desirable generation figure.

- Duncan Tanner, Sandia, stated that a hardware revision is planned for the Operational Control System (OCS) to allow it to access receiver panel temperature gradients and other essential operating information from the Data Acquisition System (DAS).

Administrative Highlights

- A staff meeting was held July 17, to review the status of the Experimental Test and Evaluation Phase. Plans for the three-year Power Production Phase were also discussed. See attachment 7 and 8.

- A Test and Evaluation to Power Production Transition Status meeting was conducted Wednesday, July 25. The meeting was devoted to a comprehensive rundown of all completion items and issues. During the meeting SCE, SNLL, MDAC, and DOE identified critical items, corrective actions, and completion dates for all remaining open items. Also during the meeting the Test Program Status was reviewed, see attachment 9.

- Milestone Event: The Experimental Testing and Evaluation Phase concluded successfully July 31st. All the operational testing has been completed and the plant automation is functional. Testing activities will hereafter, during the Power Production Phase concentrate on the long term evaluation of the plant.

  In the forthcoming three years the primary objective of the SCE O&M personnel will be maximizing power production in a safe, reliable, and efficient manner, to allow evaluation of the Central Receiver Solar Plant's viability as an electrical power generation resource. The past two years' effort by McDonnell Douglas and Stearns Catalytic personnel in optimizing the plant's operation preparatory to the three year power production phase were commendable.

Maintenance Highlights

- SCE Maintenance personnel are assuming responsibility for the Data Acquisition System (DAS) maintenance. Daily activities, previously performed by MDAC, include a DAS system check, archive tape check, and data quality check. MDAC is providing training and consulting as required for SCE maintenance personnel.

- Experimental second generation heliostats: The master control computer for the four second generation heliostats was installed and tested. None of the heliostats were available for operation to complete the testing. The Boeing heliostat operated briefly using the Boeing controller but the elevation motor failed. The McDonnell Douglas Astronautics Company (MDAC) and Arco heliostat controllers are out of service and the Martin Marietta Company (MMC) heliostat has just arrived and has yet to be installed.

- Bob Berry, MDAC, is investigating the problem with receiver panel 21's temperature control valve. Bob indicated that during full load operation on good insolation days that the panel 21 valve is operating at more than 100 percent of its rated capacity and that this may be the cause for the valve instability. Future test will concentrate on characterizing the valve stability versus load.

- Bob Breece, MDAC, reduced the Data Acquisition System (DAS) scanning rate to reduce tape usage from four to one tape per day. Subsequently, the number of plant variables to be monitored will be reduced to only those required for plant operation and performance evaluation.

- A new resin screen was installed in the #1 inline demineralizer vessel. It is suspect that the old resin screen failed due to mechanical wear.

- On July 24, in the process of placing the Thermal Storage System charging train #2 into service, it was noted that the charging train steam side pressure controller to the TSS flash tank (PCV 3111) was stuck at 72 percent open and would not move. TSS charging train #2 steam pressure controller (PCV 3111) was locally stroked and then began operating correctly. It is suspect that moisture build-up in the instrument air lines caused the problem. Charging train #2 was then returned to service.

- Auto Beam Characterization System (BCS) tests ran successfully using ten (10) selected heliostats. Testing was done on north and south targets only and without the sun-shape camera in service. According to Art Iwaki, MDAC, who is currently troubleshooting the BCS, some of the problems he encountered were: the system skips the first heliostat about half the

time, the iris on the camera will not focus properly, and the camera/computer interface times out on data transfer.

- Taps on the service water system (suction, discharge, and recirculating lines) were made for the service water jockey pump installation. The purpose of the jockey pump is to reduce parasitic load during plant inactive periods.

- The SCE Westminster repair shop replaced the ring umbrella gear in the gear box on cooling tower fan FA 901. The cast iron gear failed due to mechanical stress. The new gear is made of carbon steel for durability and strength.

- A meeting was held with T. Brittain, of General Electric, on Thursday, July 26, 1984, to discuss future turbine testing required for checkout of the modified turbine control system. The modification will allow admission steam pressure control throughout the entire admission steam pressure control range which will eliminate the previous control problem that occurred during the turbine's transition from admission steam to main steam.

- One leak on the waste water blowdown line was repaired. The pvc coupling failed at its midpoint due to compressive or tensile stresses from thermally induced temperature transients.

- Electricians and technicians are working to reduce the number of out-of-service heliostats. The current number of heliostats out of service is 64. The major problems with heliostats are related to motor seal wear and malfunction of azimuth and elevation encoders.

- Miscellaneous maintenance work accomplished during the month of July, is as follows:

  - Installed pylons around the propane tank at the Ullage Maintenance Unit (UMU) skid to protect the propane tank.

  - Realigned the gate on the 33kV yard.

  - Replaced air conditioning air filters on all buildings and remote stations.

  - Installed a 3/4 inch stainless steel ball valve for throttling acid to the cooling tower basin.

  - Replaced flowmeter on receiver panel 20 to correct erratic flowmeter readings.

  - Calibrated temperature controller on sample chiller unit CR 907.

  - Replaced fire sensor on warehouse fire alarm system.

- Repaired leak and added gear oil to the turbine lube oil centrifuge.

- Repaired pressure gauge on east air compressor (CP 901).

- Installed a new baume test station at the inline demineralizer. This allows for accurate concentration readings on acid and caustic during regeneration.

- Installed a new discharge line from the sodium hypochlorite system to the cooling tower basin.

- Replaced block valve on ammonia holding vessel.

- Replaced hand pump on hydrazine system.

- Repaired temperature control valve bonnet leaks on receiver panels 4, 6, 13, and 18.

- Repaired pre-filter leaks on receiver panels 5, 6, and 20.

Plant Statistics	July '83	July '84	Turbine Roll To Date
Net Energy Production MWH	271.4	252.8	-247.3
Energy Production (MWH net while connected to the grid)	654.6	575.2	11125.9
Hourly Peak MW (Net)	9.6*	8.9*	10.4*
On-Line Hours	111.7	98.0	2189.1
Test Hours	28.2	6.0	1621.7
Total Plant Outage Hours	205.4	6.0	1903.8
Scheduled	36.0	0.0	804.0
Unscheduled	169.4	6.0	1099.8
Weather Outage Hours	27.0	218.0	2758.1

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*Receiver Generated Steam Only

Attachments:

- Chronological Summary of Receiver Tube Defects (Attachment 1).
- Solar One Statistics: Weather outage hours, plant outage hours, test hours, and on-line hours (Attachment 2).
- Power production and plant testing were limited by 218.0 hours of weather outage (record high). July was a positive output month, 252.8 MWH (Attachment 3).
- The daily and cumulative energy production while Solar One was on-line for the year-to-date and the three previous months are shown on Attachments 4 and 5.
- Solar and Plant Utilization is trended on Attachment 6.
- Three-Year Power Production Phase (Attachments 7 and 8).
- Test Program Status (Attachment 9).

Solar One Performance Summary

1) Station Availability = $\frac{H \times kw}{Hp \times kw}$

H = Hours On-Line

kw = Rated Output

Hp = Period Hours

Receiver Availability	99.2%
Discharging Availability	100.0%
Charging Availability	99.2%
Turbine Availability	100.0%

Note: For the purpose of availability, weather outage hours are considered available operating hours.

2) Output Factor = $\frac{\text{Net Transmitted Power}}{\text{On-Line Hours} \times \text{Maximum Rated Capacity}}$

Output Factor	21.6%

3) Capacity Factor = $\frac{\text{Net Transmitted Power}}{\text{Period Hours} \times \text{Maximum Rated Capacity}}$

Capacity Factor	2.8%

4) Solar Capacity Factor =

$$\frac{\text{Net Transmitted Power}}{\text{Integrated Insolation W-HR/m}^2 \times \text{Collector Field Surface Area}}$$

Solar Capacity Factor	2.0%

Operation and Maintenance Costs

- A summary of the O&M labor, material, contract, and other costs for the month of July 1984 is shown on the attached table. Expenses are categorized as follows:

Field Office	-	Includes plant supervision, engineering, accounting, clerical, office supplies, and miscellaneous indirect expenses.
Operations	-	Includes total cost of operating staff and expenses.
Miscellaneous Support	-	Includes station supplies and rentals, safety and job training, and site security.
Maintenance	-	Includes total cost of maintenance staff and expenses allocated to major plant subsystems.
Overheads	-	Includes costs associated with direct labor plus company administrative and general expenses.

SOLAR ONE

MONTHLY O&M COST SUMMARY
($ X 1000)

MONTH OF JULY 1984

	LABOR	MATERIAL	CONTRACT	OTHER	TOTAL
FIELD OFFICE	12.6	.2	-	3.0	15.8
OPERATIONS	49.1	5.0	-	.1	54.2
MISC. SUPPORT	3.5	.1	2.8	-	6.4
MAINTENANCE					
Supervision/Indirects	12.5	1.2	.1	.2	14.0
Control System	6.9	.8	.6	-	8.3
Receiver System	3.2	.3	.4	-	3.9
Thermal Storage System	.2	.5	-	-	.7
Collector System	4.2	1.7	3.5	-	9.4
EPGS System	5.0	2.0	.1	-	7.1
Misc.	5.0	(.1)	42.2*	-	47.1
Total Maintenance	37.0	6.4	46.9	.2	90.5
SUB TOTAL	102.2	11.7	49.7	3.3	166.9
Division O. H.					18.1
TOTAL DIRECT					185.0
Workman's Compensation					.7
Payroll Tax					7.4
Pension & Benefits					22.1
Administrative & General					34.6
GRAND TOTAL					249.8

* Crosby & Overton -- Acid spill clean-up $34,459.89

Attachment 1

SOLAR ONE GENERATING STATION

Chronological Summary of Receiver Tube Defects

DATE	DESCRIPTION OF TUBE DEFECT	LOCATION
Jul 15, 1983	Interstitial weld leak	tube 30, panel 18
Jul 26, 1983	Interstitial weld leak	tube 41, panel 18
Aug 2, 1983	Bend leak	tube 70, panel 11
Aug 18, 1983	Repair/removal of sample	tube 30, panel 18
	Repair, grind & fill	tube 41, panel 18
Aug 19, 1983	Replaced cracked tube section	tube 70, panel 11
Sep 8, 1983	Crack indication	tube 30, panel 19
Oct 26, 1983	Crack indication	tube 1, panel 18
	Interstitial weld leak found & repaired	tube 41, panel 12
	Interstitial weld crack	tube 41, panel 13
Nov 1, 1983	Interstitial weld crack on:	tube 41, panel 4
		tube 41, panel 6
		tube 30, panel 7
		tube 41, panel 8
		tube 41, panel 9
		tube 30, panel 17
	Surface irregularity	tube 41, panel 10
Nov 16, 1983	Bend leak	tube 1, panel 15
	Bend crack	tube 1, panel 16
	Bend crack	tube 3, panel 16
	Bend crack	tube 1, panel 17
Dec 1983	Outage - Removal of sample	tube 1, panel 4
		tube 1, panel 6
	Repair of cracks	tube 1, panel 15
		tube 1, panel 16
		tube 2, panel 16
		tube 3, panel 16
Jan 1984	Outage - Interstitial weld crack repair	tube 41, panel 13
Feb 1984	Outage - Interstitial weld crack repair	tube 41, panel 8
	Interstitial weld crack repair	tube 41, panel 9
	Bend crack	tube 70, panel 9
	Bend crack	tube 70, panel 10
	Bend crack	tube 70, panel 11
	Bend crack	tube 70, panel 12
	Surface polished	tube 41, panel 10

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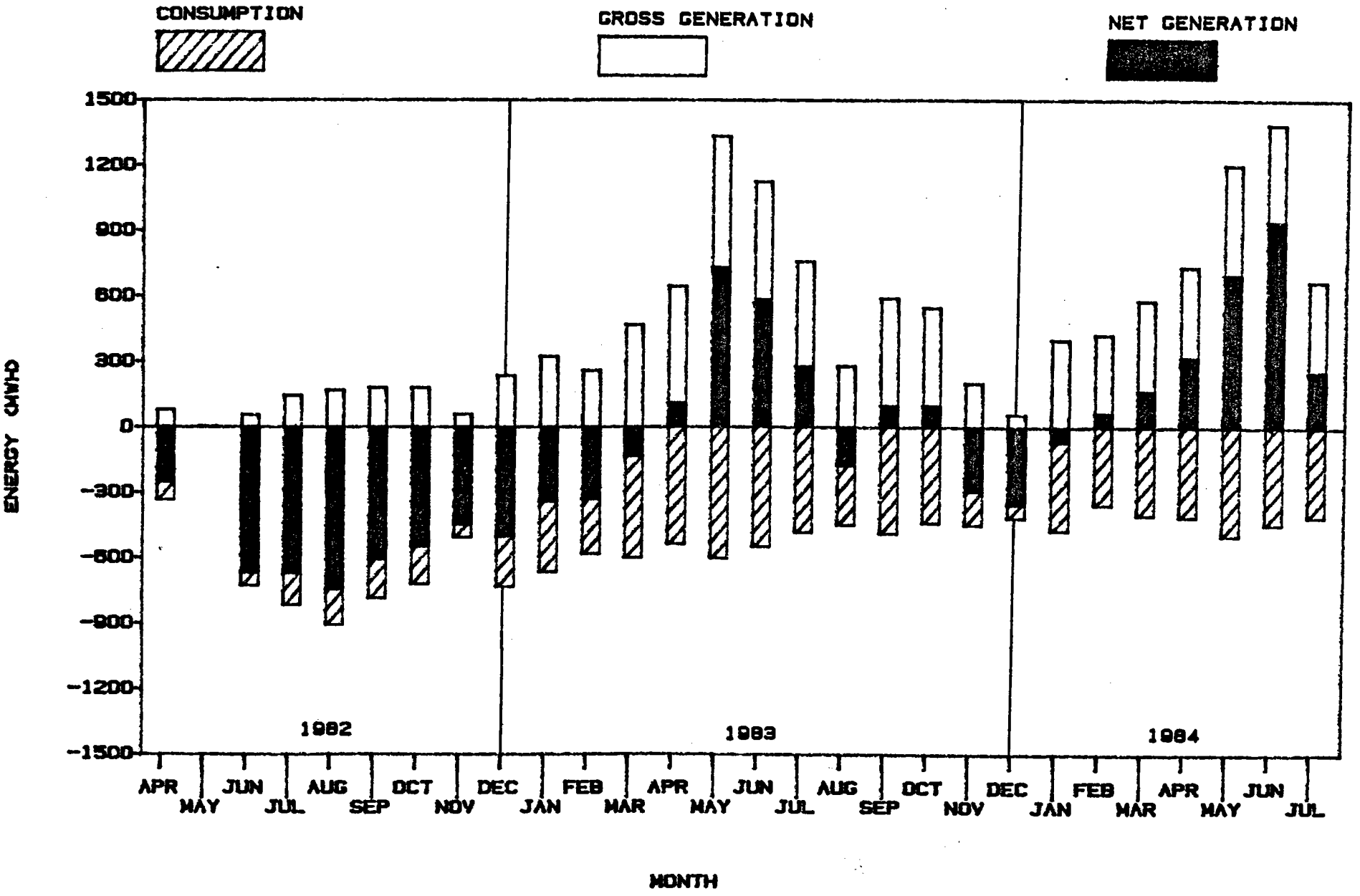
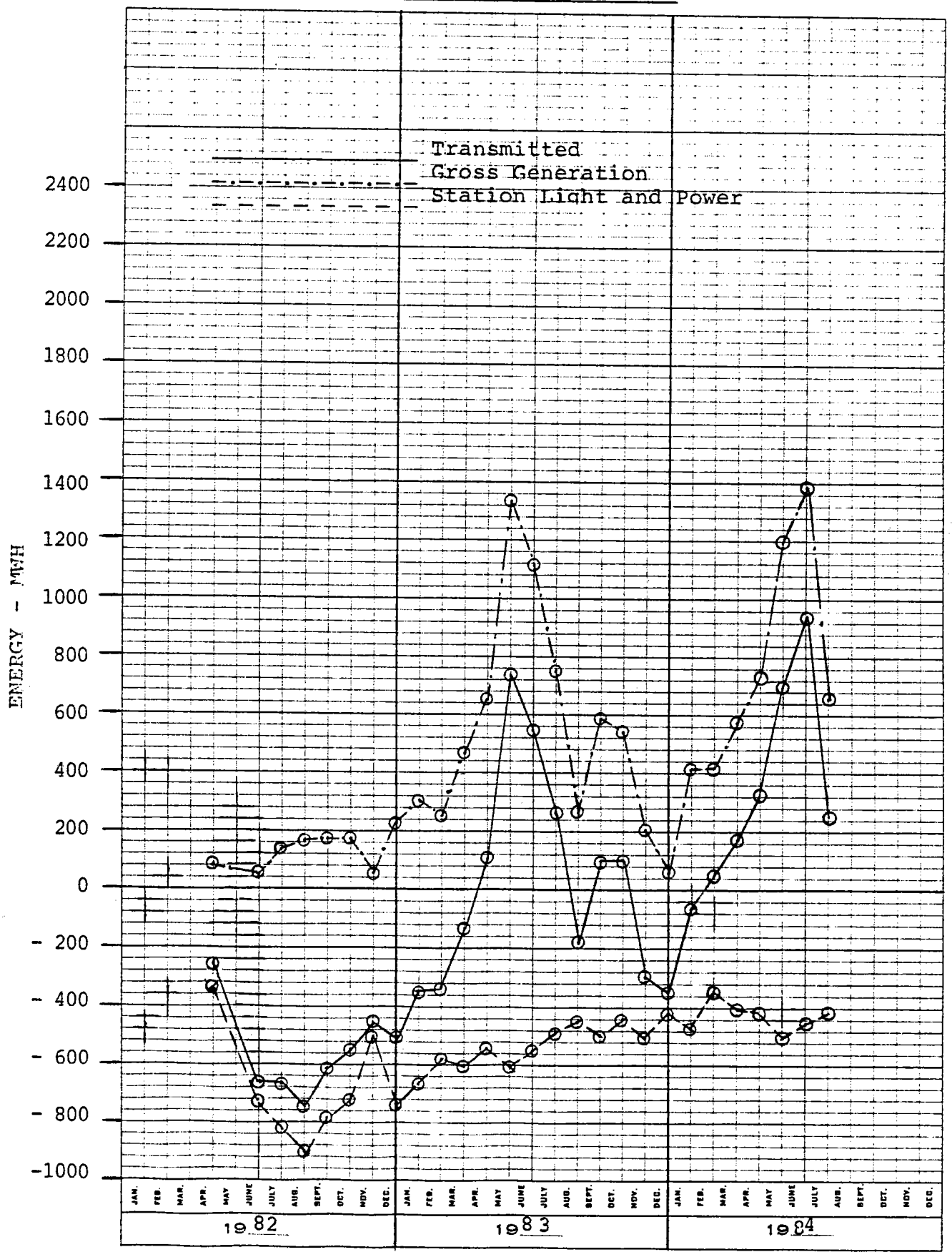
SOLAR ONE
MONTHLY ENERGY PRODUCTION



Attachment 2

ATTACHMENT 3

SOLAR ONE
MONTHLY METER REPORT SUMMARY

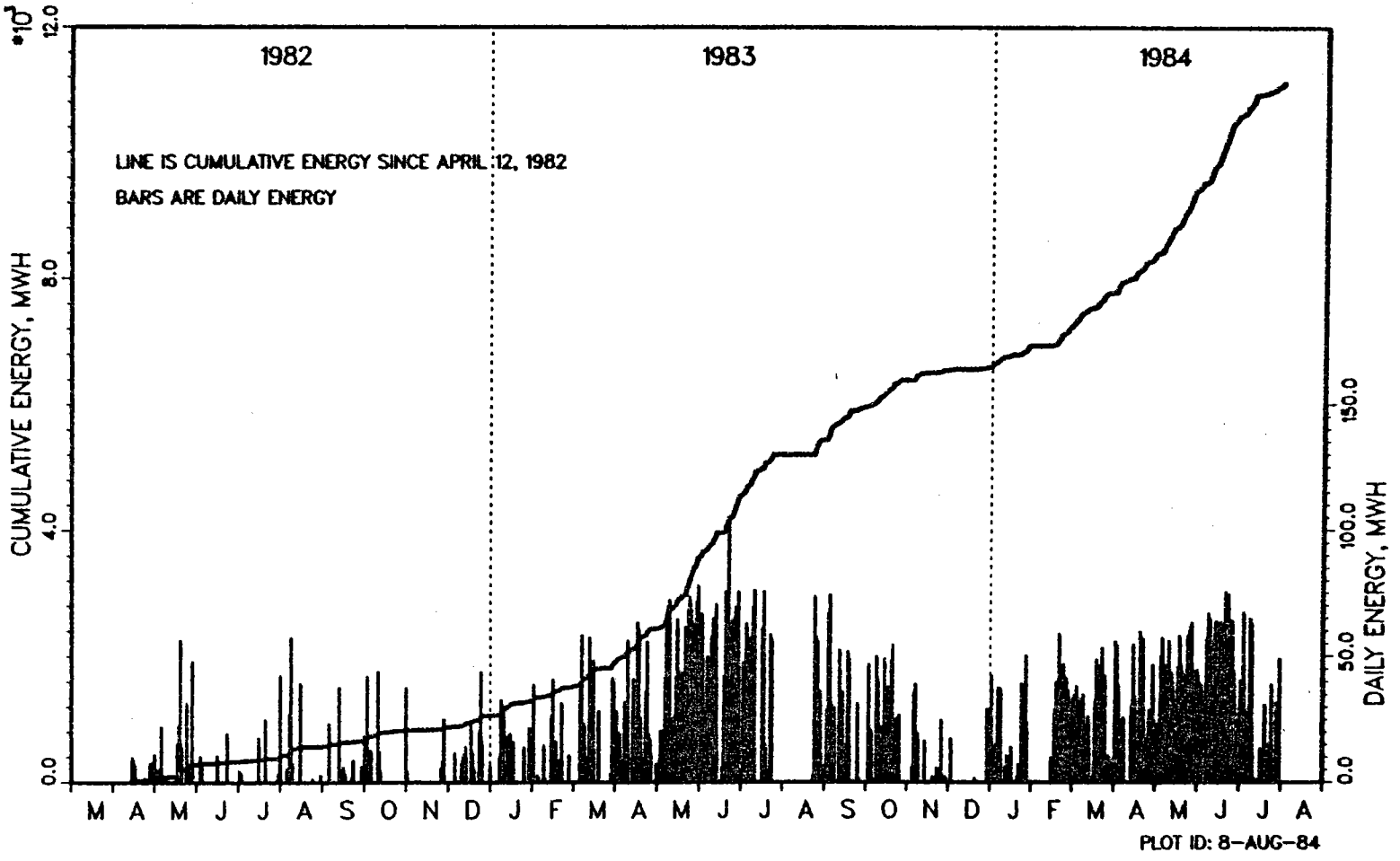


DIETZGEN CORPORATION MADE IN U.S.A.

NO. 340-T3D DIETZGEN GRAPH PAPER 3 YEARS BY MONTHS

RMA 03/09/84

SOLAR ONE NET ELECTRICAL PRODUCTION



Attachment 4

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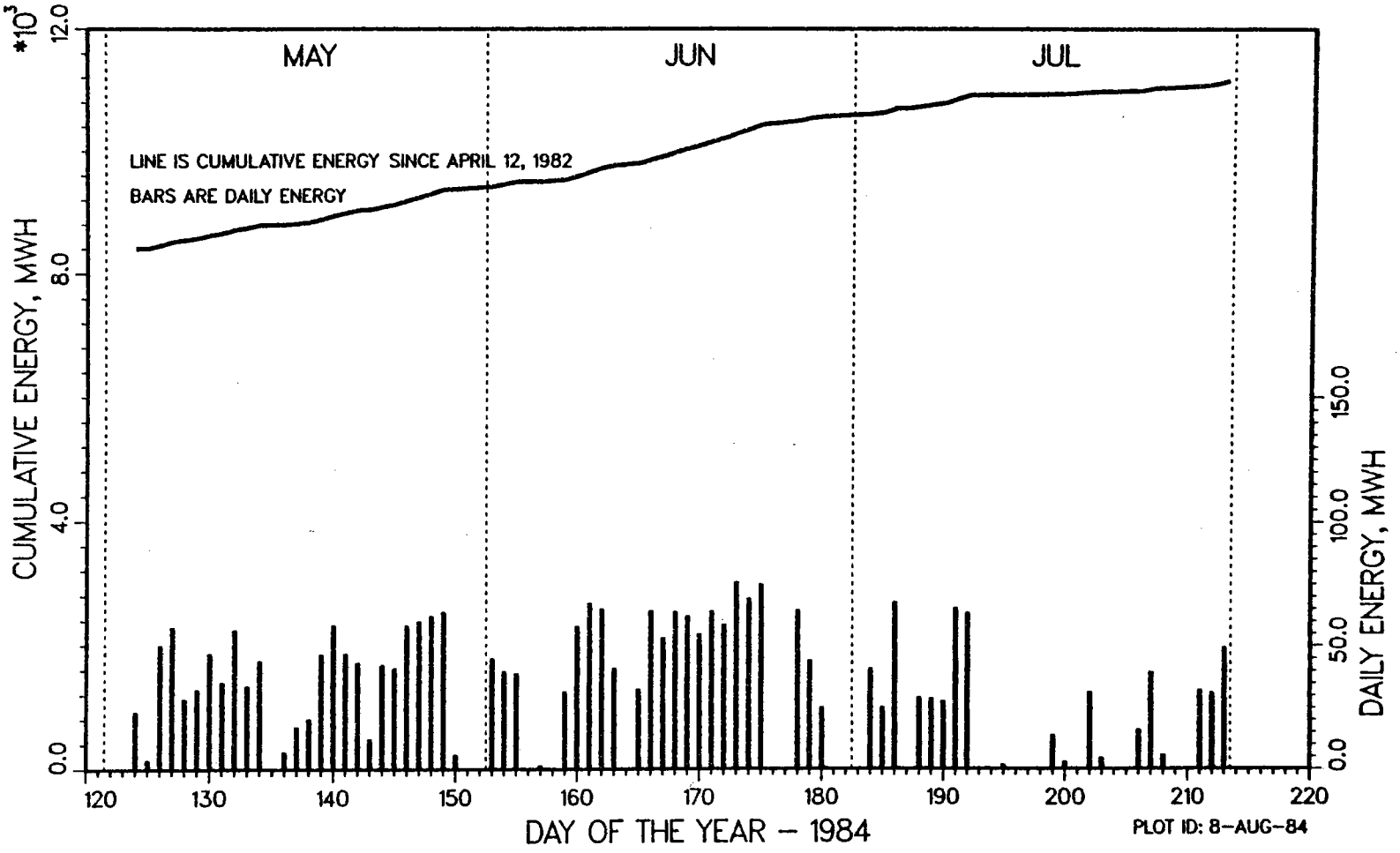
SOLAR ONE NET ELECTRICAL PRODUCTION



Attachment 5

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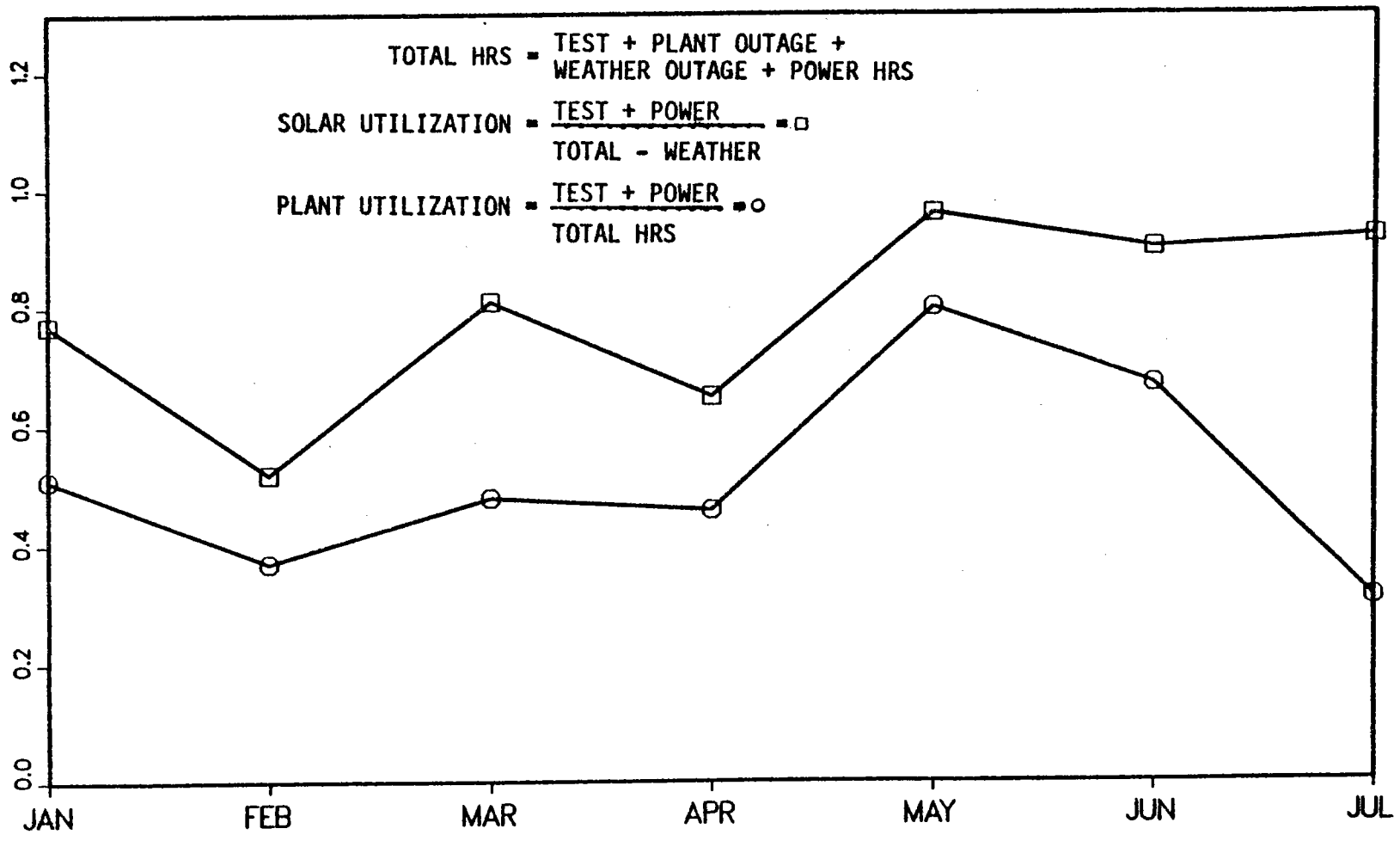
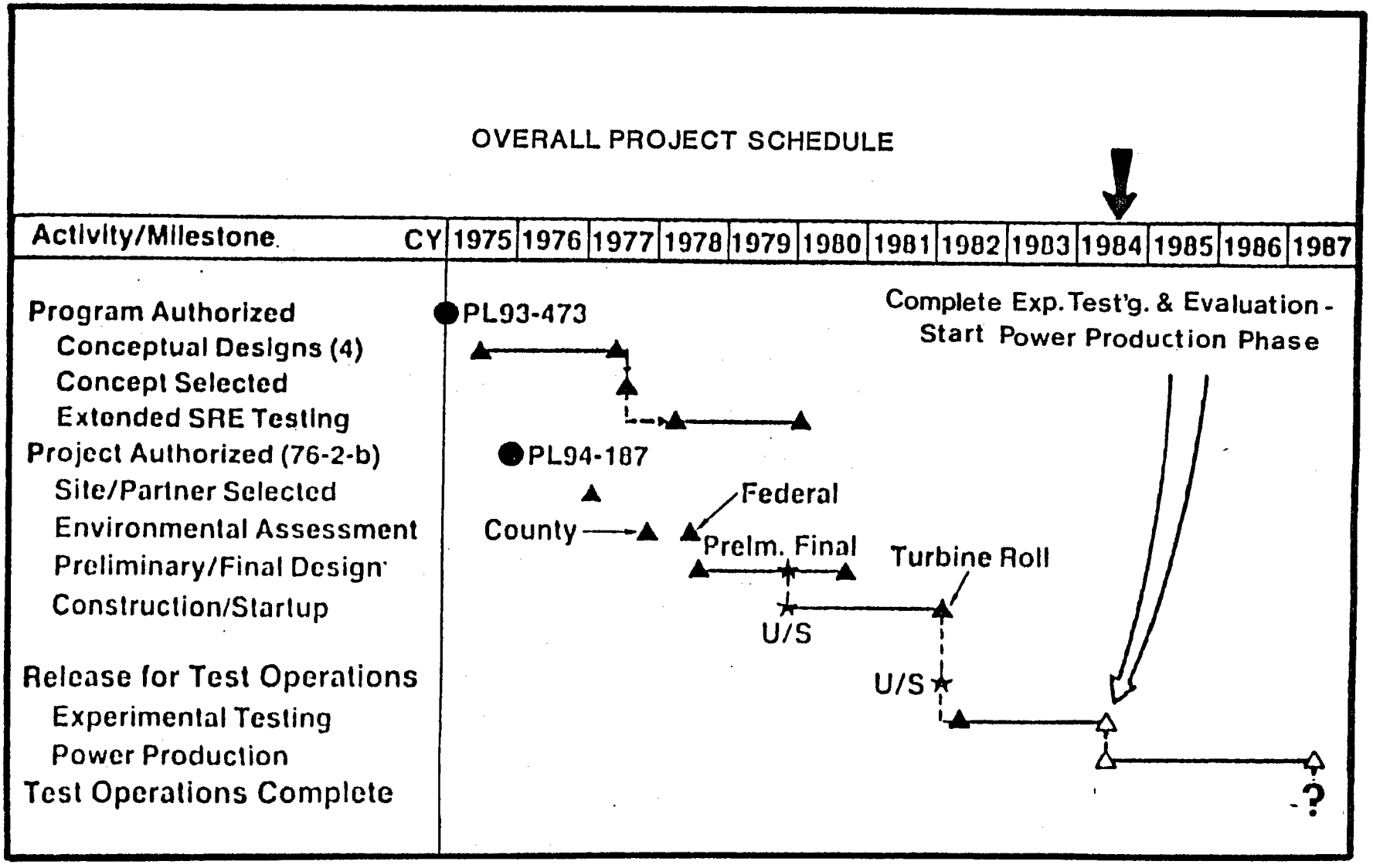
SOLAR AND PLANT UTILIZATION FOR 1984



10 MWE SOLAR THERMAL CENTRAL RECEIVER PILOT PLANT



Attachment 7

10 MWE SOLAR THERMAL CENTRAL RECEIVER PILOT PLANT

MANAGEMENT PLANNING BACKGROUND

"THE PROJECT MANAGEMENT PLAN EXPANDS THE OVERALL PROJECT BASELINE AND SETS FORTH HOW THE PROJECT WILL BE MANAGED"..... (DOE ORDER 5700.4)

DESIGN, CONSTRUCTION AND STARTUP PHASES:

- PROJECT MANAGEMENT PLAN..... OCT. 1977
- PROJECT MANAGEMENT PLAN (REV. 1)..... JULY 1979

TEST OPERATIONS PERIOD: EXPERIMENTAL TEST & EVALUATION PHASE:

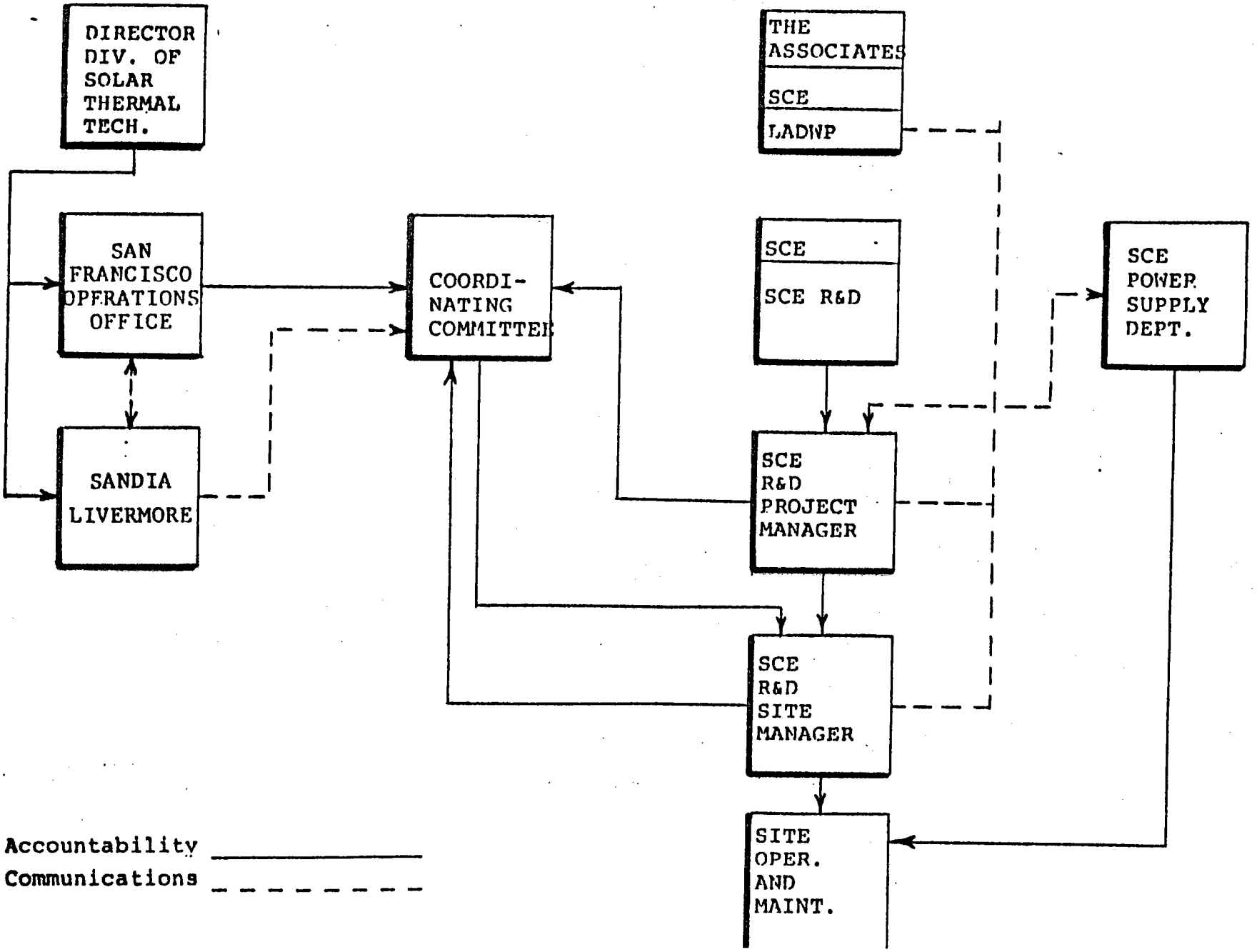
- OPERATIONAL TEST MANAGEMENT PLAN..... MAR. 1982
- OPER. TEST MANAGEMENT PLAN (UPDATE)..... APR. 1984

TEST OPERATIONS PERIOD: POWER PRODUCTION PHASE:

- OPERATIONAL TEST MANAGEMENT PLAN (REV. 1).... JULY 1984

10 MWE SOLAR THERMAL CENTRAL RECEIVER PILOT PLANT

MANAGEMENT STRUCTURE - POWER PRODUCTION PHASE



PARTICIPANTS' MANAGEMENT RESPONSIBILITIES

DOE/HQ (STT)

- o Program Integration and Planning
- o AOP Approval and Resource Allocation

DOE/SAN

- o Cooperative Agreement Administration for DOE
- o Project Management Plan
- o Annual Operating Plans
- o O&M Cost and Schedule Control
- o "Stop Operation" Authority

SCE

- o Cooperative Agreement Administration for Associates
- o Plant Operating Plan
- o O&M Cost & Schedule Estimates (Input to SAN)
- o Day-to-Day Operation and Maintenance, Data Collection
- o Utility/Industry Evaluation and Technology Transfer

SNLL

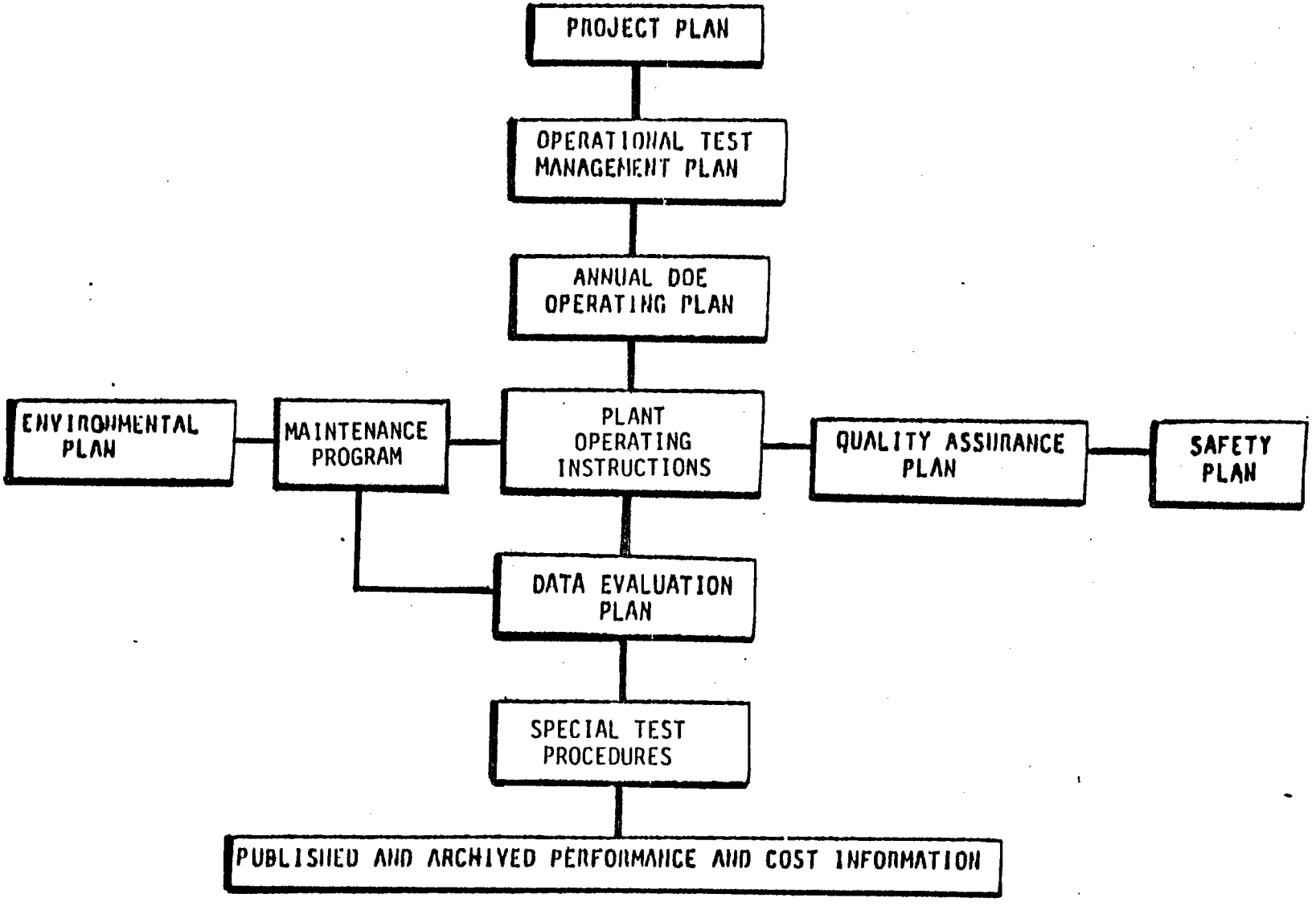
- o Data Evaluation Plan & Special Test Procedures
- o Annual Operating Plans
- o Technical Support (to SCE/Associates)
- o Technical Evaluation and Technology Transfer

COORDINATING COMMITTEE (SAN, SCE, SNLL)

- o Periodic (Quarterly) and Ad-Hoc Assessment of Status
- o Prioritization of Power Production Phase Activities
- o Review/Evaluation of Proposed Plant Improvements
- o Review/Recommendation on Future Plant Test Programs

10 MWE SOLAR THERMAL CENTRAL RECEIVER PILOT PLANT

CONTROL DOCUMENTS - POWER PRODUCTION PHASE



10 MWE SOLAR THERMAL CENTRAL RECEIVER PILOT PLANT

CONTROL DOCUMENT RESPONSIBILITIES

POWER PRODUCTION PHASE

	STT	SAN	SCE	SNLL
PROJECT PLAN	A	P	R	R
OPERATIONAL TEST MANAGEMENT PLAN	A	P/A	A	A
ANNUAL OPERATING PLANS	A	P		P
PLANT OPERATING INSTRUCTIONS		A	P	R
DATA EVALUATION PLAN	R/A	R	R	P
SPECIAL TEST PROCEDURES		R	A	P

P = PREPARE

R = REVIEW

A = APPROVE

Solar One Generating Station

July 16, 1984

Three Year
Power Production Phase - Plans

Plant to be operated and maintained per procedures common to a conventional power plant to effect its safe, reliable, and efficient operation.

Plant to be evaluated in the utility sense regarding:

- Power production
- Availability
- Reliability
- Operation and maintenance expense

Plant performance to include significant operation and maintenance experience to be documented.

The above information will be available to project participants to allow comparison of actual experience with design conditions.

The above information will also be available to public utilities and others interested in solar central receiver power generation systems.

Solar One Generating Station

July 16, 1984

Three Year Power Production

Operating Modes

Generally plant operation will be receiver direct to maximize power production.

Generally the thermal storage system will be maintained with a fifty percent charge to:

- Provide a low cost auxiliary steam supply
- Allow plant operation on partially cloudy days with or without the turbine in service

The thermal storage charging and extraction systems will be utilized weekly for power production to:

- Insure system integrity
- Allow evaluation of the thermal storage system
- Maintain operator familiarization with the system

Plant to perform special test on an exception basis as required to:

- Follow up on test and evaluation period performance results
- Evaluate and correct plant operating problems discovered during the power production phase
- Evaluate new operating strategies

Operators will routinely start-up all plant systems manually to maintain their familiarity with plant system interrelationships

TEST PROGRAM STATUS

TESTING IS ESSENTIALLY COMPLETE

REMAINING TESTS:

- COMPATIBLE WITH POWER PRODUCTION
- WINTER AND SUMMER SOLSTICE
- HELIOSTAT OPTICAL ACCURACY
- LONG TERM PERFORMANCE EVALUATION

TRANSITION STATUS REVIEW JULY 25th

Attachment 9

NEW RECORDS!

TOTAL ENERGY PRODUCTION
IN CONSECUTIVE DAY PERIODS

	7 days 6/17 - 6/23 1984	10 days 6/14 - 6/23 1984	30 days 5/25 - 6/23 1984
NET ENERGY GENERATED WHILE CONNECTED TO GRID, MW-hr	458.51	639.44	1307.74
NET ENERGY GENERATED ON A 24-HR BASIS, MW-hr	409.94	568.96	1050.17

SUMMER SOLSTICE TEST
JUNE 14 - 28, 1984

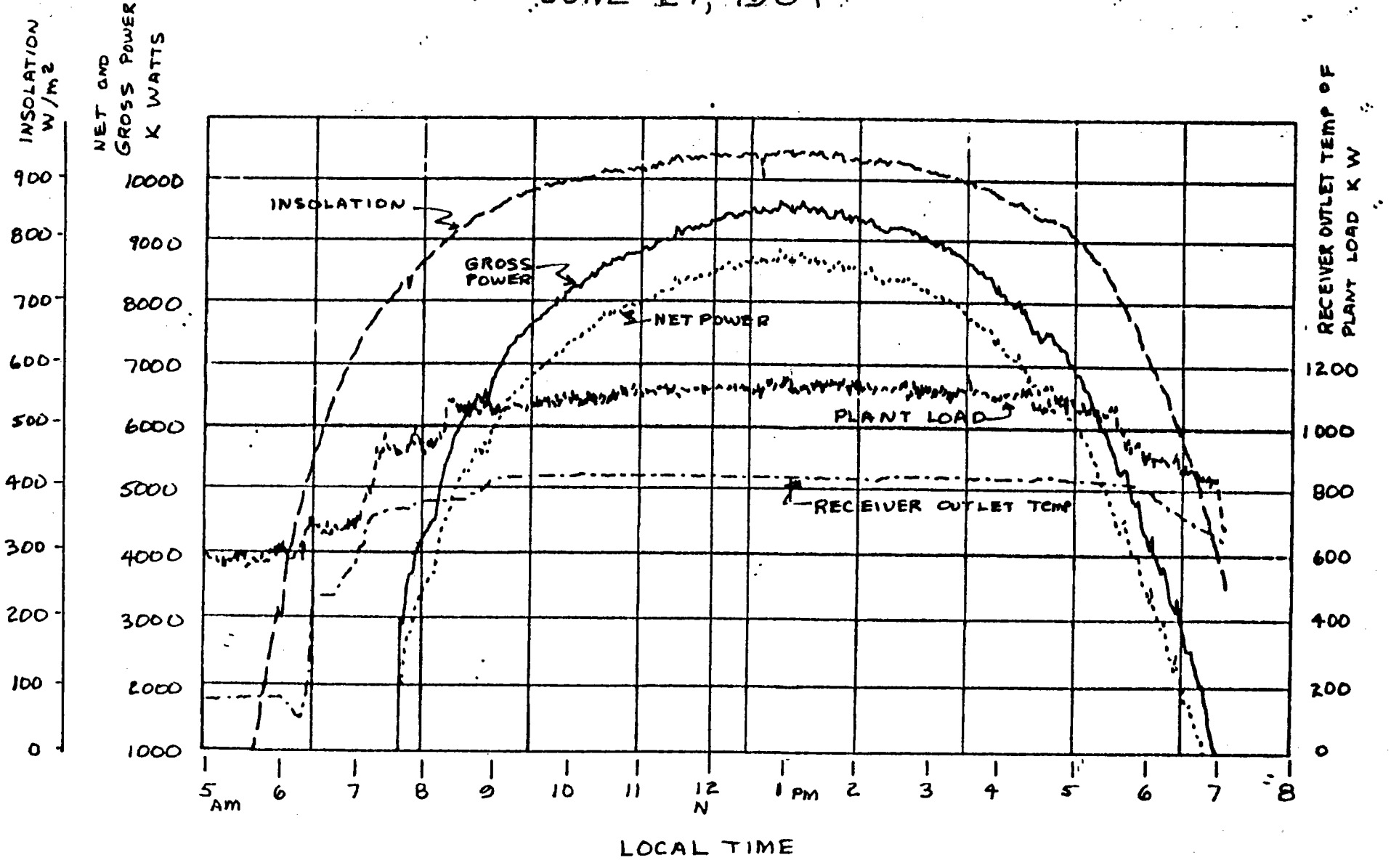
BEST PRODUCTION DAY
JUNE 21, 1984

PEAK POWER OUTPUT	9.7	MWe GROSS	
	8.6	MWe NET	
PEAK INSOLATION	957	W/m2	
ENERGY OUTPUT	85.1	MW-hr GROSS	
	75.6	MW-hr NET	*
ON-LINE TIME	11.37	HR	
NUMBER HELIOSTATS	1772		
HELIOSTAT REFLECTIVITY	.803		

* while connected to grid

SUMMER SOLSTICE

JUNE 21, 1984



PLANT AUTOMATION
STATUS

* OPERATIONAL
  MINOR TUNING AS REQUIRED

* OPERATOR TRAINING CONTINUES

* DOCUMENTATION TO BE
  COMPLETED 9/30/84

PLANT AUTOMATION FEATURES

PLANT OPERATIONAL DISPLAYS:

- GRAPHICS
- MAN/MACHINE INTERFACE
- OCS MANUAL
- TRENDS WITH PRINTER
- LOGGERS

COLLECTOR FIELD CONTROL:

- START-UP
- INTERMEDIATE POWER
- FULL POWER
- HOT STANDBY
- DEFOCUS

PLANT AUTOMATION FEATURES

AIMPOINT CONTROL:

- CHANGE AT 10 AM & 2 PM, SOLAR TIME
- MANUAL
- SEMI-AUTOMATIC
- AUTOMATIC

MODE TRANSITIONS:

MODES 1, 2, 5 AND 9

CLEAR DAY AUTOMATIC:

MODE 1
8 - 9 - 1 - 9 - 8

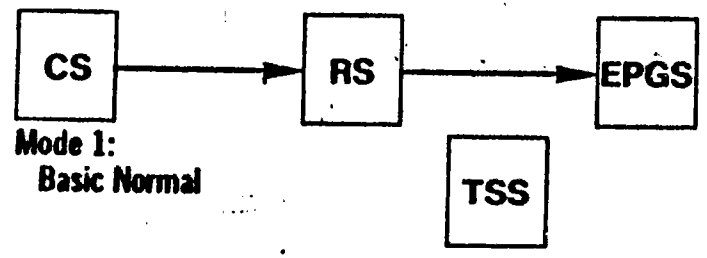
MODE 2
8 - 9 - 1 - 2 - 1 - 9 - 8

MODE 5
8 - 9 - 5 - 9 - 8

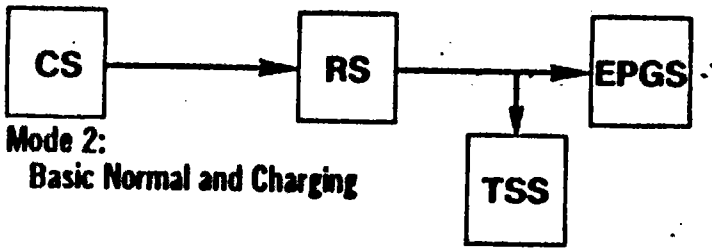
PLANT AUTOMATION FEATURES

OPTIONAL ITEMS:

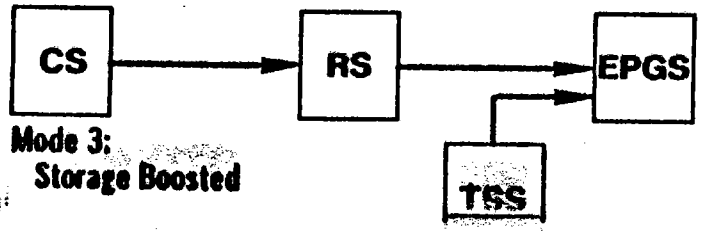
- STATUS/SEQUENCES
- MONITOR/ALARM
- PERFORMANCE CALCULATIONS
- SDPC DOWN LOAD/VERIFICATION
- DIAGNOSTICS (DELETED)
- REPORT GENERATION (DELETED)



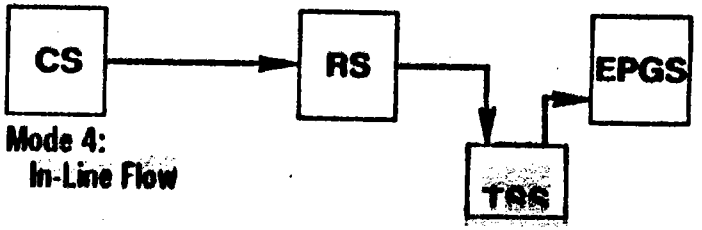
Mode 1:
Basic Normal



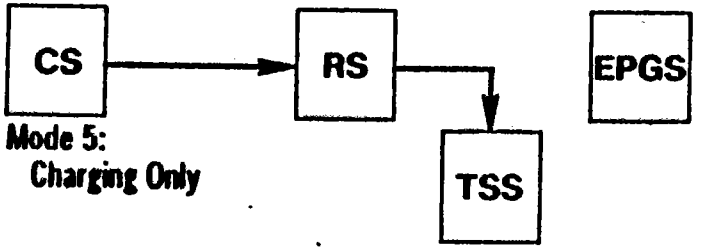
Mode 2:
Basic Normal and Charging



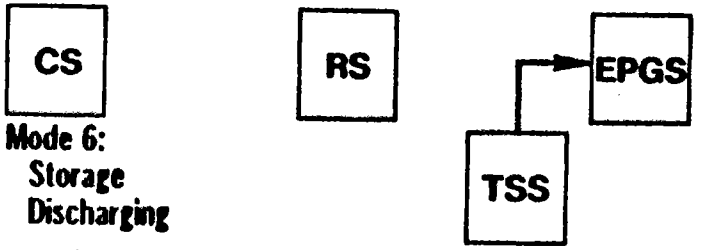
Mode 3:
Storage Boosted



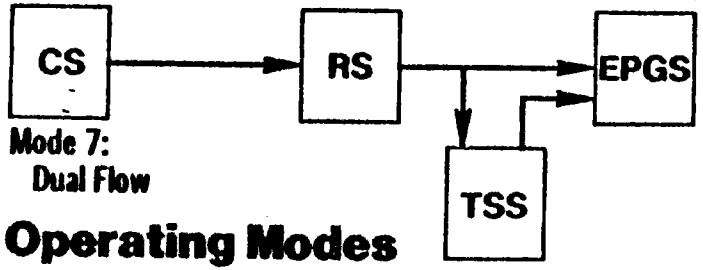
Mode 4:
In-Line Flow



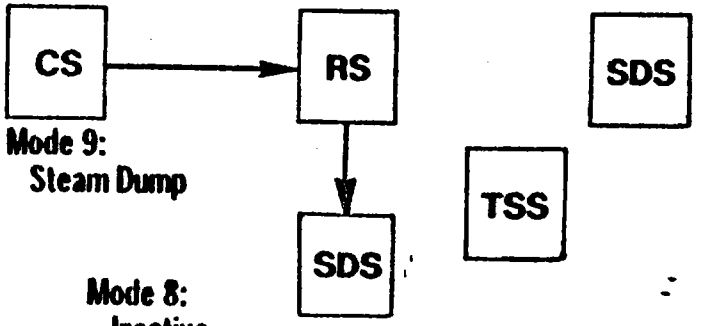
Mode 5:
Charging Only



Mode 6:
Storage
Discharging



Mode 7:
Dual Flow



Mode 9:
Steam Dump

Mode 8:
Inactive

Operating Modes

KEY: EPGS: Electric Power Generation System
TSS: Thermal Storage System
SDS: Steam Dump System
CS: Collector System
RS: Receiver System

DATA EVALUATION PLAN
POWER PRODUCTION

DRAFT RELEASED FOR REVIEW

DATA EVALUATION:

- NORMAL OPERATIONS & MAINTENANCE
- SPECIAL TESTS
- LONG TERM PERFORMANCE

SPECIAL TESTS:

- SYSTEM PERFORMANCE TESTS, WINTER AND SUMMER SOLSTICE CAMPAIGNS
- HELIOSTAT PERFORMANCE UNDER HIGH WIND CONDITIONS

R&D NEEDS FOR FUTURE CENTRAL RECEIVER PROGRAMS:

- HELIOSTAT OPTICAL ACCURACY
- MIRROR MODULE CORROSION AND SOILING
- RECEIVER ABSORBER COATING LIFE
- RECEIVER TUBE LIFE
- STORAGE FLUID DEGRADATION

DOE/SF/10501-227
(STMPO-827)

SOLAR ONE
OPERATION AND MAINTENANCE REPORT #27
JUNE 1984

THIS REPORT SUMMARIZES THE OPERATIONAL ACTIVITIES AND HIGHLIGHTS MAINTENANCE WORK THAT WAS PERFORMED DURING THE MONTH. IN ADDITION, IT PRESENTS PLANT STATISTICS AND A MONTHLY OPERATION AND MAINTENANCE COST SUMMARY.

Abstract

The gross energy production for the month of June was 1,392.0 MWH, and the net energy production was 944.8 MWH, an all time record high. Power production and testing were partially limited by 93.3 hours of inclement weather.

Operational Highlights

o Test and Operations: The two-week summer solstice power production run of June 14-28, was completed as scheduled, with weather-induced interruptions on Sunday and Monday, June 24-25, during which essential maintenance was conducted. The tests yielded new records for energy production, as of June 24, for seven, ten, and thirty consecutive day periods. The new records are as follows:

	7 days 6/17 - 6/23 1984	10 days 6/14 - 6/23 1984	30 days 5/25 - 6/23 1984
Net energy production while connected to the grid, MWH	458.51	639.44	1307.74
Net energy generated on a 24-hr basis, MWH	409.94	568.96	1050.17

The best single day's production during the June 14-28 solstice test period yielded 75.6 MWH net while connected to the grid with an on-line time of 11.37 hours. Gross peak output for that day was 9.7 MWe when the insolation was 957 w/m^2.

Approximately 1760 heliostats were on-line during the solstice tests. If all 1818 were functioning, power output could be increased by another 3 percent. Overall heliostat reflectivity was approximately 78 percent as compared to design point reflectivity of greater than 91.1 percent. A heliostat wash could have increased the total system output by 10 percent. Receiver absorptivity was 88 percent; and solstice tests were run at 850 degrees F (receiver set point

temperature) instead of the design set point temperature of 960 degrees F, with pressure remaining at 1300 psi.

While the solstice goal of 10 MWe for 7.8 hours was not met, tests were still being conducted on high insolation days, and the performance data acquired will provide valuable information for extrapolating test results to design point conditions, and for further analysis of plant performance.

- Control System Study: Personnel from Honeywell, Technology Strategy Center, were on site two days as part of their digital control system evaluation. They conducted several information gathering sessions with the plant staff. The primary focus of their effort will be on the system level control with an emphasis on requirements and approaches for extending the current technology.

- Representatives from (LBL) Lawrence Berkeley Laboratories were on site to put the circumsolar telescope into operation. It will be used to obtain sunshape data for comparison with the sunshape video camera. The sunshape camera is part of the Beam Characterization System. The circumsolar telescope operates independent of the plant systems and has its own tape recorder. Data collected by the circumsolar telescope will be sent to LBL for analysis.

- Upon receipt of a formal FY 85 budget submission (including documentation of spare parts replenishment requirements for the power production phase) from SCE, DOE/SAN will initiate the review and audit process, with the goal of achieving a negotiated agreement by October 1.

- On June 28, 1984, at 1704 hours, Daggett Sub, 33/4kV, interrupted when Montara 33kV line relayed to lockout at Barstow Sub due to pole fire caused by lightning. No electrical damage occurred at Solar One.

- T. Brittain, GE representative, has removed the admission pressure control lower limit (anti-motoring protection) which was initialized during admission steam operation. This change will allow the admission steam pressure control throughout the entire admission steam pressure control range. This revision has not been tested under actual operating conditions and will have to be monitored closely when the turbine is placed on-line under admission steam. The above was implemented to eliminate the previous control problem that occurred during transition from admission steam to main steam.

- On June 27, receiver and turbine tripped on low superheat. After the receiver was reinitialized, Panel #12 failed open and would not close. Inspection of the air conditioning unit in Remote Station #1 (receiver 14th level) found it not to be cooling the Remote Station. Receiver and turbine trip may

have been caused by overheating of control equipment (MVCU's) in Remote Station #1.

Remote Station #1 air conditioning unit failed due to filters needing replacements. A compressor lead was also found burnt, suspect a loose connection. Repairs were made, bringing the air conditioning unit to normal operation. No apparent physical damage occurred to the equipment due to the overheating problem. No operational problems were experienced during subsequent start-ups.

The alarm message for high temperature in Remote Station #1 has been changed to read "High Temperature" instead of "80 degrees F". The "80 degrees F" message was misleading in that similar alarms in other remote stations will also be changed to be more sensitive to air conditioner operations throughout the plant.

Maintenance Highlights

- Two leaks on the waste water blowdown line were repaired. Suspect PVC couplings failed at midpoint due to compressive or tensile stresses from thermally induced temperature transients.

- On June 9, the inline demineralizer acid storage tank supply line broke ahead of the isolation valve. Roughly 850 gallons of acid were spilled on the ground and the remainder was directed into the containment dike. Suspect line broke due to PVC line becoming brittle under weather conditions. Line was replaced with carbon steel and isolation valve replaced with stainless steel. See attachment 7 for incident report.

- Electricians and technicians are working to reduce the number of out-of-service heliostats. The current number of heliostats out-of-service is 35. The major problems with heliostats are related to motor seal wear and malfunction of azimuth and elevation encoders.

- Receiver preheater flowmeter 2230 operated intermittently then quit. The flowmeter was returned to normal operation following cleaning of control card edge contacts.

- During the day's operation the receiver feed pump alarmed on high speed. The problem was temporarily corrected by closing the pump's recirculation block valve, decreasing the pressure set point and increasing the temperature set point on final steam. MDAC is investigating the problem.

- DAS (Data Acquisition System) and OCS (Operational Control System) communication problem with SDPC (System Distributed Process Control) was resolved by reconnecting control cables to the correct receptacles. Additionally, it was recommended that connectors be marked, such that incorrect cable connection may be avoided in the future.

- Receiver panel edge tube stainless steel shielding was removed from between panels 15 and 16, since its effectiveness on temperature seems to have dropped off due to shielding deterioration and warping. Shielding will be returned to McDonnell Douglas for evaluation.

- The receiver tower jib crane framework was installed on the 15th level, with electrical wiring remaining to be installed. The jib crane was constructed by SCE Maintenance, which consists of a projecting arm from a lift (electrically powered) that will be used for hauling tools and equipment up to the receiver tower.

- Valve body on PV-2002 (between receiver preheat boilers and receiver flash tank) was replaced. Valve body internal lost its integrity due to erosion from mechanical wear. A hole existed inside the valve body which caused leak through from the plug and seat.

- Sample chiller for instream analyzers was repaired after detecting a leak on the regulator service valve.

- Pressure setting change from 53 to 48 psi on the backup turbine lube oil pump auto start was completed. Pressure setting change was done to avoid start-up of backup pump, when low pressure on lube oil registered while running the primary turbine lube oil pump. Suspect low pressure on lube oil is caused by low oil viscosity at high temperatures. The suspected problem with lube oil is currently under investigation.

- Miscellaneous maintenance work accomplished during the month of June, is as follows:

  - East access ladder on the north side of the condenser was installed as a safety measure.

  - Replaced seal on leaky caustic transfer pump.

  - Repaired oil cooler leak on receiver feedwater pump by tightening bolts.

  - Replaced bad check valve on east air compressor CP-901.

  - An inline demineralizer baume test station was installed for monitoring the regeneration process in a safe manner.

  - Receiver prefilter leaks were repaired, associated with receiver panels 8, 9 and 20.

  - Replaced bad pulley on west air compressor CP-902.

  - Replaced control fuse on receiver elevator.

- Replaced gear and added new oil to the turbine oil centrifuge.
- Replaced bad vent valve on superheater of TSS (Thermal Storage System) extraction boiler #2.
- Installed cut-out switch on warehouse fire alarm panel.
- Repacked receiver panel 17 temperature control valve.

Plant Statistics	June '83	June '84	Turbine Roll To Date
Net Energy Production MWH	561.8	944.8	-500.1
Energy Production (MWH net while connected to the grid)	956.9	1192.6	10550.7
Hourly Peak MW (Net)	9.4*	8.9*	10.4*
On-Line Hours	165.9	207.6	2091.1
Test Hours	0.0	30.0	1615.7
Total Plant Outage Hours	63.5	24.0	1897.8
Scheduled	48.5	1.0	804.0
Unscheduled	15.0	23.0	1093.8
Weather Outage Hours	69.0	93.3	2540.1

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*Receiver Generated Steam Only

- Net energy production of 944.8 MWH was a record high for the month. The June 14-28 solstice test run had a significant contribution.

Attachments:

- Chronological Summary of Receiver Tube Defects (Attachment 1).
- Solar One Statistics: Weather outage hours, plant outage hours, test hours, and on-line hours (Attachment 2).
- Power production and plant testing were impacted by 93.3 hours of inclement weather. June was a positive output month, 944.8 MWH (Attachment 3).
- The daily and cumulative energy production while Solar One was on-line for the year-to-date and the three previous months are shown on Attachments 4 and 5.
- Solar and Plant Utilization is trended on Attachment 6.
- Attachment 7 describes an incident report on sulfuric acid spill of 2,500 gallons from the inline demineralizer acid storage tank.

Solar One Performance Summary

1) Station Availability = $\frac{H \times kw}{Hp \times kw}$

H = Hours On-Line

kw = Rated Output

Hp = Period Hours

Receiver Availability	96.7%
Discharging Availability	100.0%
Charging Availability	96.7%
Turbine Availability	100.0%

Note: For the purpose of availability, weather outage hours are considered available operating hours.

2) Output Factor = $\frac{\text{Net Transmitted Power}}{\text{On-Line Hours} \times \text{Maximum Rated Capacity}}$

Output Factor	38.0%

3) Capacity Factor = $\frac{\text{Net Transmitted Power}}{\text{Period Hours} \times \text{Maximum Rated Capacity}}$

Capacity Factor	11.0%

4) Solar Capacity Factor =

$$\frac{\text{Net Transmitted Power}}{\text{Integrated Insolation W-HR/m}^2 \times \text{Collector Field Surface Area}}$$

Solar Capacity Factor	6.5%

Operation and Maintenance Costs

- A summary of the O&M labor, material, contract, and other costs for the month of June 1984 is shown on the attached table. Expenses are categorized as follows:

Field Office	-	Includes plant supervision, engineering, accounting, clerical, office supplies, and miscellaneous indirect expenses.
Operations	-	Includes total cost of operating staff and expenses.
Miscellaneous Support	-	Includes station supplies and rentals, safety and job training, and site security.
Maintenance	-	Includes total cost of maintenance staff and expenses allocated to major plant subsystems.
Overheads	-	Includes costs associated with direct labor plus company administrative and general expenses.

SOLAR ONE

MONTHLY O&M COST SUMMARY
($ X 1000)

MONTH OF JUNE 1984

	LABOR	MATERIAL	CONTRACT	OTHER	TOTAL
FIELD OFFICE	13.3	.6	(.1)	1.8	15.6
OPERATIONS	53.1	14.0	-	.3	67.4
MISC. SUPPORT	3.7	5.6	2.9	.1	12.3
MAINTENANCE					
Supervision/Indirects	10.3	2.3	.2	.1	12.9
Control System	7.2	.3	1.8	-	9.3
Receiver System	3.9	6.8	7.2	-	17.9
Thermal Storage System	1.1	-	.4	-	1.5
Collector System	9.0	-	-	.1	9.1
EPGS System	5.2	4.5	.4	.1	10.2
Misc.	3.6	2.0	7.4	-	13.0
Total Maintenance	40.3	15.9	17.4	.3	73.9
SUB TOTAL	110.4	36.1	20.2	2.5	169.2
Division O. H.					23.7
TOTAL DIRECT					192.9
Workman's Compensation					.8
Payroll Tax					8.1
Pension & Benefits					24.2
Administrative & General					35.7
GRAND TOTAL					261.7

Attachment 1

SOLAR ONE GENERATING STATION

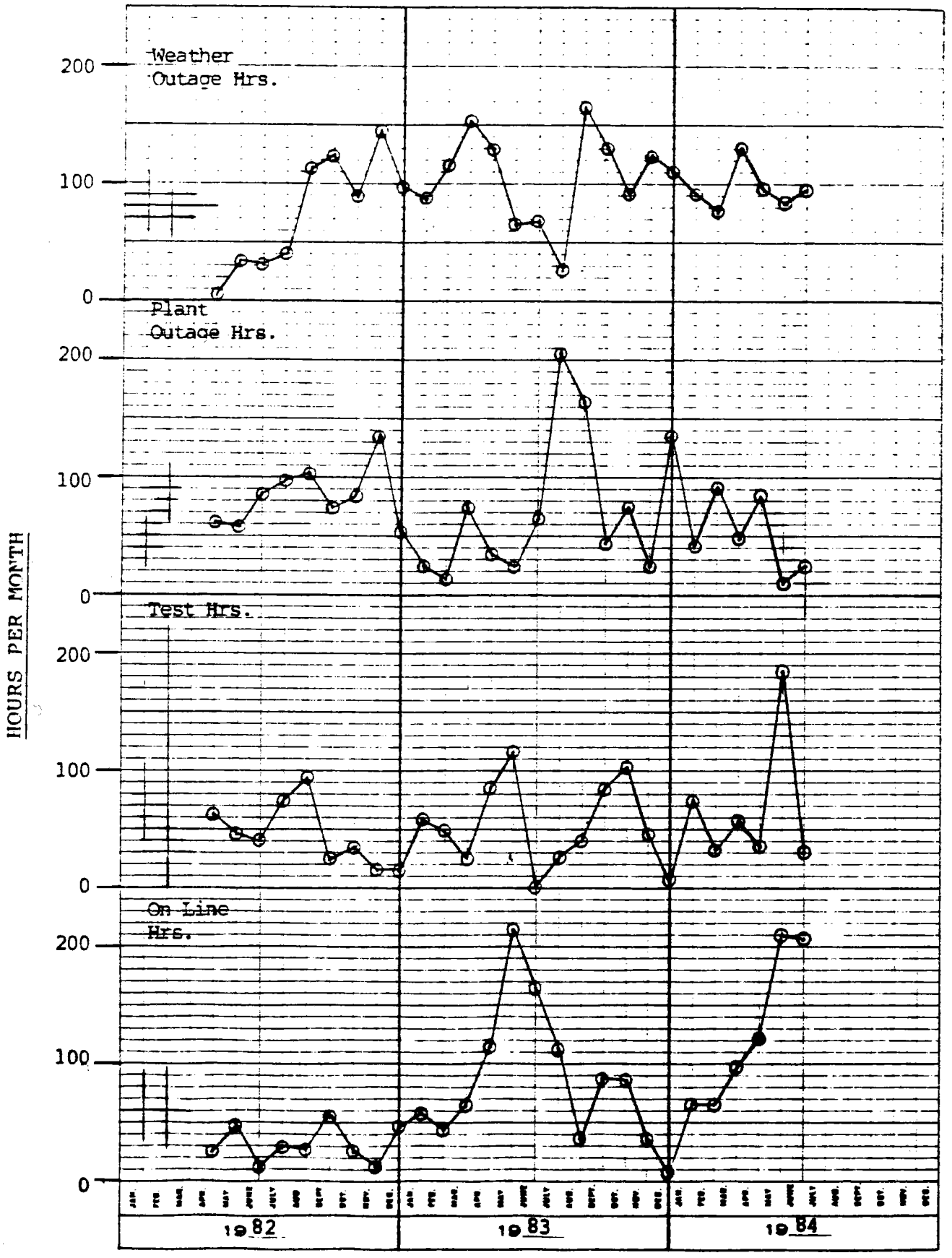
Chronological Summary of Receiver Tube Defects

DATE	DESCRIPTION OF TUBE DEFECT	LOCATION
Jul 15, 1983	Interstitial weld leak	tube 30, panel 18
Jul 26, 1983	Interstitial weld leak	tube 41, panel 18
Aug 2, 1983	Bend leak	tube 70, panel 11
Aug 18, 1983	Repair/removal of sample	tube 30, panel 18
	Repair, grind & fill	tube 41, panel 18
Aug 19, 1983	Replaced cracked tube section	tube 70, panel 11
Sep 8, 1983	Crack indication	tube 30, panel 19
Oct 26, 1983	Crack indication	tube 1, panel 18
	Interstitial weld leak found & repaired	tube 41, panel 12
	Interstitial weld crack	tube 41, panel 13
Nov 1, 1983	Interstitial weld crack on:	tube 41, panel 4
		tube 41, panel 6
		tube 30, panel 7
		tube 41, panel 8
		tube 41, panel 9
		tube 30, panel 17
	Surface irregularity	tube 41, panel 10
Nov 16, 1983	Bend leak	tube 1, panel 15
	Bend crack	tube 1, panel 16
	Bend crack	tube 3, panel 16
	Bend crack	tube 1, panel 17
Dec 1983	Outage - Removal of sample	tube 1, panel 4
		tube 1, panel 6
	Repair of cracks	tube 1, panel 15
		tube 1, panel 16
		tube 2, panel 16
		tube 3, panel 16
Jan 1984	Outage - Interstitial weld crack repair	tube 41, panel 13
Feb 1984	Outage - Interstitial weld crack repair	tube 41, panel 8
	Interstitial weld crack repair	tube 41, panel 9
	Bend crack	tube 70, panel 9
	Bend crack	tube 70, panel 10
	Bend crack	tube 70, panel 11
	Bend crack	tube 70, panel 12
	Surface polished	tube 41, panel 10

RMA:so
leaks.rno

ATTACHMENT 2

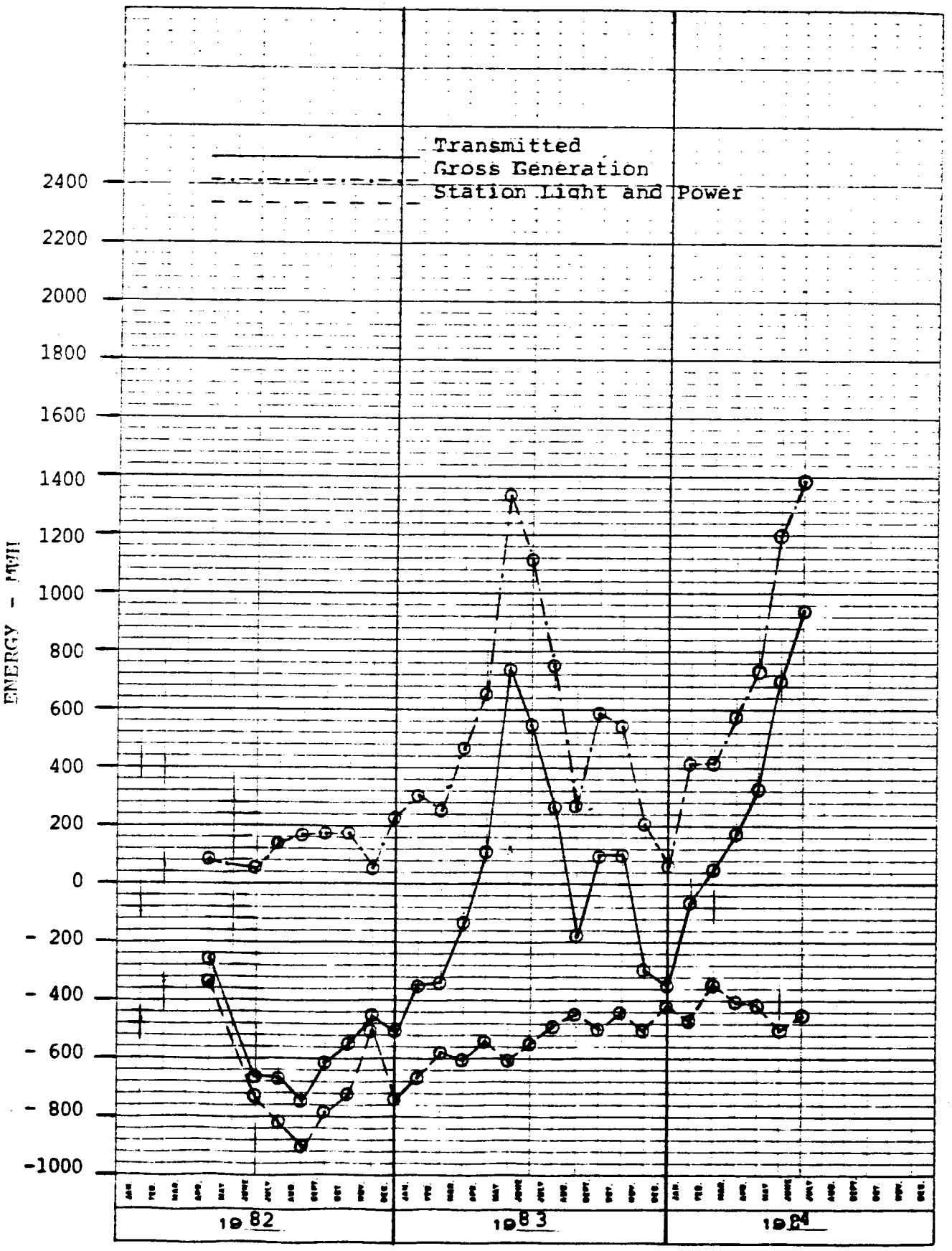
SOLAR ONE STATISTICS



RMA 03/07/84

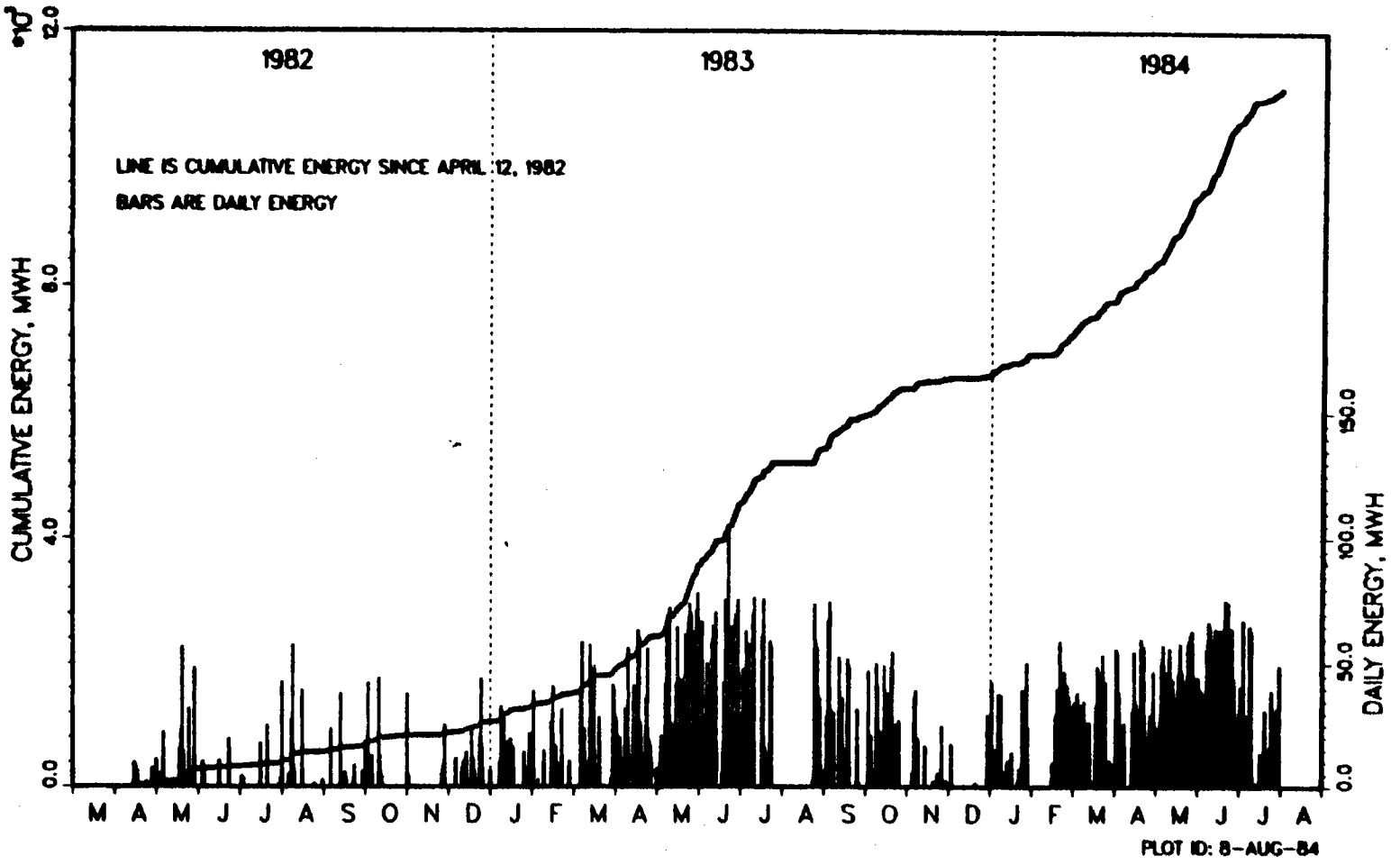
ATTACHMENT 3

SOLAR ONE
MONTHLY METER REPORT SUMMARY



RMA 03/09/84

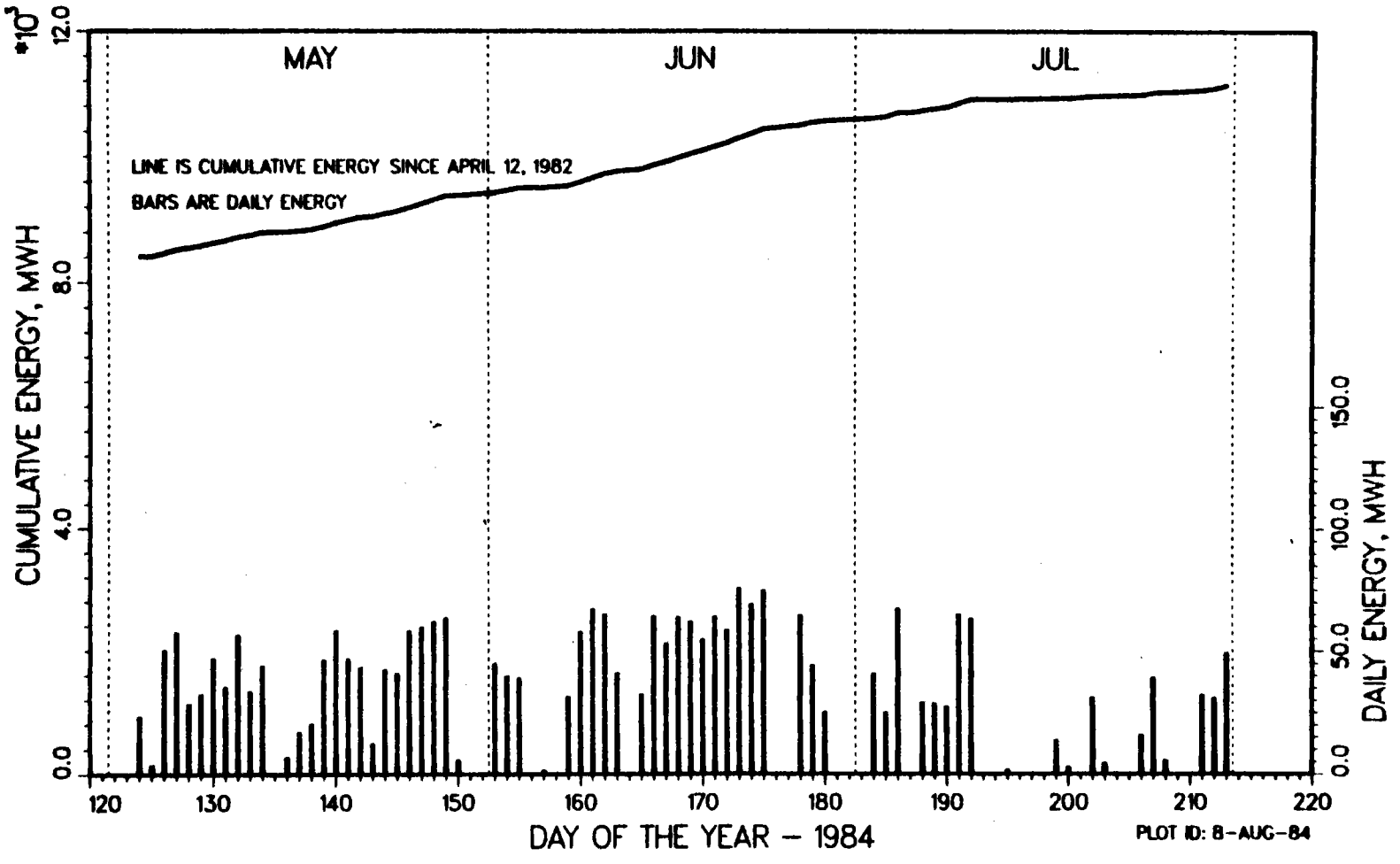
SOLAR ONE NET ELECTRICAL PRODUCTION



ATTACHMENT 4

0002

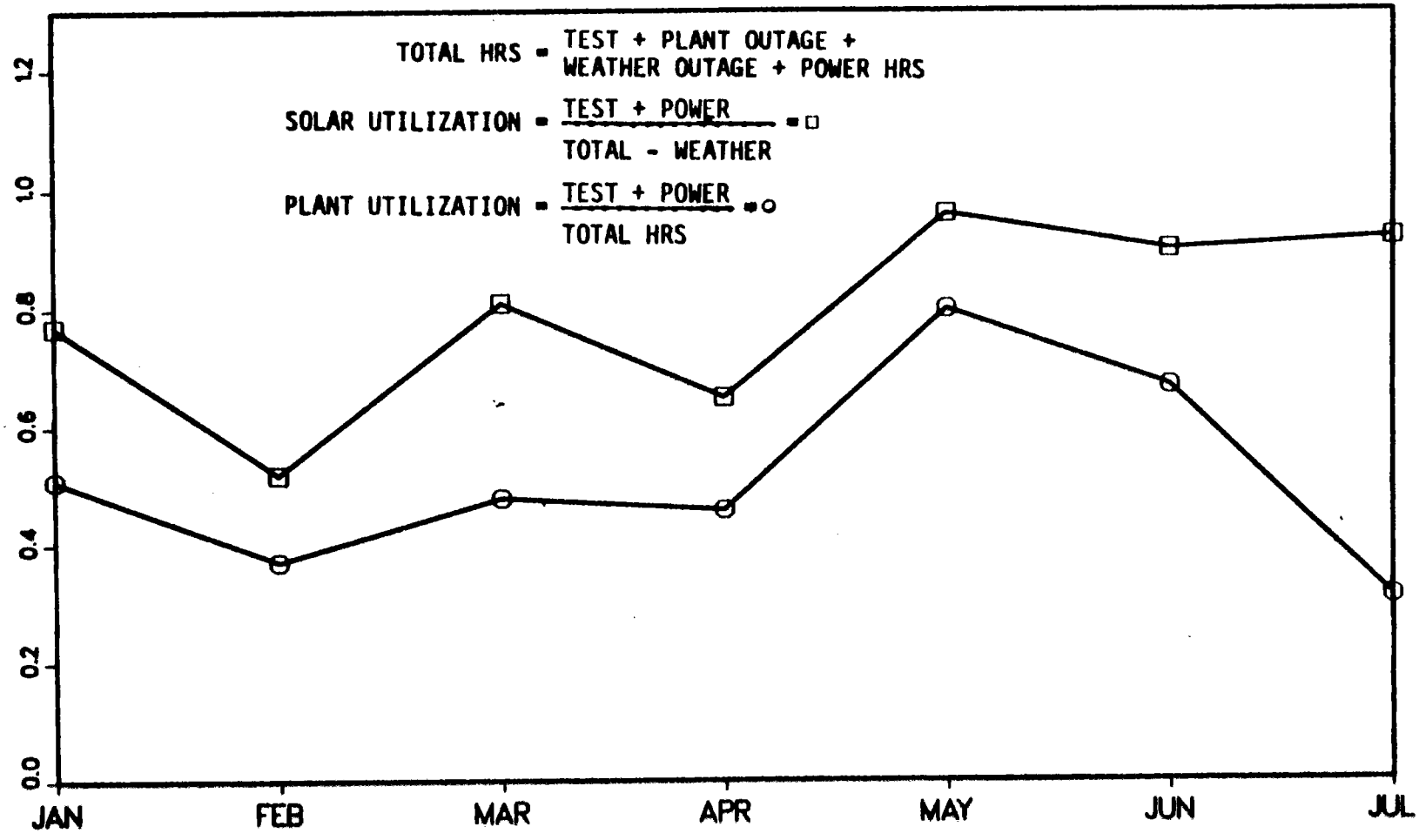
SOLAR ONE NET ELECTRICAL PRODUCTION



ATTACHMENT 5

0001

SOLAR AND PLANT UTILIZATION FOR 1984



ATTACHMENT 6

0001

SOLAR ONE GENERATING STATION
INCIDENT REPORT

INCIDENT:	Line Failure and Subsequent Spill of 2,500 Gallons of Sulfuric Acid from the Demineralizer Acid Storage Tank.
DATE:	June 9, 1984
PERSONNEL ON DUTY:	Shift Supervisor R. Irby, CO J. Linn, ACO J. Burch, PEO C. Gallinger, Shift Supervisor R. Takekawa still on station. J. Barber Electrician was on site working on heliostats.

DESCRIPTION OF INCIDENT:

At 1616 hours, acid was found leaking from the demineralizer acid storage tank by PEO Gallinger. He immediately reported it to the control operator who in turn notified Irby, Takekawa, Burch and Barber. The plastic pipe on the tank side of the root valve had separated at the valve and was dumping acid on the ground just outside of the containment dike.

Mr. Gallinger put on an acid suit and attempted to remove the tank's belly drain in order to empty the tank into the containment dike. The drain plug could not be removed so it was decided to cut the plastic pipe off within the dike. This was accomplished at 1628 hours, and a fire extinguisher cover was placed over the line and tied in place to deflect the acid into the dike. At this time Barber, Burch and Takekawa were making dirt berms to contain the spill and try to keep it away from the heliostat control boxes.

At 1632 hours, R. Irby contacted J. Raine, shift supervisor at Cool Water, and asked him to send over soda ash, and some extra people equipped with rubber boots, goggles, and respirators to help neutralize the spill. Raine also tried to contact J. Fuller and received no answer. He then called the beeper service and left a message.

At 1642 hours, Mr. Gallinger was sent home by the shift supervisor to shower and change clothes. He reported no injuries and returned at 1755 hours.

Mr. J. Sovern returned my call at 1730 hours, after returning home, and was notified of the spill and the area effected. Due to the size of the spill, it was decided to call Crosby and Overton, Inc. and have them come out to handle the spill.

At 1745 hours, Larry Boyle of Crosby and Overton was contacted and informed of the spill. I explained that the spill was 98% concentration and covered a 30 x 30 yard area, and also that the containment dike was one foot deep with acid and covered an an area of 10 x 15 feet. Larry said he would send out a stainless steel vacuum truck, a supervisor, and a crew of four along with some soda ash.

He estimated their time of arrival to be around 2200 hours, and suggested that we wait until Monday to haul off the earth, as the chemical dumps are not open on the weekend. J. Sovern was then notified of Crosby's schedule.

At 1747 hours, the area was barricaded off and Coolwater's crew (Raine, Smith and Edwards) arrived on station with six barrels of soda ash to start neutralizing the spill. The six barrels were spread out and another eight barrels were brought over and spread. This was a time consuming task, as the soda ash is stored at Coolwater in a silo, and takes time to get it into barrels.

R. Takekawa left the station at 1802 hours, as it was felt he would have to return at 0400 for shift coverage.

J. Fuller returned Raine's call at 1830 hours, and was informed of the spill. He also reminded us that pond #1 is a class one dump site.

Crosby and Overton arrived on station at 2325 hours with a pump truck, a crew truck, two other vehicles, two supervisors, a pump truck operator and a crew of four. They also brought two pallets of soda ash. The crew spread the soda ash on the major areas of the spill and put seventeen bags into the containment dike. A ph was then taken and indicated a value of less than two. It was then decided that it would take too much soda ash to raise the ph in the dike, so it was pumped out at that time. Coolwater was notified at 2350 hours that we would need some more soda ash. Raine requested help in filling the barrels so J. Burch was heldover. The barrels were brought over and the rest of the area was covered. Burch left at 0200 hours.

J. Sovern was contacted at 0223 hours to request an E.P.A. number in order for Crosby and Overton to haul off the acid. He recommended that J. Fuller be contacted. At 0225 hours, contacted J. Fuller and informed him that we had pumped 1,680 gallons of acid out of the containment dike, and needed an E.P.A. number. He told us to dump it into evaporation pond #1, and that an E.P.A. number was not needed, as it was not leaving the station. J. Raine was then notified of the acid being sent to the evaporation pond. He said he would have an operator meet the driver and escort him to pond #1.

At 0234 hours, Crosby and Overton left the station for the night, and were scheduled to return Monday morning at 0400 hours to remove soil from the spill area.

Mr. J. Fuller contacted Fossil Manager, G. Finley at 0842 hours Sunday morning to report the incident. In addition, Mr. B. Rapan of SCE Environmental Services was contacted at 0858. Per SCE procedures, Mr. Rapan contacted the Lahontan region of the California Regional Water Quality Control Boards, and reported the incident. Lahontan representative indicated no further notifications were necessary, since the spill was contained on the property.

The acid tank had approximately five feet four inches of acid in it, or around 2,518 gallons. The containment dike caught 1,680 gallons, and it was believed that around 850 gallons went on the ground. According to Crosby and Overton, the spill covered 9,000 square feet. On Monday, June 11 a small skip loader, scraper, two semi dump trucks, a crew of four laborers, and a supervisor from

Crosby and Overton arrived to clean up the contaminated area. The major clean up was completed late Tuesday, neutralizing small pockets to a ph of +5 continued through June 17. Approximately 220 cubic yards of soil was removed. In addition, 75 feet of asphalt driveway required removal. Sufficient earth was removed to indicate a ph range of 5.5 or higher. All contaminated soil was sent to BKK class one dump. A local contractor was used starting Wednesday, to bring in clean dirt to restore the ground grade.

acid.rno

DOE/SF/10501-226
(STMPO-226)

SOLAR ONE
OPERATION AND MAINTENANCE REPORT #26
MAY 1984

THIS REPORT SUMMARIZES THE OPERATIONAL ACTIVITIES AND HIGHLIGHTS MAINTENANCE WORK THAT WAS PERFORMED DURING THE MONTH. IN ADDITION, IT PRESENTS PLANT STATISTICS AND A MONTHLY OPERATION AND MAINTENANCE COST SUMMARY.

Abstract

Power production and plant testing were limited by 85.0 hours of inclement weather. The gross energy production for the month of May was 1200.0 MWH, and the net energy production was 703.0 MWH.

Operational Highlights

- Testing of OCS (Operational Control System) clear day scenario, Mode 9 to 1 (steam dump to turbine direct), Mode 1 to 2 (turbine direct to turbine direct and charging), and mode 2 to 1 to 9 (turbine direct and charging to turbine direct to steam dump) continued.

  The transition from Mode 2 to 5 (turbine direct and charging to steam dump) using OCS was performed for the first time on May 16, and was successful.

- The Solar One Project Sixth Annual Technology Review Meeting was held on Wednesday, May 16, in Claremont, California. Presentations included Test Program Review, Receiver, Thermal Storage and Heliostat Evaluations, Plant Automation, Lessons Learned, and Environmental Effects. The meeting was continued at the site May 17, with a demonstration of plant sunrise start-up, and presentations on the Power Generation and Plant Support Systems, and in Operating and Maintenance Experiences, by SCE staff.

- Manual BCS measurements of heliostats continues. As of May 25, 1531 heliostats had been measured once, while some heliostats had been measured more than once. A total of 1012 heliostats that had been measured required a pointing adjustment. Heliostat bias updates should be completed by mid-June. Repeated manual BCS adjustments will also continue on problem heliostats and on the innermost seven rows of heliostats.

- The OCS (Operational Control System) time code generator advanced by three days on May 22; this occurred during the

receiver feed pump start-up. The day before, the time was delayed by two hours. The suspected source of trouble, a large current draw from the feedwater pump, was circumvented by changing the time generator power source from the 4kV well line to the uninterruptible power supply (UPS). This problem was apparently created when the plant load supply was changed from the 33kV bug line to the 4kV well line on May 18, 1984.

- Two heliostat failures occurred. This is noteworthy because the failure types are new. The first heliostat failure occurred when a heliostat circuit breaker opened. Cabling wrapped around the bolts which mount the drive to the pedestal and the cable tightened as the heliostat moved into tracking position. The cable did not break, but the circuit breaker opened. The second heliostat was taken out of commission due to the failures of an azimuth drive gear.

- SCE, Sandia and MDAC personnel met with General Electric Medium Steam Turbine Division staff at Lynn, MA, May 23. The purpose of the meeting was to discuss the status of deficiencies in the turbine admission steam and auto-synchronization systems which preclude fully automatic start-up. As a result of this meeting the following action items have been completed or are pending:

  - SCE to reset the lube oil pump control such that the second A.C. lube oil pump starts at 48 psi. GE feels that the potential leakage in the turbine front standard is causing the low discharge pressure on the running pump. In the interim SCE should reset the pressure switch setting pending the unit inspection outage at which time leakage causes should be corrected and pressure switch reset to its original value.

  - In the next week GE to inform SCE as to new admission control valve controller setting. Presently the V2 valves transfer from pressure to minimum flow control to protect against anti-monitoring. GE was informed that SCE has provided a low-load trip and therefore this function is no longer required. Its existence causes difficulty in starting up on admission steam or in transitioning from admission steam to receiver steam. The new controller setting will eliminate the minimum flow condition allowing TSS pressure control at all flow conditions.

  - General Electric to reevaluate the relationship between the V1 and V2 valve operation. GE was informed that SCE did not feel such interaction was required and that its existence made admission pressure control during transition from admission steam to receiver steam or transition from receiver steam to admission steam difficult. GE was informed that SCE would prefer that the V2 valves operate independent of the V1 valves when operating on admission steam or on a combination of admission and receiver steam.

- General Electric (GE) to evaluate the difficulty experienced in starting up the turbine on admission steam. GE will, in the next several months, submit recommended problem correction for review.

- SCE to install the generator liquid level detector per drawings issued during the meeting.

- SCE to reposition the turbine eccentricity pick up per drawings previously submitted from GE.

- SCE to remove turning gear engagement spring and replace with solid link which is to be provided by GE to ensure positive turning gear engagement. Should this effort not be effective, GE to supply SCE an air cylinder and mounting hardware to effect even more positive engagement.

- GE to provide a revised stop valve ETD trip coil with logic to minimize coil failures.

- GE to supply SCE a replacement EHC accumulator manifold to allow returning second accumulator to service. Returning the second accumulator to service should prevent parallel operation of the two EHC pumps.

- GE and SCE will jointly review the GE ramp rate controller and the SCE auto synchronizer and resolve failure of the equipment to synchronize the generator automatically.

- GE to inform SCE if a generator halon fire protection system can be used in lieu of the present carbon dioxide system.

- GE to review SCE turbine operating instructions and past start-up records and submit their recommended procedural revisions.

o Summer Solstice Campaign: Representatives from SNLL, SCE, and MDAC are working together to maximize the efforts toward a successful campaign. Key items being considered to insure peak plant output and efficiency are maximizing collector field (heliostats) contribution, operating the receiver at optimum set point temperature, and insuring that all instrumentation is accurate and the data acquisition is reliable. System start-up will occur as early as possible on days when peak direct normal insolation is expected to reach at least 900 W/M^2. It appears that the items which provide the greatest leverage in improving plant efficiency are high heliostat availability and clean heliostats.

o On May 12, the station experienced a momentary power loss due to a line relay on the Barroid 33kV line at Gail Substation. This caused a HAC (Heliostat Array Controller) failover, receiver trip, and generator trip. The field (heliostats)

remained on the receiver until a Load All was issued followed by an emergency standby command. All but two strings of heliostats responded, and the two strings were manually removed.

- The receiver MV8000 (computer) failed on May 20, requiring the plant to shut down. SCE instrument technicians determined that the MV8000 console communication processor card failed, cause unknown. The card was subsequently replaced and the receiver MV8000 was returned to service.

- Solar One Convective Loss Experiment: Ongoing series of experiments has been designed to measure the convective energy losses from the central receiver at the Solar One Pilot Plant. The goal of these experiments is to provide convective loss measurements in order to determine the convection coefficient for the receiver. These measurements are being made in a regime in which wall to ambient temperature differences are a factor of three below those of a normal operating receiver. The tests are being performed at reduced surface temperatures to eliminate uncertainties associated with the determination of incident solar flux.

  Interest in determining the convective losses stems primarily from the desire to reduce the uncertainty in the calculation of thermal efficiency for solar central receivers. The uncertainty is reduced when more accurate predictions of losses due to reflection, thermal emission, heat conduction, and convection can be made. Convective heat transfer represents a significant fraction of the energy loss from the front surface of the central receiver. Energy transfer by radiation and conduction from an external receiver can be well characterized; the same cannot be said for convection.

- The flowmeter test station operation was initiated and calibration tests are in progress. The flowmeter test station consists of two laboratory calibrated orifice plates and pipe sections along with associated instrumentation. The test station is arranged in a piping configuration which allows series feedwater flow through a Ramapo meter being tested and through one or the other of the two orifice plates (one a high flow range and the second a low flow range). The indicated flow rate through the Ramapo is then compared with the flow through the orifice plate which is used as the standard.

  The Ramapo flowmeters are target type meters used for feedwater measurement and in the control configuration for water flow to each receiver boiler panel. Accurate flow measurement is necessary to establish confidence in receiver performance analysis.

- To help the integrity of the inline demineralizer regeneration process the following changes have been recommended by Division Chemical:

- Last step of Abro step 3 (rinse), added venting.

- Step 5 (settle resin) was changed from 2 to 5 minute duration.

- Step 7 (cation displace/anion 4% caustic) was changed from 25 to 40 minute duration.

- Step 9 (cation block flow/anion fast rinse) was changed from 15 to 30 minute duration.

o During the SCE Operations' training on the OCS (Operational Control System), Art Iwaki (MDAC) has asked for any input Operations may have concerning the use or operation of OCS. A notebook was placed near the OCS typewriter to record problems or suggestions by Operations.

Maintenance Highlights

o Modern Alloys completed retrofitting 10,036 of the 10,546 mirror modules scheduled for the vent modification as of Wednesday, May 9. The retrofit work is considered essentially completed, and the modification of the remaining 510 modules is not considered critical.

o The receiver elevator underwent its quarterly inspection at which time the gear box was overhauled. The inspection found the brake release linkage to be broken, and as a result the elevator has been removed from service awaiting a replacement linkage. The broken part is that which allows manual lowering of the elevator on failure of electrical logic or power supply.

o The heliostat wash truck was placed in service. The truck was found to be able to wash up to 21 heliostats per hour. The wash program requires two minutes to complete the heliostat wash cycle and the truck drive requires one minute to reposition the wash truck to the next heliostat to be washed. It was noted that due to the brush and brush limit switch relationship, approximately 6" of the left side of each mirror module is not washed.

  The computerized automatic system on the wash truck still continues to have problems. Parts have been ordered to implement modifications.

  Heliostat washing continued using a borrowed insulator wash truck. Currently, a total of 1307 heliostats have been washed.

o Electricians and technicians are working to reduce the number of out of service heliostats. The current number of heliostats out of service is 120. The major problems with

heliostats are related to motor seal wear, and azimuth and elevation encoders.

- The inspection on the inline demineralizer bed #1 indicated that the screen outlet allowed resin to pass through and clog the outlet resin trap. It was determined that the screen was bad due to mechanical deformation. A new screen was placed on order.

- Receiver flowmeter on panel 18 was replaced and calibrated due to unknown problem with erratic flow indications. Receiver panel 20 flowmeter is requiring frequent bias adjustments and has been scheduled for replacement.

- Three new leaks on the waste water blowdown line were repaired. Suspect PVC couplings are failing at midpoint due to compressive and tensile stress from thermally induced temperature transients.

- Installed a new caustic pump housing on the caustic transfer pump. Suspect cracked housing was due to thermal expansion or vibration.

- Receiver panel leaks were repaired on preheat panel 22 plugs 48, 50 and 32, and preheat panel 23 plug 38, and flowmeter flange on panel 20.

- TI 1022 steam temperature indicator on the main steam super heat line before the turbine stop valve failed to 0 degrees F. A bad transmitter was found and was replaced with a new transmitter. The internal problem on the bad transmitter was unknown.

- Receiver core panel expansion guide (roller) inspections (row 1, 2 & 3) were completed and no expansion guide problems were found.

- Installed 480 volt loss of phase relays on cooling tower and station service transformers. The original 220 volt relays were the wrong voltage relays.

- A 90% ground was found on the 480 volt bus B01. The ground was identified on the turbine enclosure fan 905C. Fan plug was replaced to correct the problem.

- Miscellaneous maintenance work accomplished during the month of May, is as follows:

  - Aligned west BCS (Beam Characterization System) camera.

  - Installed and connected indicating light for inline demineralizer A1 valve (acid dilution).

- Repaired suction line leak on inline demineralizer acid feed pump.
- Replaced leaky solenoid on west air dryer.
- Mounted eye wash station in the chemical lab.
- Installed ground clamps on gasoline barrels.
- Replaced leaky cooling water pipe on air compressor 901.
- Installed a rebuilt valve on caustic day tank fill line.
- Installed power supply for FT3715 on extraction train #1 (Thermal Storage System).
- Installed a ground fault interrupter on the power receptacle for the portable make-up demineralizer.
- Replaced OSP (Operating Station Processor) #4 keyboard after failing. Failure was unknown.
- Repaired memory board on DAS (Data Acquisition System) chromatics CRT (Cathode Ray Tube). Cause of problem was unknown.

Plant Statistics	May '83	May '84	Turbine Roll To Date
Net Energy Production MWH	734.0	703.0	-2853.8
Energy Production (MWH net while connected to the grid)	1138.7	995.5	9358.1
Hourly Peak MW (Net)	10.2*	8.5*	10.4*
On-Line Hours	213.6	210.0	1883.5
Test Hours	118.8	187.9	1585.7
Total Plant Outage Hours	26.3	10.0	1873.8
Scheduled	0.0	1.0	803.0
Unscheduled	26.3	9.0	1070.8
Weather Outage Hours	67.0	85.0	2446.8

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*Receiver Generated Steam Only

Attachments:

- Chronological Summary of Receiver Tube Defects (Attachment 1).
- Solar One Statistics: Weather outage hours, plant outage hours, test hours, and on-line hours (Attachment 2).
- Power production and plant testing were precluded by 85.0 hours of weather outage. May was a positive output month, 703.0 MWH (Attachment 3).
- The daily and cumulative energy production while Solar One was on-line for the year-to-date and the three previous months are shown on Attachments 4 and 5.
- Solar and Plant Utilization is trended on Attachment 6.

Operation and Maintenance Costs

- A summary of the O&M labor, material, contract, and other costs for the month of May 1984 is shown on the attached table. Expenses are categorized as follows:

Field Office	-	Includes plant supervision, engineering, accounting, clerical, office supplies, and miscellaneous indirect expenses.
Operations	-	Includes total cost of operating staff and expenses.
Miscellaneous Support	-	Includes station supplies and rentals, safety and job training, and site security.
Maintenance	-	Includes total cost of maintenance staff and expenses allocated to major plant subsystems.
Overheads	-	Includes costs associated with direct labor plus company administrative and general expenses.

SOLAR ONE

MONTHLY O&M COST SUMMARY
($ X 1000)

MONTH OF MAY 1984

	LABOR	MATERIAL	CONTRACT	OTHER	TOTAL
FIELD OFFICE	16.2	.5	.3	5.8	22.8
OPERATIONS	60.5	6.6	-	.1	67.2
MISC. SUPPORT	3.8	1.1	4.8	1.6	11.3
MAINTENANCE					
Supervision/Indirects	11.7	2.9	.1	.2	14.9
Control System	8.3	2.1	5.6	-	16.0
Receiver System	4.6	2.1	2.4	.2	9.3
Thermal Storage System	.9	3.7	1.0	-	5.6
Collector System	9.0	-	-	-	9.0
EPGS System	6.4	5.0	-	.1	11.5
Misc.	4.9	8.4	5.4	-	18.7
Total Maintenance	45.8	24.2	14.5	.5	85.0
SUB TOTAL	126.3	32.4	19.6	8.0	186.3
Division O. H.					28.3
TOTAL DIRECT					214.6
Workman's Compensation					1.0
Payroll Tax					9.6
Pension & Benefits					28.7
Administrative & General					39.3
GRAND TOTAL					293.2

Attachment 1

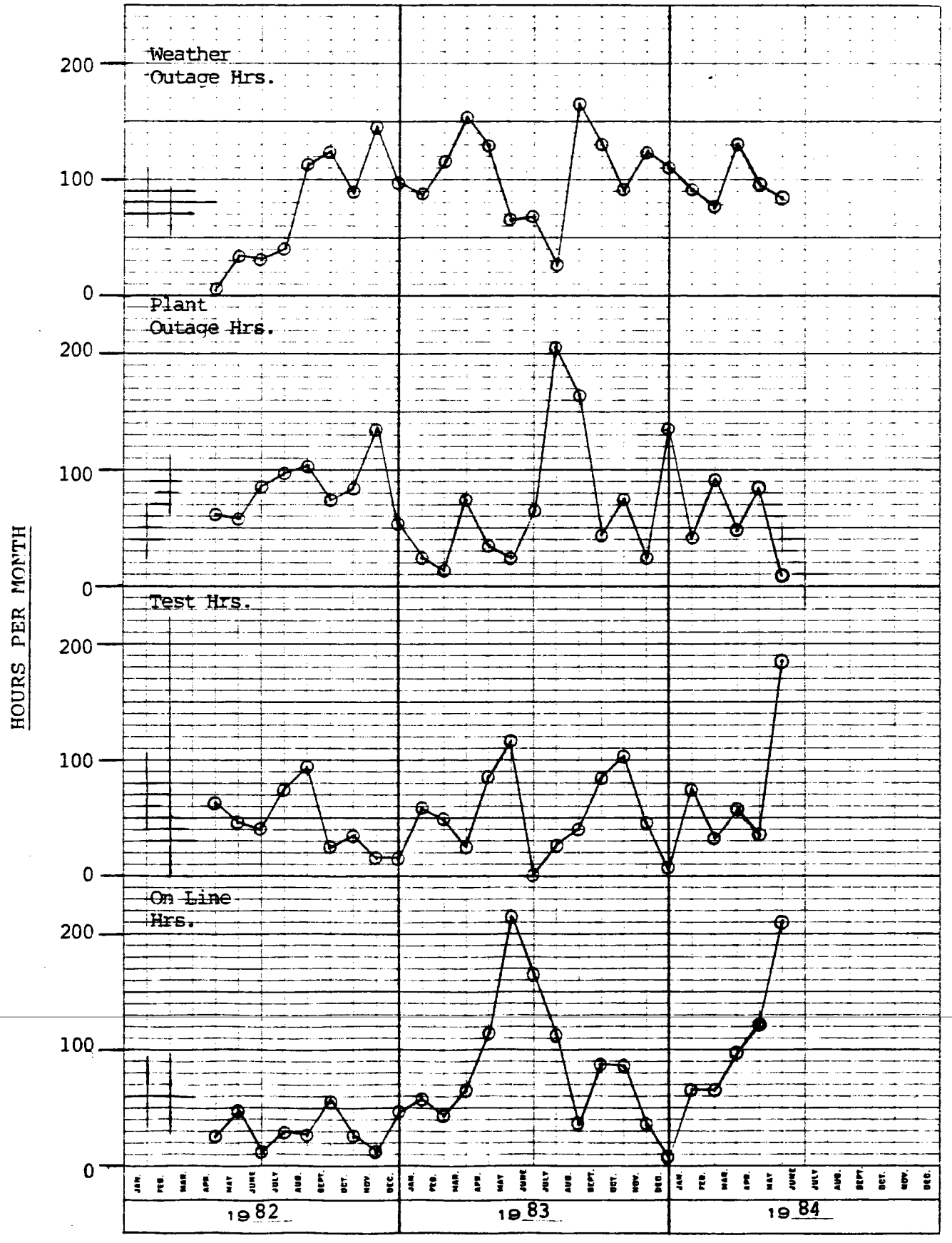
SOLAR ONE GENERATING STATION

Chronological Summary of Receiver Tube Defects

DATE	DESCRIPTION OF TUBE DEFECT	LOCATION
Jul 15, 1983	Interstitial weld leak	tube 30, panel 18
Jul 26, 1983	Interstitial weld leak	tube 41, panel 18
Aug 2, 1983	Bend leak	tube 70, panel 11
Aug 18, 1983	Repair/removal of sample	tube 30, panel 18
	Repair, grind & fill	tube 41, panel 18
Aug 19, 1983	Replaced cracked tube section	tube 70, panel 11
Sep 8, 1983	Crack indication	tube 30, panel 19
Oct 26, 1983	Crack indication	tube 1, panel 18
	Interstitial weld leak found & repaired	tube 41, panel 12
	Interstitial weld crack	tube 41, panel 13
Nov 1, 1983	Interstitial weld crack on:	tube 41, panel 4
		tube 41, panel 6
		tube 30, panel 7
		tube 41, panel 8
		tube 41, panel 9
		tube 30, panel 17
	Surface irregularity	tube 41, panel 10
Nov 16, 1983	Bend leak	tube 1, panel 15
	Bend crack	tube 1, panel 16
	Bend crack	tube 3, panel 16
	Bend crack	tube 1, panel 17
Dec 1983	Outage - Removal of sample	tube 1, panel 4
		tube 1, panel 6
	Repair of cracks	tube 1, panel 15
		tube 1, panel 16
		tube 2, panel 16
		tube 3, panel 16
Jan 1984	Outage - Interstitial weld crack repair	tube 41, panel 13
Feb 1984	Outage - Interstitial weld crack repair	tube 41, panel 8
	Interstitial weld crack repair	tube 41, panel 9
	Bend crack	tube 70, panel 9
	Bend crack	tube 70, panel 10
	Bend crack	tube 70, panel 11
	Bend crack	tube 70, panel 12
	Surface polished	tube 41, panel 10

PMA:so
leaks.rmo

SOLAR ONE STATISTICS



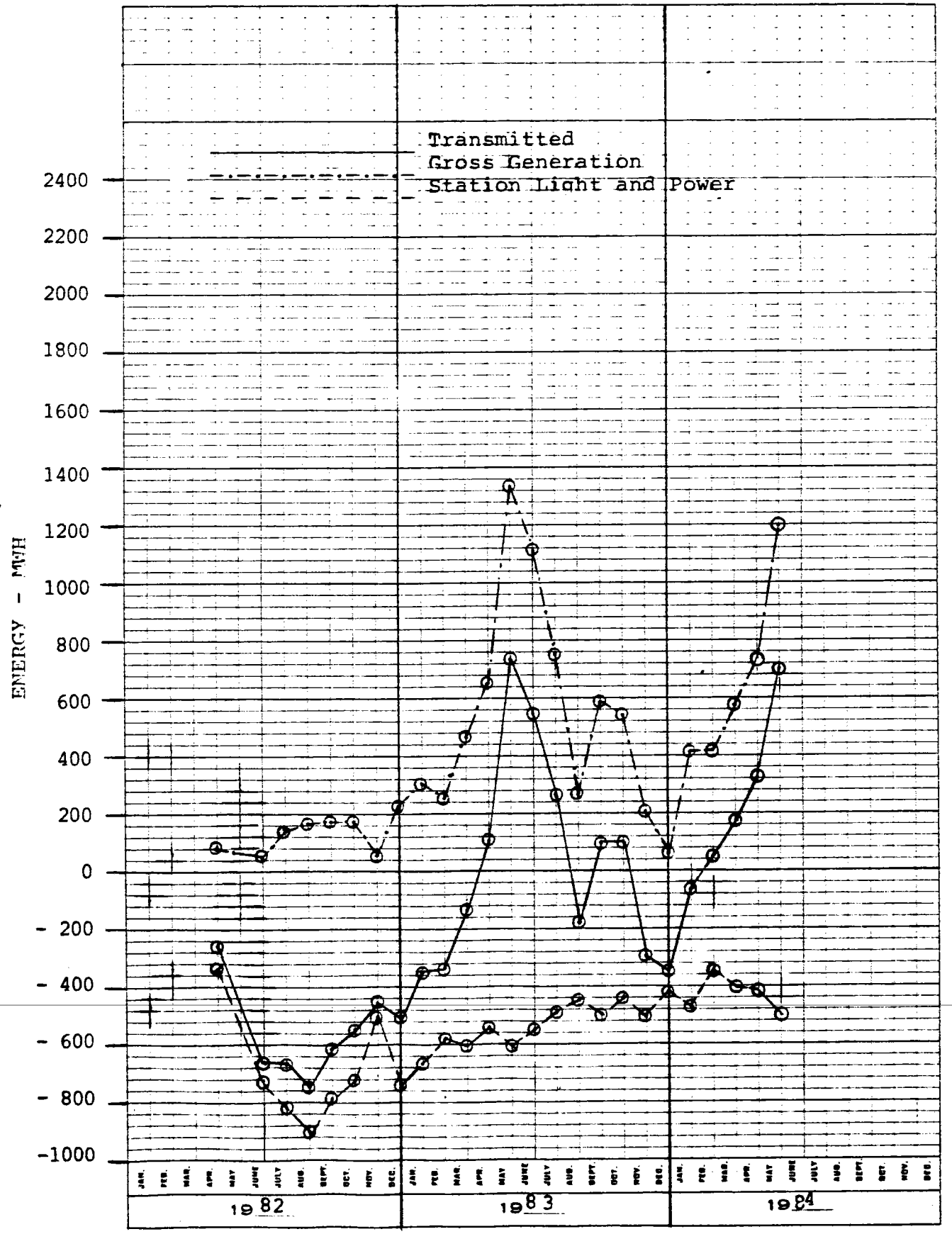
DIETZGEN CORPORATION MADE IN U.S.A.

NO. 340-T3D DIETZGEN GRAPH PAPER 3 YEARS BY MONTHS

RMA 03/07/84

ATTACHMENT 3

SOLAR ONE
MONTHLY METER REPORT SUMMARY

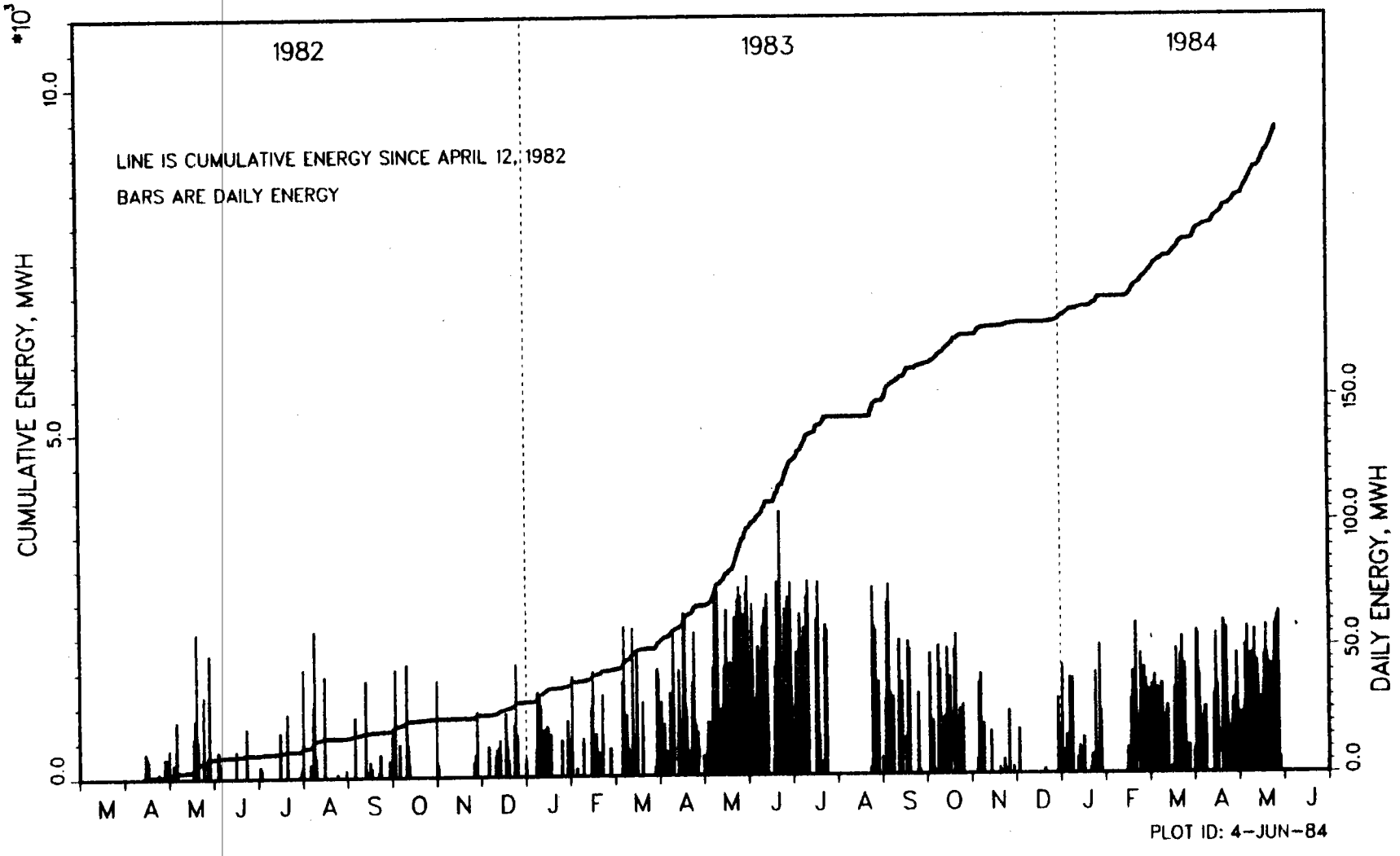


DIETZGEN CORPORATION
MADE IN U.S.A.

NO. 340-T30 DIETZGEN GRAPH PAPER
3 YEARS BY MONTHS

RMA 03/09/84

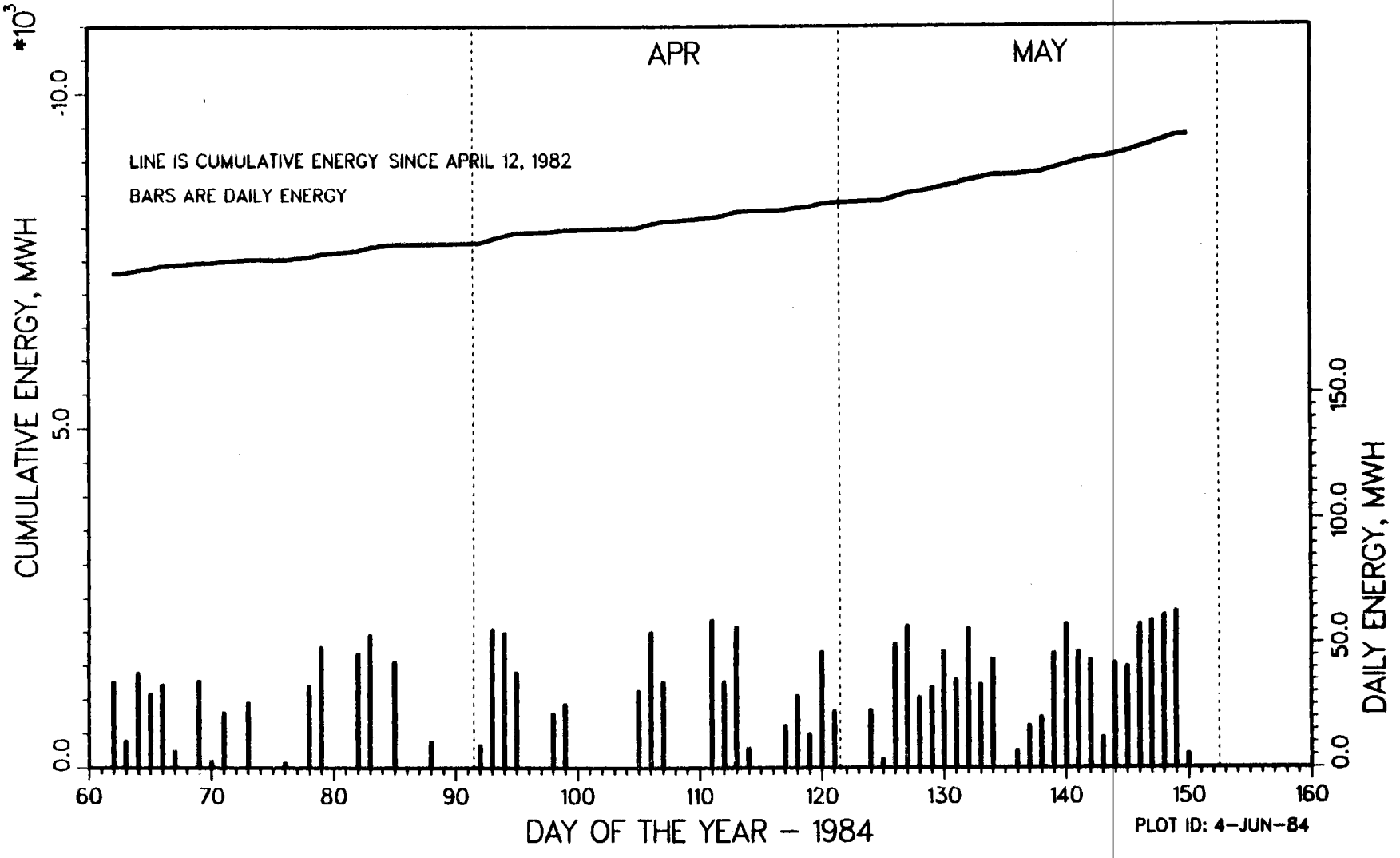
SOLAR ONE NET ELECTRICAL PRODUCTION



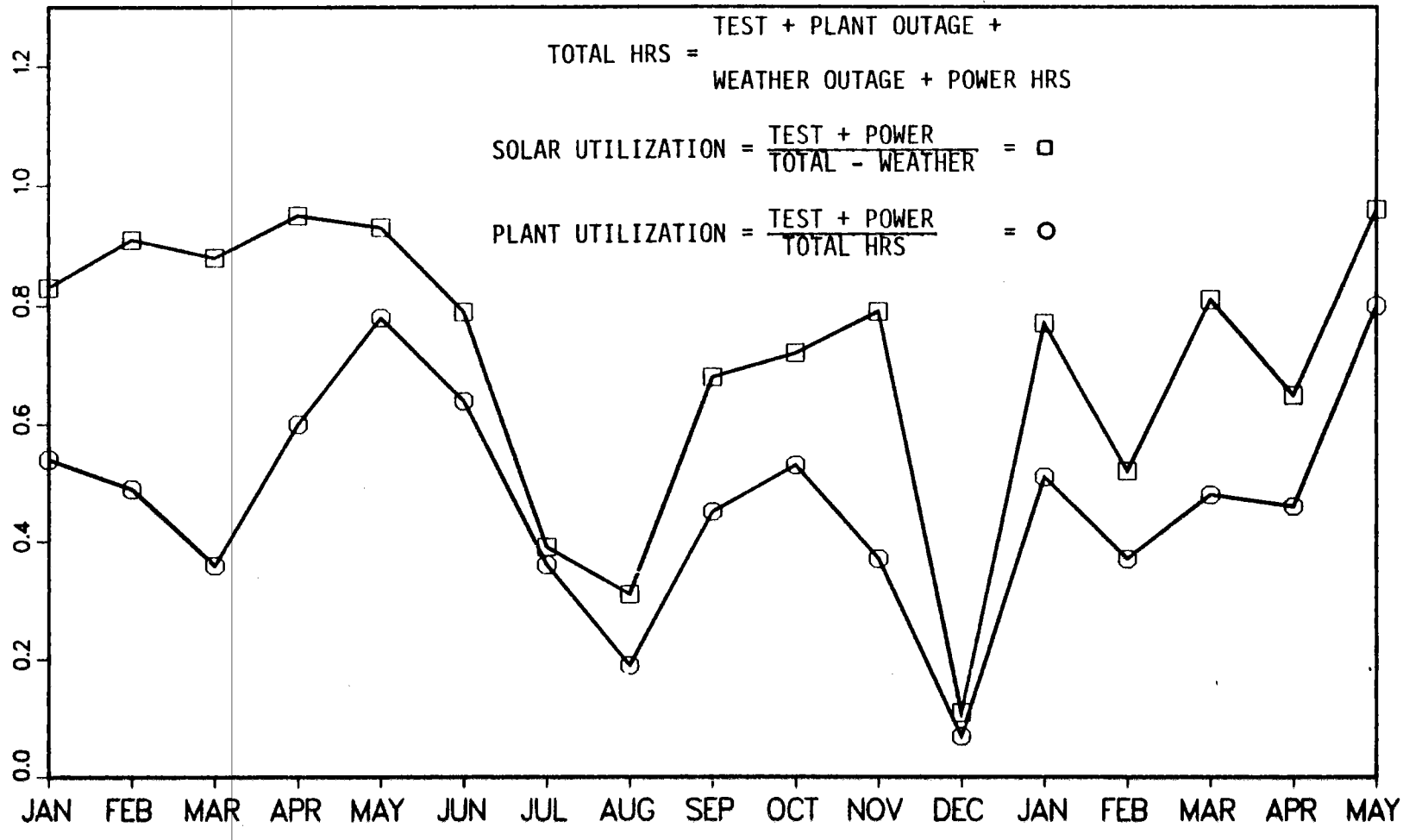
Attachment 4

Attachment 5

SOLAR ONE NET ELECTRICAL PRODUCTION



SOLAR AND PLANT UTILIZATION – 1983 AND 1984



Attachment 6

DOE/SF/10501-225
(STMPO-825)

SOLAR ONE
OPERATION AND MAINTENANCE REPORT #25
APRIL 1984

THIS REPORT SUMMARIZES THE OPERATIONAL ACTIVITIES AND HIGHLIGHTS MAINTENANCE WORK THAT WAS PERFORMED DURING THE MONTH. IN ADDITION, IT PRESENTS PLANT STATISTICS AND A MONTHLY OPERATION AND MAINTENANCE COST SUMMARY.

Abstract

Power production and plant testing were limited by 98.5 hours of inclement weather and a scheduled four-day plant outage. The gross energy production for the month was 733.4 MWH and the net energy production was 322.5 MWH.

Solar One first generated power on April 12, 1982. Attachment 7 is a report by Doug Elliott, DOE, which he prepared for the annual DOE Solar Central Receiver Meeting. Doug's report is a good summary of the Solar One Project's inception through its second anniversary of operation, i.e., April 12, 1984.

A scheduled plant outage took place April 9 through April 13, to allow for dye penetrant inspection of receiver panel interestial welds, ultrasonic inspection of receiver tube bends and inspection of all receiver panel expansion guides (rollers). The outage was extended one day due to high winds and dust which precluded outage work.

Operational Highlights

- o Moon Tracking: The northern quadrant of the heliostat field was photographed from the 15th level of the tower while tracking the moon on Tuesday, April 17. The heliostats were placed on track and photographed segment by segment, thus allowing easier identification of misaimed heliostats.

- o Beam Characterization System (BCS) work continues on solving problems with the auto BCS. There appear to be software problems in both the BCS and the Heliostat Array Controller (HAC) which prevent useful measurement of heliostat beams using the automatic program.

  Manual BCS measurements of the heliostat field, with visual analysis of the beam image on the remote TV monitors, are being taken to check and bias update as necessary the alignment of 75-100 heliostats per day. The plan is to complete the bias update before the summer solstice tests scheduled for June 1984.

- o Ed Berggren, SCE Corporate Documentation, was on-site April 23, to discuss coordination of as-built drawing records and means of accessing the drawing data base through the SCE Generation Management System computer terminal at the plant, to DOE, SCE, SNLL, Stearns Catalytic and Burns & McDonnell personnel involved in the Project and its documentation.

Ed Berggren mentioned that he will implement a cross reference index for as-built drawing records (SFDI, Stearns Catatytic, and SCE).

o Operational Control System (OCS) clear day scenario - Mode 1 (Turbine Direct) automation program is now being completely exercised by SCE Operations. OCS start-up packages are being written by McDonnell Douglas.

o A Plant Equipment Operator (PEO) position was reduced from the work-force after a PEO relocated to another station. PEO position will be cancelled due to the reduced activity level that is expected in the forthcoming years.

All PEO's were taken off graveyard shift after deciding that the level of activity during graveyard shift could be handled by a Control Operator (CO) and an Assistant Control Operator (ACO).

o A Martin Marietta Co. representative revised the Heliostat Array Controller (HAC) Program to automatically switch over to daylight savings time. MMC is currently reconfiguring HAC software to allow heliostat bias update to both the prime and backup HAC's.

o Operational control system (OCS) clear day start-up was aborted on April 27, due to Receiver TSP 2929 (temperature set point) flag in wrong state to run start-up. The problem with OCS aborting start-up task was traced to Receiver TSP 2929 (temperature set point) being left in manual after a temperature set point change was made. TSP 2929 was changed to auto for OCS clear day start-up.

o SCE Operations day shift work schedule has changed to 0800-1600. Previous Operations work schedule was 0700-1500.

o SCE Operations has reduced start-up time by 10 minutes using the Operational Control System (OCS). OCS automatically controls the collector field with respect to temperature and flow on the receiver. OCS method is quicker on start-up than the semi-automatic method previously used by operations.

Maintenance Highlights

o The new receiver flowmeter test station (check flowmeter calibration) was flushed and hydro tested to 520 psig, no leaks were detected.

o A pipe joint leak on the circulating water return line from the cooling water heat exchanger was repaired. Suspect fiberglass pipe joint failed due to absence of thrust block under elbow section of pipeline to overcome any vertical and horizontal forces.

o Dye penetrant inspection of all receiver sub-panel interstice weld areas was completed during the outage. The inspection did not evidence any tube defects.

Ultrasonic inspection of receiver boiler panel edge tubes at the outlet bend was completed on 12 of 18 panels. No new cracks were found; however, the previous crack indications in tube 70 of panel 10 and tube 1 of panel 17 now extend through the exterior tube surface. These cracks are very tight, and their repair is scheduled for a September 1984 outage.

o A receiver hydro pressure check was taken during the outage and the following was found:

- Panel 20 flowmeter has a slight leak at the stem.
- Panel 4 inspection plug 17 has a slight leak.
- Panel 8 inspection plugs 3, 19, 21, and 35 have slight leaks.
- Panel 9 inspection plugs 8, 21, 48, and 65 have slight leaks.
- Panel 15 inspection plug 2 has a slight leak.
- Panel 18 inspection plug 45 has a slight leak.
- Panel 22 inspection plugs 25, 30, 31, 32, 35, 39, 40, and 49 have leaks. 49 is bad.
- Panel 23 inspection plugs 38, 39, and 40 have slight leaks.
- Panel 16 inspection plugs 28 and 38 have moderate leaks.

All leaking plugs on receiver panels were replaced except panel 22 plugs 30, 31, 39, and 49 and panel 23 plug 39 which were previously seal welded.

Inspection plug leaks on receiver panels are continuously being repaired due to the belief of thermal cyclying causing wear on the plugs. The plan is to replace these stainless steel plugs with high grade carbon steel plugs. It is felt that use of plugs of a material that is not the same as the inlet header will minimize the leakage problem.

o Three leaks on the waste water blowdown line were repaired. Suspect PVC couplings are failing at midpoint due to compressive and tensile stress from thermally induced temperature transients.

o One phase of the 33 kV Bug line on Pole No. 1903266E fell off its insulator when a strap came loose. The line was observed resting on the crossarm. The line failure did not result in loss of power to the plant. SCE Customer Service made the repair.

o Terry Olson, Stearns Catalytic, is evaluating a receiver access modification. The modification under consideration would provide removable receiver support, for access to valving and instrumentation.

o Receiver panel expansion guides (rollers) inspection was conducted. All panel expansion guides (rollers) appeared okay except panel 17, row 5, left roller assembly. Roller assembly pulled out of right stud which was later repaired.

o The generator trip by turbine trip HEA coil (lock-up relay) was replaced due to a burnt HEA coil caused by mechanical wear.

o Modern Alloys continues to vent retrofit heliostat mirror modules, bringing the total of modules to 6,108 of the 10,546 modules scheduled for vent retrofit.

- Receiver tube welding training for SCE Cool Water and San Bernardino Generating Station Welders took place on April 2, 3, and 4 at Rocketdyne's Canoga Park facility. Welders will continue self-training before being certified for repairing receiver tubes.

- Electricians and technicians are working to reduce the number of out of service heliostats. The current number of heliostats out of service is 152. The major problems with heliostats have been attributed to motor seal wear and azimuth and elevation encoders.

- The heliostat wash truck has a computerized wash system that is non-functional. SCE Electricians are implementing a change on the heliostat wash truck that will operate on an automatic or manual mode. In case the automatic mode fails the manual mode will be available.

- New thermocouples were installed on receiver panels 9, 10, 11, 12, 17, and 18 for monitoring temperature on edge tubes. Suspect high temperatures have contributed to edge tube failures.

- Radial shields were installed between receiver panels 15 and 16, 16 and 17 to reduce their heat flux intensity, and thereby, reduce their operating temperature and their thermal expansion relative to adjacent tubes.

- Inline demineralizer bed #2 was removed from service due to water quality problems stemming from resin degradation caused by a regeneration valve failure. The valve was repaired, and the inline demineralizer was put back in service for a regeneration. The valve was cleaned internally to eliminate binding of valve internal.

- Miscellaneous maintenance work accomplished during the month of April, including work performed during the outage period, is as follows:

  - Replaced and calibrated flowmeters on receiver panels 7 and 18. Flowmeter failure problems are under investigation.

  - Repaired defective contacts for air compressor 902 because of overload trip problem. Normal wear caused defective contacts.

  - Reversed direction of fan motor on air compressor 901 due to high vibration.

  - Repaired pre-filter leaks on receiver panels 11, 14, and 16.

  - Spray water temperature valve T-V 3105 for desuperheater on charging system was inspected and internals repaired i.e. re-lapped the valve body and seat.

Plant Statistics	April '83	April '84	Turbine Roll To Date
Net Energy Production MWH	107.8	322.5	-3556.8
Energy Production (MWH net while connected to the grid)	528.4	618.4	8362.6
Hourly Peak MW (Net)	9.4*	8.1*	10.4*
On-Line Hours	114.1	120.4	1673.5
Test Hours	86.3	35.1	1397.8
Total Plant Outage Hours	35.5	85.0	1863.8
Scheduled	22.0	52.0	802.0
Unscheduled	13.5	33.0	1061.8
Weather Outage Hours	129.3	98.5	2361.8

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*Receiver Generated Steam Only

- Summary of Solar One Operation: Net energy production in April 1984, has increased as compared to April 1983. On-line hours for both months were about the same. Net energy production considerably increased by reducing parasitic load through completely shutting off the start-up electric boiler and shutting off the circulating water pumps at night.

Attachments:

- Chronological Summary of Receiver Tube Defects (Attachment 1).
- Solar One statistics: Weather outage hours, plant outage hours, test hours, and on-line hours (Attachment 2).
- A four-day scheduled plant outage, as well as 98.5 hours of weather outage, impacted energy generation and testing. April was a positive output month, 322.5 MWH (Attachment 3).
- The daily and cumulative energy production while Solar One was on-line for the year-to-date and the three previous months are shown on Attachments 4 and 5.
- Solar and Plant Utilization is trended on attachment 6.

Operation and Maintenance Costs

o A summary of the O&M labor, material, contract, and other costs for the month of April 1984 is shown on the attached table. Expenses are categorized as follows:

Field Office	- Includes plant supervision, engineering, accounting, clerical, office supplies, and miscellaneous indirect expenses.
Operations	- Includes total cost of operating staff and expenses.
Miscellaneous Support	- Includes station supplies and rentals, safety and job training, and site security.
Maintenance	- Includes total cost of maintenance staff and expenses allocated to major plant subsystems.
Overheads	- Includes costs associated with direct labor plus company administrative and general expenses.

SOLAR ONE
MONTHLY O&M COST SUMMARY
($ X 1000)
MONTH OF APRIL 1984

	LABOR	MATERIAL	CONTRACT	OTHER	TOTAL
FIELD OFFICE	24.5	.7	.7	13.1	39.0
OPERATIONS	80.0	12.7	-	(2.0)	90.7
MISC. SUPPORT	8.0	.3	3.2	(10.1)	1.4
MAINTENANCE					
Supervision/Indirects	18.3	2.3	.1	.5	21.2
Control System	7.1	.8	25.0	-	32.9
Receiver System	15.8	1.4	1.6	-	18.8
Thermal Storage System	1.7	1.2	-	(.5)	2.4
Collector System	5.3	1.1	-	-	6.4
EPGS System	6.1	2.0	(.2)	-	7.9
Misc.	5.3	5.8	4.4	(1.2)	14.3
Total Maintenance	59.6	14.6	30.9	(1.2)	103.9
SUB TOTAL	172.1	28.3	34.8	(.2)	235.0
Division O.H.					36.3
TOTAL DIRECT					271.3
Workman's Compensation					1.2
Payroll Tax					12.7
Pension & Benefits					37.7
Administrative & General					50.1
GRAND TOTAL					373.0

Attachment 1

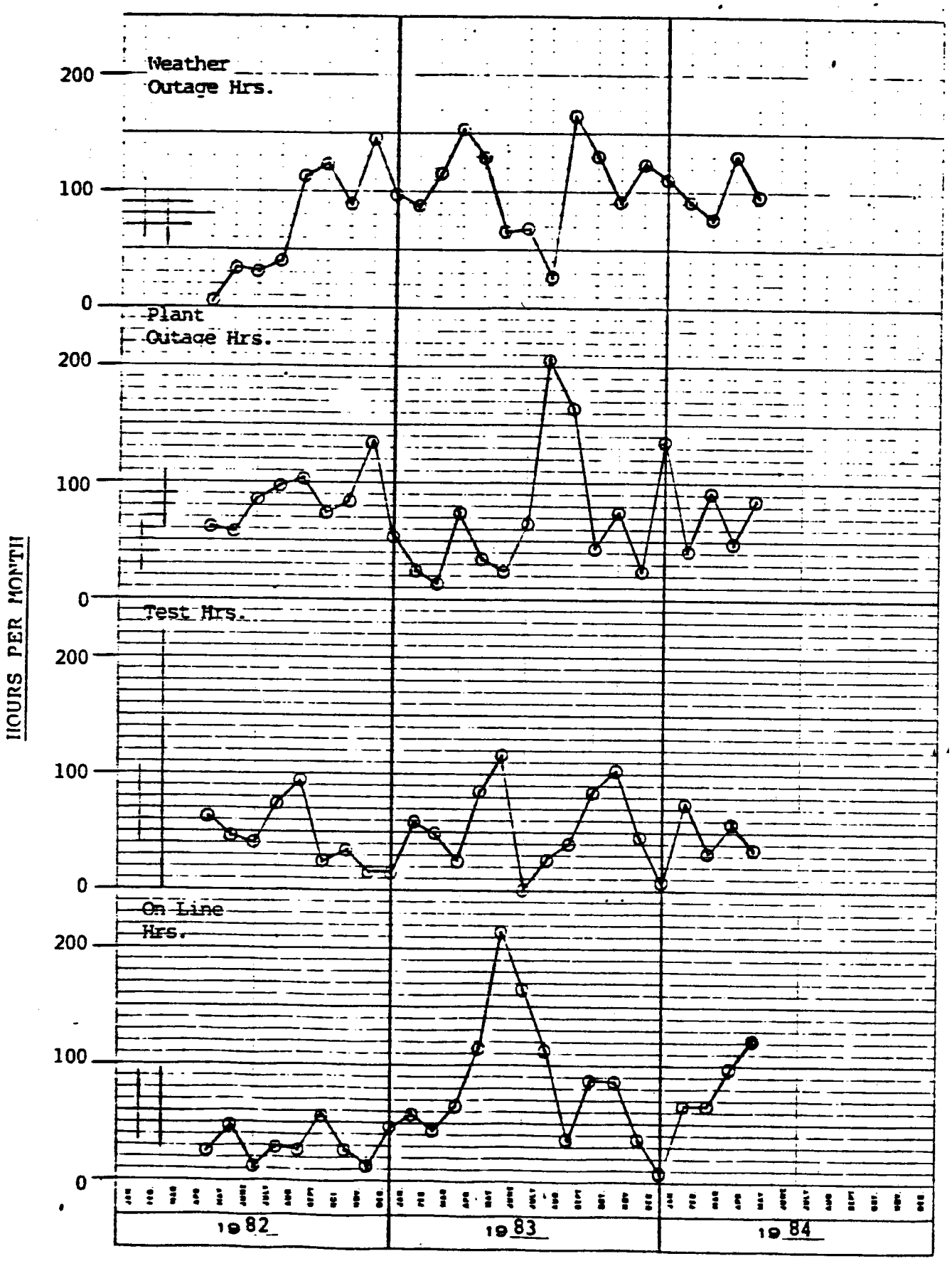
SOLAR ONE GENERATING STATION

Chronological Summary of Receiver Tube Defects

DATE	DESCRIPTION OF TUBE DEFECT	LOCATION
Jul 15, 1983	Interstitial weld leak	tube 30, panel 18
Jul 26, 1983	Interstitial weld leak	tube 41, panel 18
Aug 2, 1983	Bend leak	tube 70, panel 11
Aug 18, 1983	Repair/removal of sample	tube 30, panel 18
	Repair, grind & fill	tube 41, panel 18
Aug 19, 1983	Replaced cracked tube section	tube 70, panel 11
Sep 8, 1983	Crack indication	tube 30, panel 19
Oct 26, 1983	Crack indication	tube 1, panel 18
	Interstitial weld leak found & repaired	tube 41, panel 12
	Interstitial weld crack	tube 41, panel 13
Nov 1, 1983	Interstitial weld crack on:	tube 41, panel 4
		tube 41, panel 6
		tube 30, panel 7
		tube 41, panel 8
		tube 41, panel 9
		tube 30, panel 17
	Surface irregularity	tube 41, panel 10
Nov 16, 1983	Bend leak	tube 1, panel 15
	Bend crack	tube 1, panel 16
	Bend crack	tube 3, panel 16
	Bend crack	tube 1, panel 17
Dec 1983	Outage - Removal of sample	tube 1, panel 4
		tube 1, panel 6
	Repair of cracks	tube 1, panel 15
		tube 1, panel 16
		tube 2, panel 16
		tube 3, panel 16
Jan 1984	Outage - Interstitial weld crack repair	tube 41, panel 13
Feb 1984	Outage - Interstitial weld crack repair	tube 41, panel 8
	Interstitial weld crack repair	tube 41, panel 9
	Bend crack	tube 70, panel 9
	Bend crack	tube 70, panel 10
	Bend crack	tube 70, panel 11
	Bend crack	tube 70, panel 12
	Surface polished	tube 41, panel 10

RMA:so
leaks.rno

SOLAR ONE STATISTICS



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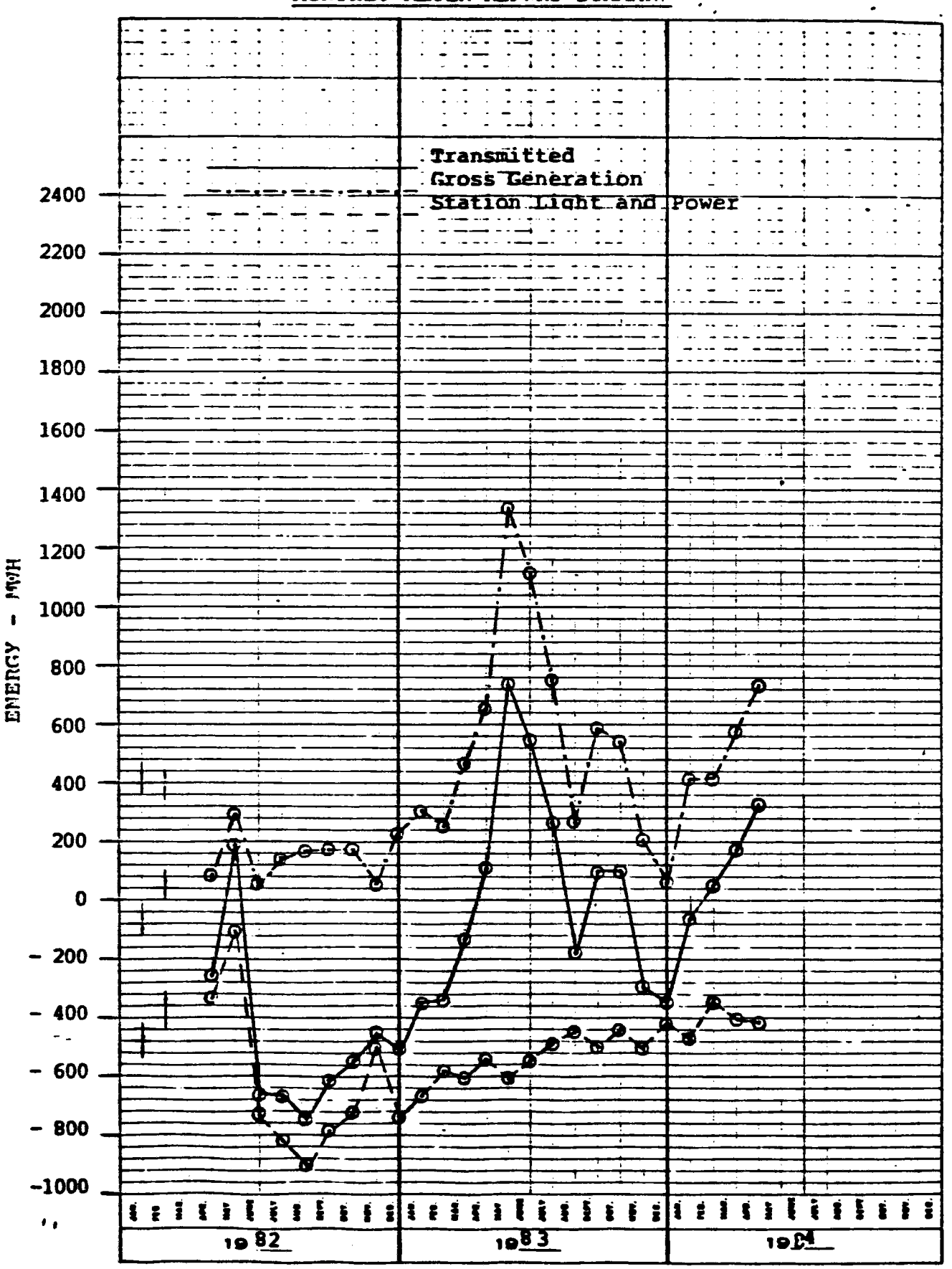
ATTACHMENT 3

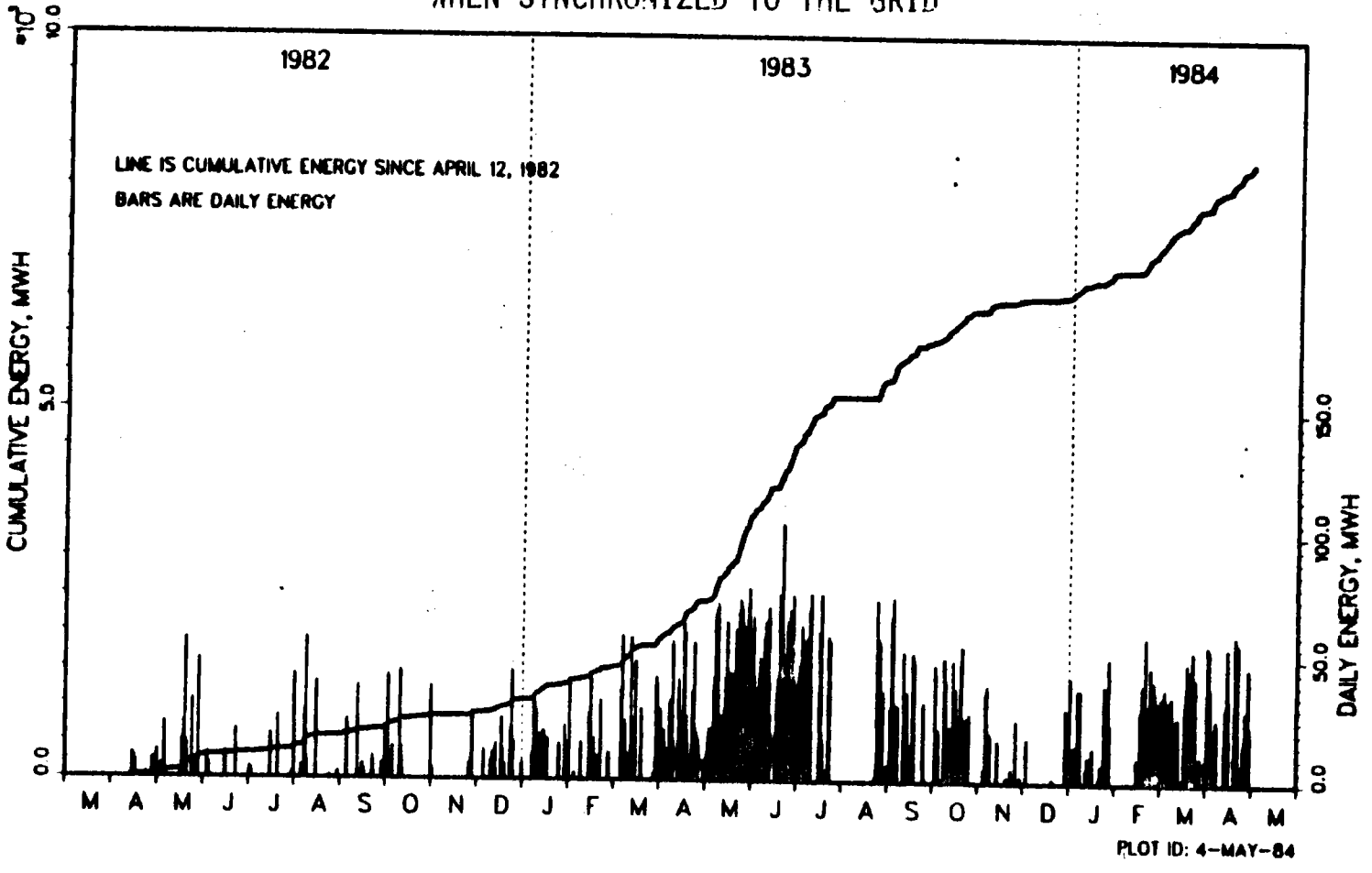
SOLAR ONE
MONTHLY METER REPORT SUMMARY



RMA 03/09/84

SOLAR ONE NET ELECTRICAL PRODUCTION

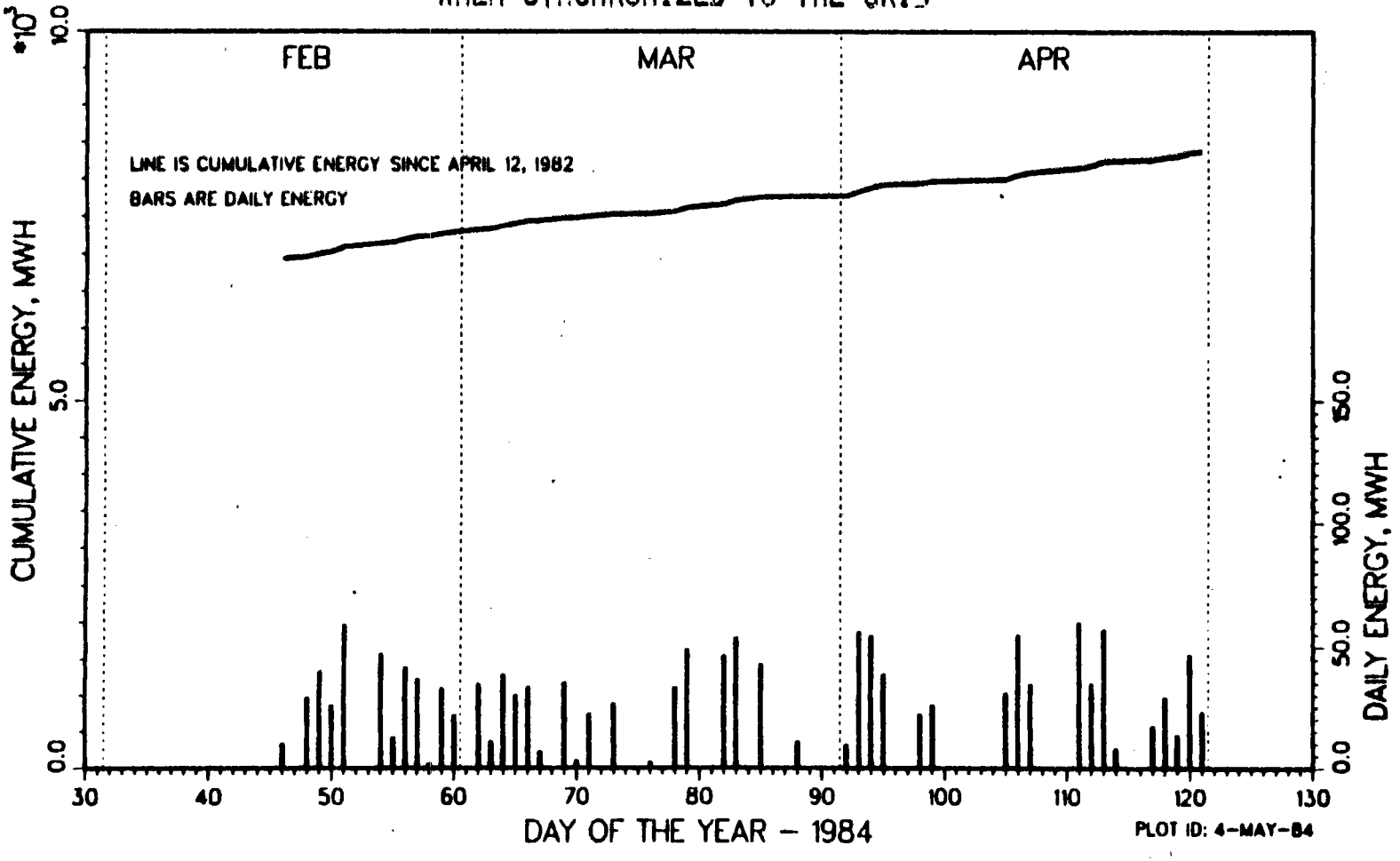
WHEN SYNCHRONIZED TO THE GRID



Attachment 4

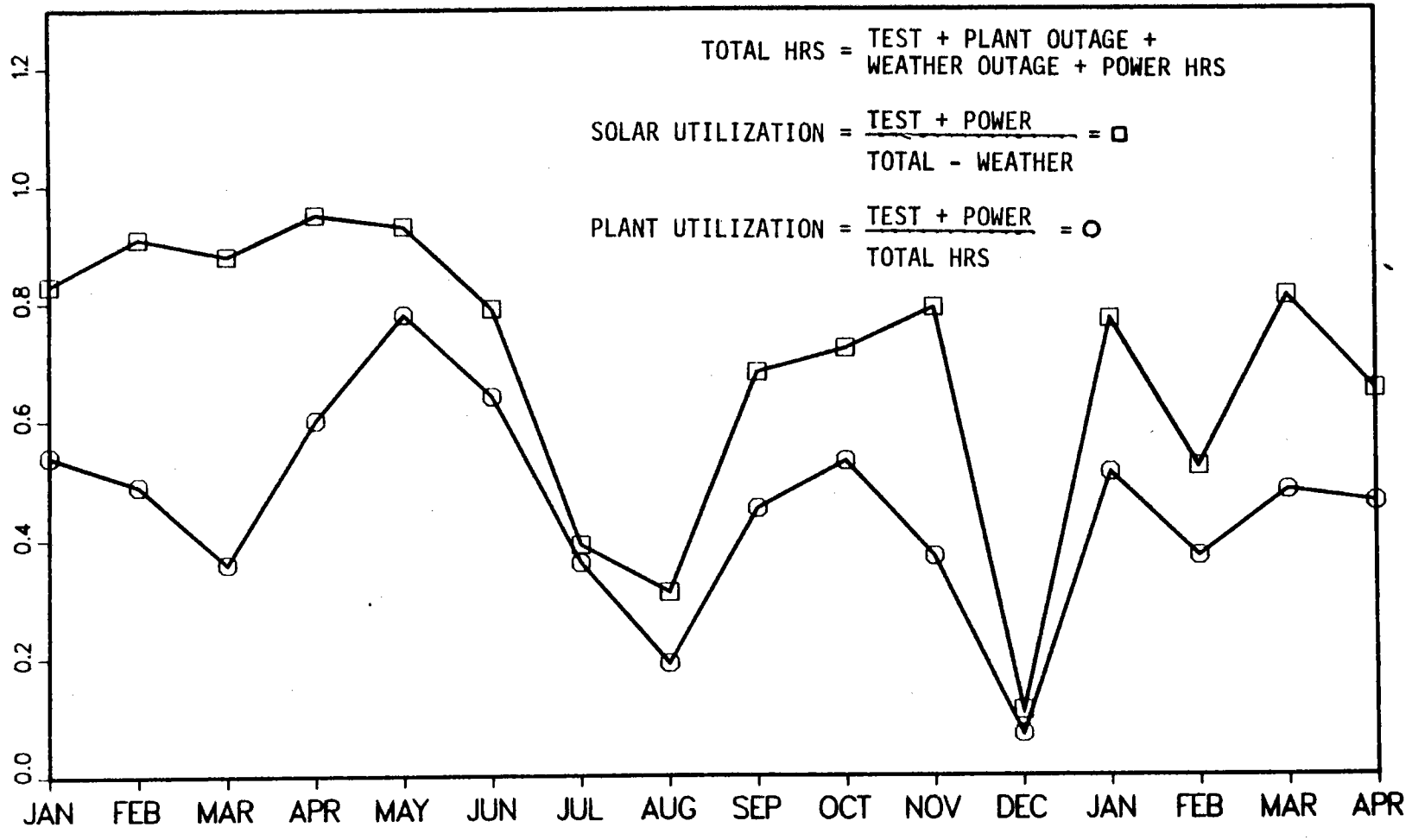
SOLAR ONE NET ELECTRICAL PRODUCTION

WHEN SYNCHRONIZED TO THE GRID



Attachment 5

SOLAR AND PLANT UTILIZATION – 1983 AND 1984



Attachment 6

BARSTOW 10 MWe PILOT PLANT

S. D. Elliott
U. S. Department of Energy

Introduction

This is month of anniveraries. Just ten years ago, following a meeting in Minneapolis where all of the potential concepts for solar thermal generation of electrical power were laid out and assessed (and which was the lineal ancestor of this meeting today), Dwain Spencer, who was departing the NSF solar thermal program for EPRI, and George Kaplan, who was taking on the program management job, decided to push for a national commitment to a 10 MWe solar thermal central receiver pilot plant. I was privileged to have been invited to the Minneapolis meeting; I am doubly privileged to speak to you today as Project Director for DOE of the working embodiment of that decision, the Solar One Pilot Plant near Barstow. I am especially happy to see several of the people here today whom I first met in Minneapolis in March, 1974, and many more whom I have come to know over the intervening years.

Objectives and Schedule

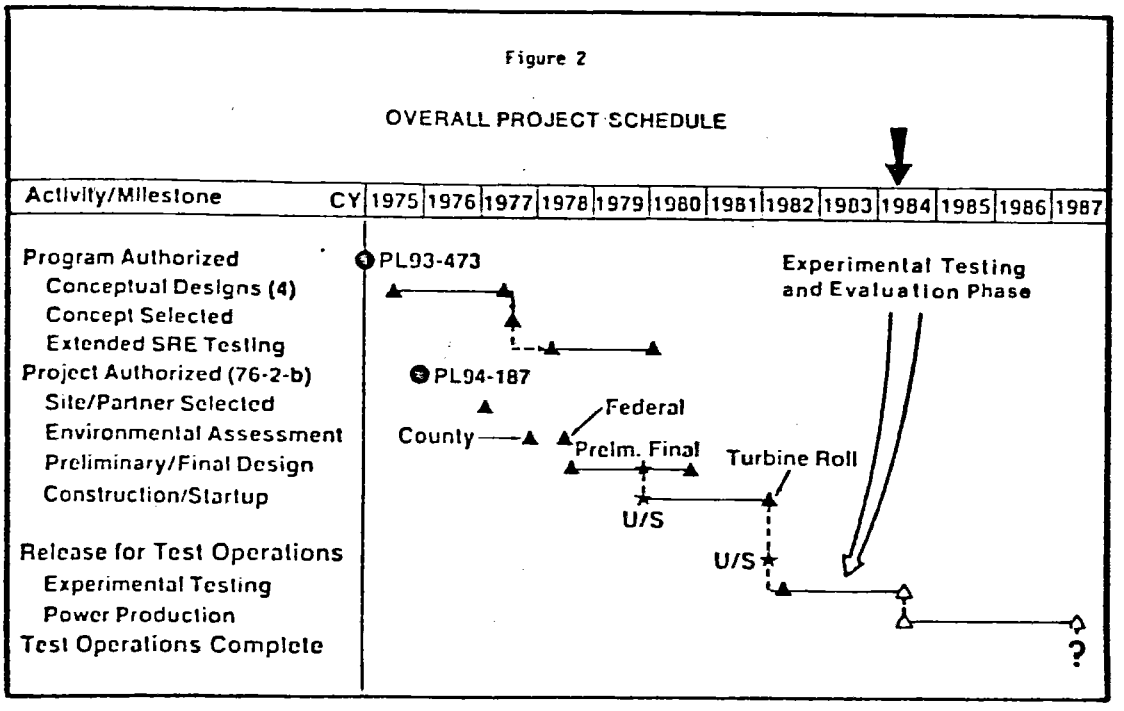
The first figure lists the principal objectives Dwain and George established for the project. It would demonstrate the technical feasibility of a solar

Figure 1

BARSTOW PILOT PLANT OBJECTIVES

- ESTABLISH THE TECHNICAL FEASIBILITY OF A SOLAR CENTRAL RECEIVER POWER PLANT
- OBTAIN DEVELOPMENT, PRODUCTION, OPERATING AND MAINTENANCE COST INFORMATION
- DETERMINE ENVIRONMENTAL IMPACTS OF CONSTRUCTION, OPERATION AND MAINTENANCE

central receiver plant as a component of a utility power generation system. It was to be designed, built, operated and maintained over a sufficient time to establish an economic basis for comparison with alternative sources of electrical energy. Finally, data would be obtained to determine its impact on the environment. With these objectives, the formal commitment to such a project was made a part of the establishing legislation for the Energy Research and Development Administration at the start of 1975 (Figure 2).



The following ten years have been busy ones: The utility partner, Southern California Edison, with support by the City of Los Angeles, and the site, to the east of Barstow, were selected in late 1976; the plant configuration was chosen among competing conceptual designs in mid-1977; an environmental assessment was done, and approved in 1978; and design and construction were completed over a three-year period from mid-1978 through September 1981. Just two years ago, on April 12, 1982, Solar One delivered its first net power to the Edison grid. With approval by the DOE administration and SCE, we entered, on August 1, 1982, into a two-year experimental testing and evaluation phase which is now drawing to its close. The next stage is three years of routine power production under full Edison control, to gather the needed long-term performance and economic data.

Current Status

Let us now focus on testing and evaluation activities. Since our last meeting, we have made a lot of progress (Figure 3). Last summer, we demonstrated the peak power and sustained operation capabilities of the plant, using direct receiver steam combined with energy recovered from storage. All of the eight operating modes have been checked out and released for use by the Edison operating staff. These people have also worked diligently to reduce the plant "housekeeping" load to levels well below those originally anticipated. Hardware and software for centralized, automated operation of the plant from

Figure 3

ACCOMPLISHMENTS OF PAST YEAR

- 0 SUMMER SOLSTICE PERFORMANCE MEASUREMENT CAMPAIGN - JUNE 1983
  - POWER: 12.1 MW_E (NET) ON RECEIVER + STORAGE STEAM
  - DURATION: 33.6 HOURS ON-LINE; 127 MW_E-HRS (NET)
- 0 PLANT RELEASED FOR USE IN ALL OPERATING MODES BY SCE - MARCH 1984
- 0 PLANT PARASITIC LOADS REDUCED WELL BELOW DESIGN LEVELS - CONTINUING
  - 1.1 MW_E vs. 1.9 MW_E, "HOT"; 0.3 MW_E "COLD"
- 0 SYSTEM-LEVEL AUTOMATIC CONTROLS INSTALLED AND IN FINAL DEVELOPMENT
  - "CLEAR DAY" AUTOMATION EFFECTIVE; ALSO HANDLES "REAL" DAYS
  - SYSTEM REDUCES OPERATOR WORKLOAD; IMPROVES PERFORMANCE
- 0 TRANSITION PLANNING FOR POWER PRODUCTION PHASE COMPLETE - MARCH 1984

a single, central control console are in place and are being checked out and refined in daily use. Routine activities are being managed by computer, freeing the operators to focus on improved performance or anomalies in plant equipment or weather. We have completed our planning for turnover of full responsibility for plant operation and maintenance to SCE at the end of July and are implementing the necessary preparations.

As for the coming year, we will be concentrating over the next several weeks on verification and fine-tuning of "clear day" automatic control capability, preparatory to releasing this procedure in early summer (Figure 4). The lat-

Figure 4

PLANS FOR COMING YEAR

- 0 "CLEAR DAY" AUTOMATION VERIFICATION TESTING - APRIL/MAY 1984
- 0 SUMMER SOLSTICE PERFORMANCE MEASUREMENT CAMPAIGN - JUNE 14-28, 1984
  - DEMONSTRATE MAXIMUM DIURNAL ENERGY (POWER x DURATION)
- 0 TRANSITION TO THREE-YEAR POWER PRODUCTION PHASE - AUGUST 1, 1984
- 0 END SANDIA FULL-TIME ON-SITE SUPPORT - AUGUST 1984
- 0 END DOE/SAN FULL-TIME ON-SITE REPRESENTATION - SEPT. 1984

ter half of June will be devoted to another summer solstice run for maximum daily energy output. On August 1, the transition to the power production phase will take place, and by the end of the fiscal year DOE, Sandia and their support resources will have left the site. We will, however, remain available, on call, to assist SCE, if needed, and for special tests.

Those of you who are able to stay with us until Thursday will hear a great deal more about these and other aspects of plant testing and evaluation, from the people who are actually doing the work. You will hear a lot of discussion of problem areas, because in most respects that is what this Pilot Plant is all about: the detection, analysis and resolution of problems to insure the success of future solar thermal central receiver plants. Over the past two years, for example, we have lost some of our reflective area to spot corrosion - about one-tenth of one percent (say, ten kilowatts). This has been traced to induction of moisture into certain of the mirror modules. As Clay Mavis will tell you, we feel that the addition of drying vents to the affected units will arrest this process, and we are just finishing doing so. We have verified the use of both natural (i.e., rain) and artificial washing, at approximately one-month intervals, to maintain reflectivity within a few percent of the clean value, and we are checking out a rig with which one man can wash the 1818-heliostat field in one week. We have found cracks, of two types, in a number of the boiler-superheater tubes, of which fewer than ten (out of 1260) have actually produced leakage. As Al Baker will show, repair is straightforward, and SCE welders are currently being qualified to do so. The "Type I" cracks have been traced to physical restraints on panel expansion; modifications to the suspension system and to the subpanel joints appear to have cured this. Type II cracks, though fewer in number, are a more subtle problem, but we have heavily instrumented the affected areas, and have a lot of talent addressing possible causes and cures. There have been some flange and tube-to-tubesheet leaks in the oil/steam heat exchangers in the storage system. As Scott Faas will tell you, high-perfomance gasketing and good Q.C. on boltup can control the former (and future plants will emphasize welded piping joints); tubesheets weep into isolation plenums, and no significant hazard or energy loss is involved. Joe Reeves may mention some problems with control of turbine startup on storage steam. Modification of a stop valve by insertion of a pilot, "needle valve" stage has provided an interim solution. We were a bit too casual in design and construction about the more mundane plumbing items, and have experienced quite a bit of leakage and joint failure, especially in non-metallic service water lines. Controls, especially for the heliostat field, have required a fair amount of debugging, and correction of communication and timing errors. And weather, as always, is a factor: abnormally low insolation in 1982-83, and too little rain to wash heliostats this year. Here, all you can do is take as long a span of plant- and site-specific data as you can, design conservatively, and then, as Jim Bartel put it in another meeting last year - pray!

Assessment

What I want you to carry away with you, though, is this: Solar One works, and works well, and all of us associated with the Project are very pleased and proud to be involved in it. To return to the original objectives:

- The solar central receiver <u>is</u> a feasible means for utility power generation;
- Costs <u>are</u> relatively high, but are coming down; and output continues to rise;
- And, as Bob Lindberg will show, it's hard to find <u>any</u> environmental effects.