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(DE84013279)

**A HIGH TEMPERATURE PROCESS STEAM APPLICATION AT  
THE SOUTHERN UNION REFINING COMPANY, HOBBS, NEW MEXICO**

**Final Report, Phase III—Operation, Maintenance, & Performance**

By

L. E. Wilson

D. R. McGuire

May 1, 1984

**Work Performed Under Contract No. AC04-78CS32223**

**Energetics Corporation  
Richardson, Texas**

**Technical Information Center  
Office of Scientific and Technical Information  
United States Department of Energy**



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A HIGH TEMPERATURE PROCESS STEAM APPLICATION AT THE  
SOUTHERN UNION REFINING COMPANY, HOBBS, NEW MEXICO

"Solar Energy in the Oil Patch"

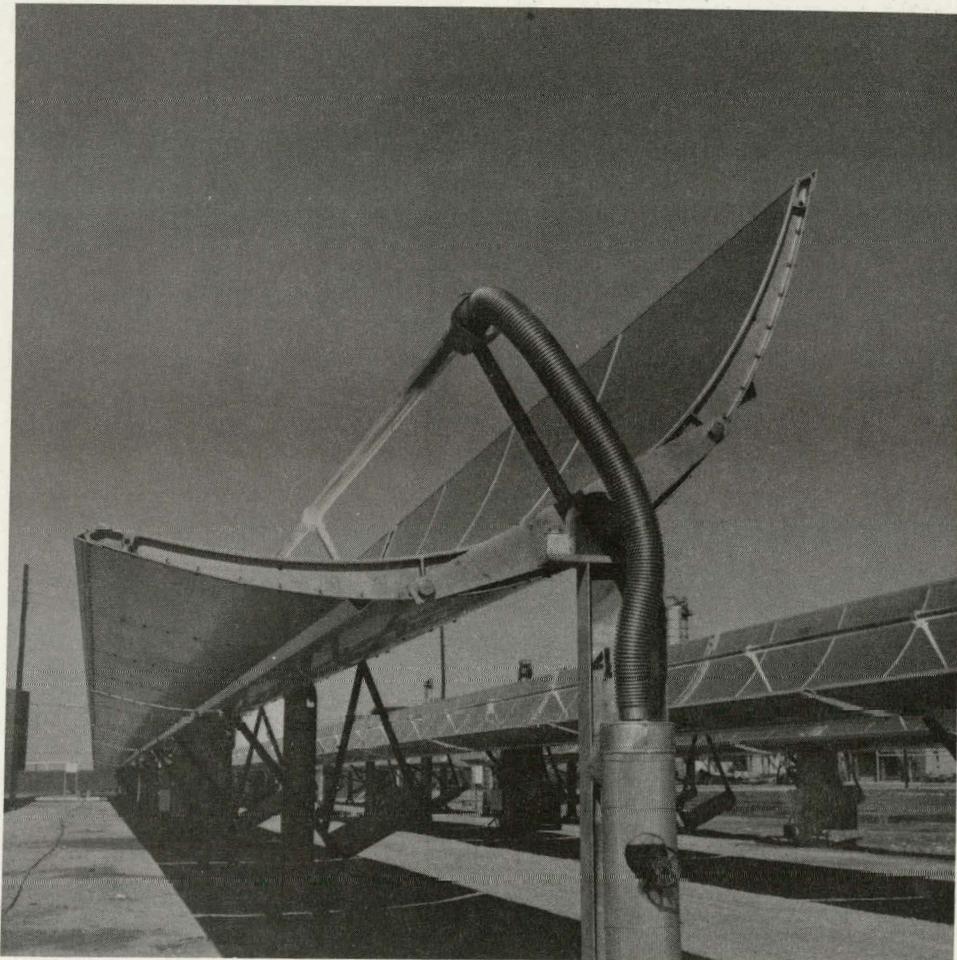
Final Report, Phase III - Operation, Maintenance, & Performance

May 1, 1984

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(Formerly Contract No. DE-AC03-78CS32223)

Energetics Corporation  
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PREPARED FOR:

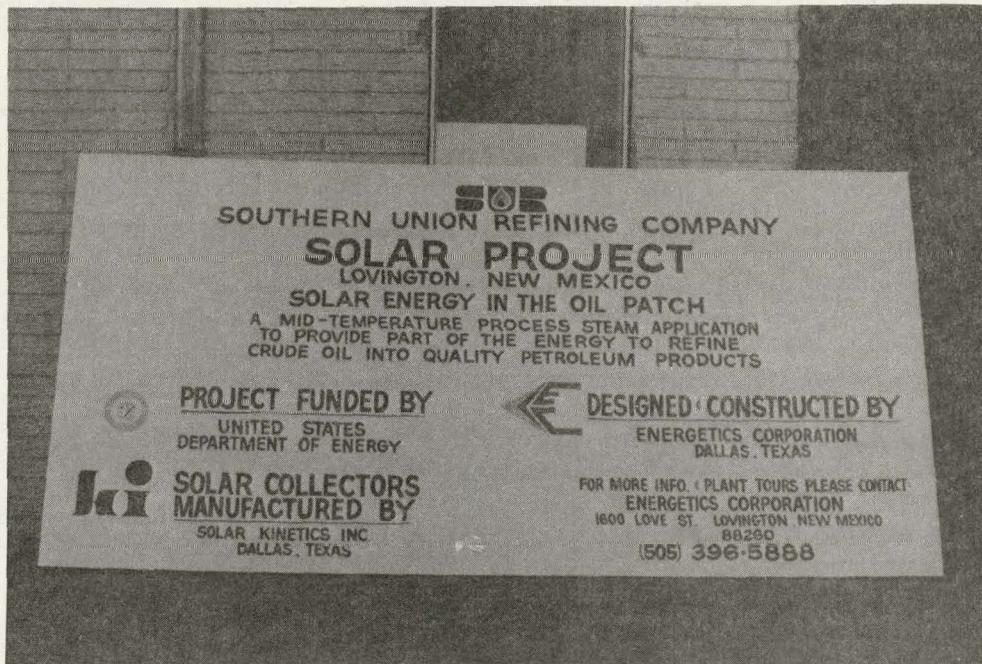
U. S. DEPARTMENT OF ENERGY

## EXECUTIVE SUMMARY

This final report summarizes the technical reports for Phase III of DOE project number DE-AC04-78CS32223. The third phase included the operation, maintenance, upgrade and performance reporting of a 10,080 square foot Solar Industrial Process Heat System installed at the Famariss Energy Refinery of Southern Union Refining Company near Hobbs, New Mexico. This report contains a description of the upgraded system, and a summary of the overall operation, maintenance and performance of the installed system.

A description of the system as completed in Phase II is reprinted on the next page from the August/September 1982 issue of "The Solar Thermal Report" published by Jet Propulsion Laboratory (see Section 2.0 for upgrade work).

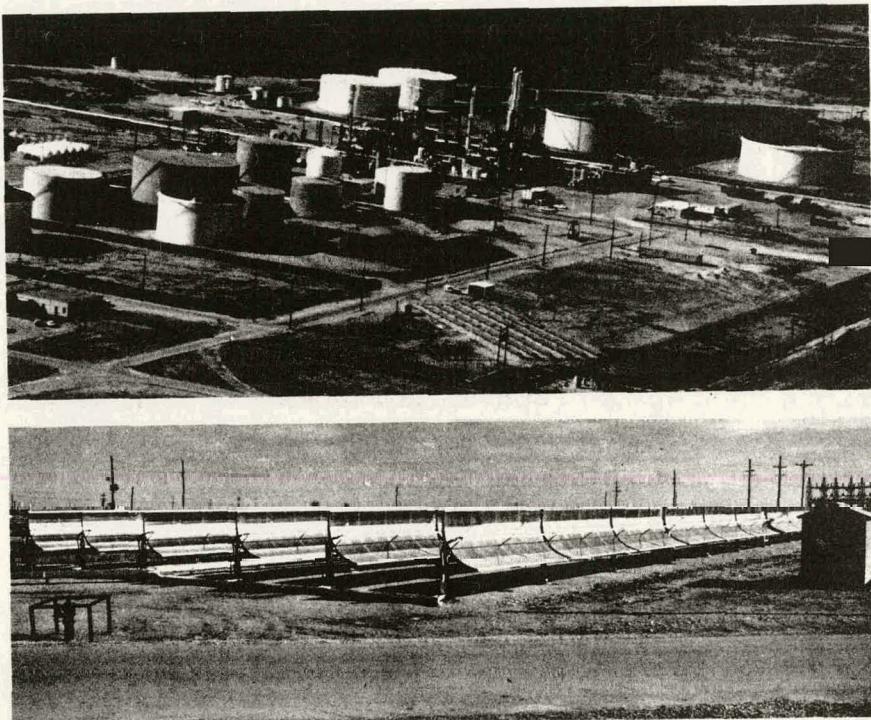
The results of the upgrade activities can be seen in the last two months of operational data. Steam production was significantly greater in peak flow and monthly total than at any previous time. Also monthly total cost savings was greatly improved even though natural gas costs remain much lower than originally anticipated.



# Solar Steam Processes Crude Oil

A parabolic trough collector system at the Famariss Refinery of the Southern Union Refining Company near Hobbs, New Mexico, has been supplying steam for processing crude oil since October 1981. The solar thermal system generates dry saturated steam at a peak rate of 816 kg/h (1800 lbm/h) to supplement the refinery's current steam usage of 9070 to 13,600 kg/h (20,000 to 30,000 lbm/h). Steam is produced continuously 24 hours per day throughout the year in two boilers fired by natural gas or No. 5 fuel oil. The solar facility provides up to 9% of the refinery's minimum steam requirement by means of its solar steam generator, which operates in parallel with the Famariss plant's existing boilers.

The solar system's 72 parabolic trough collectors, manufactured by Solar Kinetics, Inc., of Dallas, Texas, are ground-mounted in six parallel rows that track the sun from east to west. Concentrated sunlight from the collectors' 937 m<sup>2</sup> (10,080 ft<sup>2</sup>) of reflective surface heats a high-temperature oil that is circulated through the receiver tubes then fed into the solar steam generator, where



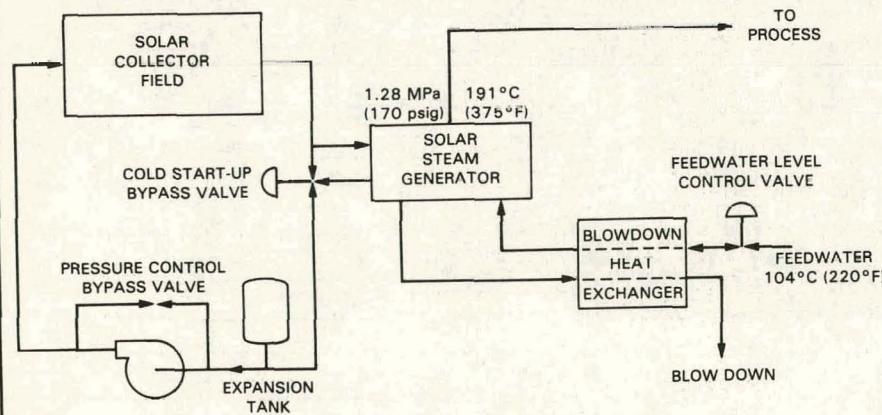
Upper photo: aerial view of the Famariss Refinery. The collector field of the solar steam system can be seen in the center foreground. Lower photo: closeup of the collector field -- six rows of parabolic troughs.

refinery feedwater is converted to steam at a temperature of 191°C (375°F) and a pressure of 1.28 MPa (170 psig). The refinery feedwater is supplied to the solar steam generator at 104°C (220°F) by the refinery's boiler feed pumps. The solar heated steam is fed into the plant's steam main piping for refinery use; the heat transfer oil is returned to the collector field for reheating in the receiver tubes.

Energetics Corporation of Richardson, Texas, the prime contractor for this industrial process steam project sponsored by the U.S. Department of Energy, completed the design phase in September 1979. Site work began the following July after a thorough evaluation of five possible locations at the refinery. Collector installation was completed in March 1981, and steam was supplied for refining crude oil in October 1981. The solar thermal facility's data acquisition and performance analysis phase, which began in February of this year, will extend through March 1983.

Performance projections indicate an annual solar system efficiency of 40% (after deducting all parasitic losses) and an annual equivalent fossil fuel energy savings of almost 4300 Mcf of natural gas.

For further information contact L. E. Wilson, Energy Systems, Texas Energetics Corporation, 1201 Richardson Dr., Suite 216, Richardson, Texas 75080. □



Schematic of solar steam system for Southern Union Refinery.

## TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>	<u>PAGE</u>
	Executive Summary	1
	"Solar Steam Processes Crude Oil"	2
	Table of Contents	3
	List of Figures	4
	List of Tables	4
1.0	Introduction	5
2.0	Project Description including Upgrade	6
3.0	Operation and Maintenance	11
4.0	Energy/Economic Performance	17
5.0	Summary	20

Appendix A      Acceptance Tests and Incident Report

Appendix B      Monthly Operation and Performance Data  
(Report Tables 1, 2, 3, and B5)

## LIST OF FIGURES

<u>FIGURE</u>	<u>TITLE</u>	<u>PAGE</u>
1	Solar System Flow Diagram including Phase III Upgrade	7
2	Solar System Schematic	10

## LIST OF TABLES

<u>TABLE</u>	<u>TITLE</u>	<u>PAGE</u>
2-1	Project Description	9
3-1	Component Failure Chart	15
4-1	Solar Project Performance	18
4-2	Solar Project Economics	19

## 1.0

### INTRODUCTION

The Solar Industrial Process Heat Project at Southern Union Refining Company near Lovington, New Mexico has been supplying steam for use in refining crude oil since October, 1981.

Previously completed phases of this project were the design and construction activities for the installed solar system. These activities were summarized in the first and second phase final reports.

The third phase of the project began in February, 1982 upon completion of the phase two acceptance test. Originally, the third phase included one year of operation, maintenance and data reporting on the installed solar IPH system. In April 1983, the third phase was extended another year to include additional system design changes and construction activities along with continued operation, maintenance, and data reporting. System upgrade changes were performed and another acceptance test was completed in March 1984. At that time automatic operation was accomplished, performance improvement was documented, and the upgraded system was turned over to Southern Union for operation as scheduled at the beginning of April, 1984.

This report summarizes the results of the third phase. It begins with a brief description of the installed solar IPH system and the completed upgrade activities. That is followed by a summary of operation and maintenance experience. The next section presents the system energy and economic performance data both before and after performance upgrade activities and the final section includes a summary.

## 2.0 PROJECT DESCRIPTION INCLUDING UPGRADE

This solar industrial process heat system was designed for and installed at the Famariss Refinery of the Southern Union Refining Company in the south-eastern corner of New Mexico (near Hobbs, N. M.). The solar system was designed to generate 170 psig/375<sup>0</sup>F (1.28 MPa/191<sup>0</sup>C) dry saturated steam at a peak rate of 1930.1bm/hr (875 Kg/hr) to supplement the refinery's revised current steam usage of 40,000 1bm/hr (18,140 Kg/hr). The system redesign in Phase II reduced peak steam rate to about 1800 1bs/hr (816 Kg/hr). Steam is generated continuously for the refinery 24 hours per day throughout the year in a pair of boilers fired by either natural gas or No. 5 fuel oil. Therefore, since the peak solar system output will be about five percent of the minimum refinery requirement, no energy storage for the solar system will be necessary nor advantageous.

The solar system provides steam from a solar steam generator (SSG) which operates in parallel with the Famariss Plant's existing boilers. Feedwater is supplied to the SSG at approximately 220<sup>0</sup>F (104<sup>0</sup>C) by the refinery's boiler feed pumps while a separate heat transfer oil (HTO) recirculation loop will supply the collected solar energy to the SSG from the collector field. The HTO was recirculated by a positive displacement pump with a separate, lower capacity, higher head pump utilized for cold system startup. The positive displacement pumps were replaced by a single more reliable centrifugal pump in the phase three upgrade. Figure 1 shows the upgraded two loop solar system interface with the Famariss Plant. As indicated, Loop I is the primary thermal transport loop where the HTO is recirculated through the solar collectors and SSG. Loop II is the interfacing loop between the Famariss Refinery and the solar system formed by the feedwater and steam piping.

The solar collectors are east-west oriented linear parabolic trough collectors as manufactured by Solar Kinetics, Inc., of Dallas, Texas (Model T-700).

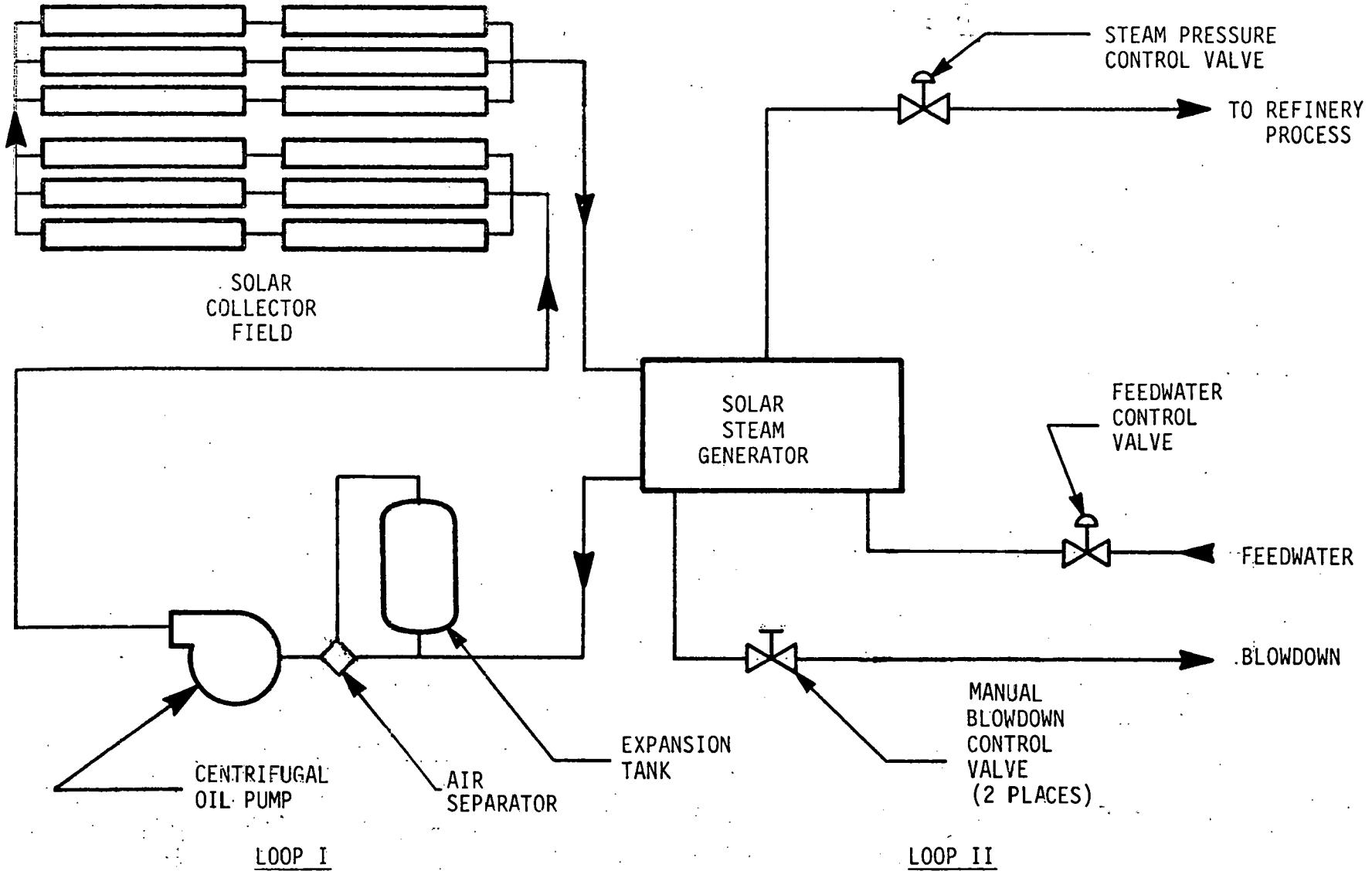


FIGURE 1 SOLAR SYSTEM FLOW DIAGRAM INCLUDING  
PHASE III UPGRADE

Seventy-two collectors, each with a 7 ft. by 20 ft. (2.13m by 6.1 m) aperture provide a total collector field area of 10,080 ft<sup>2</sup> (936 m<sup>2</sup>). The collector field is divided into three equal parallel flow paths with twenty four collectors per path. Both east-west and north-south collector row orientations were studied in Phase I. However, even though it was determined that the north-south orientation could collect approximately 8% more thermal energy annually, the extreme seasonal variation in this orientation (i.e., the collector thermal winter output is only about 25% of the summer output) provided the lowest output when the refinery's steam demand, due to increased tank heating requirements, was greatest. Thus, east-west aligned rows were selected.

The HT0 recirculation loop on the solar side of the process interface (Loop I in Figure 1) is a nearly constant flow system. Thus, the oil temperature at the exit of the collector field varies in response to variations in the solar input between 500<sup>0</sup>F (260<sup>0</sup>C), or the maximum recommended collector operating temperature, down to about 375<sup>0</sup>F (191<sup>0</sup>C), or the saturated steam temperature in the SSG.

The installed system including upgrade modifications in Phase III is further described in table 2-1 and Figure 2. System performance projections indicate that the annual solar system efficiency will be about 40% (after all system parasitic losses). The system was originally designed to produce 3,540 Million BTU's annually with 85% clear days. This design value was reduced to 3,285 Million BTU's to account for line losses associated with the collector field redesign and relocation during Phase II. Additional system design details are available from the Phase I final report, the Phase II Appendix A "As-Built" Drawings, and the Upgrade "As-Built" Drawings in the O&M Manual submitted to the refinery. Upgrade activities performed during the phase III extension are described in the next section.

ENERGETICS CORPORATION

Table 2-1

PROJECT DESCRIPTION

Application:	Solar production of process steam at 375°F for processing crude oil at the Southern Union Refining Company near Hobbs, N.M.
Site:	32°45'N. Latitude, 103°15'W. Longitude, Elevation = 3,650 ft (1112m).
Process Schedule:	24-hour operation, 7 days per week, 50 weeks per year.
Process Load Profile:	40,000 lbm/hr. (18,140 Kg/hr) of 375°F (191°C) saturated steam.
Auxiliary Fuel:	Natural gas, boiler efficiency and line losses = 65%
Collectors:	Solar Kinetics, Inc., Model T-700 parabolic troughs. Total Aperture Area = 10,080 ft. <sup>2</sup> (937m <sup>2</sup> ) Total Gross Area = 23,205 ft. <sup>2</sup> (2157m <sup>2</sup> ). Mounted on ground, horizontal, east-west axis. Packing Factor = .434
Fluid Type, Flow Rate:	Oil - Texatherm Operational Pump = 77 gpm
Storage:	None
Design Energy Delivery:	3,285 MBTU/yr (3466 GJ/yr) - Includes 7.2% energy reduction for collector site relocation
Phase I Cost (Design):	\$200,005
Phase II Cost (Construction):	\$813,750 excludes 50,000 for data acquisition and \$152,912 for collector site relocation/redesign.

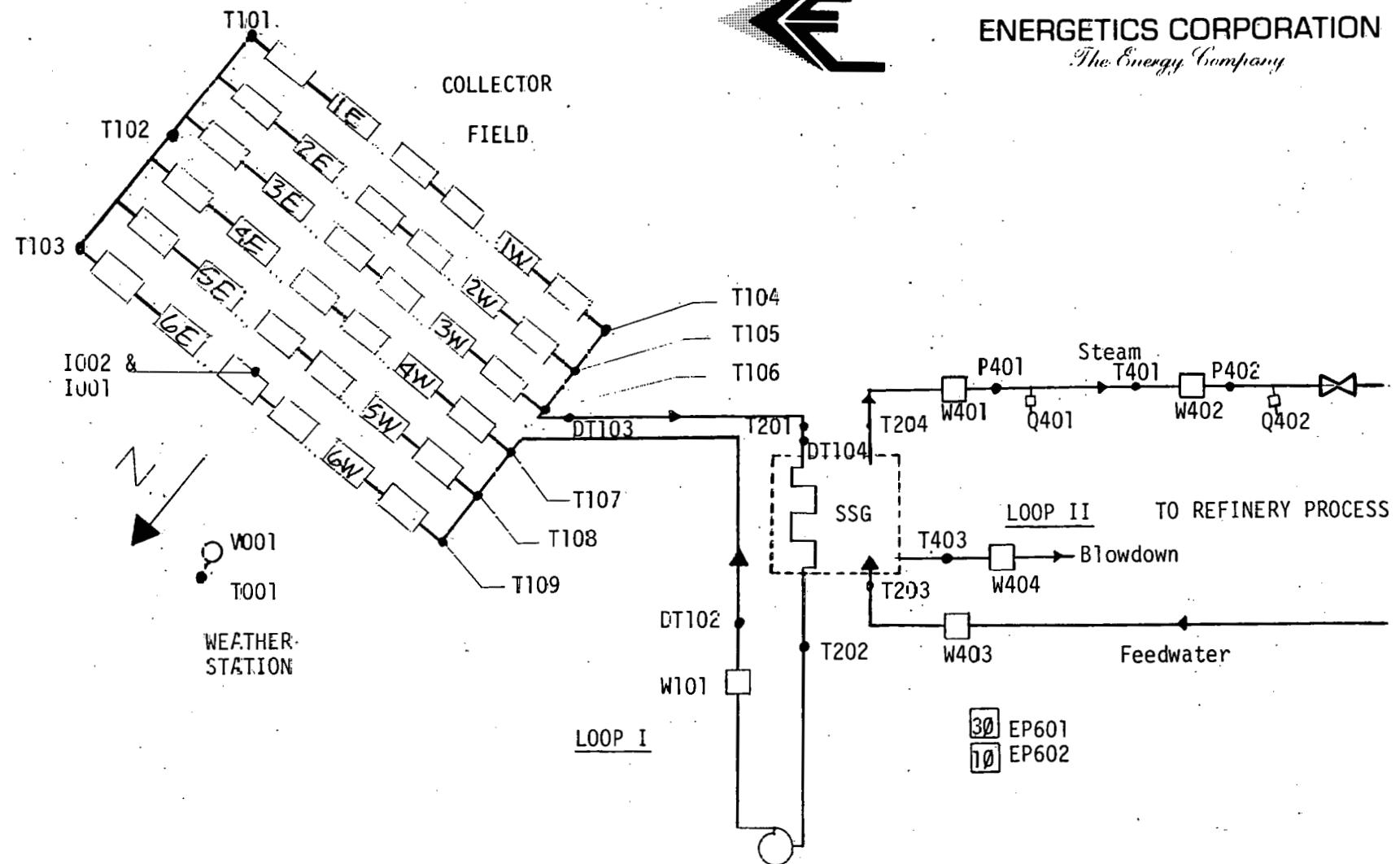
The solar collector system shown in figure 2. supplies steam to the refinery process. This steam provides part of the energy required to refine crude oil into quality petroleum products.

Steam is produced in the Solar Steam Generator (SSG) when feedwater from the refinery (see Loop II) is sufficiently heated by high temperature oil from the solar collector field (Loop I). This oil is heated in three parallel rows of solar collectors, circulated through the SSG, and returned to the collectors for reheating.

No storage is used and the system provides all the available steam produced to the refinery process. This amounts to about 5% of the minimum refinery requirement during peak solar output.



ENERGETICS CORPORATION  
*The Energy Company*



Southern Union Refining Company - Solar System Schematic

Figure 2

The system operated and was maintained on a regular basis from February 1982 through March 1984. Details of operation and maintenance by month are provided in Appendix B of this report and a summary of component failure and time of occurrence is provided in this section (Table 3-1). Upgrade activities were performed during the second year of operation based on first year operating experience, equipment improvements by the collector manufacturer, and recommendations provided by SERI and SNLA.

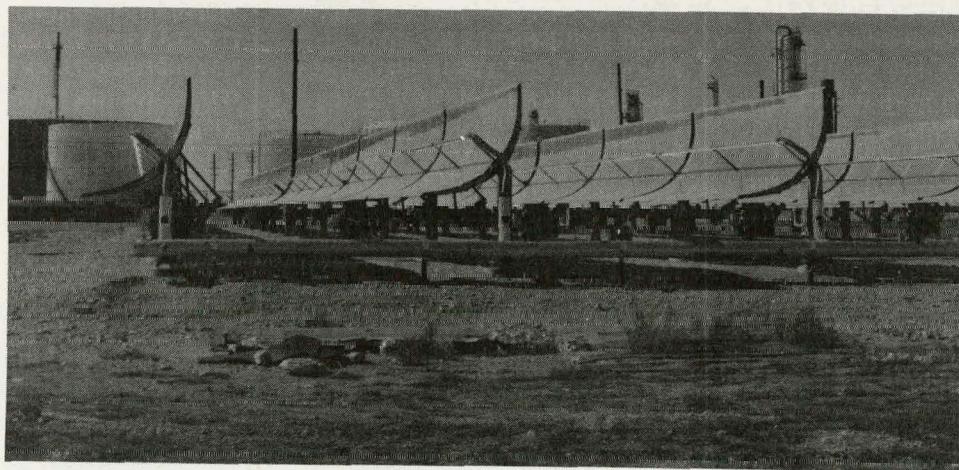
This section summarizes the overall operation, maintenance and upgrade activities and the following section addresses the results as energy and cost savings.

The first year of operation (February 82 to March 83) resulted in production of steam on a fairly regular basis. Initial system problems included a third HTO pump mechanical seal failure, recurring valve failures and a flow switch malfunction. During operation an increasing number of collector drive units and microprocessor unit failures occurred. Also, considerable receiver glass tube breakage was noted during the summer.

In August, 1982, Solar Kinetics, (SKI) restored the collectors to 100% operation with substantial repairs to most of the drive units. Significant operational performance improvement was noted in the latter part of the year due to the SKI repairs and the improved maintenance performed by Energetics. During the winter, feedwater lines and steam traps froze, the pump motor gear reducer failed along with various other controls and collector problems.

Unpredicted reduction in the number of operating days occurred during the first year. This was primarily due to excessive maintenance requirements, lack of spare parts, numerous windy or cloudy days, no system operator, and intermittent data acquisition (ODAS) problems. Additionally reduced steam production during operational days was due to dirty collectors, collector drive unit problems, and numerous sources of heat losses.

Upgrade activities were planned for the second year extension (March 83 to March 84). In order to improve performance and reliability of the system, Energetics performed these activities along with continued operation. The activities performed and expected results were as follows:



- (1) Operation was restored to the wind damaged north row of collectors by replacement of mirror modules and receiver assemblies. This restored 20% more energy collection to the system.
- (2) HTO (heat transfer oil) piping changes were made in order to eliminate 250 feet of 3" supply pipe to the collector field. This significantly reduced startup and operational heat losses.
- (3) HTO piping changes were made to accommodate a single centrifugal pump in the equipment room. This eliminated the startup pump, mechanical seal, and the need for mechanical seal cooling water.
- (4) Cold traps were incorporated in the piping to the steam generator and expansion tank in order to reduce non-operational heat losses.
- (5) An air separator was added to the HTO piping ahead of the pump and a hot oil diffuser was installed in the expansion tank. These components resulted in continuous elimination of air bubbles in the HTO piping loop and deletion of the nitrogen pressure system on the expansion tank.
- (6) Reinsulation was performed on any exposed or changed piping. All pipe anchors and permanent instrumentation were reinsulated to reduce heat losses.
- (7) Leaks from the steam generator at the manhole cover seal and out of the blowdown valve were repaired to prevent steam losses.
- (8) Freeze damaged steam traps were replaced with freeze proof units to reduce steam losses.
- (9) All broken glass tubes in the collector field were replaced. All receiver supports were modified and improved dust seals were installed. All glass tubes and assemblies were carefully cleaned and aligned during replacements. This reduced heat losses and improved focus on the receivers.
- (10) Spiral flow ribbons were removed from all 72 receiver tubes. Tubes were removed, inspected, cleaned, reinstalled, aligned, and tightened. This reduced HTO flow resistance and leakage.
- (11) The solenoid operated feedwater valve was replaced with a motor driven ball valve. This completely eliminated valve closure problems and water hammer during feedwater injection.
- (12) Blowdown was reduced to a manual once-a-month maintenance procedure. Also, an externally vented line was added to the steam generator level switch column to facilitate blowdown. This reduced steam losses and prevented feedwater control problems.

- (13) Spare parts for the collectors and the system were purchased and stocked in the equipment and visitor rooms. Major items such as the pump and single source items such as collector tracker heads were obtained in order to reduce future maintenance downtime and cost.
- (14) Spare flex hoses were stocked equal to one half of the collector field inventory. Collector travel was restricted to 45° elevation angle to the north in order to reduce stresses on the existing flex hoses during search mode operation.

Further upgrade activities were finalized late in the second year and the performance of this work was subcontracted to the collector manufacturer. These activities and the results expected were as follows:

- (1) SKI installed SNLA furnished search mode tracker boards, including new mounting boxes with an external row control switch on all hydraulic drive units. This installation also included new wiring harnesses with proximity limit switches. This resulted in search mode capability, higher reliability components, and better environmental protection for the collector controls.
- (2) Modified hydraulic bypass valves were installed on all hydraulic drives. Time delay relays in the controls were also incorporated. This resulted in more reliable high speed/slow speed tracking capability.
- (3) A heavy duty hydraulic drive motor relay was installed on each drive unit to improve reliability.
- (4) Nitrogen leak repairs, recharging of accumulators, and pressure switch adjustment was performed on each drive unit where needed. This increased high speed operation and assured drive out of focus protection during power failure.
- (5) The central control microprocessor was reprogrammed for search mode operation and the new rotating light switch was adjusted. This provided improved partly cloudy day operation and better start up and shut down times in order to reduce pumping heat losses and power consumption from excessive run time.
- (6) New components were waranteed by SKI to assure long term operation.

This concluded the upgrade activities. Other operation and maintenance activities were performed throughout the third phase extension and are detailed in the Appendix B monthly reports. These component failure occurrences are also summarized in Table 3-1. It can be seen that a significant amount of failures occurred around the coldest winter months. Most of the failures listed in Table 3-1 have been reduced or eliminated as part of upgrade repairs. One exception was the steam line check valve at the refinery which was overhauled but intermittently failed to close. This failure was most likely due to insufficient pressure drop across the valve during steamline cooldown. Data acquisition system (DAS) problems were also

identified but not fully resolved. However, the DAS was not part of the operational system and is scheduled for removal.

Wind damage to the collectors occurred about the same time in 1984 as in 1983. The 83 occurrence is described in the hot line report, Appendix A. The 84 occurrence happened during operation after completion of the final acceptance test. This wind damage and other acceptance test recommendations are also discussed in Appendix A.

Table 3-1 COMPONENT FAILURE CHART

TIME AND FREQUENCY OF OCCURRENCE									
EQUIPMENT	1982				1983				1984
	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr
MECHANICAL									
Pump Motor Speed Reducer					X				
Feedwater Valve	X	X	X	X				X	XX XXX
SSG Gasket Leak								X	X
Steam Trap Froze					X				
Feedwater Line Froze					X			X	X
Pump Shaft Mechanical Seal Failed	X								
Check Valve at Refinery Tie-in Failed Open		X			X				X
CONTROL SYSTEM									
Flowswitch	X							X	X
Start Pump to Main Pump Change-over Switch					X	X			
SSG Level Controller Malfunction			X		X			X	
Central Control Microprocessor Failed		XX		X		X			
Central Control Microprocessor Program Lost					XXX				
Central Control Aux Battery System Failed						X			X
COLLECTORS									
(1) Collector Drive(s) Unit Failed to Operate		X XX	X X	X X X	X	X	X	X	
Row Control Board Failed				X	X X				
Tracker Head Failed			X	X	X			X	
Drive Unit Hydraulic Leak		X						X	

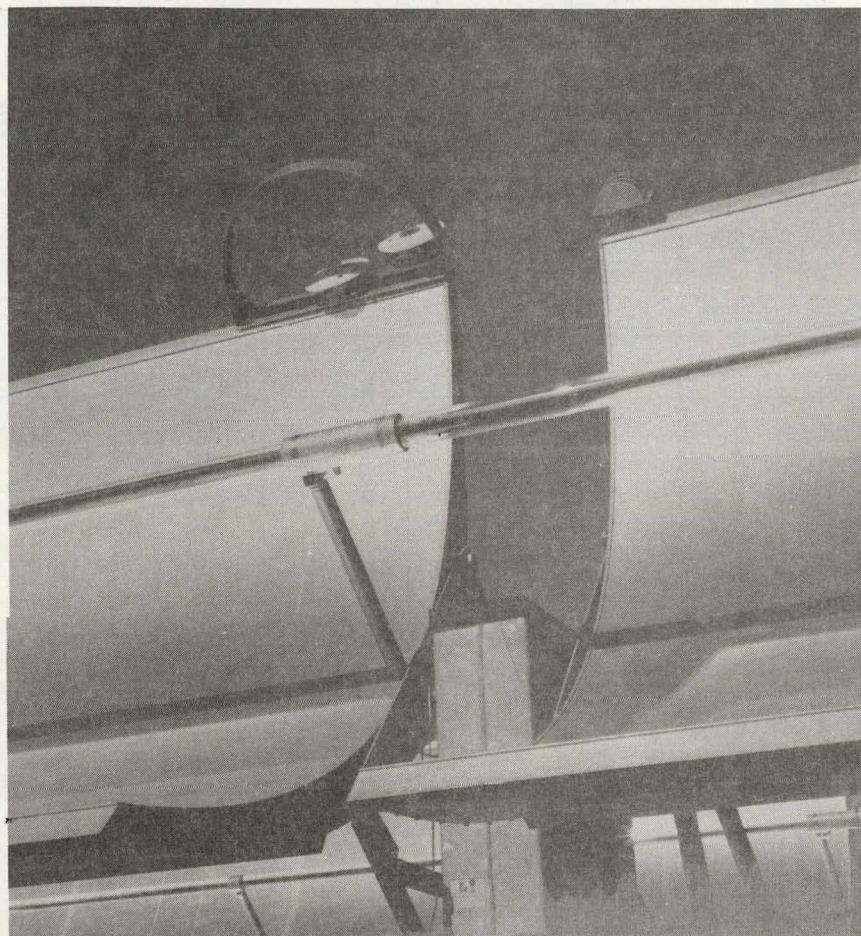
TIME AND FREQUENCY OF OCCURRENCE									
	1982				1983				1984
	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr
COLLECTORS cont.									
Glass Tube Breakage	X	XX	X		X	XX	X	XX	
Nitrogen Leaks in Hyd Accumulator	X	X	X		X	X	X		
Receiver Tube Leak			X						
(2) Poor Tracking Accuracy		X				XX	X		
									X
ODAS									
(3) Failed To Record Data		XX			X	XX	X X	XX	

NOTES: (1) Failure to operate of one or more collector drive units due to various hydraulic or electrical component failures.

(2) Failure of one or more collector rows to track properly.

(3) Failure of the ODAS system did not result in system down time, however, it did reduce reported monthly performance as shown in Table 4-1.

## 4.0

ENERGY/ECONOMIC PERFORMANCE

A summary of the energy and economic performance of this system during phase III is shown in Tables 4-1 and 4-2. Energy savings showed significant increase in October 1982 as a result of SKI drive unit repairs. The second highest month occurred in May 1983 even though only 5 out of 6 rows of collectors were operational. Upgrade construction activities began on site in August 1983 and some performance improvement was noted in November 1983. After a severely cold winter and completion of nearly all upgrade site work, the system produced the greatest amount of steam and energy savings ever in February 1984.

Energy cost savings are summarized in Table 4-2. Unacceptable total savings was caused primarily from less than predicted fuel savings and high O & M cost. Fuel savings are low because of low cost of fossil fuel displaced and lower than predicted energy savings. O & M costs were also higher than anticipated due to maintenance and liability insurance. Insurance cost was determined from system replacement costs of \$600,000.

However, as a result of upgrade work the system did operate profitably in February and March 1984.

TABLE 4-1 SOLAR PROJECT PERFORMANCE

MONTH/ YEAR	ENERGY IN MILLION BTU						NOTES
	ENERGY IN COLLECTOR PLANE	ENERGY COLLECTED	ENERGY DELIVERED	GROSS ENERGY SAVINGS	PARASITIC ENERGY USED	NET ENERGY SAVINGS	
Feb 82	-						
Mar 82	190.3	61.3	39.6	61.0	5.5	55.4	1
Apr 82	172.6	51.0	30.3	46.7	8.0	38.7	1
May 82	96.9	41.7	22.4	34.4	5.3	29.1	
Jun 82	-	-	-	-	-	-	3
Jul 82	107.2	24.9	-	-	3.7	-	3
Aug 82	70.5	15.2	6.3	9.7	2.6	7.1	2
Sep 82	167.8	46.5	28.0	43.0	5.6	37.5	1
Oct 82	242.5	83.3	51.6	79.4	8.1	71.3	1
Nov 82	183.6	60.2	36.6	56.3	6.6	49.7	1
Dec 82	70.4	25.7	13.8	21.2	3.4	17.8	2
Jan 83	195.1	53.6	26.8	41.3	6.2	35.1	1
Feb 83	141.7	40.8	23.5	36.2	5.3	30.9	
Mar 83	181.0	61.8	43.2	66.5	6.4	60.0	1
Apr 83	176.5	49.4	40.4	62.2	6.4	55.7	1
May 83	233.5	48.6	48.2	74.2	7.0	67.3	1
Jun 83	147.3	29.7	23.3	36.0	5.1	30.8	
Jul 83	232.1	55.4	40.0	62.7	9.6	53.1	1
Aug 83	86.1	23.9	13.2	20.3	3.7	16.5	4
Sep 83	14.2	-	-	-	-	-	4
Oct 83	89.5	14.3	20.3	31.3	3.0	28.3	4
Nov 83	156.3	54.3	36.2	55.7	8.7	47.0	1
Dec 83	71.3	36.1	11.7	18.0	5.0	13.0	2
Jan 84	34.9	4.2	5.9	9.0	2.9	6.1	2
Feb 84	245.2	69.1	79.4	122.2	14.1	108.1	1
Mar 84	228.3	67.3	68.8	105.8	12.1	93.7	1

## NOTES:

1. System operated for a significant portion of the month with few O & M problems.
2. System not operated much of month due to inclement weather, equipment failure, refinery down for maintenance or no operator.
3. ODAS Vortex Flowmeter removed for calibration. No data available.
4. System down for upgrade construction.

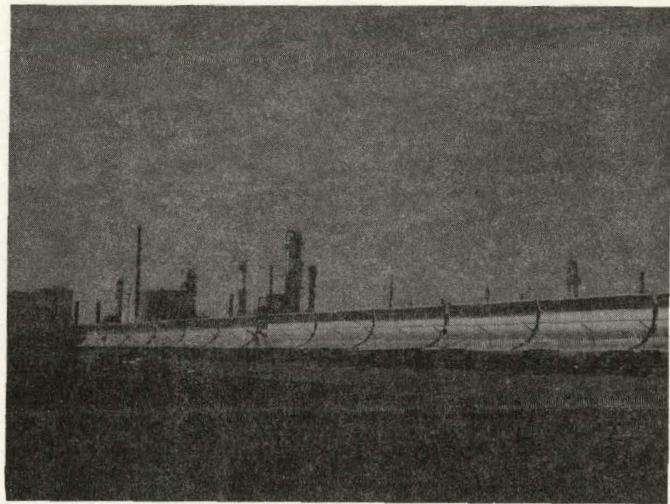
TABLE 4-2 SOLAR PROJECT ECONOMICS

MONTH/ YEAR	DOLLARS					NOTES
	GROSS FUEL SAVINGS	*PARASITIC ENERGY COST	NET FUEL SAVINGS	O & M COSTS INCL *	TOTAL SAVINGS (PROFIT)	
Feb 82	-	-	-	-	-	
Mar 82	208.75	27.93	180.80	-	-	1
Apr 82	160.32	40.68	119.65	-	-	
May 82	118.07	27.14	90.93	-	-	
Jun 82	-	-	-	-	-	
Jul 82	-	-	-	-	-	
Aug 82	33.16	13.13	20.02	-	-	
Sep 82	147.58	28.24	119.34	-	-	
Oct 82	272.39	41.42	230.97	321.42	25.25	
Nov 82	193.27	33.66	159.61	320.58	- 48.17	
Dec 82	72.74	17.32	55.43	324.23	-251.81	
Jan 83	141.75	31.62	110.13	786.54	-644.79	2
Feb 83	124.26	27.09	97.17	246.06	- 99.50	
Mar 83	228.04	32.66	195.38	249.42.	- 4.96	
Apr 83	213.25	32.72	180.53	247.64	- 34.39	
May 83	254.58	35.38	219.20	230.30	24.30	
Jun 83	123.04	25.79	97.25	300.71	-177.67	
Jul 83	215.20	48.7	166.43	254.13	7.13	
Aug 83	69.59	19.01	50.58	213.92	-144.34	
Sep 83	-	-	-	-	-	3
Oct 83	117.37	15.18	102.19	210.10	- 92.72	
Nov 83	208.94	44.47	164.47	239.39	- 30.45	4
Dec 83	67.62	25.60	42.02	180.52	-112.91	
Jan 84	33.77	14.72	19.05	200.04	-166.63	
Feb 84	458.3	72.0	386.87	226.88	231.45	
Mar 84	396.8	61.7	335.14	216.59	180.22	

\* \$5.09 per MBTU for source electrical energy

NOTES:

1. Gross fossil fuel savings based on 65% boiler efficiency (including idle and line losses) and a natural gas cost of \$3.43 per MBTU.
2. Main pump gear reducer failed resulting in high repair cost.
3. System down for upgrade construction.
4. Natural gas costs revised to \$3.75 per MBTU.



With completion of the upgrade activities and proper maintenance, the Solar IPH system at Southern Union should easily exceed the already acceptable energy production levels of the last two months of the third phase. Given the quality of maintenance available from Southern Union, the support of the collector manufacturer, and the excellent available solar energy at this site, it is believed that this system can operate in an economically acceptable manner to the refinery.

## APPENDIX A

Energy Technology Engineering Center  
Energy Systems Group  
P.O. Box 1449  
Canoga Park, CA 91304  
(213) 341-1000



Operated for U.S. Department of Energy

February 19, 1982

82ETEC-DRF-0773

Mr. William D. Nettleton, Jr., Project Manager  
Engineering and Facilities Management Division  
San Francisco Operations Office  
U. S. Department of Energy  
1333 Broadway  
Oakland, CA 94612

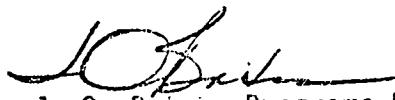
Subject: Trip Report - Acceptance Test of the Southern Union Oil  
Refinery Solar IPH Project

Dear Mr. Nettleton:

Enclosed are copies of trip report for the acceptance test conducted by ETEC at the Southern Union Oil Refinery Solar Project in Lovington, New Mexico. The project is a Cycle III, high temperature, high pressure steam solar facility on which construction has been completed and operation initiated. The inspection and testing were completed on January 22, 1982.

If you have any questions, please contact Bill Bigelow at (213) 700-5527.

Sincerely yours,

  
J. O. Bates, Programs Manager  
Energy Programs  
Energy Technology Engineering Center

Enclosure: as noted (3 copies)

cc w/encl: W. W. Auer, DOE-HQ  
J. Greyerbiehl, DOE-HQ  
A. N. Pappas, DOE-ALO  
E. Davis, DOE-ALO  
J. K. Hartman, DOE-ETEC PO  
J. A. Leonard, Sandia  
D. E. Randall, Sandia  
L. Wilson, Energetics  
W. Price, Energetics  
W. Carlile, Energetics

# Internal Letter

# Rockwell International

Date: . February 19, 1982

No: . 82-202-1-034

TO: (Name, Organization, Internal Address)

- J. O. Bates
- ETEC
- 720-202 T036

FROM: (Name, Organization, Internal Address, Phone)

- W. L. Bigelow
- ETEC
- 720-202 T036
- 5527

Subject: . Trip Report - Acceptance Test of the Southern Union Oil Refinery Solar IPH Project

## Summary:

An acceptance test of the Southern Union Refining Company Solar Project was conducted the week of January 20, 1982. The system performed well in demonstrating the emergency and protective modes and during normal operation. No major problems were observed in the operation of the collector field or the on-site data acquisition system (ODAS). A punch list of minor items was generated by the inspection team and turned over to Energetics (A&E) for correction of the discrepancies. The team agreed that Energetics had successfully completed Phase II of the program and recommended that DOE-SAN proceed with Phase III.

## Discussion:

ETEC representatives conducted an acceptance test of the Southern Union Oil Refinery Solar IPH Project in Lovington, New Mexico, on January 20, 21 and 22, 1982. Personnel from Energetics Corporation, DOE, and Sandia Labs were also present. In attendance were:

Lee Wilson, Energetics  
Wayne Price, Energetics  
Bill Nettleton, DOE-SAN  
Errol Davis, DOE-ALO  
Duane Randall, Sandia  
Dick Saunders, ETEC  
Jack Roberts, ETEC  
Bill Bigelow, ETEC

Site inspection and system tests were conducted on January 20 and 21, and test results and findings were discussed on January 22. The inspection and tests resulted in a punch list of 25 items (Attachment 1). The small number of discrepancies noted by the inspection team indicates that Energetics was well prepared for the acceptance test. The only major item noted was possible evidence of receiver tube leakage.

Evidence of oil deposition was observed on the glass covers at several receiver tube connections in the collector field. This condition occurs at the B-nut connectors joining the ten-foot lengths of receiver tube. The oil deposition is not the result of gross leakage but appears as a light, oily mist forming on the inside of the glass covers. A similar

To: J. O. Bates  
Subject: Trip Report - Acceptance Test of the  
Southern Union Oil Refinery Solar  
IPH Project

82-202-1-034  
February 19, 1982  
Page 2

condition was experienced with the solar kinetics T-700 collectors at the Lone Star Brewery Solar Project in San Antonio, Texas. Attempts to mechanically check the therminol leaks there were unsuccessful, and each row of receiver tubes was subsequently welded together to form the 90-foot length of run. Item 1 of the punch list recommends that close surveillance of the collectors be maintained to identify any change in this condition.

Insulation of the collector field piping and the runs to the mechanical room were well done in general, but the aluminum wrappers covering the fiberglass insulation were not well sealed. Rainwater running along the piping runs could travel under the wrapper seam and into the insulation, thus reducing system efficiency. Use of a suitable sealer at the wrapper seams would prevent wetting of the fiberglass.

All operational tests were performed with a minimum of difficulty, and the results of the acceptance test are listed in Attachment 2. The emergency and protective tests were completed about 3:00 P.M. on January 20, and the normal operating tests were conducted the following day. Average beam solar radiation at the time measured 108 BTU/FT<sup>2</sup>-HR and produced a temperature rise across the collector field of 25.7°F. This translated to a collector efficiency of about 32%.

The inspection team along with the Energetics people met with Bill McDonnell, the Southern Union Plant Maintenance Manager on January 22. Bill Nettleton stated that Energetics had successfully passed the acceptance test, concluding Phase II of the program. Some discussion followed regarding solar site tours and the specific responsibilities of Energetics and Southern Union during Phase III (data gathering and evaluation) of the program.

Attached are the comments on the inspection checklist and the operational tests.



W. L. Bigelow, Project Engineer  
Energy Programs  
Energy Technology Engineering Center

Attachments: as noted

SOUTHERN UNION OIL REFINERY ACCEPTANCE TEST PUNCH LIST  
January 20, 21 and 22, 1982

Collector Field

1. Oil deposits at several locations on receiver tube glass covers around the B-nut connections. Suggest mapping B-nut connections of entire field and maintain close surveillance for any changes during operation over the next few weeks.
2. Reflector focus is generally good but needs some fine tuning as more operating time is logged.
3. Broken glass covers in rows 4 and 6.
4. Oil deposits on most B-nuts connecting the flex hoses to the manifold downcomer pipes at both ends of the collector rows. Needs attention before insulation and aluminum wrappers are replaced.
5. Replace all water or oil-soaked fiberglass insulation.
6. Oil leak observed at the mid-row expansion loop on Row 2.
7. Waterproof sealing of aluminum wrapper joints needs to be provided over entire outdoor piping system.
8. Hydraulic oil leakage/spillage observed at several drive module locations.
9. General observation that receiver tubes tend to move in an easterly direction rather than equally in both axial directions during thermal expansion.
10. Some grading of excavation needs to be completed.
11. Paint/touch up areas with galvanized paint at pipe support connections on collector pylons and as needed.
12. Record and observe the areas where film delamination is starting on collector reflector surfaces.
13. Modify flex connection installation to remove kink in flex hose (Row 6).
14. A fine tune balance of the flow through the collector rows will probably improve performance.
15. Select and procure collector washing equipment.
16. Install a total global radiation sensor that measures total radiation incident to the plane of the collectors.

Mechanical Room

1. Resolve main pump leakage problem.
2. Color code piping, flow arrows, and component identification.
3. Transfer instrumentation for monitoring steam flow from its present location in the mechanical room to the steam line interface at the refinery.
4. Consider adding a vent opening high in north wall of equipment room to provide natural circulation for heat and oil fume removal.

Control Room

1. Locate a P&I and ODAS channel index diagram in the control room to coordinate information between system and ODAS.
2. Install door stops/closers to prevent doors from slamming in high wind conditions.
3. Provide cover for back of control panel.

General

1. Define Southern Union's responsibilities for system surveillance and maintenance in Phase III.
2. Define safety measures involved with system operation.
3. Provide a sign at entrance to solar field giving particulars for solar project (i.e., facility name, engineering firm/constructor, funding by DOE, collector manufacturer, collector field size, system operating conditions, etc.

Energy Technology Engineering Center  
Energy Systems Group  
Rockwell International Corporation  
P.O. Box 1449  
Canoga Park, California 91304

(213) 700-8200

Operated for U.S. Department  
of Energy

Rockwell  
International

April 24, 1984

84ETEC-DRF-1539

Mr. George N. Pappas  
U.S. Department of Energy  
Solar Energy Division  
Post Office Box 5400  
Albuquerque, N.M. 87115

Subject: Trip Report - Acceptance Test of the Southern Union Oil  
Refining Co. Solar IPH Upgrade Project

Dear Mr. Pappas:

Enclosed are copies of the trip report for the acceptance test conducted by ETEC at the Southern Union Oil Refining Co. Solar Project in Lovington, New Mexico. The project is an upgrade of a Cycle III, high temperature, high pressure steam solar facility that has been upgraded and operation resumed. The site inspection and testing was completed on March 28, 1984.

If you have any questions, please contact Bill Bigelow on (818) 700-5527.

Sincerely yours,

  
Oscar R. Hillig, Program Manager  
Energy Programs  
Energy Technology Engineering Center

Enclosure: As Noted (3 copies)

cc w/encl: J. M. Greyerbiehl, DOE-HQ  
J. E. Weiseger, DOE-ALO  
J. A. Leonard, Sandia  
E. L. Harley, Sandia  
E. E. Rush, Sandia  
W. McDonald, So. Union Oil Refining Co.  
L. E. Wilson, Energetics Corp.  
J. M. Slaminski, ETEC PO

cc w/o encl: T. A. Vaeth, ETEC PO

WLB3

**Internal Letter****Rockwell International**

Date: April 24, 1984

No: 84-290-7-047

TO: (Name, Organization, Internal Address)

FROM: (Name, Organization, Internal Address, Phone)

- O. R. Hillig
- ETEC
- 720-290 T036

- W. L. Bigelow
- ETEC
- 720-290 T036
- X5527

Subject: Trip Report - Acceptance Test of the Southern Union Oil Refining Co. Solar IPH Upgrade Project

**Summary**

An acceptance test of the Southern Union Oil Refining Co. Solar Project was conducted by ETEC during the week of March 26, 1984. The system generally performed well while demonstrating normal operation and emergency protective modes. A punch list of comments and noted discrepancies (attachment 1) was generated by the inspection team and will be forwarded to Energetics (A&E) for correction.

High wind effects and mechanical interference of collector components were judged to be the only items of major concern and are discussed below. Submission of a final report will conclude Energetic's contractual obligations and the project will be turned over to Southern Union Oil for future operation and maintenance.

**Discussion**

ETEC representatives conducted an acceptance test of the Southern Union Oil Refining Co. IPH Upgrade Project in Lovington, New Mexico during the week of March 26, 1984. Personnel from Energetics Corporation and Sandia Laboratories were also present, in attendance were:

- Lee Wilson - Energetics Corp.
- Dave McGuire - Energetics Corp.
- Earl Rush - Sandia
- Jack Roberts - ETEC
- Bill Bigelow - ETEC

Site inspection and system testing were performed on March 27 and 28, and resulted in a punch list of seventeen items. The only two items of major concern were: 1) buffeting of the collectors during high level wind conditions; and 2) mechanical interference between the pylons and the collector end strut mounting bolts.

Considerable buffeting and vibration of the reflector bodies was observed at wind velocities below the 30-35 mph protective stow level. The wind meter must sense a steady state wind speed in excess of 30-35 miles mph range for a given time increment before a collector stow command is triggered. It is possible therefore, that the collectors can be exposed to intermittent wind gusts far in excess of the 30-35 mph sensor level. Reducing the sensor level or the response time would most probably result in adjusting the system to an over-sensitive condition causing unnecessary collector reaction. The best solution appears to be the erection of a windbreak, as needed, around the

To: O. R. Hillig  
Subj: Trip Report - Acceptance Test  
of the So. Union Oil Refining  
Co. Solar IPH Upgrade Project

-2-

84-290-7-047  
April 24, 1984

collector field. Partial screening such as that provided by weaving slats into a chain-link fence may prove sufficient. The break may not be required around the entire field, but only screening the sides exposed to the high wind and gusting conditions. Subsequent to the acceptance test, wind damage to one collector row was sustained on March 30. The system was restarted in the automatic mode on April 4 with 5 of the 6 rows operational.

Upon rotation of the collectors during normal tracking operation, thermal expansion of the collector causes an axial movement withing the rows away from the fixed location at the hydraulic drive module. This shifting of the collector can result in an interference between the reflector end strut mounting bolts and the fixed pylon. This condition has been observed at several other sites using the SKI T-700 model collector. Severe buckling and damage to the reflectors can be sustained if the bolt head locks against the pylon as the drive system continues to rotate the collector row during the tracking excursion. SKI has designed and installed collars around the trunnions that restricts the axial movement of the collector. This approach has provided a satisfactory solution to the problem at the other sites and needs to be implemented as soon as possible at the Lovington project.

The system appeared to function satisfactorily in normal automatic operation and a data slice around solar noon on March 28 indicated a collector efficiency of about 37% under a direct insolation of  $319 \text{ Btu/hr-ft}^2$ . A temperature rise of  $66^{\circ}\text{F}$  across the collector field was supplying steam to the process at a rate of about 1423 lb/hr.

ETEC judged the upgrading and operation of the system at Southern Union to be acceptable and suggest that the project be turned over to the owner once the punch list deficiencies have been corrected.



W. L. Bigelow, Project Engineer  
Solar Heating & Cooling

Attach: as noted

WLB4

ATTACHMENT 1

Acceptance Test Punch List for the Southern Union Oil  
Refining Co. Solar IPH Upgrade Program  
Conducted March 26, 27, and 28, 1984

1. The aluminum wrappers covers around the insulation on the supply and return headers need sealing and weather-proofing at the joints.
2. A general clean-up of the collector field area is needed.
3. Rusting on receiver tube standoffs, bearing blocks and trunnions need clean-up and painting.
4. Temperature sensor wires routed along the supply and return header pipes need rigging.
5. Collector reflector surfaces and receiver tube glass need cleaning.
6. Insolation meter wires (total and diffuse Eppley sensors) mounted on Row 5 West-3 need rigging.
7. Oil leaks at hydraulic drive modules.
8. Minor delamination of the FEK on the collector surfaces in several areas.
9. Receiver tube oil leaks at Row 5 West, 1-2-5 and 6.
10. Remove old receiver tube temperature sensor wires from each row.
11. Evidence of interference between the pylon and collector end strut mounting bolts was observed at three places. Rather severe scuffing of bolt head and the pylon was noted at Row 5 West-6. Install SKI trunnion collars to prevent damage to the collectors.
12. Broken receiver tube glass on Row 1 East-6.
13. Component and piping identification and flow direction arrows needed.
14. Considerable buffeting of the collectors was observed under conditions of strong wind gusting. A fence or barrier is needed.
15. Rotational speed of two collector rows is much slower than that of the other four rows. Hydraulic fluid and nitrogen pressure levels need to be checked.
16. Collector focus is generally good.
17. Insulation in the field and mechanical room is generally well done.



ENERGETICS CORPORATION  
*The Energy Company*

TEXAS ENERGETICS CORPORATION  
1201 Richardson Drive  
Suite 216  
Richardson, Texas 75080  
(214) 783-4731

ENERGETICS CORPORATION  
Post Office Box 1596  
Lovington, New Mexico 88260  
(505) 396-5889

April 12, 1983

TO: Distribution  
FROM Lee E. Wilson, Project Manager  
SUBJECT: HOT LINE REPORT  
RE: Southern Union Solar IPH  
Contract #DEAC04-78CS32223  
Collector Wind Damage

Collector damage due to high winds was encountered at the Southern Union Solar IPH Project near Hobbs, New Mexico during early morning hours of April 1, 1983.

On April 6 and 7, we visited the site, assessed the damage and took pictures. It was observed that the north row of collectors sustained severe damage to four collectors adjacent to the two drive pylons. Slight damage was observed to four other collectors and no observable damage occurred to the four collectors farthest away from the drive pylons on the north row (See attached sketch and pictures).

At least 20 (out of 24) glass receiver tube covers on the north row were cracked or broken, several supporting brackets or receiver stands were deformed, and a heat transfer oil leak occurred at the receiver tube union near the east drive pylon.

No other wind damage or operational problem was detectable in any of the other five rows of collectors. All collectors were in the stow position during the occurrence and all collector hydraulic drive units are operational.

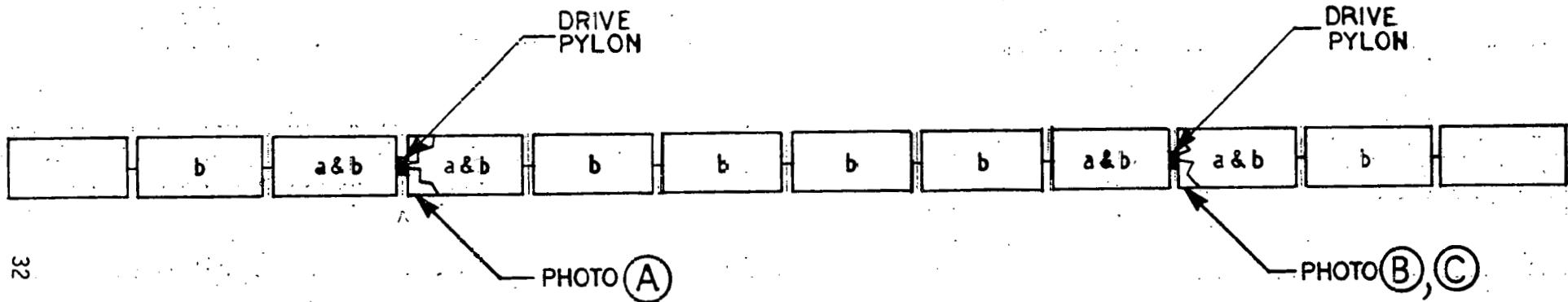
High wind damage was reported to various structures in nearby Hobbs and Lovington on the same date. Regarding insurance, ownership of the collectors was stated to belong to Southern Union by DOE representatives at a site meeting in January 1982. Discussions with refinery management indicate that collector field insurance is provided for liability coverage but not for physical damage.

Energetics Corporation assessment of the damage concludes that four collectors will need replacement along with repairs to the receiver assemblies in order to restore full system operation. In our opinion, the slight damage incurred to four other collectors is acceptable and will not significantly affect the system performance.

A cost estimate for the proposed repairs to restore full system operation is in preparation.

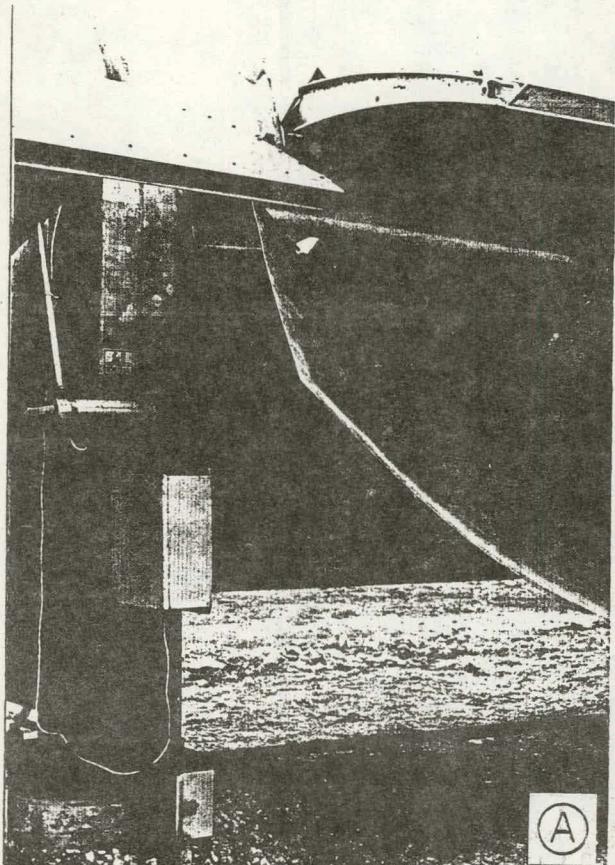
*Lee E. Wilson*

Lee E. Wilson  
Project Manager

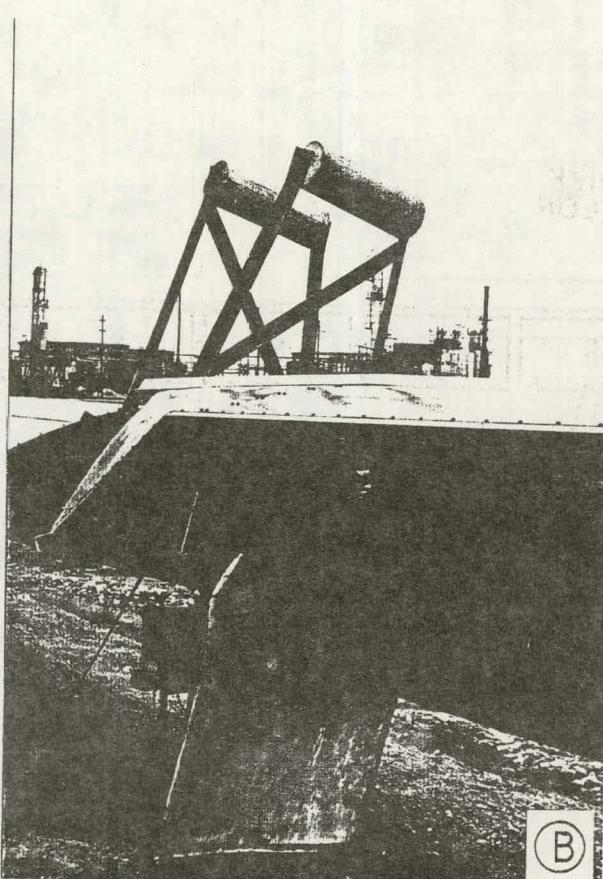


- a) REFLECTOR DAMAGE
- b) BROKEN GLASS

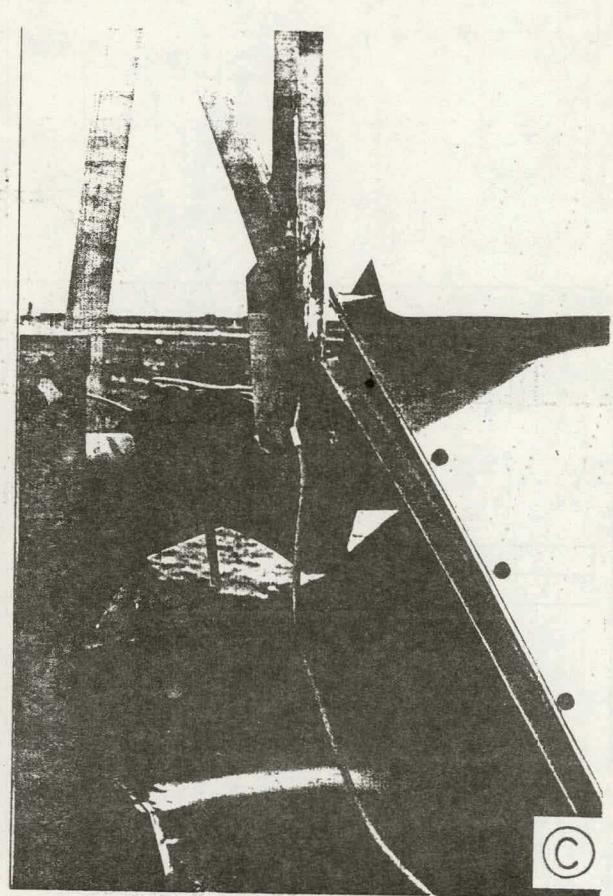
FOR COLLECTOR FIELD  
ORIENTATION SEE  
ATTACHED SHEET



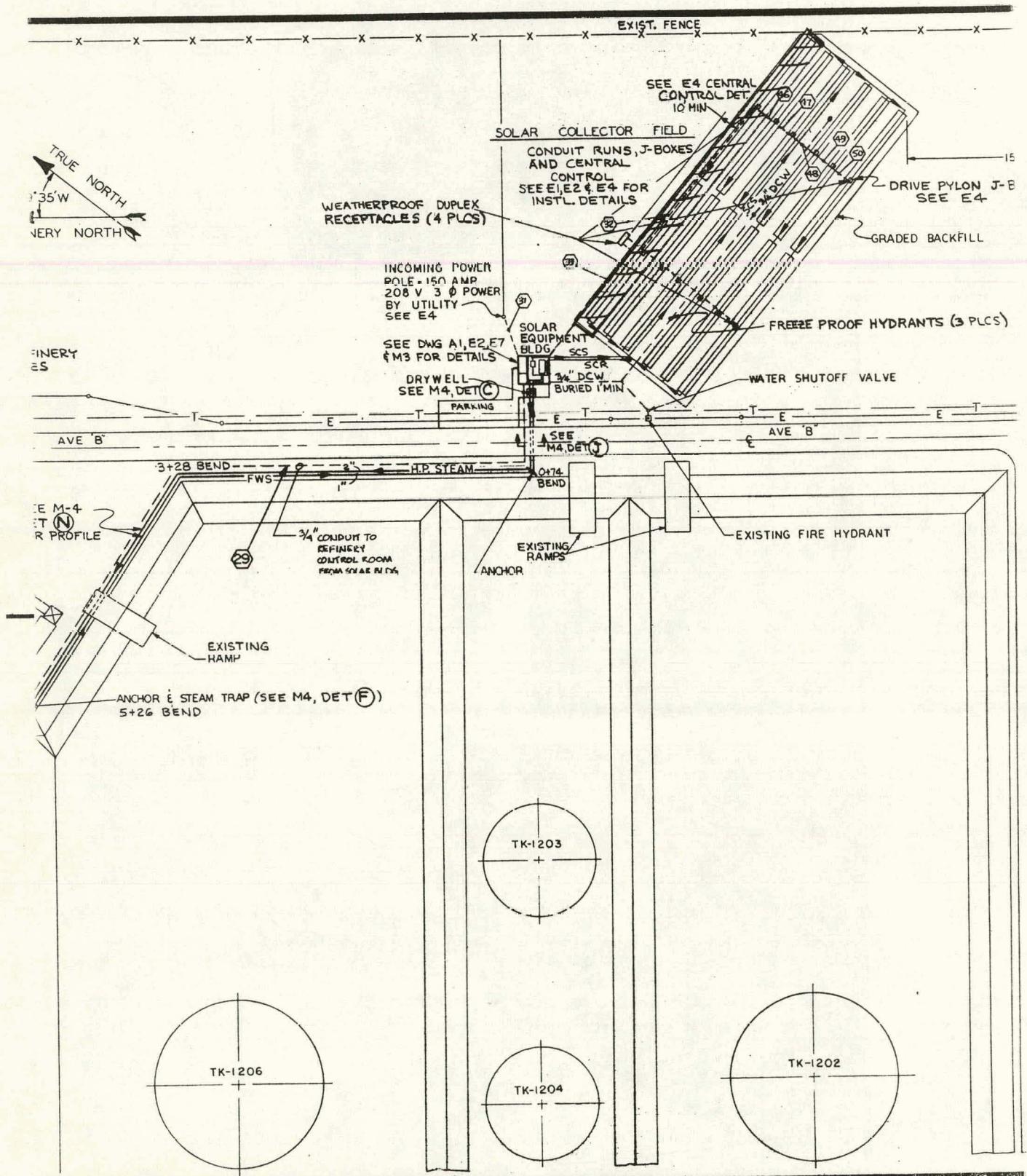
(A)



(B)



(C)



## APPENDIX B

Table I      SOUTHERN UNION REFINING COMPANY - SYSTEM OPERATION SUMMARY TABLE  
FEBRUARY 1982

Date	Julian Day	Status Code	Weather	Remarks
2/1	32	2	P	Mechanical problem - feedwater valve
2/2	33	2	P	Mechanical problem - feedwater valve
2/3	34	2	P	Mechanical problem - feedwater valve
2/4	35	1	C	
2/5	36	1	C	
2/6	37	3	P	No operator
2/7	38	3	P	No operator
2/8	39	1	C	
2/9	40	1	F	3896 lbs. (of steam to refinery)
2/10	41	1	F	4324 lbs.
2/11	42	1	P	82 lbs.
2/12	43	1	F	4800 lbs.
2/13	44	1	C	
2/14	45	3	P	No operator
2/15	46	1	C	
2/16	47	1	F	5550 lbs.
2/17	48	1	F	3341 lbs.
2/18	49	1	P	1 lb.
2/19	50	1	F	4416 lbs.
2/20	51	1	P	4 lbs.
2/21	52	3	C	No operator
2/22	53	1	P	286 lbs.
2/23	54	1	P	Data Acquisition System down
2/24	55	1	P	Data Acquisition System down
2/25	56	1	C	Data Acquisition System down
2/26	57	1	C	
2/27	58	1	P	{ 28 lbs. Removed fixed pyrometer and re-mounted it on the collector. Repaired anemometer and reprogrammed ODAS.
2/28	59	1	P	

F: Fair	<u>Status Code</u>
P: Partly Cloudy	1: Solar system up/Plant up
C: Fog or Overcast	2: Solar system down/Plant up
R: Rain	3: Solar system idle/Plant up

ENERGETICS CORPORATION

III. Operating Experience

Mechanical problems developed in early February with the feedwater valve sticking open. This repeatedly flooded the steam generator with feedwater and resulted in system automatic shutdown on high water level. To correct this a new piston assembly for the valve was ordered and replaced.

Inclement weather in February reduced the number of operational days and problems with the On-site Data Acquisition System (ODAS) were encountered. The Autodata 10 was reprogrammed to correct some errors and some unnecessary outputs eliminated to conserve processor memory.

A fair amount of steam was produced for 7 days when good insulation and an operator were available. It should be noted that although the system can operate automatically it was decided not to do so until a fire detection system is installed in the solar equipment room with a warning system tied into the refinery control room. This will be accomplished along with training of refinery personnel as part of Phase III activities.

Table 1 SOUTHERN UNION REFINING COMPANY - SYSTEM OPERATION SUMMARY TABLE  
MARCH 1982

Date	Julian Day	Status Code	Weather	Remarks
3/1	60	3	C	
3/2	61	3	C	
3/3	62	1	P	
3/4	63	1	C	
3/5	64	3	C	
3/6	65	1	F	
3/7	66	1	F	
3/8	67	1	C	
3/9	68	1	F	
3/10	69	1	C	
3/11	70	1	C	
3/12	71	3	C	
3/13	72			No Operator.
3/14	73			No Operator.
3/15	74			No Operator.
3/16	75	1	C	
3/17	76			No Data - DAS Failure.
3/18	77			No Data - DAS Failure.
3/19	78	1	F	DAS Program correction.
3/20	79	1	F	
3/21	80	1	F	
3/22	81	3	C	
3/23	82	1	C	
3/24	83	1	F	
3/25	84	3	C	
3/26	85	3	C	
3/27	86	1	F	
3/28	87	3	C	
3/29	88	3	F	High winds.
3/30	89	1	C	
3/31	90	1	F	

F: Fair	<u>Status Code</u>
P: Partly Cloudy	1: Solar system up/Plant up
C: Fog or Overcast	2: Solar system down/Plant up
R: Rain	3: Solar system idle/Plant up
S: Snow	4: Solar system up/Plant down
	5: Solar system down/Plant down
	6: Solar system idle/Plant down

ENERGETICS CORPORATION

III. Operating Experience

The solar collector system was fully operational during March except for three days when an operator was not available and two days when the ODAS recorder was not operating. These days were not counted in the total number of days since the weather conditions were not recorded and the system was not down for repair.

No significant mechanical problems occurred with the collector system this month but an abnormally high number of cloudy days reduced the operational period.

Problems were encountered again with the ODAS output for insolation and electrical parasitic load data. This condition was corrected on March 19 with a program change to the Autodata 10.

The system operation summary is shown in Table 1. More detailed log data will be provided for next month's report.

ENERGETICS CORPORATION

TABLE 2 MONTHLY SYSTEM ENERGY PERFORMANCE--MAR. 1982

TIME		ENERGY BALANCE						EFFICIENCY	
JULIAN	DAY	DATE	INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE	PIPING LOSSES -OPERA TIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM
			MIL-BTU	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU	%
60	MAR 1	0.271	0.000	0.0000	0.	0.000	0.110	0.0	0.0
61	MAR 2	0.128	0.000	0.0000	0.	0.000	0.047	0.0	0.0
62	MAR 3	10.765	3.211	1.8830	1993.	0.178	0.284	29.8	17.5
63	MAR 4	4.822	1.131	0.1347	171.	0.045	0.150	23.5	2.8
64	MAR 5	0.113	0.000	0.0000	0.	0.000	0.179	0.0	0.0
65	MAR 6	18.470	6.504	4.8797	5085.	0.293	0.335	35.2	26.4
66	MAR 7	17.716	5.988	4.2491	4443.	0.280	0.358	33.8	24.0
67	MAR 8	1.185	0.820	0.0000	0.	0.000	0.021	69.2	0.0
68	MAR 9	15.899	5.526	4.2108	4305.	0.222	0.417	34.8	26.5
69	MAR 10	6.170	1.568	0.1659	218.	0.044	0.190	25.4	2.7
70	MAR 11	4.381	2.066	0.3631	530.	0.177	0.162	47.2	8.3
71	MAR 12	0.222	0.000	0.0000	0.	0.000	0.004	0.0	0.0
72	MAR 13	0.309	0.000	0.0000	0.	0.000	0.006	0.0	0.0
73	MAR 14	0.334	0.000	0.0000	0.	0.000	0.091	0.0	0.0
74	MAR 15	0.414	0.000	0.0000	0.	0.000	0.008	0.0	0.0
75	MAR 16	4.468	1.219	0.0000	0.	0.000	0.079	27.3	0.0
78	MAR 19	13.297	4.770	3.8881	4127.	0.164	0.194	35.9	29.2
79	MAR 20	20.088	7.001	5.7069	5837.	0.280	0.475	34.9	28.4
80	MAR 21	16.676	5.430	3.8295	4051.	0.265	0.452	32.6	23.0
81	MAR 22	0.440	0.000	0.0000	0.	0.000	0.059	0.0	0.0
82	MAR 23	3.045	0.295	0.0000	0.	0.000	0.201	9.7	0.0
83	MAR 24	18.485	6.230	4.5888	4757.	0.252	0.431	33.7	24.8
84	MAR 25	0.412	0.000	0.0000	0.	0.000	0.054	0.0	0.0
85	MAR 26	0.148	0.000	0.0000	0.	0.000	0.051	0.0	0.0
86	MAR 27	15.606	4.703	2.8247	3006.	0.318	0.428	30.1	18.1
87	MAR 28	0.103	0.000	0.0000	0.	0.000	0.054	0.0	0.0
88	MAR 29	0.470	0.000	0.0000	0.	0.000	0.052	0.0	0.0
89	MAR 30	3.682	0.785	0.0690	175.	0.029	0.244	21.3	1.9
90	MAR 31	12.191	4.012	2.7664	2857.	0.175	0.357	32.9	22.7
TOTL/AVG		190.309	61.259	39.5597	41666.	2.724	5.492	32.2	20.8

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - MARCH 1982

ENERGETICS CORPORATION

TABLE 3 MONTHLY SOLAR SYSTEM SAVINGS-ENERGY & DOLLARS--MAR, 1982

TIME		ENERGY					DOLLARS		
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA- SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
				MIL-BTU	MIL-BTU	MIL-BTU			
							\$	\$	\$
60	MAR 1	0.000	0.110	-0.110	-0.021	-0.110	0.00	0.56	-0.56
61	MAR 2	0.000	0.047	-0.047	-0.009	-0.047	0.00	0.24	-0.24
62	MAR 3	2.897	0.294	2.613	0.505	2.613	9.94	1.44	8.49
63	MAR 4	0.207	0.150	0.057	0.011	0.057	0.71	0.76	-0.05
64	MAR 5	0.000	0.179	-0.179	-0.035	-0.179	0.00	0.91	-0.91
65	MAR 6	7.507	0.335	7.172	1.385	7.172	25.75	1.70	24.05
66	MAR 7	6.537	0.358	6.179	1.193	6.179	22.42	1.82	20.60
67	MAR 8	0.000	0.021	-0.021	-0.004	-0.021	0.00	0.11	-0.11
68	MAR 9	6.478	0.417	6.061	1.170	6.061	22.22	2.12	20.10
69	MAR 10	0.255	0.190	0.065	0.013	0.065	0.88	0.97	-0.09
70	MAR 11	0.559	0.162	0.397	0.077	0.397	1.92	0.82	1.09
71	MAR 12	0.000	0.004	-0.004	-0.001	-0.004	0.00	0.02	-0.02
72	MAR 13	0.000	0.006	-0.006	-0.001	-0.006	0.00	0.03	-0.03
73	MAR 14	0.000	0.091	-0.091	-0.018	-0.091	0.00	0.46	-0.46
74	MAR 15	0.000	0.008	-0.008	-0.001	-0.008	0.00	0.04	-0.04
75	MAR 16	0.000	0.079	-0.079	-0.015	-0.079	0.00	0.40	-0.40
76	MAR 17	5.982	0.194	5.788	1.117	5.788	20.52	0.99	19.53
77	MAR 18	8.780	0.475	8.305	1.603	8.305	30.11	2.42	27.70
78	MAR 19	5.892	0.452	5.440	1.050	5.440	20.21	2.30	17.91
79	MAR 20	0.000	0.059	-0.059	-0.011	-0.059	0.00	0.30	-0.30
80	MAR 21	0.000	0.201	-0.201	-0.039	-0.201	0.00	1.02	-1.02
81	MAR 22	7.060	0.431	6.629	1.280	6.629	24.21	2.19	22.02
82	MAR 23	0.000	0.054	-0.054	-0.010	-0.054	0.00	0.28	-0.28
83	MAR 24	0.000	0.051	-0.051	-0.010	-0.051	0.00	0.26	-0.26
84	MAR 25	4.346	0.428	3.917	0.756	3.917	14.91	2.18	12.73
85	MAR 26	0.000	0.054	-0.054	-0.010	-0.054	0.00	0.27	-0.27
86	MAR 27	0.000	0.052	-0.052	-0.010	-0.052	0.00	0.27	-0.27
87	MAR 28	0.106	0.244	-0.138	-0.027	-0.138	0.36	1.24	-0.88
88	MAR 29	4.256	0.357	3.899	0.753	3.899	14.60	1.81	12.78
TOTAL		60.861	10.984	55.369	10.689	55.369	208.75	27.93	180.82

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - MARCH 1982 CONTINUED

## ENERGETICS CORPORATION

Table 1. SOUTHERN UNION REFINING COMPANY - SYSTEM OPERATION SUMMARY TABLE

APRIL 1982

Date	Julian Day	Status Code	Weather	Remarks
4/1	91	3*	C	
4/2	92	3	P	High winds - several shutdowns
4/3	93	3	C	
4/4	94	1**	F	High winds - one shutdown
4/5	95	1	F	
4/6	96	1	P	
4/7	97	3	P	High winds
4/8	98	1	F	
4/9	99	3	C	
4/10	100	2	F	Cleaned collector glass tubes
4/11	101	-	-	No operator
4/12	102	1	P	
4/13	103	1	P	
4/14	104	1	P	
4/15	105	1	F	
4/16	106	1	F	
4/17	107	3	C	
4/18	108	1	P	
4/19	109	3	C	
4/20	110	3	C	
4/21	111	3	C	
4/22	112	3	R	
4/23	113	3	R	
4/24	114	1	P	
4/25	115	6	-	Plant turn around - collectors stowed in turned-down position
4/26	116	6	-	"
4/27	117	6	-	"
4/28	118	6	-	"
4/29	119	6	-	"
4/30	120	6	-	"

F: Fair

Status Code

P: Partly Cloudy

1: Solar system up/Plant up

2: Solar system down/Plant up

C: Fog or Overcast

3: Solar system idle/Plant up

4: Solar system up/Plant down

R: Rain

5: Solar system down/Plant down

6: Solar system idle/Plant down

S: Snow

\* covers days when zero or very small amounts of  
energy were collected and/or delivered due to  
weather conditions.

\*\* covers days when all systems are "up" and significant amounts of energy are delivered.

ENERGETICS CORPORATION

III. Operating Experience

The operation of the solar system was significantly affected during April by unseasonably cloudy weather. The system collected little or no solar energy on 11 days of the month due to cloud cover. The solar system collected and delivered significant amounts of solar energy on 10 days of the month.

The system was down for one day due to "no operator."

The plant was down from April 25 to April 30 due to Refinery scheduled maintenance shutdown.

The check valve at the steam line tie-in to the main refinery steam line failed in the open position leaving the main steam line energized. This occurred on April 7 and 8. This valve has been replaced in order to minimize overnight heat losses. Intermittent failure to close has also been encountered on the SSG feedwater valve.

Substantial improvement was made in April with the operation of the Data Acquisition System. Data was obtained for every day of significant operation.

Twenty-four (24) hour data collection began on April 1st to account for longer summer days and to gather windspeed and temperature data for the refinery.

## ENERGETICS CORPORATION

TIME		ENERGY BALANCE						EFFICIENCY	
JULIAN	INCIDENT SOLAR ENERGY COLLECTED	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY		PIPING LOSSES - OPERATIONAL	PARASITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM	
			STEAM LINE	MIL-BTU					
DAY	DATE	MIL-BTU	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU	%	%
91	APR 1	0.683	0.083	0.0108	1.	-0.011	0.149	12.2	1.6
92	APR 2	1.734	0.090	0.0083	4.	-0.008	0.164	4.6	0.5
93	APR 3	4.152	1.036	0.0000	0.	0.000	0.502	25.0	0.0
94	APR 4	17.602	5.250	4.0699	4178.	0.260	0.499	29.8	23.1
95	APR 5	16.681	5.214	3.5140	3633.	0.274	0.510	31.3	21.1
96	APR 6	5.202	1.539	0.7274	769.	0.096	0.351	24.8	11.7
97	APR 7	3.340	0.557	0.0000	0.	0.000	0.214	16.7	0.0
98	APR 8	16.304	4.761	3.6052	3721.	0.231	0.466	29.2	22.1
99	APR 9	0.505	0.000	0.0000	0.	0.000	0.134	0.0	0.0
100	APR 10	4.292	0.866	0.0137	42.	0.014	0.255	17.7	0.3
101	APR 11	0.967	0.000	0.0000	0.	0.000	0.137	0.0	0.0
102	APR 12	11.540	3.346	0.9476	1089.	0.151	0.492	29.0	8.2
103	APR 13	10.076	1.859	1.0076	1202.	0.120	0.404	18.4	10.0
104	APR 14	9.308	2.901	1.4327	1545.	0.132	0.415	31.2	15.4
105	APR 15	10.911	7.033	5.8126	5993.	0.238	0.465	37.2	30.7
106	APR 16	18.596	6.980	5.7359	5947.	0.241	0.511	37.5	30.8
107	APR 17	0.504	0.805	0.0309	66.	0.016	0.254	133.3	5.1
108	APR 18	13.912	4.209	2.1896	2353.	0.209	0.506	30.3	15.7
109	APR 19	0.931	0.574	0.0000	0.	0.000	0.231	61.7	0.0
110	APR 20	3.554	0.835	0.0000	0.	0.000	0.275	23.5	0.0
111	APR 21	0.303	0.000	0.0000	0.	0.000	0.134	0.0	0.0
112	APR 22	0.104	0.000	0.0000	0.	0.000	0.133	0.0	0.0
113	APR 24	9.325	3.028	1.2746	1458.	0.159	0.310	32.5	13.7
115	APR 25	1.027	0.000	0.0000	0.	0.000	0.139	0.0	0.0
116	APR 26	0.964	0.000	0.0000	0.	0.000	0.139	0.0	0.0
117	APR 27	0.192	0.000	0.0000	0.	0.000	0.137	0.0	0.0
118	APR 28	0.000	0.000	0.0000	0.	0.000	0.011	0.0	0.0
119	APR 29	0.234	0.000	0.0000	0.	0.000	0.056	0.0	0.0
TOTAL/AVG		172.645	50.951	30.3818	32092.	27133.	7.998	29.5	17.6

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - APR, 1992

## ENERGETICS CORPORATION

TIME		ENERGY					DOLLARS		
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED (SOURCE)	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
				MIL-BTU	MIL-BTU	MIL-BTU			
91	APR 1	0.017	0.149	-0.132	-0.025	-0.132	0.06	0.75	-0.70
92	APR 2	0.013	0.166	-0.153	-0.029	-0.153	0.04	0.84	-0.80
93	APR 3	0.000	0.502	-0.502	-0.097	-0.502	0.00	2.56	-2.56
94	APR 4	5.261	0.499	5.762	1.112	5.762	21.48	2.54	18.94
95	APR 5	5.406	0.510	4.896	0.945	4.896	18.54	2.59	15.95
96	APR 6	1.119	0.351	0.768	0.148	0.768	3.84	1.79	2.05
97	APR 7	0.000	0.214	-0.214	-0.041	-0.214	0.00	1.09	-1.09
98	APR 8	5.547	0.486	5.080	0.981	5.080	19.02	2.37	16.65
99	APR 9	0.000	0.134	-0.134	-0.026	-0.134	0.00	0.68	-0.68
100	APR 10	0.021	0.255	-0.234	-0.045	-0.234	0.07	1.30	-1.22
101	APR 11	0.000	0.137	-0.137	-0.026	-0.137	0.00	0.70	-0.70
102	APR 12	1.458	0.492	0.765	0.186	0.765	5.00	2.50	2.50
103	APR 13	1.550	0.404	1.144	0.221	1.144	5.32	2.05	3.25
104	APR 14	2.206	0.415	1.790	0.346	1.790	7.57	2.11	5.45
105	APR 15	0.942	0.465	0.478	1.637	0.478	30.67	2.37	28.31
106	APR 16	0.824	0.511	0.314	1.605	0.314	30.37	2.60	27.67
107	APR 17	0.048	0.254	-0.206	-0.040	-0.206	0.16	1.29	-1.13
108	APR 18	3.349	0.506	2.863	0.553	2.863	11.55	2.57	8.98
109	APR 19	0.000	0.231	-0.231	-0.045	-0.231	0.00	1.17	-1.17
110	APR 20	0.000	0.275	-0.275	-0.053	-0.275	0.00	1.40	-1.40
111	APR 21	0.000	0.134	-0.134	-0.026	-0.134	0.00	0.68	-0.68
112	APR 22	0.000	0.133	-0.133	-0.026	-0.133	0.00	0.67	-0.67
113	APR 24	1.761	0.310	1.651	0.319	1.651	6.73	1.58	5.15
115	APR 25	0.000	0.139	-0.139	-0.027	-0.139	0.00	0.71	-0.71
116	APR 26	0.000	0.139	-0.139	-0.027	-0.139	0.00	0.71	-0.71
117	APR 27	0.000	0.137	-0.137	-0.027	-0.137	0.00	0.70	-0.70
118	APR 28	0.000	0.211	-0.211	-0.022	-0.211	0.00	0.06	-0.06
119	APR 29	0.000	0.056	-0.056	-0.011	-0.056	0.00	0.28	-0.28
TOTAL		46.741	7.998	38.744	7.479	38.744	160.32	40.68	119.65

TABLE 3 - EERC MONTHLY PERFORMANCE TABLE - APR, 1982

Table 1 SOUTHERN UNION REFINING COMPANY - SYSTEM OPERATION SUMMARY TABLE  
MAY 1982

Julian Day	Date	Status Code	Weather	Remarks
121	5/1	6	-	Refinery shutdown completed
122	5/2	3	R	
123	5/3	2	-	Collector maintenance shutdown
124	5/4	2	-	"
125	5/5	2	-	"
126	5/6	2	-	"
127	5/7	2	-	"
128	5/8	1	F	Collector maint. (1/2 day)-Drive Unit #6w down
129	5/9	1	F	"
130	5/10	1	F	Collector maint. (1/2 day)
131	5/11	1	F	
132	5/12	1	F	Drive Unit #6W not tracking properly
133	5/13	1	P	Collector Surfaces sprayed with oil
134	5/14	1	P	
135	5/15	1	P	Drive Unit #3E, 4E down
136	5/16	1	F	"
137	5/17	3	C	
138	5/18	-	-	No Operator
139	5/19	1	F	Drive Units #6W, 3E, 4E down
140	5/20	1	F	"
141	5/21	1	P	DAS failure = 1474 lbs. steam (est)
142	5/22	2	-	Collector microprocessor failure-System down
143	5/23	2	-	"
144	5/24	2	-	"
145	5/25	2	-	"
146	5/26	2	-	"
147	5/27	2	-	"
148	5/28	2	P	Replace microprocessor - Drive Unit #6W down
149	5/29	1	F	Drive Unit #6W down
150	5/30	-	-	No Operator
151	5/31	-	-	No Operator

F: Fair

Status Code

P: Partly Cloudy

\*1: Solar system up/Plant up

C: Fog or Overcast

2: Solar system down/Plant up

R: Rain

\*\*3: Solar system idle/Plant up

S: Snow

4: Solar system up/Plant down

5: Solar system down/Plant down

6: Solar system idle/Plant down

\* covers days when all systems are "up" and significant amounts of energy are delivered.

\*\* covers days when zero or very small amounts of energy were collected and/or delivered due to weather conditions.

III. Operating Experience

Steam production was significantly reduced in May primarily due to collector control and drive unit problems. Solar Kinetics (SKI) maintenance personnel were on site from May 3 through May 10. SKI made repairs to several drive units and replaced numerous broken glass tubes. The row 6W drive unit (drive for collector with the ODAS insulation sensor in the collector plane) failed to operate after May 16, consequently no insulation data were obtained for the remainder of the month.

On May 13, the collector field was accidentally sprayed with oil by refinery maintenance personnel. This occurrence appears to have reduced the reflectance of the collector surfaces on the west side of the field and will require thorough cleaning. Refinery management was notified about this situation in order to prevent reoccurrence. Procedures and arrangements to clean the collectors have been undertaken by Energetics.

The collector central control microprocessor failed on May 22 and did not operate until a replacement was installed on May 29. The system was also down three days in May due to no operator and one day for completion of refinery maintenance shutdown.

ENERGETICS CORPORATION

TIME		ENERGY BALANCE						EFFICIENCY	
JUL IAN	DAY	INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE	PIPING LOSSES OPERA TIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM	
		DATE	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU	%	%
127	MAY 7	1.496	0.104	0.0000	0.	0.000	0.095	7.0	0.0
128	MAY 8	-0.789	2.384	1.0309	1097.	0.087	0.253	-302.3	130.7
129	MAY 9	-1.103	2.834	1.5875	1795.	0.110	0.271	-256.0	143.9
130	MAY 10	5.812	1.129	0.4485	568.	0.069	0.286	19.4	7.7
131	MAY 11	12.734	4.021	2.7422	2891.	0.180	0.345	31.6	21.5
132	MAY 12	14.977	4.664	2.9460	3110.	0.262	0.464	31.1	19.7
133	MAY 13	14.654	4.211	2.4292	2593.	0.268	0.469	28.7	16.6
134	MAY 14	3.368	0.829	0.4439	518.	0.044	0.129	24.6	13.2
135	MAY 15	14.299	3.621	1.9790	2089.	0.170	0.445	25.3	13.8
136	MAY 16	13.314	3.618	1.8546	2001.	0.178	0.360	27.2	13.9
137	MAY 17	-0.763	0.000	0.0000	0.	0.000	0.083	0.0	0.0
138	MAY 18	-0.998	0.000	0.0000	0.	0.000	0.073	0.0	0.0
139	MAY 19	-1.043	3.741	1.7574	1894.	0.156	0.432	-358.6	168.5
140	MAY 20	-1.176	4.463	2.7446	2947.	0.232	0.477	-379.4	233.3
141	MAY 21	-0.255	0.000	0.0000	0.	0.000	0.065	0.0	0.0
142	MAY 22	-0.723	0.000	0.0000	0.	0.000	0.068	0.0	0.0
143	MAY 23	-0.774	0.000	0.0000	0.	0.000	0.063	0.0	0.0
144	MAY 24	-0.998	0.000	0.0000	0.	-0.001	0.057	0.0	0.0
145	MAY 25	-0.677	0.000	0.0000	0.	0.000	0.057	0.0	0.0
146	MAY 26	-1.343	0.000	0.0000	0.	-0.007	0.056	0.0	0.0
148	MAY 28	-1.205	1.660	0.0232	88.	0.006	0.192	-129.2	1.8
149	MAY 29	-1.306	4.255	2.3837	2540.	0.189	0.435	-306.9	172.0
150	MAY 30	-1.447	0.000	0.0000	0.	0.000	0.070	0.0	0.0
151	MAY 31	-1.307	0.117	0.0000	0.	0.000	0.091	8.4	0.0
TOTL/AVG		96.790	41.651	22.3780	24134.	1.941	5.335	-43.0	-23.4

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - MAY, 1982

ENERGETICS CORPORATION

TIME		ENERGY					DOLLARS		
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT-SITE)	NET FOSSIL FUEL SAVINGS
				MIL-BTU	MIL-BTU	MIL-BTU			
				BARRELS OIL	MCF NAT GAS				
127	MAY 7	0.000	0.095	-0.095	-0.018	-0.095	0.00	0.48	-0.48
128	MAY 8	1.586	0.253	1.333	0.257	1.333	5.44	1.29	4.15
129	MAY 9	2.442	0.271	2.171	0.419	2.171	8.38	1.38	7.00
130	MAY 10	0.690	0.286	0.404	0.078	0.404	2.37	1.45	0.92
131	MAY 11	4.219	0.345	3.874	0.748	3.874	14.47	1.75	12.72
132	MAY 12	4.532	0.464	4.068	0.785	4.068	15.54	2.36	13.18
133	MAY 13	3.737	0.469	3.268	0.631	3.268	12.82	2.39	10.43
134	MAY 14	0.683	0.129	0.554	0.107	0.554	2.34	0.65	1.69
135	MAY 15	3.045	0.445	2.600	0.502	2.600	10.44	2.26	8.18
136	MAY 16	2.853	0.360	2.493	0.481	2.493	9.79	1.83	7.96
137	MAY 17	0.000	0.083	-0.083	-0.016	-0.083	0.00	0.42	-0.42
138	MAY 18	0.000	0.073	-0.073	-0.014	-0.073	0.00	0.37	-0.37
139	MAY 19	2.704	0.432	2.272	0.439	2.272	9.27	2.20	7.07
140	MAY 20	4.222	0.477	3.745	0.723	3.745	14.48	2.43	12.05
141	MAY 21	0.000	0.065	-0.065	-0.013	-0.065	0.00	0.33	-0.33
142	MAY 22	0.000	0.068	-0.068	-0.013	-0.068	0.00	0.35	-0.35
143	MAY 23	0.000	0.063	-0.063	-0.012	-0.063	0.00	0.32	-0.32
144	MAY 24	0.000	0.057	-0.057	-0.011	-0.057	0.00	0.29	-0.29
145	MAY 25	0.000	0.057	-0.057	-0.011	-0.057	0.00	0.29	-0.29
146	MAY 26	0.010	0.056	-0.046	-0.009	-0.046	0.03	0.29	-0.26
148	MAY 28	0.034	0.192	-0.158	-0.031	-0.158	0.12	0.98	-0.86
149	MAY 29	3.668	0.435	3.233	0.624	3.233	12.58	2.21	10.37
150	MAY 30	0.000	0.070	-0.070	-0.014	-0.070	0.00	0.36	-0.36
151	MAY 31	0.000	0.091	-0.091	-0.018	-0.091	0.00	0.46	-0.46
TOTAL		34.425	5.335	29.089	5.616	29.089	118.07	27.14	90.93

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - MAY, 1982

Table 1 SOUTHERN UNION REFINING COMPANY - SYSTEM OPERATION SUMMARY TABLE  
JUNE 1982

Julian Day	Date	Status Code	Weather	Remarks
152	6/1	-	-	No operator
153	6/2	1	F	Drive Units #3E, 4E & 6W down
154	6/3	2	F	Collectors down for washing
155	6/4	3	C	"
156	5/5	1	P	Drive Units #3E, 4E & 6W down
157	5/6	1	P	"
158	5/7	-	-	No operator
159	5/8	3	P	Drives 3E, 4E & 6W down
160	5/9	2	P	Drives 3E, 4E, 3W & 6W down, Note 1
161	5/10	3	C	
162	5/11	-	-	DAS failure to record
163	5/12	-	-	"
164	5/13	2	-	Collectors down for SKI repairs
165	5/14	2	-	"
166	5/15	2	-	"
167	5/16	2	-	"
168	5/17	2	-	"
169	5/18	2	-	"
170	5/19	2	-	"
171	5/20	2	-	Collectors down for SKI repairs
172	5/21	1	P	SKI test run - drive Unit 3W down
173	5/22	2	P	Collectors down for SKI repairs
174	5/23	1	P	Drive Unit 3W down
175	5/24	1	P	"
176	5/25	3	C	
177	5/26	1	P	Drive Unit 6E down
178	5/27	3	C	
179	5/28	1	F	Drive Unit 6E down
180	6/29	3	C	
181	6/30	1	P	Drive Unit 6E down

F: Fair

Status Code

\*1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

\*\*3: Solar system idle/Plant up

4: Solar system up/Plant down

R: Rain

5: Solar system down/Plant down

6: Solar system idle/Plant down

S: Snow

\* covers days when all systems are "up" and significant amounts of energy are delivered.

\*\* covers days when zero or very small amounts of energy were collected and/or delivered due to weather conditions.

Note 1 Flowmeter (W401) removed for calibration

ENERGETICS CORPORATION

III. Operating Experience

Steam production in June again was significantly reduced primarily due to problems with the hydraulic drive units. The solar system was shut down on June 13 after four out of twelve drive units failed to operate for several days. Solar Kinetics (SKI) maintenance personnel arrived on site shortly thereafter and performed repairs for about one week. SKI personnel repaired the inoperable drive units, replaced and aligned the receiver tube support stands and replaced numerous broken glass receiver tubes throughout the entire field.

The collectors were cleaned on June 3 and 4 with a hot water high pressure spray. Oil deposited on the collectors in May appears to have been removed after thorough cleaning and rinsing.

On June 9, the ODAS vortex shedding flowmeter used to measure steam-flow was removed for calibration as planned. Daily steam flow will be estimated with the orifice plate flowmeter until the ODAS flowmeter is reinstalled.

ODAS solar insolation measured in the collector plane was again not available for the first half of June due to the hydraulic drive unit failure on row #6W. SKI repairs enabled measurement after June 20th.

The system was also down two days due to no operator and two days for DAS failure to record.

ENERGETICS CORPORATION

TIME		ENERGY BALANCE					EFFICIENCY		
JUL IAN	COLLEC PLANE	INCIDENT SOLAR ENERGY	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY	PIPING LOSSES -OPERA TIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM	
		DAY	DATE	MIL-BTU	MIL-BTU	MIL-BTU	MIL-BTU	%	%
152	JUN 1	-8.628	0.000	0.0000	0.	0.000	0.037	0.0	0.0
153	JUN 2	-4.438	4.361	2.3126	2478.	0.223	0.446	274.5	156.2
154	JUN 3	-4.489	0.000	0.0000	0.	0.000	0.072	0.0	0.0
155	JUN 4	-8.753	0.000	0.0000	0.	0.046	0.074	0.0	0.0
156	JUN 5	-1.082	2.744	1.1138	1161.	0.125	0.321	257.7	103.8
157	JUN 6	-1.224	3.589	2.0751	2197.	0.164	0.384	293.2	169.5
158	JUN 7	-0.978	0.000	0.0000	0.	0.000	0.076	0.0	0.0
159	JUN 8	-8.003	1.710	0.1938	224.	0.041	0.299	473.6	21.2
160	JUN 9	-1.005	0.997	0.0077	50.	0.015	0.166	77.2	0.2
161	JUN 10	-0.543	0.000	0.0002	0.	0.000	0.070	0.0	0.0
172	JUN 21	7.512	2.171	-0.0003	600.	-0.001	0.250	28.9	0.0
173	JUN 22	3.551	0.567	0.0000	0.	0.000	0.154	16.0	0.0
174	JUN 23	14.749	4.482	-0.0000	30360.	-0.000	0.407	30.4	0.0
175	JUN 24	13.844	4.178	-0.0000	2149.	-0.000	0.395	30.2	0.0
176	JUN 25	1.124	0.000	0.0000	0.	0.000	0.033	0.0	0.0
177	JUN 26	9.916	3.235	-0.0000	14650.	-0.000	0.301	32.4	0.0
178	JUN 27	0.834	0.000	0.0000	0.	0.000	0.056	0.0	0.0
179	JUN 28	16.013	5.412	-0.0000	30000.	-0.000	0.419	33.8	0.0
180	JUN 29	0.922	0.000	0.0000	0.	0.000	0.057	0.0	0.0
181	JUN 30	7.586	2.397	-0.0000	762.	-0.000	0.245	31.6	0.0
TOTAL/AVG		86.529	35.243	5.7753	1176.	-0.113	4.242	41.4	6.1
17114.									

TABLE 2 ~ SURC MONTHLY PERFORMANCE TABLE ~ JUN, 1982

## ENERGETICS CORPORATION

TIME		ENERGY				DOLLARS		
JUL	IAN	GROSS	PARA	NET FOSSTL FUEL	SAVED	GROSS	COST OF	NET
		FOESTL	SITIC					
DAY	DATE	MIL-BTU	MIL-BTU	MIL-BTU	MIL-BTU	BARRELS	MCF NAT	
						OIL	GAS	
152	JUN 1	0.000	0.037	-0.037	-0.007	-0.037	0.00	0.19
153	JUN 2	3.558	0.446	3.112	0.601	3.112	12.20	2.27
154	JUN 3	0.000	0.072	-0.072	-0.014	-0.072	0.00	0.37
155	JUN 4	0.049	0.074	-0.025	-0.005	-0.025	0.17	0.38
156	JUN 5	1.714	0.321	1.393	0.269	1.393	5.88	1.63
157	JUN 6	3.192	0.384	2.808	0.542	2.808	10.95	4.25
158	JUN 7	0.000	0.076	-0.076	-0.015	-0.076	0.00	0.39
159	JUN 8	0.298	0.299	-0.001	-0.000	-0.001	1.02	1.52
160	JUN 9	0.012	0.166	-0.154	-0.070	-0.154	0.84	0.50
161	JUN 10	0.000	0.070	-0.070	-0.014	-0.070	0.20	0.36
172	JUN 21	0.001	0.250	-0.247	-0.049	-0.247	0.00	1.27
173	JUN 22	0.000	0.154	-0.154	-0.030	-0.154	0.70	0.78
174	JUN 23	0.000	0.407	-0.407	-0.079	-0.407	0.00	2.07
175	JUN 24	0.000	0.396	-0.396	-0.076	-0.396	0.00	2.02
176	JUN 25	0.000	0.033	-0.033	-0.004	-0.033	0.00	0.00
177	JUN 26	0.000	0.301	-0.301	-0.050	-0.301	0.00	1.53
178	JUN 27	0.000	0.056	-0.056	-0.011	-0.056	0.20	0.22
179	JUN 28	0.000	0.419	-0.419	-0.061	-0.419	0.00	2.17
180	JUN 29	0.000	0.057	-0.057	-0.011	-0.057	0.00	0.29
181	JUN 30	0.000	0.245	-0.245	-0.047	-0.245	0.00	1.25
TOTAL		0.024	4.262	-4.561	-0.321	-4.561	20.26	21.68
								0.50

TABLE 3 - SURG MONTHLY PERFORMANCE TABLE - JUN, 1992

Table 1. SURC - SYSTEM OPERATION SUMMARY TABLE - JULY 1982

Julian Day	Date	Status Code	Weather	Remarks
182	7/1	-	-	No Operator
183	7/2	1	P	
184	7/3	1	P	
185	7/4	1	P	Drive Units #3E & 6W down
186	7/5	3	C	
187	7/6	-	-	No Operator - 6 hours
188	7/7	1	P	Drive Units #3E & 6E down
189	7/8	1	P	3E, 6E down, trouble with 6W
190	7/9	-	-	No Operator
191	7/10	1	F	3E, 6E down, 2W failed
192	7/11	-	-	DAS Recorder Problem, Note 1
193	7/12	-	-	"
194	7/13	-	-	"
195	7/14	-	-	"
196	7/15	-	-	"
197	7/16	-	-	DAS Recorder Problem, No Operator
198	7/17	-	-	DAS Recorder Problem, Note 1 & 2
199	7/18	-	-	DAS Recorder Problem, Note 1
200	7/19	1	P	Note 1, Trouble with 1E, 4E & 6W
201	7/20	2	P	Note 1 & 2, 1E failed to stow
202	7/21	1	P	Note 3
203	7/22	1	P	"
204	7/23	1	P	Feedwater Level Control Problems, Note 3
205	7/24	-	-	No Operator
206	7/25	1	P	Feedwater Level Control Problems, Note 3
207	7/26	2	P	"
208	7/27	3	C	Cleaned Glass Receiver Tubes
209	7/28	-	-	No Operator
210	7/29	3	C	
211	7/30	2	P	Cleaned Feedwater Float on SSG
212	7/31	2	P	Reinstalled W401 Steam Flowmeter

F: Fair

\*1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

\*\*3: Solar system down/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

\* covers days when all systems are "up" and significant amounts of energy are delivered.

\*\* covers days when zero or very small amounts of energy were collected and/or delivered due to weather conditions.

Note 1 Drive Units #2W, 3E, 6E down

Note 2 Control System auto shut down on high feedwater

Note 3 Drive Units 1E, 2W, 3E, 6E down, trouble with 4E &amp; 6W

## ENERGETICS CORPORATION

### III. Operating Experience

Again steam production in July was significantly reduced primarily due to problems with the hydraulic drive units. Some drive units must be manually started and manually returned to stow or have intermittent operational problems. As a result, an operator has been required full time to insure proper and safe operation of the system. Numerous operational days in July have been lost due to a combination of partial cloudiness and inoperable drive units, or no operator.

A power failure occurred on the night of July 11 and a malfunction of the cassette recorder resulted in loss of data from July 11 through July 19. Steam was produced during this time and recorded on paper tape.

The vortex shedding flowmeter (W401) was returned from calibration by the vendor late in July and reinstalled on July 31. Also "solar insolation in the collector plane" data was available throughout July since drive unit #6W remained operational after repair in June.

Since replacement of the broken glass tubes throughout the collector field in June, only one significant leakage of HT0 has occurred at the receiver tubes, however more operational time is needed for observation of leakage.

Finally, a problem with the feedwater control valve occurred again in July. Blowdown and cleaning after the system has been down seems to remedy this problem.

## ENERGETICS CORPORATION

TIME		ENERGY BALANCE						EFFICIENCY	
JUL IAN	DATE	INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE		PIPING LOSSES -OPERA TIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM
		MIL-BTU	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU	%	%
182	JUL 1	-0.576	0.000	0.0000	0.	0.000	0.034	0.0	0.0
183	JUL 2	9.906	3.267	0.0000	1269	0.000	0.269	33.0	0.0
184	JUL 3	10.660	3.429	0.0000	1316	0.000	0.332	32.2	0.0
185	JUL 4	3.399	0.590	0.0000	0.	0.000	0.172	17.4	0.0
186	JUL 5	-0.843	0.000	0.0000	0.	0.000	0.057	0.0	0.0
187	JUL 6	1.945	0.036	0.0000	0.	0.000	0.069	1.9	0.0
188	JUL 7	6.148	1.687	0.0000	2408	0.000	0.239	27.4	0.0
189	JUL 8	8.772	2.595	0.0000	1199	0.000	0.295	29.6	0.0
190	JUL 9	-0.957	0.000	0.0000	0.	0.000	0.057	0.0	0.0
191	JUL 10	13.410	3.723	0.0000	1315	0.000	0.381	27.8	0.0
193	JUL 12	-0.000	0.000	0.0000	1472	0.000	0.000	0.0	0.0
200	JUL 19	10.348	2.582	0.0000	1245	0.000	0.296	25.0	0.0
201	JUL 20	0.000	0.000	0.0000	0.	0.000	0.007	0.0	0.0
202	JUL 21	9.811	1.934	0.0000	423	0.000	0.321	19.7	0.0
203	JUL 22	9.838	2.239	0.0000	724	0.000	0.326	22.8	0.0
204	JUL 23	8.952	1.890	0.0000	610	0.000	0.312	21.1	0.0
205	JUL 24	-1.071	0.000	0.0000	0.	0.000	0.059	0.0	0.0
206	JUL 25	6.744	0.968	0.0000	332	0.000	0.224	14.4	0.0
207	JUL 26	-0.002	0.000	0.0000	0.	0.000	0.014	0.0	0.0
208	JUL 27	1.057	0.000	0.0000	0.	0.000	0.051	0.0	0.0
209	JUL 28	-0.714	0.000	0.0000	0.	0.000	0.060	0.0	0.0
210	JUL 29	-0.779	0.000	0.0000	0.	0.000	0.061	0.0	0.0
211	JUL 30	-1.132	0.000	0.0000	0.	0.000	0.061	0.0	0.0
212	JUL 31	-0.125	0.000	0.0000	0.	0.000	0.025	0.0	0.0
TOTAL/AVG		107.190	24.941	0.0000	16,210	0.000	3.729	23.3	0.0

STEAM DELIVERED: JUL 11 = 1403 LB/DAY  
 JUL 13-18 = 1450, 1012, 1209, 0, 0, 991 LB/DAY RESPECTIVELY

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - JUL, 1982

## ENERGÉTICS CORPORATION

TIME		ENERGY					DOLLARS		
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
				MIL-BTU	MIL-BTU	MIL-BTU			
182	JUL 1	0.000	0.034	-0.034	-0.007	-0.034	0.00	0.17	-0.17
183	JUL 2	0.000	0.269	-0.269	-0.052	-0.269	0.00	1.37	-1.37
184	JUL 3	0.000	0.332	-0.332	-0.064	-0.332	0.00	1.69	-1.69
185	JUL 4	0.000	0.172	-0.172	-0.033	-0.172	0.00	0.88	-0.88
186	JUL 5	0.000	0.057	-0.057	-0.011	-0.057	0.00	0.29	-0.29
187	JUL 6	0.000	0.069	-0.069	-0.013	-0.069	0.00	0.35	-0.35
188	JUL 7	0.000	0.239	-0.239	-0.046	-0.239	0.00	1.22	-1.22
189	JUL 8	0.000	0.295	-0.295	-0.057	-0.295	0.00	1.50	-1.50
190	JUL 9	0.000	0.057	-0.057	-0.011	-0.057	0.00	0.29	-0.29
191	JUL 10	0.000	0.381	-0.381	-0.074	-0.381	0.00	1.94	-1.94
193	JUL 12	0.000	0.008	-0.008	-0.002	-0.008	0.00	0.04	-0.04
200	JUL 19	0.000	0.296	-0.296	-0.057	-0.296	0.00	1.50	-1.50
201	JUL 20	0.000	0.007	-0.007	-0.001	-0.007	0.00	0.04	-0.04
202	JUL 21	0.000	0.321	-0.321	-0.062	-0.321	0.00	1.63	-1.63
203	JUL 22	0.000	0.326	-0.326	-0.063	-0.326	0.00	1.66	-1.66
204	JUL 23	0.000	0.312	-0.312	-0.068	-0.312	0.00	1.59	-1.59
205	JUL 24	0.000	0.059	-0.059	-0.011	-0.059	0.00	0.30	-0.30
206	JUL 25	0.000	0.224	-0.224	-0.043	-0.224	0.00	1.14	-1.14
207	JUL 26	0.000	0.014	-0.014	-0.003	-0.014	0.00	0.07	-0.07
208	JUL 27	0.000	0.051	-0.051	-0.010	-0.051	0.00	0.26	-0.26
209	JUL 28	0.000	0.060	-0.060	-0.012	-0.060	0.00	0.31	-0.31
210	JUL 29	0.000	0.061	-0.061	-0.012	-0.061	0.00	0.31	-0.31
211	JUL 30	0.000	0.061	-0.061	-0.012	-0.061	0.00	0.31	-0.31
212	JUL 31	0.000	0.025	-0.025	-0.005	-0.025	0.00	0.13	-0.13
TOTAL		0.000	3.729	-3.729	-0.720	-3.729	0.00	18.97	-18.97

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - JUL. 1982

Table 1. SURC - SYSTEM OPERATION SUMMARY TABLE - AUGUST 1982

Julian Day	Date	Status Code	Weather	Remarks
213	8/1	1		
214	8/2	-		No Operator
215	8/3	1		
216	8/4	1		
217	8/5	-		No Operator
218	8/6	1		
219	8/7	2		System Shutdown
220	8/8	2		" "
221	8/9	2		" "
222	8/10	2		System Shutdown Pending Repairs
223	8/11	2		" " " "
224	8/12	2		" " " "
225	8/13	2		" " " "
226	8/14	2		" " " "
227	8/15	2		" " " "
228	8/16	2		" " " "
229	8/17	2		" " " "
230	8/18	2		" " " "
231	8/19	2		" " " "
232	8/20	2		" " " "
233	8/21	2		" " " "
234	8/22	2		" " " "
235	8/23	2		" " " "
236	8/24	2		" " " "
237	8/25	2		SKI On-Site Repairs
238	8/26	2		" " " "
239	8/27	2		" " " "
240	8/28	2		" " " "
241	8/29	1		
242	8/30	-		No Operator
243	8/31	1		

F: Fair

\*1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast.

\*\*3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

\* covers days when all systems are "up" and significant amounts of energy are delivered.

\*\* covers days when zero or very small amounts of energy were collected and/or delivered due to weather conditions.

III. Operating Experience

Steam production in August was further reduced as more collector drive units became inoperable. The system was shut down on August 8 after 6 out of 12 drive units failed to operate.

At the end of August SKI personnel arrived on site, made repairs to all 12 drive units, restored the system to full operation. These repairs required extensive troubleshooting and parts replacement such as several motor relays, hoses, tracker heads, numerous pressure switches, an accumulator, a P.C. board, a 4-way valve, and several fittings and flex hoses.

At the end of the month the only other problems were several broken glass tubes and one leak at receiver tube connection inside a glass tube.

ENERGETICS CORPORATION

TIME		ENERGY BALANCE					EFFICIENCY		
JUL	IAN	INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE	PIPING LOSSES OPERATIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM	
DAY	DATE	MIL-BTU	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU	%	%
214	AUG 2	8.744	2.183	0.8749	966.	0.082	0.218	25.0	10.0
215	AUG 3	0.879	0.000	0.0000	0.	0.000	0.059	0.0	0.0
216	AUG 4	13.067	3.273	1.6197	1741.	0.156	0.359	25.0	12.4
217	AUG 5	11.228	1.976	0.5274	645.	0.120	0.342	17.6	4.7
218	AUG 6	4.100	0.000	0.0000	0.	0.000	0.059	0.0	0.0
219	AUG 7	10.958	2.380	1.0178	1233.	0.190	0.327	21.7	9.3
220	AUG 8	1.229	0.068	0.0000	0.	0.000	0.130	5.5	0.0
221	AUG 9	0.771	0.000	0.0000	0.	0.000	0.064	0.0	0.0
222	AUG 10	0.929	0.000	0.0000	0.	0.007	0.057	0.0	0.0
239	AUG 27	0.238	0.428	0.0004	11.	0.000	0.145	100.0	0.2
240	AUG 28	4.013	0.064	0.0000	0.	0.000	0.097	6.3	0.0
241	AUG 29	7.147	1.728	0.6207	692.	0.092	0.249	24.2	8.7
242	AUG 30	0.684	0.000	0.0000	0.	0.000	0.059	0.0	0.0
243	AUG 31	12.415	3.080	1.6161	1776.	0.191	0.418	24.8	13.0
TOTL/AVG		70.482	15.180	6.2841	7064.	0.824	2.582	21.5	8.9

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - AUG, 1982

## ENERGETICS CORPORATION

TIME		ENERGY				DOLLARS			
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED	NET FOSSIL FUEL SAVED		GROSS SAVINGS	COST OF PARASITIC ENERGY (AT-SITE)	NET FOSSIL FUEL SAVINGS	
		(SOURCE)	MIL-BTU	MIL-BTU	MIL-BTU	BARRELS OIL	MCF NAT GAS	\$	
214	AUG 2	1.346	0.218	1.128	0.218	1.129	4.62	1.11	3.51
215	AUG 3	0.000	0.059	-0.059	-0.011	-0.059	0.00	0.30	-0.30
216	AUG 4	2.491	0.359	2.132	0.412	2.132	8.54	1.83	6.71
217	AUG 5	0.811	0.342	0.469	0.091	0.469	2.78	1.74	1.04
218	AUG 6	0.000	0.059	-0.059	-0.011	-0.059	0.00	0.30	-0.30
219	AUG 7	1.567	0.327	1.240	0.239	1.240	5.37	1.66	3.71
220	AUG 8	0.000	0.130	-0.130	-0.025	-0.130	0.00	0.66	-0.66
221	AUG 9	0.000	0.064	-0.064	-0.012	-0.064	0.00	0.33	-0.33
222	AUG 10	0.011	0.057	-0.046	-0.009	-0.046	0.04	0.29	-0.25
239	AUG 27	0.001	0.145	-0.144	-0.028	-0.144	0.00	0.74	-0.74
240	AUG 28	0.000	0.097	-0.097	-0.019	-0.097	0.00	0.49	-0.49
241	AUG 29	0.955	0.249	0.706	0.136	0.706	3.28	1.27	2.01
242	AUG 30	0.000	0.059	-0.059	-0.011	-0.059	0.00	0.30	-0.30
243	AUG 31	2.487	0.418	-2.069	-0.399	-2.069	8.53	2.13	6.40
TOTAL		9.669	2.582	7.086	1.368	7.086	33.16	13.13	20.03

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - AUG. 1982

## ENERGETICS CORPORATION

Table 1. SURC - SYSTEM OPERATION SUMMARY TABLE - September, 1982

Julian Day	Date	Status Code	Weather	Remarks
244	9/1	1	F	DOE Personnel on Site
245	9/2	-	-	No Operator
246	9/3	-	-	No Operator
247	9/4	1	F	
248	9/5	2	P	Steam Valve Electrical Failure
249	9/6	2	P	Steam Valve Electrical Failure
250	9/7	1	F	Repaired Steam Valve
251	9/8	3	C	
252	9/9	3	C	
253	9/10	3	C	
254	9/11	1	F	
255	9/12	1	P	
256	9/13	-	-	No Operator
257	9/14	1	F	Repaired 6 W & 4 W By-Pass Coils
258	9/15	3	C	Cleaned Collector Receiver Tubes
259	9/16	3	C	
260	9/17	1	F	Replace Fuse on 3E, Note 1 on 2E, Note 2 on 3W, 4W
261	9/18	1	P	Note 1 on 2E, 3E, 3W, 4W & 6W
262	9/19	1	F	Note 1 on 4E, Note 2 on 6E
263	9/20	3	R	Cleaned Collectors (Rain)
264	9/21	3	C	Cleaned Receiver Tubes
265	9/22	1	F	
266	9/23	3	P	3E, 4E, 5E, 5W Down, Note 3
267	9/24	1	F	3E, 4E, 5E, 5W Down, Note 3
268	9/25	2	P	3E, 4E, 5E, 5W Down, Main Pump Noise, Note 3
269	9/26	2	-	3E, 4E, 5E, 5W Down, Main Pump Noise, Note 3
270	9/27	1	F	3E, 4E, 5E, 5W Down, Note 3
271	9/28	1	P	1E, 5W, Down
272	9/29	3	R	
273	9/30	3	R	

F: Fair

\*1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

\*\*3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

\* covers days when all systems are "up" and significant amounts of energy are delivered.

Note 1 - Adjust Collector Drive Unit  
Deadband

\*\*

covers days when zero or very small amounts of energy were collected and/or delivered due to weather conditions.

Note 2 - Adjust Collector Tracker Heads

Note 3 - Various Collector Drive Unit Problems

## ENERGETICS CORPORATION

### III. Operating Experience

Extensive collector drive unit repairs were performed by SKI in late August which resulted in significant operational improvement in September but several drive units developed new problems. Repairs were performed on two of these units by Energetics.

Adjustments to tracker heads and row control deadband were also performed per SKI directions. At the end of the month several drive units remained down after repair attempts by Energetics and one collector drive unit did not return to stow during automatic shutdown on several occasions.

Arrangements were made with SKI to conduct a repair training session for Energetics personnel at SKI's facility.

Other operation activities included collector cleaning by rain exposure and glass receiver tube cleaning. No significant performance improvement could be observed until several drive unit problems are resolved.

The only other operational problem not related to collector drives was a steam valve electrical failure. This was repaired on site and operation was restored after two days downtime.

Three days of data recorded on paper tape but failed to record on cassette and consequently were omitted from the monthly summary.

## ENERGETICS CORPORATION

TIME		ENERGY BALANCE						EFFICIENCY	
JUL	IAN	INCIDENT SOLAR ENERGY COLLECTED	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE	PIPING LOSSES -OPERATIONAL	PARASITIC ENERGY USED	COLLECTOR ARRAY (SOURCE)	SYSTEM	
DAY	DATE	MIL-BTU	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU	%	%
244	SEP 1	6.565	1.139	0.3166	368.	0.043	0.303	17.3	4.8
245	SEP 2	0.363	0.000	0.0000	0.	0.000	0.053	0.0	0.0
246	SEP 3	0.018	0.000	0.0000	0.	0.000	0.013	0.0	0.0
247	SEP 4	14.776	4.857	3.1771	3320.	0.158	0.370	32.9	21.5
248	SEP 5	5.073	0.648	0.0000	285.	0.000	0.241	12.8	0.0
249	SEP 6	0.637	0.000	0.0000	0.	0.000	0.053	0.0	0.0
250	SEP 7	4.699	1.040	0.1828	442.	0.064	0.167	22.1	3.9
251	SEP 8	5.158	0.847	0.0000	0.	0.000	0.270	16.4	0.0
252	SEP 9	-0.001	0.000	0.0000	0.	0.000	0.007	0.0	0.0
253	SEP10	0.000	0.000	0.0000	0.	0.000	0.002	0.0	0.0
254	SEP11	11.500	3.225	2.1173	2415.	0.165	0.273	28.0	18.4
255	SEP12	11.862	3.281	1.9158	2244.	0.147	0.286	27.7	16.2
256	SEP13	0.589	0.000	0.0000	0.	0.000	0.054	0.0	0.0
257	SEP14	16.007	4.140	2.7449	3254.	0.208	0.430	25.9	17.1
258	SEP15	0.328	0.000	0.0000	0.	0.000	0.070	0.0	0.0
259	SEP16	0.242	0.000	0.0000	0.	0.000	0.027	0.0	0.0
260	SEP17	17.441	6.062	4.3995	4682.	0.255	0.452	34.8	25.2
261	SEP18	9.249	2.773	1.4304	1652.	0.175	0.310	30.0	15.5
262	SEP19	15.664	5.447	4.6517	5094.	0.320	0.418	34.8	29.7
263	SEP20	0.120	0.000	0.0000	0.	0.000	0.081	0.0	0.0
264	SEP21	0.218	0.000	0.0000	0.	0.000	0.076	0.0	0.0
265	SEP22	17.353	6.195	4.2473	4570.	0.258	0.452	35.7	24.5
266	SEP23	7.600	1.600	0.0320	113.	0.028	0.382	21.1	0.4
267	SEP24	11.378	3.226	1.8925	2176.	0.146	0.338	28.4	16.6
271	SEP28	10.477	2.066	0.8592	981.	0.115	0.290	19.7	8.2
272	SEP29	0.256	0.000	0.0000	0.	0.000	0.069	0.0	0.0
273	SEP30	0.195	0.000	0.0000	0.	0.000	0.065	0.0	0.0
TOTL/AVG		167.767	46.546	27.9671	32483.	2.081	5.552	27.7	16.7

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - SEP, 1982

ENERGETICS CORPORATION

TIME		ENERGY				DOLLARS		
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED		GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
		MIL-BTU	MIL-BTU	MIL-BTU	BARRELS OIL	MCF NAT GAS	\$	\$
244	SEP 1	0.488	0.303	0.185	0.036	0.185	1.67	1.54
245	SEP 2	0.000	0.053	-0.053	-0.010	-0.053	0.00	0.27
246	SEP 3	0.000	0.013	-0.013	-0.003	-0.013	0.00	0.07
247	SEP 4	4.887	0.370	4.517	0.872	4.517	16.76	1.88
248	SEP 5	0.000	0.241	-0.241	-0.047	-0.241	0.00	1.23
249	SEP 6	0.000	0.053	-0.053	-0.010	-0.053	0.00	0.27
250	SEP 7	0.281	0.167	0.114	0.022	0.114	0.96	0.85
251	SEP 8	0.000	0.270	-0.270	-0.052	-0.270	0.00	1.37
252	SEP 9	0.000	0.007	-0.007	-0.001	-0.007	0.00	0.03
253	SEP10	0.000	0.002	-0.002	-0.000	-0.002	0.00	0.01
254	SEP11	3.257	0.273	2.984	0.576	2.984	11.17	1.39
255	SEP12	2.946	0.286	2.660	0.514	2.660	10.10	1.46
256	SEP13	0.000	0.054	-0.054	-0.010	-0.054	0.00	0.27
257	SEP14	4.224	0.430	3.794	0.732	3.794	14.49	2.19
258	SEP15	0.000	0.070	-0.070	-0.014	-0.070	0.00	0.35
259	SEP16	0.000	0.027	-0.027	-0.005	-0.027	0.00	0.14
260	SEP17	6.769	0.452	6.317	1.219	6.317	23.22	2.30
261	SEP18	2.201	0.310	1.891	0.365	1.891	7.55	1.58
262	SEP19	7.157	0.418	6.739	1.301	6.739	24.55	2.12
263	SEP20	0.000	0.081	-0.081	-0.016	-0.081	0.00	0.41
264	SEP21	0.000	0.076	-0.076	-0.015	-0.076	0.00	0.39
265	SEP22	6.535	0.452	6.003	1.174	6.083	22.42	2.30
266	SEP23	0.049	0.382	-0.333	-0.064	-0.333	0.17	1.94
267	SEP24	2.912	0.338	2.574	0.497	2.574	9.99	1.72
271	SEP28	1.322	0.290	1.032	0.199	1.032	4.53	1.48
272	SEP29	0.000	0.069	-0.069	-0.013	-0.069	0.00	0.35
273	SEP30	0.000	0.065	-0.065	-0.013	-0.065	0.00	0.33
TOTAL		43.028	5.552	37.476	7.235	37.476	147.58	28.24
								119.34

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - SEP. 1982

## ENERGETICS CORPORATION

Table 1. SURC - SYSTEM OPERATION SUMMARY TABLE - October, 1982

Julian Day	Date	Status Code	Weather	Remarks
274	10/1	1	F	3E & 5W down, Note 3
275	10/2	-	-	No Operator
276	10/3	3	C	3E, 5W, 6W down, clean glass tubes
277	10/4	1	P	3E, 5W, 6W down, Note 3
278	10/5	3	C	3E, 5W, 6W down, Note 3
279	10/6	1	P	3E, 5W, 6W down, DAS down
280	10/7	1	F	3E, 5W down, repair 6W by-pass coil, DAS down
281	10/8	1	F	3E, 5W down
282	10/9	1	F	3E, 5W down, DAS down
283	10/10	1	F	3E, 5W down, DAS down
284	10/11	3	C	Repair 3E; work on 5W
285	10/12	3	C	5W down
286	10/13	1	P	5W down
287	10/14	1	F	5W down
288	10/15	1	F	Replace by-pass coil 5W, Note 1 on 3E
289	10/16	3	C	-
290	10/17	1	P	5W tracking poorly
291	10/18	1	F	-
292	10/19	1	F	Note 1 on 3E, DAS down
293	10/20	1	P	5W down, insulate piping Row 6
294	10/21	1	F	5W down, Note 1 on 3E
295	10/22	2	F	FW valve stuck, insulate Row 4,5
296	10/23	1	P	5W down, blowdown SSG
297	10/24	1	P	5W down
298	10/25	1	P	5W down, Note 1 on 3E, 4W, 6E
299	10/26	1	P	5W down, insulate 3W piping
300	10/27	3	C	Insulate piping 2W, 3W & 5E
301	10/28	1	F	Repair tracking board 5W
302	10/29	1	F	Insulate Row 6, DAS down
303	10/30	1	P	HTO leak in Row 3E, ADJ 3E
304	10/31	1	F	Note 1 on 5E

F: Fair

\*1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

\*\*3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

\* covers days when all systems are "up" and significant amounts of energy are delivered.

Note 1 - Adjust Collector Drive Unit  
Deadband

\*\* covers days when zero or very small amounts of energy were collected and/or delivered due to weather conditions.

Note 2 - Adjust Collector Tracker Heads

Note 3 - Various Collector Drive Unit Problems

## ENERGETICS CORPORATION

### III. Operating Experience

Collector drive operation was improved, however, three units operated occasionally or not at all. Two of these were repaired and a third was partially restored by Energetics personnel. During October, two people from Energetics visited SKI for a trouble shoot and repair training session.

SERI personnel visited the site on October 20. Reflectivity of collector surfaces was checked. An increase from 66% to 83% was achieved by wiping. Low pressure water cleaning raised the reflectance from 66% to 80%. No permanent degradation of the reflective surface was noted due to contamination.

Insulation previously removed on the inlet and outlet pipes for leak checks in the collector field was replaced by Energetics personnel. Also, the SSG oil inlet header was insulated.

An operational problem occurred with the feedwater valve when the valve stuck in a partially open position. After SSG blowdown, it was restored to operation and resulted in one day of downtime.

Some operational problems also occurred with the DAS recording system.

System performance for the month is shown in Table 1.

## ENERGETICS CORPORATION

TIME		ENERGY BALANCE					EFFICIENCY	
JUL IAN	INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE	PIPING LOSSES OPERATIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM
		DAY	DATE	MIL-BTU	MIL-BTU	MIL-BTU	MIL-BTU	%
274	OCT 1	18,479	5.319	3,3494	3593.	0.241	0.442	28.8 18.1
275	OCT 2	0.469	0.000	0.0000	0.	0.000	0.069	0.0 0.0
276	OCT 3	0.546	0.000	0.0000	0.	0.000	0.075	0.0 0.0
277	OCT 4	0.890	4.280	2,2248	2400.	0.164	0.437	481.1 250.1
278	OCT 5	0.503	0.580	0.0000	0.	0.000	0.213	115.4 0.0
279	OCT 6	0.089	0.013	0.0000	0.	0.000	0.039	14.3 0.0
280	OCT 7	3.603	1.032	0.4655	548.	0.084	0.136	28.6 12.9
281	OCT 8	11.061	2.818	1.9364	2237.	0.155	0.339	25.5 17.5
282	OCT 9	10.400	3.445	2.2024	2424.	0.138	0.258	33.1 21.2
285	OCT 12	0.121	0.000	0.0000	0.	0.000	0.050	0.0 0.0
286	OCT 13	11.889	3.741	1.4158	1775.	0.103	0.449	31.5 11.9
287	OCT 14	17.020	5.915	4.1154	4402.	0.299	0.471	34.8 24.2
288	OCT 15	17.361	5.869	3.9050	4178.	0.251	0.471	33.8 22.5
290	OCT 17	8.400	3.138	2.8164	3015.	0.131	0.200	37.4 33.5
291	OCT 18	17.052	8.156	4.3518	4848.	0.255	0.498	36.1 25.5
292	OCT 19	0.213	0.000	0.0000	0.	0.000	0.044	0.0 0.0
293	OCT 20	11.923	3.847	2.2638	2502.	0.178	0.369	32.3 19.0
274	OCT 21	15.500	5.138	3.1545	3390.	0.247	0.454	33.1 20.4
295	OCT 22	0.196	0.000	0.0000	0.	0.000	0.050	0.0 0.0
296	OCT 23	11.840	3.911	1.9757	2147.	0.163	0.340	33.0 16.7
297	OCT 24	10.763	3.229	1.8132	1957.	0.153	0.331	30.0 16.8
298	OCT 25	12.363	3.990	2.2280	2440.	0.157	0.395	32.3 18.0
299	OCT 26	12.697	3.635	1.6155	1768.	0.167	0.416	28.6 12.7
300	OCT 27	0.184	0.000	0.0000	0.	0.000	0.073	0.0 0.0
301	OCT 28	16.680	6.152	4.2027	4426.	0.257	0.464	36.9 25.2
302	OCT 29	4.846	1.355	1.0640	1138.	0.090	0.171	28.0 22.0
303	OCT 30	14.819	5.143	3.5576	3747.	0.237	0.454	34.7 24.0
304	OCT 31	12.657	4.572	2.9659	3114.	0.191	0.387	36.1 23.4
TOTAL/AVG		242.341	63.278	31.6235	56092.	3.744	8.144	34.3 21.3

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - OCT. 1982

## ENERGETICS CORPORATION

TIME		ENERGY					DOLLARS		
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
		(SOURCE)	MIL-BTU	MIL-BTU	MIL-BTU	BARRELS OIL	MCF NAT GAS	\$	\$
274	OCT 1	5.153	0.442	4.711	0.909	4.711	17.67	2.25	15.42
275	OCT 2	0.000	0.069	-0.069	-0.013	-0.069	0.00	0.35	-0.35
276	OCT 3	0.000	0.075	-0.075	-0.014	-0.075	0.00	0.38	-0.38
277	OCT 4	3.423	0.437	2.986	0.576	2.986	11.74	2.22	9.52
278	OCT 5	0.000	0.213	-0.213	-0.041	-0.213	0.00	1.08	-1.08
279	OCT 6	0.000	0.039	-0.039	-0.008	-0.039	0.00	0.20	-0.20
280	OCT 7	0.716	0.136	0.580	0.112	0.580	2.46	0.67	1.77
281	OCT 8	2.978	0.339	2.639	0.509	2.639	10.21	1.72	8.49
282	OCT 9	3.388	0.258	3.130	0.604	3.130	11.62	1.31	10.31
285	OCT 12	0.000	0.050	-0.050	-0.010	-0.050	0.00	0.25	-0.25
286	OCT 13	2.178	0.449	1.729	0.334	1.729	7.47	2.29	5.18
287	OCT 14	6.331	0.471	5.860	1.131	5.860	21.72	2.40	19.32
288	OCT 15	6.008	0.471	5.537	1.069	5.537	20.51	2.37	18.22
290	OCT 17	4.333	0.200	4.133	0.798	4.133	14.96	1.02	13.94
291	OCT 18	6.695	0.498	6.197	1.195	6.197	22.96	2.53	20.43
292	OCT 19	0.000	0.044	-0.044	-0.008	-0.044	0.00	0.22	-0.22
293	OCT 20	3.483	0.369	3.114	0.601	3.114	11.95	1.88	10.07
294	OCT 21	4.852	0.464	4.388	0.847	4.388	18.64	2.36	14.28
295	OCT 22	0.000	0.090	-0.090	-0.017	-0.090	0.00	0.46	-0.46
296	OCT 23	3.039	0.340	2.699	0.521	2.699	10.42	1.73	8.69
297	OCT 24	2.790	0.331	2.459	0.475	2.459	9.57	1.68	7.89
298	OCT 25	3.428	0.395	3.033	0.586	3.033	11.76	2.01	9.75
299	OCT 26	2.485	0.416	2.069	0.399	2.069	8.52	2.12	6.40
300	OCT 27	0.000	0.073	-0.073	-0.014	-0.073	0.00	0.37	-0.37
301	OCT 28	6.467	0.454	6.003	1.159	6.003	22.18	2.34	19.82
302	OCT 29	1.637	0.171	1.466	0.283	1.466	5.61	0.87	4.74
303	OCT 30	5.473	0.454	5.019	0.959	5.019	18.77	2.31	16.46
304	OCT 31	4.562	0.387	4.175	0.806	4.175	15.65	1.97	13.68
TOTAL		79.419	8.144	71.274	13.759	71.274	272.37	41.42	230.97

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - OCT. 1982

Table B-5 SURC - MONTHLY COST SUMMARY TABLE -  
October, 1982

Maintenance

Scheduled-Cleaning	Hours	4 (est)
	Avg \$/h	10.00
	Labor Cost (\$)	40.00
	Materials (\$)	5.00
	Total (\$)	45.00
Unscheduled-	Hours	2
Blowdown SSG	Avg \$/h	16.00
	Labor Cost (\$)	32.00
	Materials (\$)	
	Parts (\$)	
	Total (\$)	32.00
Unscheduled- Drive Unit Adjustments	Hours	4 (est)
	Avg \$/h	10.00
	Labor Cost (\$)	40.00
	Materials (\$)	
	Parts (\$)	
	Total (\$)	40.00
	Total	\$117.00

Operation and Fixed Cost

Property Taxes (\$)		
Insurance (\$)		154.92
Parasitic Energy	kWh Used	838.96 *
	\$/kWh	.059
	Total (\$)	49.50 *
	Total	\$204.42
TOTAL COST		\$321.42

Fossil Fuel Savings

MIL-BTU (natural gas) 101.07<sup>a</sup> \*  
\$/MIL-BTU 3.43

Total	\$346.66*
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TOTAL SAVINGS	\$346.66
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NET SAVINGS	\$ 25.25
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a 65% burner efficiency assumed.

Table 1. SURC - SYSTEM OPERATION SUMMARY TABLE - November 1982

Julian Day	Date	Status Code	Weather	Remarks
305	11/1	1	F	3E down, corrected by rewiring
306	11/2	-	-	No Operator
307	11/3	1	F	Adj. 2W & 4W
308	11/4	1	F	Hi steam pressure
309	11/5	1	F	
310	11/6	1	F	
311	11/7	3	C	
312	11/8	3	C	Insulate pipes on rows 1E & 2E
313	11/9	1	P	Insulate pipes on rows 2W & 4W
314	11/10	3	R	Clean receiver tubes Rows 1,2, & 3
315	11/11	3	C	
316	11/12	3	C	
317	11/13	1	P	
318	11/14		P	No Operator
319	11/15	1	P	
320	11/16	3	C	Clean receiver tubes 4,5, & 6
321	11/17	3	C	Clean receiver tubes 1, 2, & 3
322	11/18	1	P	
323	11/19	1	F	1E down
324	11/20	1	P	1E down, 2E malfunction
325	11/21	1	P	1E down
326	11/22	1	P	1E down
327	11/23	3	C	
328	11/24	3	S	Snow
329	11/25	3	S	Snow
330	11/26	3	S	Snow
331	11/27	3	C	
332	11/28	3	C	
333	11/29	1	P	1 E down, main pump noise, repaired steam leak
334	11/30	3	C	

F: Fair

\*1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

\*\*3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

\* covers days when all systems are "up" and significant amounts of energy are delivered.

\*\* covers days when zero or very small amounts of energy were collected and/or delivered due to weather conditions.

ENERGETICS CORPORATION

III. Three collector drive units continued to have or developed new problems. One unit was repaired by Energetics personnel by rewiring. The remaining two continued to operate sporadically, however, the system generally had eleven out of twelve units operating.

All insulation previously removed for leak detection has been replaced by Energetics personnel.

A steam leak developed on the steam flow transmitter fitting. Repair was implemented by tightening flange connection with no significant loss of steam production.

System performance for the month is shown in Table 1.

## ENERGETICS CORPORATION

TIME		ENERGY BALANCE						EFFICIENCY	
JUL IAN		INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE		PIPING LOSSES OPERA TIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM
		DAY	DATE	MIL-BTU	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU
305	NOV 1	13.736	5.014	3.5887	3728.	0.207	0.386	36.5	26.1
306	NOV 2	0.238	0.000	0.0000	0.	0.000	0.087	0.0	0.0
307	NOV 3	14.926	4.875	3.1974	3368.	0.241	0.460	32.7	21.4
308	NOV 4	13.959	5.144	3.2826	3406.	0.278	0.481	36.9	23.4
309	NOV 5	16.096	5.878	4.0657	4189.	0.263	0.490	34.9	24.1
310	NOV 6	12.794	4.704	3.4450	3504.	0.188	0.388	36.8	26.9
311	NOV 7	0.157	0.000	0.0000	0.	0.000	0.097	0.0	0.0
312	NOV 8	0.162	0.000	0.0000	0.	0.000	0.087	0.0	0.0
313	NOV 9	11.239	3.466	1.2283	1314.	0.131	0.365	30.8	10.9
314	NOV 10	0.054	0.000	0.0000	0.	0.000	0.045	0.0	0.0
315	NOV 11	4.495	0.974	0.0000	30.	0.000	0.242	21.7	0.0
316	NOV 12	0.058	0.000	0.0000	0.	0.000	0.093	0.0	0.0
317	NOV 13	11.550	4.121	2.5510	2701.	0.140	0.334	35.7	22.2
318	NOV 14	0.144	0.000	0.0000	0.	0.000	0.100	0.0	0.0
319	NOV 15	11.046	3.413	1.6968	1845.	0.166	0.398	30.9	15.4
320	NOV 16	0.174	0.000	0.0000	0.	0.000	0.075	0.0	0.0
321	NOV 17	0.010	0.000	0.0000	0.	0.000	0.030	0.0	0.0
322	NOV 18	12.132	4.024	2.0045	2113.	0.198	0.394	33.2	16.5
323	NOV 19	15.927	5.414	3.8856	3775.	0.278	0.445	34.0	24.4
324	NOV 20	12.167	4.107	2.9402	3058.	0.183	0.326	33.8	24.2
325	NOV 21	8.138	2.040	0.7789	920.	0.136	0.280	25.1	9.6
326	NOV 22	10.137	2.900	1.6280	1636.	0.135	0.345	28.6	16.1
327	NOV 23	0.162	0.000	0.0000	0.	0.000	0.090	0.0	0.0
328	NOV 24	0.318	0.000	0.0000	0.	0.000	0.101	0.0	0.0
329	NOV 25	0.018	0.000	0.0000	0.	-0.005	0.032	0.0	0.0
330	NOV 26	12.840	4.084	2.3342	2495.	0.183	0.340	31.8	18.2
331	NOV 27	0.085	0.000	0.0000	0.	0.000	0.085	0.0	0.0
TOTL/AVG		193.560	60.158	36.6257	38722.	2.720	6.618	32.8	20.0

TABLE 2 - EURE MONTHLY PERFORMANCE TABLE - NOV. 1982

## ENERGETICS CORPORATION

TIME		ENERGY				DOLLARS			
JUL 1982	DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED		GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
			MIL-BTU	MIL-BTU	MIL-BTU	BARRELS OIL	MCF NAT GAS	\$	\$
305	NOV 1	5.522	0.386	5.136	0.992	5.136	18.94	1.96	16.98
306	NOV 2	0.000	0.087	-0.087	-0.017	-0.087	0.00	0.44	-0.44
307	NOV 3	4.918	0.460	4.458	0.861	4.458	16.87	2.34	14.53
308	NOV 4	5.025	0.481	4.545	0.877	4.545	17.24	2.45	14.79
309	NOV 5	6.256	0.470	5.766	1.113	5.766	21.46	2.49	18.97
310	NOV 6	5.301	0.388	4.913	0.948	4.913	18.18	1.97	16.21
311	NOV 7	0.000	0.097	-0.097	-0.019	-0.097	0.00	0.49	-0.49
312	NOV 8	0.000	0.087	-0.087	-0.017	-0.087	0.00	0.44	-0.44
313	NOV 9	1.890	0.365	1.525	0.294	1.525	6.48	1.86	4.62
314	NOV 10	0.000	0.046	-0.046	-0.009	-0.046	0.00	0.23	-0.23
315	NOV 11	0.000	0.242	-0.242	-0.047	-0.242	0.00	1.23	-1.23
316	NOV 12	0.000	0.093	-0.093	-0.018	-0.093	0.00	0.47	-0.47
317	NOV 13	3.740	0.334	3.606	0.696	3.606	13.51	1.70	11.81
318	NOV 14	0.000	0.100	-0.100	-0.019	-0.100	0.00	0.51	-0.51
319	NOV 15	2.611	0.398	2.213	0.427	2.213	18.96	2.02	16.94
320	NOV 16	0.000	0.095	-0.095	-0.018	-0.095	0.00	0.48	-0.48
321	NOV 17	0.000	0.030	-0.030	-0.005	-0.030	0.00	0.15	-0.15
322	NOV 18	3.882	0.395	2.686	0.519	2.686	10.57	2.01	8.56
323	NOV 19	5.977	0.445	5.532	1.068	5.532	20.50	2.27	18.23
324	NOV 20	4.524	0.326	4.198	0.810	4.198	15.52	1.66	13.86
325	NOV 21	1.198	0.280	0.918	0.177	0.918	4.11	1.42	2.69
326	NOV 22	2.505	0.345	2.160	0.417	2.160	8.59	1.75	6.84
327	NOV 23	0.000	0.070	-0.070	-0.017	-0.070	0.00	0.45	-0.45
328	NOV 24	0.000	0.101	-0.101	-0.019	-0.101	0.00	0.51	-0.51
329	NOV 25	0.007	0.032	-0.025	-0.005	-0.025	0.02	0.16	-0.14
330	NOV 26	3.571	0.340	3.251	0.628	3.251	12.32	1.73	10.59
331	NOV 27	0.000	0.085	-0.085	-0.016	-0.085	0.00	0.43	-0.43
TOTAL		56.348	6.618	49.727	9.600	49.727	193.27	33.66	159.61

TABLE 34 - SURC MONTHLY PERFORMANCE TABLE - NOV, 1982

Table B-5 SURC - MONTHLY COST SUMMARY TABLE - November, 1982

Maintenance

Scheduled Cleaning	Hours	6
	Avg \$/h	10.00
	Labor Cost (\$)	60.00
	Materials (\$)	
	Total (\$)	60.00
Unscheduled Repair Drive Units	Hours	4
	Avg \$/h	10.00
	Labor Cost (\$)	40.00
	Materials (\$)	
	Parts (\$)	
	Total (\$)	40.00
Unscheduled Repair Steam Leak	Hours	2
	Avg \$/h	16.00
	Labor Cost (\$)	32.00
	Materials (\$)	
	Parts (\$)	
	Total (\$)	32.00
	Total	\$132.00

Operation and Fixed Cost

Property Taxes (\$)		
Insurance (\$)		154.92
Parasitic Energy	kWh Used	571
	\$/kWh	.059
	Total (\$)	33.66
	Total	\$188.58

TOTAL COST		\$320.58
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Fossil Fuel Savings	MIL-BTU (natural gas)	79.419
	\$/MIL-BTU	3.43
	Total	\$272.41
TOTAL SAVINGS		\$272.41
NET SAVINGS		(\$ 48.17)

Table 1. SURC - SYSTEM OPERATION SUMMARY TABLE - December 1982

Julian Day	Date	Status Code	Weather	Remarks
335	12/1	3	C	
336	12/2	3	C	
337	12/3	3	S	Snow, checked out Freeze Prot.
338	12/4	1	P	Drive 6W, IE down
339	12/5	1	F	Drive IE down
340	12/6	1	F	" " "
341	12/7	1	P	Repl IE P.C. Board, Lube Pylon Brgs.
342	12/8	3	C	Ice Storm
343	12/9	6	C	Utility and Refinery Power Failure
344	12/10	6	C	" " " " " " "
345	12/11	6	C	" " " " " " "
346	12/12	6	C	" " " " " " "
347	12/13	6	C	Clean Receiver Tubes, Check Freeze Prot.
348	12/14	1	F	Auto hi wind shutdown, Lube Brgs.
349	12/15	1	P	Drives 6E, 4E operated erratically
350	12/16	1	P	Drive IE down, P.C. Board failure
351	12/17	3	P	Short circuit at P.C. Board - fuses blown.
352	12/18	2	F	Note 1, Microprocessor, failure
353	12/19	2	F	Note 1, cleaned Recvr. Tubes
354	12/20	2	F	Note 1, vented gas from Exp. Tank
355	12/21	2		Note 1, recharged batteries
356	12/22	2		Note 1
357	12/23	2		" "
358	12/24	2		" "
359	12/25	2		" "
360	12/26	3	S	" " - Snow
361	12/27	3	S	" " - "
362	12/28	3	C	" "
363	12/29	2		" "
364	12/30	2		" "
365	12/31	2		Install Microprocessor

F: Fair

\*1: Solar system up/Plant up  
2: Solar system down/Plant up

P: Partly Cloudy

\*\*3: Solar system idle/Plant up  
4: Solar system up/Plant down

C: Fog or Overcast

5: Solar system down/Plant down  
6: Solar system idle/Plant down

R: Rain

\* covers days when all systems are "up" and significant amounts of energy are delivered.

S: Snow

\*\* covers days when zero or very small amounts of energy were collected and/or delivered due to weather conditions.

Note 1 - Microprocessor sent to SKI for repair - system down

## ENERGETICS CORPORATION

### III. Operating Experience

Four of the twelve collector drive units developed operational problems during December, however, not more than two drive units were down at the same time. This was due to field repairs by Energetics personnel per SKI direction. Replacement of P.C. boards, fuses, and repair of drive unit control wiring short circuits were the major maintenance items.

On December 17, a short circuit during replacement of a P.C. board resulted in several blown fuses. The collectors remained in focus approximately 15 minutes while emergency shutdown was performed. No physical damage to the collectors was observed, but some overheating of the HTO apparently did occur.

Also, failure of the microprocessor occurred and it was sent to SKI for repair. Absence of a spare unit on site or at SKI resulted in an additional ten days downtime. On December 31, the microprocessor was re-installed by Energetics on site personnel and system operation restored.

Other maintenance items in December included receiver tube cleaning, lubrication of collector pillow block bearings, and adjustment of the feedwater freeze protection system.

## ENERGETICS CORPORATION

TIME		ENERGY BALANCE						EFFICIENCY	
		INCIDENT	SOLAR ENERGY COLLECTED	SOLAR ENERGY	PIPING	PARA			
JUL		SOLAR ENERGY COLLECTED	COLLECTED	DELIVERED TO REFINERY STEAM LINE	LOSSES -OPERATIONAL	SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM	
IAN		PLANE							
DAY	DATE	MIL-BTU	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU	%	%
335	DEC 1	0.066	0.000	0.0000	0.	0.000	0.047	0.0	0.0
336	DEC 2	0.076	0.000	0.0000	0.	0.000	0.104	0.0	0.0
337	DEC 3	0.089	0.000	0.0000	0.	0.000	0.092	0.0	0.0
338	DEC 4	-0.083	2.729	1.0657	1179.	0.119	0.285	43307.0	41291.4
339	DEC 5	-0.136	3.577	2.1511	2257.	0.177	0.333	42633.0	41503.4
340	DEC 6	11.925	4.103	2.4972	2605.	0.175	0.389	34.4	20.9
341	DEC 7	11.671	3.670	2.2425	2381.	0.173	0.354	31.4	19.2
342	DEC 8	0.021	0.000	0.0000	0.	0.000	0.111	0.0	0.0
343	DEC 9	0.026	0.000	0.0000	0.	0.000	0.124	0.0	0.0
348	DEC14	10.137	2.996	1.0637	1115.	0.110	0.321	29.6	10.5
349	DEC15	12.454	4.007	2.4292	2488.	0.181	0.424	32.2	19.5
350	DEC16	14.303	4.188	2.3339	2365.	0.180	0.456	29.3	16.3
351	DEC17	7.310	0.368	0.0000	7.	0.000	0.101	5.0	0.0
352	DEC18	0.025	0.000	0.0000	0.	0.000	0.027	0.0	0.0
353	DEC19	0.214	0.000	0.0000	0.	0.000	0.021	0.0	0.0
354	DEC20	0.363	0.014	0.0000	0.	0.000	0.055	3.9	0.0
355	DEC21	0.127	0.001	0.0000	0.	0.000	0.024	0.8	0.0
356	DEC22	0.082	0.000	0.0000	0.	0.000	-0.000	0.0	0.0
357	DEC23	0.081	0.000	0.0000	0.	0.000	-0.000	0.0	0.0
358	DEC24	0.101	0.000	0.0000	0.	0.000	-0.000	0.0	0.0
359	DEC25	0.137	0.000	0.0000	0.	0.000	-0.000	0.0	0.0
360	DEC26	0.292	0.000	0.0000	0.	0.000	0.000	0.0	0.0
362	DEC28	0.160	0.000	0.0000	0.	0.000	-0.000	0.0	0.0
363	DEC29	0.103	0.000	0.0000	0.	0.000	0.000	0.0	0.0
364	DEC30	0.125	0.000	0.0000	0.	0.000	0.044	0.0	0.0
365	DEC31	0.301	0.000	0.0000	0.	0.000	0.094	0.0	0.0
TOTL/AVG		70.407	25.653	13.7833	14397.	1.115	3.405	36.4	19.6

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - DEC.1982

ENERGETICS CORPORATION

TIME		ENERGY				DOLLARS			
		GROSS FOSSIL FUEL	PARASITIC ENERGY	NET FOSSIL FUEL SAVED		GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS	
JUL IAN	DAY	SAVED	USED (SOURCE)		BARRELS	MCF NAT			
		MIL-BTU	MIL-BTU	MIL-BTU	OIL	GAS	\$	\$	
335	DEC 1	0.000	0.047	-0.047	-0.009	-0.047	0.00	0.24	-0.24
336	DEC 2	0.000	0.104	-0.104	-0.020	-0.104	0.00	0.53	-0.53
337	DEC 3	0.000	0.092	-0.092	-0.018	-0.092	0.00	0.47	-0.47
338	DEC 4	1.640	0.285	1.355	0.262	1.355	5.63	1.45	4.18
339	DEC 5	3.309	0.333	2.976	0.575	2.976	11.35	1.69	9.66
340	DEC 6	3.842	0.389	3.453	0.667	3.453	13.18	1.98	11.20
341	DEC 7	3.450	0.354	3.096	0.598	3.096	11.83	1.80	10.03
342	DEC 8	0.000	0.111	-0.111	-0.021	-0.111	0.00	0.57	-0.57
343	DEC 9	0.000	0.124	-0.124	-0.024	-0.124	0.00	0.63	-0.63
348	DEC14	1.637	0.321	1.316	0.254	1.316	5.61	1.63	3.98
349	DEC15	3.738	0.424	3.314	0.640	3.314	12.82	2.16	10.66
350	DEC16	3.591	0.456	3.135	0.605	3.135	12.32	2.32	10.00
351	DEC17	0.000	0.101	-0.101	-0.019	-0.101	0.00	0.51	-0.51
352	DEC18	0.000	0.027	-0.027	-0.005	-0.027	0.00	0.14	-0.14
353	DEC19	0.000	0.021	-0.021	-0.004	-0.021	0.00	0.11	-0.11
354	DEC20	0.000	0.055	-0.055	-0.011	-0.055	0.00	0.28	-0.28
355	DEC21	0.000	0.024	-0.024	-0.005	-0.024	0.00	0.12	-0.12
356	DEC22	0.000	-0.000	0.000	0.000	0.000	0.00	-0.00	0.00
357	DEC23	0.000	-0.000	0.000	0.000	0.000	0.00	-0.00	0.00
358	DEC24	0.000	-0.000	0.000	0.000	0.000	0.00	-0.00	0.00
359	DEC25	0.000	-0.000	0.000	0.000	0.000	0.00	-0.00	0.00
360	DEC26	0.000	0.000	0.000	0.000	0.000	0.00	0.00	-0.00
362	DEC28	0.000	-0.000	0.000	0.000	0.000	0.00	-0.00	0.00
363	DEC29	0.000	0.000	0.000	0.000	0.000	0.00	0.00	-0.00
364	DEC30	0.000	0.044	-0.044	-0.008	-0.044	0.00	0.22	-0.22
365	DEC31	0.000	0.094	-0.094	-0.018	-0.094	0.00	0.48	-0.48
TOTAL		21.207	3.405	17.801	3.436	17.801	72.74	17.32	55.42

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - DEC, 1982

Table 85. SURC - MONTHLY COST SUMMARY TABLE - December 1982

Maintenance

## Scheduled-

Cleaning

Receiver Tubes  
and Lubricate  
bearings

Hours	6
Avg \$/h	\$10.00
Labor Cost (\$)	60.00
Materials (\$)	
Total (\$)	60.00

## Unscheduled-

Repair SKI Drive  
Units and Central  
Controller

Hours	6
Avg \$/h	\$10.00
Labor Cost. (\$)	
Materials (\$)	
Parts (\$)	
Total (\$)	60.00

## Scheduled-Maintenance

check Freeze  
Protection System

Hours	2
Avg \$/h	16.00
Labor Cost (\$)	32.00
Materials (\$)	
Parts (\$)	
Total (\$)	32.00

Total	\$152.00
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Operation and Fixed Cost

Property Taxes (\$)	
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Insurance (\$)	\$154.92
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Parasitic Energy	kWh Used	294
	\$/kWh	.059
	Total (\$)	\$17.31

Total	\$172.23
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TOTAL COST	\$324.23
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Gross

## Fossil Fuel Savings

MIL-BTU (natural gas)	21,207
\$/MIL-BTU	3.43

Total	\$72.42
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TOTAL SAVINGS	\$72.42
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NET SAVINGS	(\$251.81)
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a 65% burner efficiency assumed.

Table 1. SURC - SYSTEM OPERATION SUMMARY TABLE - January 1983

Julian Day	Date	Status Code	Weather	Remarks
1	1/1	3	S	Snow
2	1/2	3	S	Snow
3	1/3	2	F	Microprocessor not operational
4	1/4	1	P	Microprocessor check out, see note 1
5	1/5	1	P	Install new back-up batteries, see note 1
6	1/6	1	F	See note 1
7	1/7	1	P	" " "
8	1/8	1	F	" " "
9	1/9	1	F	" " "
10	1/10	1	P	Main pump gear reducer failure
11	1/11	2	-	Main pump gear reducer repair
12	1/12	2	-	Main pump gear reducer repair
13	1/13	1	F	Repaired open circuit #5W control wires
14	1/14	1	P	See note 1
15	1/15	3	C	-
16	1/16	1	F	See note 1
17	1/17	1	P	" " "
18	1/18	3	C	Cleaned collector rows 1,2, and 3
19	1/19	3	R	Cleaned collector rows 4,5, and 6
20	1/20	3	R	Rain
21	1/21	3	S	Snow
22	1/22	1	F	See Note 1
23	1/23	1	P	" " "
24	1/24	4	-	Refinery shut down for maintenance
25	1/25	3	C	See Note 1
26	1/26	1	P	" " "
27	1/27	1	P	" " "
28	1/28	1	P	" " "
29	1/29	-	-	No operator
30	1/30	-	-	" "
31	1/31	3	R	Rain

F: Fair

\*1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

\*\*3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

\* covers days when all systems are "up" and significant amounts of energy are delivered.

\*\* covers days when zero or very small amounts of energy were collected and/or delivered due to weather conditions.

Note 1 - Drive Units 1E and 2E down - awaiting control PC Boards from SKI

ENERGETICS CORPORATION

III. Operating Experience

All but two collector drive units operated without failure. These two units were down due to a lack of available P.C. control boards from SKI.

The repaired microprocessor was installed on December 31. Checkout and testing was delayed due to inclement weather. This resulted in no data or operation for the first several days of January.

Failure of the speed reduction gears on the main pump occurred. This resulted in two days downtime. Vendor repair and replacement of parts restored operation on January 12.

Maintenance items in January included cleaning of collector surfaces using a water rinse. It was determined that a high pressure spray washer would be needed for thorough cleaning.

## ENERGETICS CORPORATION

TIME		ENERGY BALANCE					EFFICIENCY		
JUL IAN	INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE	PIPING LOSSES -OPERA TIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM		
DAY	DATE	MIL-BTU	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU	%	%
5	JAN 5	6.983	1.911	1.3971	1449.	0.140	0.192	27.4	20.0
6	JAN 6	13.799	3.980	2.3653	2492.	0.178	0.344	28.8	17.1
7	JAN 7	9.616	2.468	1.3909	1533.	0.135	0.260	25.7	14.5
8	JAN 8	15.856	4.838	2.9832	3201.	0.228	0.427	30.5	18.8
9	JAN 9	15.163	4.331	2.8105	2979.	0.226	0.395	28.6	18.5
10	JAN10	6.285	1.185	0.0952	197.	0.062	0.261	18.9	1.5
11	JAN11	0.059	0.000	0.0000	0.	0.000	0.075	0.0	0.0
12	JAN12	6.617	1.588	0.0072	79.	0.016	0.239	24.0	0.1
13	JAN13	15.726	4.142	2.3078	2556.	0.213	0.396	26.3	14.7
14	JAN14	14.621	3.744	1.8593	2106.	0.229	0.377	25.6	12.7
15	JAN15	0.365	0.000	0.0000	0.	0.000	0.079	0.0	0.0
16	JAN16	15.302	4.537	2.1326	2327.	0.221	0.392	29.6	13.9
17	JAN17	6.093	1.550	0.2930	398.	0.079	0.205	25.4	4.8
18	JAN18	0.057	0.000	0.0000	0.	0.000	0.059	0.0	0.0
19	JAN19	0.045	0.000	0.0000	0.	0.000	0.059	0.0	0.0
20	JAN20	0.305	0.000	0.0000	0.	0.000	0.071	0.0	0.0
21	JAN21	0.036	0.000	0.0000	0.	0.000	0.021	0.0	0.0
22	JAN22	14.337	4.694	2.3445	2716.	0.268	0.396	32.7	16.4
23	JAN23	13.176	3.699	2.2782	3212.	0.366	0.377	28.1	17.3
24	JAN24	4.234	0.900	0.0414	264.	0.031	0.214	21.3	1.0
25	JAN25	2.788	0.586	0.0000	34.	0.000	0.201	21.0	0.0
26	JAN26	14.142	4.382	2.4230	2567.	0.209	0.367	31.0	17.1
27	JAN27	9.663	2.367	0.8835	1079.	0.130	0.354	24.5	9.1
28	JAN28	9.665	2.744	1.2449	1661.	0.202	0.337	28.4	12.9
29	JAN29	0.103	0.000	0.0000	0.	0.029	0.083	0.0	0.0
31	JAN31	0.019	0.000	0.0000	0.	0.000	0.034	0.0	0.0
TOTL/AVG		195.054	53.646	26.8609	31319.	2.961	6.216	27.5	13.8

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - JAN, 1983

## ENERGETICS CORPORATION

TIME		ENERGY				DOLLARS			
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
		MIL-BTU	MIL-BTU	MIL-BTU	BARRELS	MCF	NAT	\$	\$
					OIL	GAS			
5	JAN 5	2.149	0.192	1.957	0.378	1.957	7.37	0.98	6.39
6	JAN 6	3.639	0.344	3.295	0.636	3.295	12.48	1.75	10.73
7	JAN 7	2.140	0.260	1.880	0.343	1.880	7.34	1.32	6.02
8	JAN 8	4.590	0.427	4.163	0.804	4.163	15.74	2.17	13.57
9	JAN 9	4.324	0.395	3.929	0.758	3.929	14.83	2.01	12.82
10	JAN 10	0.146	0.261	-0.115	-0.022	-0.115	0.50	1.33	-0.83
11	JAN 11	0.000	0.075	-0.075	-0.014	-0.075	0.00	0.39	-0.39
12	JAN 12	0.011	0.239	-0.228	-0.044	-0.228	0.04	1.22	-1.18
13	JAN 13	3.551	0.396	3.155	0.609	3.155	12.18	2.02	10.16
14	JAN 14	2.960	0.377	2.483	0.479	2.483	9.81	1.92	7.89
15	JAN 15	0.000	0.079	-0.079	-0.015	-0.079	0.00	0.40	-0.40
16	JAN 16	3.282	0.392	2.890	0.558	2.890	11.26	1.99	9.27
17	JAN 17	0.451	0.205	0.246	0.047	0.246	1.55	1.04	0.51
18	JAN 18	0.000	0.059	-0.059	-0.011	-0.059	0.00	0.30	-0.30
19	JAN 19	0.000	0.059	-0.059	-0.011	-0.059	0.00	0.30	-0.30
20	JAN 20	0.000	0.071	-0.071	-0.014	-0.071	0.00	0.36	-0.36
21	JAN 21	0.000	0.021	-0.021	-0.004	-0.021	0.00	0.10	-0.10
22	JAN 22	3.607	0.395	3.211	0.620	3.211	12.37	2.01	10.36
23	JAN 23	3.504	0.377	3.127	0.604	3.127	12.02	1.92	10.10
24	JAN 24	0.064	0.214	-0.150	-0.029	-0.150	0.22	1.07	-0.97
25	JAN 25	0.000	0.201	-0.201	-0.039	-0.201	0.00	1.02	-1.02
26	JAN 26	3.728	0.367	3.361	0.649	3.361	12.79	1.87	10.92
27	JAN 27	1.359	0.354	1.005	0.194	1.005	4.86	1.80	2.86
28	JAN 28	1.916	0.337	1.579	0.305	1.579	6.57	1.71	4.86
29	JAN 29	0.005	0.083	-0.078	-0.015	-0.078	0.02	0.42	-0.40
31	JAN 31	0.000	0.034	-0.034	-0.007	-0.034	0.00	0.17	-0.17
TOTAL		41.326	6.216	35.111	6.778	35.111	141.75	31.62	110.13

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - JAN, 1983

Table 5. SURC - MONTHLY COST SUMMARY TABLE - January 1983

Maintenance

Unscheduled	Hours	6
Repair Main Pump	Avg \$/h	20.00
Gear Reducer	Labor Cost (\$)	120.00
	Materials (\$)	420.00
	Total (\$)	540.00
Unscheduled	Hours	4
Repair Microprocessor	Avg \$/h	10.00
and Drive Units	Labor Cost (\$)	40.00
	Materials (\$)	
	Parts (\$)	
	Total (\$)	40.00
Scheduled	Hours	2
Clean Collector	Avg \$/h	10.00
Surfaces	Labor Cost (\$)	20.00
	Materials (\$)	
	Parts (\$)	
	Total (\$)	20.00
Total		\$600.00

Operation and Fixed Cost

Property Taxes (\$)		
Insurance (\$)		154.92
Parasitic Energy	kWh Used	536
	\$/kWh	.059
	Total (\$)	31.62
Total		\$186.54
TOTAL COST		\$786.54
Fossil Fuel Savings		
	MIL-BTU (natural gas)	41,326
	\$/MIL-BTU	3.43
Total		\$141.75
TOTAL SAVINGS		\$141.75
NET SAVINGS		(\$644.79)

a 65% burner efficiency assumed.

Table 1. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - February, 1983

Julian Day	Date	Status Code	Weather	Remarks
32	2/1	3	C	
33	2/2	1	P	Note 1
34	2/3	3	C	Cleaned Receiver Tubes #1,2
35	2/4	3	S	Cleaned Receiver Tubes #2,3
36	2/5	3	S	
37	2/6	-	-	No Operator
38	2/7	1	P	Note 1, Clean Receiver Tubes #5,6
39	2/8	3	C	
40	2/9	1	P	Note 1
41	2/10	1	P	" ", Closed SSG Blowdown Valve
42	2/11	1	F	" "
43	2/12	-	-	No Operator
44	2/13	-	-	No Operator
45	2/14	1	P	Note 1
46	2/15	1	P	" "
47	2/16	1	P	" "
48	2/17	1	F	Replace Circuit Boards 1E & 5W, See Note 2
49	2/18	1	F	Note 2
50	2/19	1	P	" "
51	2/20	3	C	
52	2/21	3	C	Cleaned Rec. Tubes #1,2,3
53	2/22	3	C	Performed Manual Blowdown of SSG
54	2/23	1	P	Note 2
55	2/24	1	P	" "
56	2/25	3	C	Added Water to Backup Batteries
57	2/26	-	-	No Operator
58	2/27	6	P	Refinery Power Outage, Microprocessor Down
59	2/28	1	F	Note 2

F: Fair

\*1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

\*\*3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

\* covers days when all systems are "up" and significant amounts of energy are delivered.

\*\* covers days when zero or very small amounts of energy were collected and/or delivered due to weather conditions.

Note 1: Drive Units 1E &amp; 5W Down - Awaiting Circuit Boards From SKI

Note 2: All Collectors Are Operable &amp; Tracking

III. Operating Experience

Two collector drive units were repaired midway through the report period. This restored all twelve drive units to full operational status.

A plant power outage on February 27 resulted in both the refinery and the solar site shutting down. Data aquisition for that day was also down, however, normal operation resumed when power was restored.

Automatic SSG blowdown was discontinued on February 10. Manual SSG blowdown will be scheduled as required on shutdown or cloudy days in order to minimize system heat losses.

Procurement of a portable spray washer was completed in February and arrived on site late in the month. Performance improvement as the result of reduced blowdown, drive repairs, and collector cleaning can best be seen on Feb. 28 (as compared to Feb. 9).

DAS information was lost on Feb. 17 and 18, due to an operational error. Log sheets show that 3,488 lbs. and 4,951 lbs. respectively of steam were produced on those days.

## ENERGETICS CORPORATION

TIME		ENERGY BALANCE						EFFICIENCY	
JUL	IAN	INCIDENT SOLAR ENERGY COLLECTED PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE		PIPING LOSSES -OPERATIONAL	PARASITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM
DAY	DATE	MIL-BTU	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU	%	%
32	FEB 1	0.331	0.000	0.0000	0.	0.000	0.055	0.0	0.0
33	FEB 2	6.704	1.804	0.3725	528.	0.074	0.275	26.9	5.6
34	FEB 3	0.006	0.000	0.0000	0.	0.000	0.023	0.0	0.0
35	FEB 4	0.475	0.000	0.0000	0.	0.000	0.082	0.0	0.0
36	FEB 5	0.495	0.000	0.0000	0.	0.000	0.091	0.0	0.0
37	FEB 6	0.133	0.000	0.0000	0.	0.000	0.085	0.0	0.0
38	FEB 7	-0.002	0.000	0.0000	0.	0.000	0.007	0.0	0.0
39	FEB 8	3.217	0.723	0.0000	13.	0.000	0.212	22.5	0.0
40	FEB 9	15.723	4.486	2.4251	2561.	0.207	0.427	28.5	15.4
41	FEB 10	11.819	3.138	1.5954	1886.	0.130	0.379	26.6	13.5
42	FEB 11	16.293	5.045	3.2062	3403.	0.226	0.480	31.0	19.7
43	FEB 12	0.045	0.000	0.0000	0.	0.089	0.083	0.0	0.0
44	FEB 13	0.058	0.000	0.0000	0.	0.059	0.083	0.0	0.0
45	FEB 14	11.331	3.102	1.4004	2048.	0.148	0.352	27.4	12.4
46	FEB 15	14.665	4.178	2.6404	3494.	0.394	0.417	28.5	18.0
47	FEB 16	13.244	2.954	1.4719	1587.	0.154	0.468	22.3	11.1
48	FEB 17	-0.002	0.000	0.0000	0.	0.000	0.017	0.0	0.0
50	FEB 19	4.549	1.124	0.5978	709.	0.087	0.194	24.7	13.1
51	FEB 20	0.861	0.000	0.0000	0.	0.000	0.132	0.0	0.0
52	FEB 21	0.121	0.000	0.0000	0.	0.000	0.056	0.0	0.0
53	FEB 22	0.172	0.000	0.0000	0.	0.000	0.094	0.0	0.0
54	FEB 23	14.232	4.479	2.5942	2674.	0.154	0.427	31.5	18.2
55	FEB 24	11.143	3.521	2.0001	2116.	0.182	0.387	31.6	17.9
56	FEB 25	0.036	0.000	0.0000	0.	0.000	0.076	0.0	0.0
57	FEB 26	0.000	0.000	0.0000	0.	0.000	0.006	0.0	0.0
58	FEB 27	0.030	0.000	0.0000	0.	0.000	0.032	0.0	0.0
59	FEB 28	16.012	6.219	5.1703	5144.	0.227	0.397	38.8	32.3
TOTL/AVG		141.692	40.773	23.5467	31658.	2.130	5.326	28.8	16.6

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - FEB, 1983

## ENERGETICS CORPORATION

TIME		ENERGY					DOLLARS		
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
		MIL-BTU	MIL-BTU	MIL-BTU	OIL	GAS	\$	\$	\$
32	FEB 1	0.000	0.055	-0.055	-0.011	-0.055	0.00	0.28	-0.28
33	FEB 2	0.573	0.275	0.298	0.058	0.298	1.97	1.40	0.57
34	FEB 3	0.000	0.023	-0.023	-0.004	-0.023	0.00	0.12	-0.12
35	FEB 4	0.000	0.082	-0.082	-0.016	-0.082	0.00	0.42	-0.42
36	FEB 5	0.000	0.081	-0.081	-0.016	-0.081	0.00	0.41	-0.41
37	FEB 6	0.000	0.085	-0.085	-0.016	-0.085	0.00	0.43	-0.43
38	FEB 7	0.000	0.007	-0.007	-0.001	-0.007	0.00	0.03	-0.03
39	FEB 8	0.000	0.212	-0.212	-0.041	-0.212	0.00	1.08	-1.08
40	FEB 9	3.731	0.427	3.304	0.638	3.304	12.80	2.17	10.63
41	FEB 10	2.455	0.379	2.076	0.401	2.076	8.42	1.93	6.49
42	FEB 11	4.931	0.480	4.451	0.857	4.451	16.91	2.44	14.47
43	FEB 12	0.094	0.083	0.011	0.002	0.011	0.32	0.42	-0.10
44	FEB 13	0.017	0.083	-0.065	-0.013	-0.066	0.06	0.42	-0.36
45	FEB 14	2.154	0.352	1.802	0.348	1.802	7.39	1.79	5.60
46	FEB 15	4.064	0.417	3.647	0.704	3.647	13.94	2.12	11.82
47	FEB 16	2.264	0.468	1.796	0.347	1.796	7.77	2.38	5.39
48	FEB 17	0.000	0.017	-0.017	-0.003	-0.017	0.00	0.08	-0.08
50	FEB 19	0.920	0.194	0.726	0.140	0.726	3.16	0.98	2.18
51	FEB 20	0.000	0.132	-0.132	-0.025	-0.132	0.00	0.67	-0.67
52	FEB 21	0.000	0.056	-0.056	-0.011	-0.056	0.00	0.28	-0.28
53	FEB 22	0.000	0.094	-0.094	-0.018	-0.094	0.00	0.48	-0.48
54	FEB 23	3.971	0.427	3.564	0.688	3.564	13.69	2.17	11.52
55	FEB 24	3.077	0.387	2.690	0.519	2.690	10.55	1.97	8.58
56	FEB 25	0.000	0.076	-0.076	-0.015	-0.076	0.00	0.39	-0.39
57	FEB 26	0.000	0.006	-0.006	-0.001	-0.006	0.00	0.03	-0.03
58	FEB 27	0.000	0.032	-0.032	-0.006	-0.032	0.00	0.16	-0.16
59	FEB 28	7.954	0.397	7.557	1.459	7.557	27.28	2.02	25.26
TOTAL		36.225	5.326	30.898	5.985	30.898	124.26	27.09	97.17

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - FEB. 1983

Table 5. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE -  
FEBRUARY 1983Maintenance

Unscheduled Replace Circuit Boards	Hours	2
	Avg \$/h	10.00
	Labor Cost (\$)	20.00
	Materials (\$)	
	Total (\$)	20.00
Scheduled - Clean Receiver Tubes and Collectors, Blowdown SSG, Maintain Batteries	Hours	4
	Avg \$/h	10.00
	Labor Cost (\$)	40.00
	Materials (\$)	
	Parts (\$)	
	Total (\$)	40.00
	Hours	
	Avg \$/h	
	Labor Cost (\$)	
	Materials (\$)	
	Parts (\$)	
	Total (\$)	
	Total	\$60.00

Operation and Fixed Cost

Property Taxes (\$)	
Insurance (\$)	154.92
Parasitic Energy	kWh Used
	\$/kWh
	Total (\$)
Total	\$186.06*

TOTAL COSTFossil Fuel Savings

MIL-BTU (natural gas)	42.728*
\$/MIL-BTU	3.43
Total	\$146.56
TOTAL SAVINGS	\$146.56*
NET SAVINGS	(\$99.50)

a 65% burner efficiency assumed.

\*Values Adjusted for Feb. 17 and 18  
Steam Production Which Were Not  
Included in DAS Tables.

## ENERGETICS CORPORATION

Table 1. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - March, 1983

Julian Day	Date	Status Code	Weather	Remarks
60	3/1	3	C	
61	3/2	5	P	Power Failure (See Note 1)
62	3/3	3	C	
63	3/4	3	C	Manual Blowdown of SSG
64	3/5	-	-	No Operator
65	3/6	-	-	No Operator
66	3/7	2	P	Reprogrammed Microprocessor
67	3/8	1	P	Note 2
68	3/9	3	C	Clean Receiver Tubes
69	3/10	1	F	SW Down
70	3/11	1	F	SW Down
71	3/12	-	-	No Operator
72	3/13	1	F	System Tripped - Low SSG Water Level
73	3/14	3	C	Drained and Refilled SSG, Note 3
74	3/15	3	C	Clean Receiver Tubes - Rows 1,2,3, Note 3
75	3/16	3	C	Clean Receiver Tubes - Rows 4,5,6
76	3/17	1	F	
77	3/18	3	P	Note 2 - Repaired Tracker Head
78	3/19	-	-	No Operator
79	3/20	-	-	No Operator
80	3/21	3	C	Cleaned Rec. Tubes - Rows 1,2,3
81	3/22	1	P	
82	3/23	1	P	
83	3/24	1	F	
84	3/25	3	P	
85	3/26	3	P	System Shutdown Due to High Winds
86	3/27	1	F	System Tripped - Low SSG Water Level
87	3/28	1	P	Repaired IE Overtemperature Switch
88	3/29	1	P	
89	3/30	1	F	
90	3/31	1	F	Windy Late Afternoon

F: Fair

\*1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

\*\*3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

\* covers days when all systems are "up" and significant amounts of energy are delivered.

\*\* covers days when zero or very small amounts of energy were collected and/or delivered due to weather conditions.

Note 1: Power Failure Caused Microprocessor Program Failure

Note 2: SW Tracking Problem

Note 3: DAS Loss of Data

ENERGETICS CORPORATION

III. Operating Experience

All collector drive units operated normally with the exception of one tracking sensor and one temperature sensor problem. The tracking sensor was removed, repaired, and reinstalled, and the temperature sensor connections were repaired.

A power outage on March 2 resulted in loss of the program in the microprocessor. This software is the tracking logic which controls the SKI collector drive units. The system was down several days due to this occurrence. SKI indicates this problem may be due to a faulty battery or uninterruptable power supply in the microprocessor. A spare microprocessor would alleviate this recurring problem.

The steam generator (SSG) water level switch which controls the feed-water valve failed several times during March. This caused the system to automatically shutdown on low water level. Repeated draining of the level switch column and manual SSG blowdown remedied the situation.

ODAS information was lost March 14 and 15 due to an operational problem. This however, was not a significant loss as these were overcast days. A partial loss occurred on the 8th. Log sheets show steam production of 3211 lbs. in addition to that shown in Table 4. This amount has been accounted for in the energy cost savings.

A problem continued with the steam check valve at the refinery tie-in. Refinery maintenance personnel disassembled, cleaned, and reinstalled the check valve.

## ENERGETICS CORPORATION

TIME		ENERGY BALANCE						EFFICIENCY	
JULIAN	DAY	INCIDENT SOLAR	SOLAR	SOLAR ENERGY DELIVERED	TO REFINERY STEAM LINE	PIPING LOSSES	PARASITIC	COLLECTOR ARRAY	SYSTEM
		ENERGY COLLECTED	COLLECTED	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU	%
60	MAR 1	2.018	0.215	0.0000	0.	0.000	0.183	10.7	0.0
61	MAR 2	0.114	0.000	0.0000	0.	0.000	0.042	0.0	0.0
62	MAR 3	0.400	0.000	0.0000	0.	0.000	0.085	0.0	0.0
63	MAR 4	0.205	0.000	0.0000	0.	0.000	0.077	0.0	0.0
64	MAR 5	0.104	0.000	0.0000	0.	0.000	0.059	0.0	0.0
65	MAR 6	0.214	0.000	0.0000	0.	0.000	0.066	0.0	0.0
66	MAR 7	0.784	0.052	0.0000	0.	0.000	0.083	6.6	0.0
67	MAR 8	1.505	0.341	0.1146	177.	0.045	0.081	22.7	7.6
68	MAR 9	0.784	0.000	0.0000	0.	0.000	0.043	0.0	0.0
69	MAR 10	17.932	6.873	5.6045	5675.	0.265	0.457	38.3	31.3
70	MAR 11	14.207	4.768	3.1641	3298.	0.252	0.441	33.6	22.3
71	MAR 12	0.314	0.000	0.0000	0.	0.000	0.079	0.0	0.0
72	MAR 13	12.159	4.383	3.0955	3196.	0.193	0.356	36.0	25.5
73	MAR 14	0.285	0.000	0.0000	0.	0.000	0.047	0.0	0.0
74	MAR 15	15.601	6.707	4.7344	4932.	0.268	0.424	43.0	30.3
75	MAR 16	2.342	0.321	0.0000	0.	0.000	0.057	13.7	0.0
76	MAR 17	0.247	0.000	0.0000	0.	0.000	0.094	0.0	0.0
77	MAR 18	0.253	0.000	0.0000	0.	0.000	0.095	0.0	0.0
78	MAR 19	0.332	0.000	0.0000	0.	0.000	0.101	0.0	0.0
79	MAR 20	10.405	3.727	1.7706	1940.	0.125	0.357	35.8	17.0
80	MAR 21	11.051	3.702	2.5794	2420.	0.134	0.368	33.5	22.3
81	MAR 22	13.941	5.453	4.6734	4822.	0.219	0.323	39.1	33.5
82	MAR 23	4.338	0.901	0.0497	130.	0.072	0.230	20.8	1.1
83	MAR 24	1.380	0.350	0.0000	0.	0.000	0.184	25.4	0.0
84	MAR 25	14.169	4.289	2.9084	3060.	0.245	0.373	30.3	20.5
85	MAR 26	10.324	3.268	1.8890	1967.	0.137	0.363	31.7	18.3
86	MAR 27	11.533	4.009	2.6884	2748.	0.176	0.369	34.8	23.3
87	MAR 28	15.987	5.980	4.6544	4716.	0.263	0.438	34.6	27.4
88	MAR 29	17.475	6.590	5.2882	5352.	0.240	0.424	37.7	30.3
TOTL/AVG		180.968	61.929	43.2146	44637.	2.637	6.422	34.2	23.9

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - MAR. 1993

ENERGETICS CORPORATION

TIME		ENERGY					DOLLARS		
		GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
JUL IAN	(SOURCE)	MIL-BTU	MIL-BTU	MIL-BTU	BARRELS OIL	MCF NAT GAS	\$	\$	\$
DAY	DATE								
50	MAR 1	0.000	0.183	-0.183	-0.035	-0.183	0.00	0.93	-0.93
51	MAR 2	0.000	0.042	-0.042	-0.008	-0.042	0.00	0.21	-0.21
52	MAR 3	0.000	0.085	-0.085	-0.016	-0.085	0.00	0.43	-0.43
53	MAR 4	0.000	0.077	-0.077	-0.015	-0.077	0.00	0.39	-0.39
54	MAR 5	0.000	0.059	-0.059	-0.011	-0.059	0.00	0.30	-0.30
55	MAR 6	0.000	0.066	-0.066	-0.013	-0.066	0.00	0.34	-0.34
56	MAR 7	0.000	0.083	-0.083	-0.016	-0.083	0.00	0.42	-0.42
57	MAR 8	0.176	0.081	0.095	0.018	0.095	0.40	0.41	0.19
58	MAR 9	0.000	0.063	-0.063	-0.012	-0.063	0.00	0.32	-0.32
59	MAR 10	8.623	0.457	8.166	1.576	8.166	29.58	2.32	27.26
60	MAR 11	4.868	0.441	4.427	0.855	4.427	16.70	2.24	14.46
71	MAR 12	0.000	0.079	-0.079	-0.015	-0.079	0.00	0.40	-0.40
72	MAR 13	4.763	0.356	4.407	0.851	4.407	16.34	1.81	14.53
75	MAR 14	0.000	0.047	-0.047	-0.009	-0.047	0.00	0.24	-0.24
76	MAR 17	7.284	0.424	6.860	1.324	6.860	24.98	2.15	22.83
77	MAR 18	0.000	0.157	-0.157	-0.030	-0.157	0.00	0.80	-0.80
78	MAR 19	0.000	0.094	-0.094	-0.018	-0.094	0.00	0.48	-0.48
79	MAR 20	0.000	0.095	-0.095	-0.019	-0.095	0.00	0.49	-0.49
80	MAR 21	0.000	0.101	-0.101	-0.019	-0.101	0.00	0.51	-0.51
81	MAR 22	2.724	0.357	2.367	0.457	2.367	9.34	1.82	7.52
82	MAR 23	3.968	0.368	3.600	0.695	3.600	13.61	1.87	11.74
83	MAR 24	7.190	0.323	6.867	1.326	6.867	24.66	1.64	23.02
84	MAR 25	0.077	0.230	-0.153	-0.030	-0.153	0.26	1.17	-0.91
85	MAR 26	0.000	0.184	-0.184	-0.036	-0.184	0.00	0.93	-0.93
86	MAR 27	4.474	0.373	4.101	0.792	4.101	15.35	1.90	13.45
87	MAR 28	2.906	0.363	2.543	0.491	2.543	9.57	1.85	8.12
88	MAR 29	4.137	0.369	3.768	0.727	3.768	14.19	1.88	12.31
89	MAR 30	7.161	0.438	6.723	1.298	6.723	24.56	2.23	22.33
90	MAR 31	8.135	0.424	7.711	1.499	7.711	27.90	2.16	25.74
TOTAL		65.486	6.422	60.065	11.595	60.066	228.04	32.66	195.38

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - MAR. 1983

Table 5. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE -  
MARCH 1983Maintenance

	Hours	2
Repair Steam	Avg \$/h	10.00
Check Valve	Labor Cost (\$)	20.00
	Materials (\$)	
	Total (\$)	20.00
Scheduled - Clean	Hours	4
Receiver Tubes and	Avg \$/h	10.00
Collectors, Blowdown	Labor Cost (\$)	40.00
SSG	Materials (\$)	
Repair Collectors	Parts (\$)	
	Total (\$)	40.00
	Hours	
	Avg \$/h	
	Labor Cost (\$)	
	Materials (\$)	
	Parts (\$)	
	Total (\$)	
Total		\$60.00

Operation and Fixed Cost

Property Taxes (\$)	
Insurance (\$)	154.92
Parasitic Energy	kWh Used
	585*
	\$/kWh
	.059
	Total (\$)
	34.49
Total	\$189.41

TOTAL COST \$249.41

Fossil Fuel Savings	
	MIL-BTU (natural gas) 71.269*
	\$/MIL-BTU 3.43
Total	\$244.45
TOTAL SAVINGS	\$244.45

NET SAVINGS (\$4.96)

a 65% burner efficiency assumed.

\* Values Adjusted for March 8  
 Steam Production Which Were Not  
 Included in DAS Tables.

Table 1. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - APRIL 1983

Julian Day	Date	Status Code	Weather	Remarks
91	4/1	2	P	See Note 1
92	4/2	2	F	Low Feedwater Level
93	4/3	2	F	Low Oil Level
94	4/4	3	C	System Shut Down Due to Low Oil Level
95	4/5	-	-	Note 2
96	4/6	3	C	Note 3
97	4/7	3	S	
98	4/8	3	C	5W & 1E Overtemp. SW. Failed
99	4/9	2	F	Note 3, Main Pump Developed Oil Leak
100	4/10	-	-	Note 2
101	4/11	1	F	
102	4/12	1	P	Note 3
103	4/13	1	P	Washed 5W, 5E, 4E and 3E
104	4/14	1	F	
105	4/15	1	F	
106	4/16	-	-	Note 2
107	4/17	1	F	
108	4/18	-	-	Note 2
109	4/19	1	F	System Shut Off Twice Due to High Winds
110	4/20	1	P	
111	4/21	1	F	
112	4/22	1	P	System Off Once Due to High Winds
113	4/23	-	-	Note 2
114	4/24	-	-	Note 2
115	4/25	1	F	
116	4/26	1	F	
117	4/27	6	F	Refinery Shut Down
118	4/28	6	C	Refinery Shut Down
119	4/29	-	-	Note 2
120	4/30	-	-	Note 2

F: Fair

\*1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

\*\*3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant up

6: Solar system idle/Plant down

\* covers days when all systems are "up" and significant amounts of energy are delivered.

\*\* covers days when zero or very small amounts of energy were collected and/or delivered due to weather conditions.

NOTE 1: High winds caused damage to the North row of collectors. This row was isolated and the system operated on the other five rows throughout April.

NOTE 2: No operator

NOTE 3: Microprocessor malfunction

### III Operating Experience

High winds in the early morning of April 1, 1983 caused irreparable damage to four of the collectors. Locally high winds from the North aided by strong gusts damaged four of the collectors adjacent to the Drive Pylons. This row was isolated by closing the HTO valves at the East and West ends. The system continued to operate on the other 5 rows throughout April. A detailed explanation of this damage is outlined in a hot line report, dated April 12, 1983.

The system shut down several times during April due to low water level. This occurred almost simultaneously with a reduction in Refinery steam pressure. It appears that this reduced pressure allows the SSG to operate at a reduced boiling point. Consequently, feedwater is consumed in the SSG at a rate higher than the restricted feedwater line can supply. This condition can be alleviated by waiting until the Refinery resumes normal operating steam pressure. If this problem continues other alternatives will be considered during redesign.

The start up pump failed to operate properly and an electrical control problem is suspected. The system can be operated automatically with the main pump. This problem will be eliminated by the redesign now in progress.

Data Acquisition System (DAS) information was not recorded on April 1 & 24. This is not significant data since the system was not operational on these days. Also, due to the wind damage, the pyranometers were moved from row 6W to 5W.

Finally, the check valve at the Refinery tie-in continued to fail open. This appears to be due to a low differential pressure across the check valve and it is under investigation as part of the redesign.

## ENERGETICS CORPORATION

TIME		ENERGY BALANCE						EFFICIENCY	
JUL IAN	DAY	DATE	INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE	PIPING LOSSES -OPERA TIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM
			MIL-BTU	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU	%
92	APR 2	0.299	0.000	0.0000	0.	0.000	0.049	0.0	0.0
93	APR 3	0.463	0.067	0.0000	0.	0.000	0.088	14.5	0.0
94	APR 4	0.321	0.027	0.0000	0.	0.000	0.091	8.4	0.0
95	APR 5	0.338	0.000	0.0000	0.	0.000	0.061	0.0	0.0
96	APR 6	0.220	0.008	0.0000	0.	0.000	0.083	3.6	0.0
97	APR 7	0.476	0.144	0.0000	0.	0.000	0.126	30.2	0.0
98	APR 8	0.349	0.000	0.0000	0.	0.000	0.087	0.0	0.0
99	APR 9	0.259	0.000	0.0000	0.	0.000	0.039	0.0	0.0
100	APR10	0.568	0.000	0.0000	0.	0.000	0.083	0.0	0.0
101	APR11	5.058	4.203	3.9349	4088.	0.253	0.455	83.1	77.8
102	APR12	12.904	2.371	2.5991	2745.	0.172	0.359	18.4	20.1
103	APR13	7.540	2.095	1.1244	1199.	0.111	0.292	27.8	14.9
104	APR14	14.310	3.539	3.4475	3586.	0.253	0.398	24.7	24.1
105	APR15	17.307	3.740	4.3187	4459.	0.255	0.486	21.6	25.0
106	APR16	1.019	0.000	0.0000	0.	0.000	0.065	0.0	0.0
107	APR17	11.571	10.318	3.8368	3811.	0.165	0.344	89.2	33.2
108	APR18	1.095	0.000	0.0000	0.	0.000	0.066	0.0	0.0
109	APR19	16.855	4.046	4.4145	4495.	0.216	0.460	24.0	26.2
110	APR20	10.863	2.201	2.1011	2182.	0.167	0.326	20.3	19.3
111	APR21	16.620	3.276	4.2471	4315.	0.239	0.435	19.7	25.6
112	APR22	14.914	2.896	2.8611	2981.	0.247	0.430	19.4	19.2
113	APR23	0.918	0.000	0.0000	0.	0.000	0.070	0.0	0.0
115	APR25	17.071	4.824	2.9830	3263.	0.216	0.522	28.3	17.5
116	APR26	18.489	3.870	4.4988	4662.	0.253	0.519	20.9	24.3
117	APR27	4.695	1.763	0.0471	109.	0.021	0.221	37.5	1.0
118	APR28	0.869	0.000	0.0000	0.	-0.000	0.096	0.0	0.0
119	APR29	0.499	0.000	0.0000	0.	-0.001	0.093	0.0	0.0
120	APR30	0.633	0.000	0.0000	0.	0.000	0.090	0.0	0.0
TOTL/AVG		176.520	49.388	40.4150	41898.	2.566	6.433	28.0	22.9

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - APR, 1983

## ENERGETICS CORPORATION

TIME		ENERGY					DOLLARS		
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
		MIL-BTU	MIL-BTU	MIL-BTU	BARRELS OIL	MCF NAT GAS	\$	\$	\$
92	APR 2	0.000	0.049	-0.049	-0.009	-0.049	0.00	0.25	-0.25
93	APR 3	0.000	0.088	-0.088	-0.017	-0.088	0.00	0.45	-0.45
94	APR 4	0.000	0.091	-0.091	-0.018	-0.091	0.00	0.46	-0.46
95	APR 5	0.000	0.061	-0.061	-0.012	-0.061	0.00	0.31	-0.31
96	APR 6	0.000	0.083	-0.083	-0.016	-0.083	0.00	0.42	-0.42
97	APR 7	0.000	0.126	-0.126	-0.024	-0.126	0.00	0.64	-0.64
98	APR 8	0.000	0.087	-0.087	-0.017	-0.087	0.00	0.44	-0.44
99	APR 9	0.000	0.039	-0.039	-0.008	-0.039	0.00	0.20	-0.20
100	APR10	0.000	0.083	-0.083	-0.016	-0.083	0.00	0.42	-0.42
101	APR11	6.053	0.455	5.598	1.081	5.598	20.76	2.31	18.45
102	APR12	3.999	0.359	3.640	0.703	3.640	13.72	1.83	11.89
103	APR13	1.730	0.292	1.438	0.278	1.438	5.93	1.48	4.45
104	APR14	5.303	0.398	4.905	0.947	4.905	18.19	2.02	16.17
105	APR15	6.645	0.486	6.159	1.189	6.159	22.79	2.47	20.32
106	APR16	0.000	0.065	-0.065	-0.013	-0.065	0.00	0.33	-0.33
107	APR17	5.904	0.344	5.560	1.073	5.560	20.25	1.75	18.50
108	APR18	0.000	0.066	-0.066	-0.013	-0.066	0.00	0.34	-0.34
109	APR19	6.791	0.460	6.331	1.222	6.331	23.29	2.34	20.95
110	APR20	3.231	0.326	2.905	0.561	2.905	11.08	1.66	9.42
111	APR21	6.533	0.435	6.098	1.177	6.098	22.41	2.21	20.20
112	APR22	4.401	0.430	3.971	0.767	3.971	15.10	2.19	12.91
113	APR23	0.000	0.070	-0.070	-0.014	-0.070	0.00	0.35	-0.35
115	APR25	4.589	0.522	4.067	0.785	4.067	15.74	2.65	13.09
116	APR26	6.920	0.519	6.401	1.236	6.401	23.74	2.64	21.10
117	APR27	0.072	0.221	-0.149	-0.029	-0.149	0.25	1.12	-0.87
118	APR28	0.000	0.096	-0.096	-0.019	-0.096	0.00	0.49	-0.49
119	APR29	0.001	0.093	-0.092	-0.018	-0.092	0.00	0.48	-0.48
120	APR30	0.000	0.090	-0.090	-0.017	-0.090	0.00	0.46	-0.46
TOTAL		62.172	6.433	55.738	10.760	55.738	213.25	32.72	180.53

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - APR. 1983

Table 5. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE -  
APRIL 1983

Maintenance

Unscheduled	Hours	2
Adjusted Microprocessor	Avg \$/h	10.00
and replaced 5W	Labor Cost (\$)	20.00
tracker head	Materials (\$)	
	Total (\$)	20.00
Scheduled - Clean	Hours	4
Receiver Tubes and	Avg \$/h	10.00
Collectors, Blowdown	Labor Cost (\$)	40.00
SSG	Materials (\$)	
Repair Collectors	Parts (\$)	
	Total (\$)	40.00
	Hours	
	Avg \$/h	
	Labor Cost (\$)	
	Materials (\$)	
	Parts (\$)	
	Total (\$)	
Total		\$ 60.00

Operation and Fixed Cost

Property Taxes (\$)	
Insurance (\$)	\$ 154.92
Parasitic Energy	
kWh Used	555
\$/kWh	.059
Total (\$)	32.72
Total	\$ 187.64
TOTAL COST	\$ 247.64

Fossil Fuel Savings

MIL-BTU (natural gas)	62.172
\$/MIL-BTU	3.43
Total	\$ 213.24
TOTAL SAVINGS	\$ 213.24

NET SAVINGS (\$ 34.39)

a 65% burner efficiency assumed.

Table 1. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - May 1983

Julian Day	Date	Status Code	Weather	Remarks
121	5/1	3	-	Note 3
122	5/2	1	P	Note 1
123	5/3	1	F	
124	5/4	1	F	
125	5/5	1	F	
126	5/6	1	F	Note 1
127	5/7	3	-	Note 3
128	5/8	3	-	Note 3
129	5/9	1	P	
130	5/10	1	P	
131	5/11	1	F	
132	5/12	1	F	
133	5/13	3	-	Note 3
134	5/14	3	-	Note 3
135	5/15	3	-	Note 3
136	5/16	1	F	
137	5/17	1	P	Note 1
138	5/18	1	F	
139	5/19	3	-	Note 3
140	5/20	3	-	Note 3
141	5/21	3	-	Note 3
142	5/22	3	-	Note 3
143	5/23	1	F	
144	5/24	1	P	
145	5/25	1	P	Note 7
146	5/26	4	P	Note 4, 7
147	5/27	3	-	Note 3, 7
148	5/28	1	P	
149	5/29	3	-	Note 3
150	5/30	3	-	Note 3
151	5/31	1	C	Overcast - Drained SSG

F: Fair

1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

$$A = \frac{1, 3, 4, 6}{1 \text{ thru } 6} \times 100\% \quad U = \frac{(1, 4)}{(1, 3, 4, 6)} \times 100\%$$

Note 1: The system shut down automatically due to high winds

Note 3: Solar system not turned on

Note 4: Solar system tripped on high steam pressure, due to pressure tests at the Refinery

Note 7: DAS failed to record on cassette tape

III OPERATING EXPERIENCE

The system operated throughout the month of May with five of six rows operational. One row is down as a result of wind damage incurred during April.

The system shut down several days during the month automatically due to high winds. When wind speed and other determining factors returned to normal, the system restarted automatically.

On May 26, the system shut down due to high steam pressure. It was discovered that the Refinery had been performing tests that involved operating their boiler at a higher than normal pressure. The solar system is set to shut down at a steam pressure of 190 PSI. The system shut down and reset automatically when refinery steam pressure returned to normal. The Refinery has recently completed an expansion project and it is believed that pressure variations will soon return to normal.

Three days of May's performance data was lost due to an operational problem with DAS cassette tape, however, it appears to have been corrected.

## ENERGETICS CORPORATION

TIME		ENERGY BALANCE					EFFICIENCY	
JUL	IAN	INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE	PIPING LOSSES -OPERA TIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM
DAY	DATE	MIL-BTU	MIL-BTU	MIL-BTU LB/DAY	MIL-BTU	MIL-BTU	%	%
121	MAY 1	0.115	0.000	0.0000	0.	0.000	0.031	0.0
122	MAY 2	11.030	3.133	2.2847	2337.	0.132	0.320	28.4
123	MAY 3	19.158	4.319	4.8338	4991.	0.254	0.503	22.5
124	MAY 4	18.388	3.425	3.7955	3928.	0.252	0.524	18.6
125	MAY 5	19.263	3.922	4.5335	4668.	0.246	0.492	20.4
126	MAY 6	13.255	2.806	2.9772	3030.	0.187	0.357	21.2
127	MAY 7	1.480	0.000	0.0000	0.	0.000	0.065	0.0
128	MAY 8	0.998	0.000	0.0000	0.	0.000	0.067	0.0
129	MAY 9	13.571	3.843	2.0950	2193.	0.185	0.440	28.3
130	MAY 10	13.057	2.734	2.7010	2791.	0.166	0.377	20.9
131	MAY 11	15.401	2.963	3.7248	3865.	0.208	0.399	19.2
132	MAY 12	16.117	3.473	4.2813	4351.	0.211	0.402	21.5
133	MAY 13	1.386	0.000	0.0000	0.	0.000	0.068	0.0
134	MAY 14	0.964	0.000	0.0000	0.	0.000	0.081	0.0
135	MAY 15	1.385	0.000	0.0000	0.	0.000	0.068	0.0
136	MAY 16	17.973	4.279	3.5927	3777.	0.240	0.514	23.8
137	MAY 17	14.861	2.784	3.2508	3381.	0.213	0.396	18.7
138	MAY 18	19.029	3.779	4.6903	4818.	0.265	0.522	19.9
139	MAY 19	1.364	0.000	0.0000	0.	0.000	0.077	0.0
140	MAY 20	1.427	0.000	0.0000	0.	0.000	0.066	0.0
141	MAY 21	1.547	0.000	0.0000	0.	0.000	0.066	0.0
142	MAY 22	1.305	0.000	0.0000	0.	0.000	0.074	0.0
143	MAY 23	17.795	4.720	4.0344	4168.	0.242	0.511	26.5
144	MAY 24	5.688	1.877	0.6373	702.	0.070	0.182	33.0
148	MAY 28	5.041	0.585	0.8157	916.	0.077	0.163	11.6
149	MAY 29	0.832	0.000	0.0000	0.	0.000	0.063	0.0
150	MAY 30	0.904	0.000	0.0000	0.	0.000	0.068	0.0
151	MAY 31	0.166	0.000	0.0000	0.	0.000	0.059	0.0
TOTAL/AVG		233.501	48.642	48.2480	49915.	2.948	6.956	20.8
								20.7

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - MAY, 1983

ENERGETICS CORPORATION

TIME		ENERGY					DOLLARS		
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
		MIL-BTU	MIL-BTU	MIL-BTU	BARRELS OIL	MCF NAT GAS	\$	\$	\$
121	MAY 1	0.000	0.031	-0.031	-0.006	-0.031	0.00	0.16	-0.16
122	MAY 2	3.514	0.320	3.194	0.617	3.194	12.05	1.63	10.42
123	MAY 3	7.437	0.503	6.934	1.339	6.934	25.51	2.56	22.95
124	MAY 4	5.840	0.524	5.316	1.026	5.316	20.03	2.66	17.37
125	MAY 5	6.975	0.492	6.483	1.252	6.483	23.92	2.50	21.42
126	MAY 6	4.580	0.357	4.223	0.815	4.223	15.71	1.82	13.89
127	MAY 7	0.000	0.065	-0.065	-0.013	-0.065	0.00	0.33	-0.33
128	MAY 8	0.000	0.067	-0.067	-0.013	-0.067	0.00	0.34	-0.34
129	MAY 9	3.223	0.440	2.783	0.537	2.783	11.05	2.24	8.81
130	MAY 10	4.156	0.377	3.779	0.730	3.779	14.26	1.92	12.34
131	MAY 11	5.730	0.399	5.331	1.029	5.331	19.65	2.03	17.62
132	MAY 12	6.587	0.402	6.185	1.194	6.185	22.59	2.04	20.55
133	MAY 13	0.000	0.068	-0.068	-0.013	-0.068	0.00	0.35	-0.35
134	MAY 14	0.000	0.081	-0.081	-0.016	-0.081	0.00	0.41	-0.41
135	MAY 15	0.000	0.068	-0.068	-0.013	-0.068	0.00	0.34	-0.34
136	MAY 16	5.527	0.514	5.013	0.968	5.013	18.96	2.61	16.35
137	MAY 17	5.001	0.396	4.605	0.889	4.605	17.15	2.01	15.14
138	MAY 18	7.216	0.522	6.694	1.292	6.694	24.75	2.65	22.10
139	MAY 19	0.000	0.077	-0.077	-0.015	-0.077	0.00	0.39	-0.39
140	MAY 20	0.000	0.066	-0.066	-0.013	-0.066	0.00	0.34	-0.34
141	MAY 21	0.000	0.066	-0.066	-0.013	-0.066	0.00	0.34	-0.34
142	MAY 22	0.000	0.074	-0.074	-0.014	-0.074	0.00	0.38	-0.38
143	MAY 23	6.207	0.511	5.696	1.100	5.696	21.29	2.60	18.69
144	MAY 24	0.980	0.182	0.798	0.154	0.798	3.36	0.93	2.43
148	MAY 28	1.255	0.163	1.072	0.211	1.072	4.30	0.83	3.47
149	MAY 29	0.000	0.063	-0.063	-0.012	-0.063	0.00	0.32	-0.32
150	MAY 30	0.000	0.068	-0.068	-0.013	-0.068	0.00	0.35	-0.35
151	MAY 31	0.000	0.059	-0.059	-0.011	-0.059	0.00	0.30	-0.30
TOTAL		74.228	6.956	67.273	12.987	67.273	254.58	35.38	219.20

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - MAY, 1983

Table 5. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE -  
MAY 1983Maintenance

	Hours	
	Avg \$/h	
	Labor Cost (\$)	
	Materials (\$)	
	Total (\$)	
Scheduled - Clean Glass	Hours	4
Receiver Tubes and	Avg \$/h	10.00
Drain SSG.	Labor Cost (\$)	40.00
	Materials (\$)	
	Parts (\$)	
	Total (\$)	40.00
	Hours	
	Avg \$/h	
	Labor Cost (\$)	
	Materials (\$)	
	Parts (\$)	
	Total (\$)	
Total		\$ 40.00

Operation and Fixed Cost

Property Taxes (\$)		
Insurance (\$)		\$ 154.92
Parasitic Energy	kWh Used	600
	\$/kWh	.059
	Total (\$)	33.38
Total		\$ 190.30
TOTAL COST		\$ 230.30

Fossil Fuel Savings

MIL-BTU (natural gas)	74.228	
\$/MIL-BTU	3.43	
Total		\$ 254.60
TOTAL SAVINGS		\$ 254.60
NET SAVINGS		\$ 24.30

a 65% burner efficiency assumed.

Table 1. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - JUNE 1983

Julian Day	Date	Status Code	Weather	Remarks
152	6/1	3	-	Note 3
153	6/2	2	-	Note 2, wash collectors 3E, 4E and 5E
154	6/3	3	-	Note 3
155	6/4	2	F	Note 2, wash collectors 1E and 2E
156	6/5	3	-	Note 3
157	6/6	3	-	Note 3
158	6/7	1	F	Repair expansion tank relief valve
159	6/8	1	F	Replaced bypass solenoid on 2W hydraulic unit
160	6/9	1	C	Wash collectors 1W and 2W
161	6/10	1	C	Wash collectors 3W, 4W and 5W
162	6/11	3	-	Note 3
163	6/12	3	-	Note 3
164	6/13	1	F	
165	6/14	1	F	
166	6/15	1	C	Replace bypass solenoid on 5E hydraulic drive unit
167	6/16	3	-	Note 3
168	6/17	3	-	Note 3
169	6/18	3	-	Note 3
170	6/19	3	-	Note 3
171	6/20	1	F	4E down
172	6/21	1	F	4E down
173	6/22	1	F	Replace fuse in 4E track control board
174	6/23	1	C	Washed rows 3, 4 and 5 east and west
175	6/24	1	C	Washed rows 2E and 2W
176	6/25	3	-	Note 3
177	6/26	3	-	Note 3
178	6/27	1	F	DAS did not record
179	6/28	1	F	DAS did not record
180	6/29	1	F	DAS did not record
181	6/30	4	F	Note 4

F: Fair

1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

$$A = \frac{1, 3, 4, 6}{1 \text{ thru } 6} \times 100\% \quad U = \frac{(1, 4)}{(1, 3, 4, 6)} \times 100\%$$

Note 2: The relief valve located on top of the expansion tank leaked, resulting in loss of nitrogen blanket on HTO. Erratic pump operation occurs in this situation. Therefore, the system was not operated.

Note 3: Solar system not turned on.

Note 4 Solar system shut down automatically due to high steam pressure at the refinery.

III. OPERATING EXPERIENCE

The system operated in the month of June with five of six rows operational. Row 6E and 6W were damaged by high winds last April.

A bypass solenoid malfunctioned on two drive pylons (2W & 5E). These were replaced and the units restored to operational status with minimum downtime. Also a blown fuse resulted in 4E being down several days before this problem was diagnosed and repaired.

Two days of June's performance data failed to record on cassette tape. This was noted and corrected on site by the operator.

On June 30 the system automatically shut down due to high steam pressure in the Refinery process lines.

ENERGETICS CORPORATION

TIME		ENERGY BALANCE						EFFICIENCY	
JUL	IAN	INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE	PIPING LOSSES -OPERA TIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM	
DAY	DATE	MIL-BTU	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU	%	%
152	JUN 1	0.941	0.000	0.0000	0.	0.000	0.059	0.0	0.0
153	JUN 2	1.536	0.001	0.0000	0.	0.000	0.057	0.1	0.0
154	JUN 3	1.551	0.001	0.0000	0.	0.000	0.052	0.1	0.0
155	JUN 4	1.214	0.000	0.0000	0.	0.000	0.046	0.0	0.0
156	JUN 5	1.467	0.000	0.0000	0.	0.000	0.045	0.0	0.0
157	JUN 6	0.656	0.000	0.0000	0.	0.000	0.043	0.0	0.0
158	JUN 7	13.274	3.090	1.9513	2108.	0.160	0.384	23.3	14.7
159	JUN 8	14.175	2.847	3.2669	3375.	0.208	0.422	20.1	23.0
160	JUN 9	0.591	0.000	0.0000	0.	0.000	0.050	0.0	0.0
161	JUN 10	1.401	0.000	0.0000	0.	0.000	0.083	0.0	0.0
162	JUN 11	1.346	0.000	0.0000	0.	0.000	0.070	0.0	0.0
163	JUN 12	1.591	0.000	0.0000	0.	0.000	0.062	0.0	0.0
164	JUN 13	14.710	3.606	3.3319	3346.	0.167	0.422	24.5	22.7
165	JUN 14	17.782	3.859	4.4294	4557.	0.257	0.522	21.7	24.9
166	JUN 15	1.052	0.000	0.0000	0.	0.000	0.075	0.0	0.0
167	JUN 16	1.292	0.000	0.0000	0.	0.000	0.069	0.0	0.0
171	JUN 20	10.673	3.508	1.6182	1552.	0.080	0.299	32.9	15.2
172	JUN 21	16.158	3.293	2.8206	2916.	0.201	0.483	20.4	17.5
173	JUN 22	16.264	3.043	2.9048	2990.	0.203	0.515	18.7	17.9
174	JUN 23	1.250	0.000	0.0000	0.	0.000	0.081	0.0	0.0
175	JUN 24	2.225	1.295	0.0000	0.	0.000	0.192	58.2	0.0
176	JUN 25	1.573	0.000	0.0000	0.	0.000	0.078	0.0	0.0
177	JUN 26	1.647	0.000	0.0000	0.	0.000	0.081	0.0	0.0
178	JUN 27	0.010	0.000	0.0000	0.	0.000	0.025	0.0	0.0
179	JUN 28	3.127	0.321	0.7439	839.	0.079	0.100	10.3	23.8
180	JUN 29	14.112	2.905	2.2172	2325.	0.154	0.490	20.6	15.7
181	JUN 30	5.645	1.958	0.0330	93.	0.027	0.265	34.7	0.6
TOTL/AVG		147.261	29.727	23.3172	24101.	1.536	5.071	20.2	15.8

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - JUN, 1983

## ENERGETICS CORPORATION

TIME		ENERGY				DOLLARS			
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
		MIL-BTU	MIL-BTU	MIL-BTU	BARRELS OIL	MCF NAT GAS	\$	\$	\$
152	JUN 1	0.000	0.059	-0.059	-0.011	-0.059	0.00	0.30	-0.30
153	JUN 2	0.000	0.057	-0.057	-0.011	-0.057	0.00	0.29	-0.29
154	JUN 3	0.000	0.052	-0.052	-0.010	-0.052	0.00	0.26	-0.26
155	JUN 4	0.000	0.046	-0.046	-0.009	-0.046	0.00	0.23	-0.23
156	JUN 5	0.000	0.045	-0.045	-0.009	-0.045	0.00	0.23	-0.23
157	JUN 6	0.000	0.043	-0.043	-0.008	-0.043	0.00	0.22	-0.22
158	JUN 7	3.002	0.384	2.618	0.505	2.618	10.30	1.95	8.35
159	JUN 8	5.026	0.422	4.604	0.889	4.604	17.24	2.15	15.09
160	JUN 9	0.000	0.050	-0.050	-0.010	-0.050	0.00	0.26	-0.26
161	JUN 10	0.000	0.083	-0.083	-0.016	-0.083	0.00	0.42	-0.42
162	JUN 11	0.000	0.070	-0.070	-0.014	-0.070	0.00	0.35	-0.35
163	JUN 12	0.000	0.062	-0.062	-0.012	-0.062	0.00	0.31	-0.31
164	JUN 13	5.126	0.422	4.704	0.908	4.704	17.58	2.15	15.43
165	JUN 14	6.814	0.522	6.292	1.215	6.292	23.37	2.66	20.71
166	JUN 15	0.000	0.075	-0.075	-0.014	-0.075	0.00	0.38	-0.38
167	JUN 16	0.000	0.069	-0.069	-0.013	-0.069	0.00	0.35	-0.35
171	JUN 20	2.490	0.299	2.191	0.423	2.191	8.54	1.52	7.02
172	JUN 21	4.339	0.483	3.856	0.744	3.856	14.88	2.45	12.43
173	JUN 22	4.469	0.515	3.954	0.763	3.954	15.33	2.62	12.71
174	JUN 23	0.000	0.081	-0.081	-0.016	-0.081	0.00	0.41	-0.41
175	JUN 24	0.000	0.192	-0.192	-0.037	-0.192	0.00	0.98	-0.98
176	JUN 25	0.000	0.078	-0.078	-0.015	-0.078	0.00	0.40	-0.40
177	JUN 26	0.000	0.081	-0.081	-0.016	-0.081	0.00	0.41	-0.41
178	JUN 27	0.000	0.025	-0.025	-0.005	-0.025	0.00	0.13	-0.13
179	JUN 28	1.145	0.100	1.045	0.202	1.045	3.93	0.51	3.42
180	JUN 29	3.410	0.490	2.920	0.564	2.920	11.70	2.49	9.21
181	JUN 30	0.051	0.265	-0.214	-0.041	-0.214	0.17	1.35	-1.18
TOTAL		35.872	5.071	30.802	5.946	30.802	123.04	25.79	97.25

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - JUN. 1983

TABLE 5. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - JUNE 1983

Maintenance

Scheduled - Clean Collectors	Hours	8
	Avg \$/h	<u>10.00</u>
	Labor Cost (\$)	<u>80.00</u>
	Materials (\$)	
	Total (\$)	<u>80.00</u>
Unscheduled - Replaced two solenoid valves, replace fuse in row controls	Hours	4
	Avg \$/h	<u>10.00</u>
	Labor Cost (\$)	<u>40.00</u>
	Materials (\$)	
	Parts (\$)	
	Total (\$)	<u>40.00</u>
	Hours	
	Avg \$/h	
	Labor Cost (\$)	
	Materials (\$)	
	Parts (\$)	
	Total (\$)	
Total		\$ <u>120.00</u>

Operation and Fixed Cost

Property Taxes (\$)	
Insurance (\$)	<u>154.92</u>
Parasitic Energy	
	kWh Used
	\$/kWh
	Total (\$)
Total	\$ <u>180.71</u>
TOTAL COST	\$ <u>300.71</u>

Fossil Fuel Savings

MIL-BTU (natural gas)	<u>35.872</u>
\$/MIL-BTU	<u>3.43</u>
Total	\$ <u>123.04</u>
TOTAL SAVINGS	\$ <u>123.04</u>
NET SAVINGS	( \$ <u>177.67</u> )

a 65% burner efficiency assumed.

## ENERGETICS CORPORATION

Table 1. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - JULY, 1983

Julian Day	Date	Status Code	Weather	Remarks
182	7/1	4	F	
183	7/2	4	-	
184	7/3	4	-	
185	7/4	4	-	
186	7/5	1	F	Wash 5E & 5W
187	7/6	1	P	Note 1
188	7/7	1	F	Note 1, Note 7
189	7/8	1	P	System shut-down due to high steam pressure, Note 7
190	7/9	1	P	
191	7/10	3	-	Note 3
192	7/11	1	F	
193	7/12	1	C	
194	7/13	1	P	4E & 4W tracking improperly
195	7/14	1	C	Wash collectors
196	7/15	1	F	
197	7/16	1	F	
198	7/17	3	-	Note 3
199	7/18	1	P	Change nitrogen bottle, Note 7
200	7/19	1	P	Recharged A/C with freon
201	7/20	1	P	
202	7/21	1	P	
203	7/22	1	F	
204	7/23	3	-	Note 3
205	7/24	3	-	Note 3
206	7/25	1	P	
207	7/26	1	F	
208	7/27	1	P	
209	7/28	1	P	
210	7/29	1	P	
211	7/30	3	-	Note 3
212	7/31	3	-	Note 3

F: Fair

1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

$$A = \frac{1, 3, 4, 6}{1 \text{ thru } 6} \times 100\% \quad U = \frac{(1, 4)}{(1, 3, 4, 6)} \times 100\%$$

Note 1: Texas Energetics staff on site to perform pressure tests for piping upgrade and electrical changes for controls upgrade.

Note 3: Solar system not turned on.

Note 4: Refinery down for maintenance.

Note 7: DAS failed to record.

III. OPERATING EXPERIENCE

The system continued to operate in the month of July with five of six rows operational. Replacement parts for wind damaged collectors were ordered and installation is planned for August.

On July 8 the system automatically shut down due to high steam pressure at the refinery. The system was manually reset and resumed normal operation.

On July 13 row 4E and 4W were tracking improperly due to cloud cover. Apparently the row control tracking system on 4E and 4W began tracking bright clouds rather than the sun. As cloudiness continued the central control later stowed all of the collectors due to low insolation.

Several days of data were lost due to the DAS cassette tape not recording. This may be due to new operator error or quite possibly high temperature in the control room. The window A/C unit quit cooling and is in process of repair.

## ENERGETICS CORPORATION

TIME		ENERGY BALANCE						EFFICIENCY	
JUL IAN	DAY	INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE		PIPING LOSSES -OPERA TIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM
		DATE	MIL-BTU	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU	%
182	JUL 1	1.288	0.000	0.0000	0.	0.000	0.050	0.0	0.0
183	JUL 2	1.588	0.000	0.0000	0.	0.000	0.110	0.0	0.0
184	JUL 3	1.645	0.000	0.0000	0.	0.000	0.191	0.0	0.0
185	JUL 4	1.498	0.000	0.0000	0.	0.000	0.191	0.0	0.0
186	JUL 5	0.793	0.000	0.0000	0.	0.000	0.125	0.0	0.0
187	JUL 6	16.310	3.732	2.0460	2166.	0.205	0.621	22.9	12.5
188	JUL 7	0.479	0.000	0.0000	0.	0.000	0.053	0.0	0.0
189	JUL 8	0.150	0.000	0.0000	0.	0.000	0.036	0.0	0.0
190	JUL 9	15.397	3.465	2.8878	2976.	0.206	0.544	22.5	18.8
191	JUL 10	1.552	0.000	0.0000	0.	0.000	0.071	0.0	0.0
192	JUL 11	17.432	4.833	3.8423	3951.	0.234	0.539	27.7	22.0
193	JUL 12	5.338	2.318	0.2535	288.	0.041	0.283	43.4	4.7
194	JUL 13	13.575	3.494	1.6952	1892.	0.238	0.549	25.7	12.5
195	JUL 14	0.594	0.049	0.0000	0.	0.000	0.074	8.2	0.0
196	JUL 15	14.807	2.186	3.9242	4063.	0.244	0.390	14.8	26.5
197	JUL 16	14.413	3.203	3.6760	3811.	0.235	0.408	22.2	25.5
198	JUL 17	1.309	0.000	0.0000	0.	0.000	0.175	0.0	0.0
199	JUL 18	2.716	2.254	0.0000	0.	0.000	0.191	83.0	0.0
200	JUL 19	8.337	1.192	1.9736	2163.	0.157	0.269	14.3	23.7
201	JUL 20	16.109	3.704	3.5154	3635.	0.242	0.476	23.0	21.8
202	JUL 21	11.668	3.487	1.7193	1885.	0.146	0.476	29.9	14.7
203	JUL 22	15.962	3.794	3.3851	3490.	0.201	0.499	23.0	21.2
204	JUL 23	1.482	0.000	0.0000	0.	0.000	0.091	0.0	0.0
205	JUL 24	1.485	0.000	0.0000	0.	0.000	0.167	0.0	0.0
206	JUL 25	10.806	3.732	1.7833	1867.	0.147	0.436	34.5	16.5
207	JUL 26	16.251	4.036	3.4876	3564.	0.244	0.580	24.8	21.5
208	JUL 27	11.546	2.899	1.4826	1631.	0.157	0.565	25.1	12.8
209	JUL 28	12.377	2.949	2.3799	2508.	0.192	0.555	23.8	19.2
210	JUL 29	13.420	4.109	2.7275	2858.	0.199	0.546	30.6	20.3
211	JUL 30	1.369	0.000	0.0000	0.	0.000	0.168	0.0	0.0
212	JUL 31	0.425	0.000	0.0000	0.	0.000	0.163	0.0	0.0
TOTL/AVG		232.122	55.436	40.7793	42793.	3.089	9.589	23.9	17.6

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - JUL. 1983

## ENERGETICS CORPORATION

TIME		ENERGY					DOLLARS		
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
		MIL-BTU	MIL-BTU	MIL-BTU	BARRELS OIL	MCF NAT GAS	\$	\$	\$
182	JUL 1	0.000	0.050	-0.050	-0.010	-0.050	0.00	0.25	-0.25
183	JUL 2	0.000	0.110	-0.110	-0.021	-0.110	0.00	0.56	-0.56
184	JUL 3	0.000	0.191	-0.191	-0.037	-0.191	0.00	0.97	-0.97
185	JUL 4	0.000	0.191	-0.191	-0.037	-0.191	0.00	0.97	-0.97
186	JUL 5	0.000	0.125	-0.125	-0.024	-0.125	0.00	0.64	-0.64
187	JUL 6	3.149	0.621	2.528	0.488	2.528	10.80	3.16	7.64
188	JUL 7	0.000	0.053	-0.053	-0.010	-0.053	0.00	0.27	-0.27
189	JUL 8	0.000	0.036	-0.036	-0.007	-0.036	0.00	0.18	-0.18
190	JUL 9	4.443	0.544	3.899	0.753	3.899	15.24	2.77	12.47
191	JUL 10	0.000	0.071	-0.071	-0.014	-0.071	0.00	0.36	-0.36
192	JUL 11	5.912	0.539	5.373	1.037	5.373	20.28	2.74	17.54
193	JUL 12	0.390	0.283	0.107	0.021	0.107	1.34	1.44	-0.10
194	JUL 13	2.608	0.549	2.059	0.397	2.059	8.95	2.79	6.16
195	JUL 14	0.000	0.074	-0.074	-0.014	-0.074	0.00	0.37	-0.37
196	JUL 15	6.036	0.390	5.646	1.090	5.646	20.70	1.98	18.72
197	JUL 16	5.655	0.408	5.247	1.013	5.247	19.40	2.07	17.33
198	JUL 17	0.000	0.175	-0.175	-0.034	-0.175	0.00	0.89	-0.89
199	JUL 18	0.000	0.191	-0.191	-0.037	-0.191	0.00	0.97	-0.97
200	JUL 19	3.036	0.269	2.767	0.534	2.767	10.41	1.37	9.04
201	JUL 20	5.408	0.476	4.932	0.952	4.932	18.55	2.42	16.13
202	JUL 21	2.646	0.476	2.170	0.419	2.170	9.08	2.42	6.66
203	JUL 22	5.208	0.499	4.709	0.909	4.709	17.86	2.54	15.32
204	JUL 23	0.000	0.091	-0.091	-0.018	-0.091	0.00	0.46	-0.46
205	JUL 24	0.000	0.167	-0.167	-0.032	-0.167	0.00	0.85	-0.85
206	JUL 25	2.744	0.436	2.308	0.446	2.308	9.41	2.22	7.19
207	JUL 26	5.366	0.580	4.786	0.924	4.786	18.41	2.95	15.46
208	JUL 27	2.281	0.565	1.716	0.331	1.716	7.82	2.87	4.95
209	JUL 28	3.661	0.555	3.106	0.600	3.106	12.56	2.83	9.73
210	JUL 29	4.196	0.546	3.650	0.705	3.650	14.39	2.78	11.61
211	JUL 30	0.000	0.168	-0.168	-0.032	-0.168	0.00	0.86	-0.86
212	JUL 31	0.000	0.163	-0.163	-0.031	-0.163	0.00	0.83	-0.83
TOTAL		62.739	9.589	53.147	10.260	53.147	215.20	48.77	166.43

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - JUL, 1983

Table 5. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - JULY 1983

Maintenance

Scheduled - Clean Collectors	Hours	4
	Avg \$/h	<u>10.00</u>
	Labor Cost (\$)	<u>40.00</u>
	Materials (\$)	
	Total (\$)	<u>40.00</u>
	Hours	
	Avg \$/h	
	Labor Cost (\$)	
	Materials (\$)	
	Parts (\$)	
	Total (\$)	
	Hours	
	Avg \$/h	
	Labor Cost (\$)	
	Materials (\$)	
	Parts (\$)	
	Total (\$)	
Total		\$ <u>40.00</u>

Operation and Fixed Cost

Property Taxes (\$)		
Insurance (\$)		<u>154.92</u>
Parasitic Energy	kWh Used	<u>1004</u>
	\$/kWh	<u>.059</u>
	Total (\$)	<u>59.21</u>
Total		\$ <u>214.13</u>
TOTAL COST		\$ <u>254.13</u>

Fossil Fuel Savings

MIL-BTU (natural gas)	<u>76.17*</u>
\$/MIL-BTU	<u>3.43</u>
Total	\$ <u>261.26</u>
TOTAL SAVINGS	<u>261.26</u>
NET SAVINGS	<u>7.13</u>

a 65% burner efficiency assumed.

\* Savings adjusted to account for steam delivered but not recorded by DAS

Table 1. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - AUGUST, 1983

Julian Day	Date	Status Code	Weather	Remarks
213	8/1	1	P	
214	8/2	1	F	
215	8/3	1	P	
216	8/4	1	F	
217	8/5	1	C	
218	8/6	1	PP	
219	8/7	1	P	
220	8/8	1	P	
221	8/9	2	F	System down for electrical upgrade work
222	8/10	2	R	" " " "
223	8/11	3		Note 3
224	8/12	3		"
225	8/13	3		"
226	8/14	3		"
227	8/15	3		"
228	8/16	3		"
229	8/17	3		"
230	8/18	3		"
231	8/19	3		"
232	8/20	4		Note 4
233	8/21	4		"
234	8/22	4		Inspect new collectors
235	8/23	4		Install new collectors
236	8/24	4		Install new collectors
237	8/25	4		Install receiver tube 6E
238	8/26	4		Note 4
239	8/27	4		"
240	8/28	4		"
241	8/29	4		"
242	8/30	4		"
243	8/31	1	C	Cleaned collectors 3E, 2E, 1E, & 1W

F: Fair

1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

$$A = \frac{1, 3, 4, 6}{1 \text{ thru } 6} \times 100\% \quad U = \frac{(1, 4)}{(1, 3, 4, 6)} \times 100\%$$

Note 3: Solar system not turned on - no operator.

Note 4: Refinery down for maintenance.

Note 7: DAS not operated from Aug. 11 through Aug. 28.

# ENERGETICS CORPORATION

## III. OPERATING EXPERIENCE

The system continued to operate in the first week of August with five of six rows operational. Replacement parts for wind damaged collectors were received and installation was completed in August.

The window AC unit was repaired but the DAS was not operated most of August due to loss of operator and refinery maintenance shutdown from August 11 through August 28.

Construction activities included hiring a temporary site crew for collector repair. All twelve collectors on the north row were removed, four new collectors were installed adjacent to the drive pylons and the undamaged collectors reinstalled. Receiver assemblies for 6 collectors were reinstalled and drive unit operation was restored. The other 6 collectors are awaiting modified retainers and new seals for qualification testing before the north row can be restored to operation.

Other construction activities included the successful installation of a search mode tracker board on drive unit row 4W and a new central rotating light switch at the central control.

Operational time was reduced in August due to shutdown for electrical installation, refinery maintenance shutdown and loss of the summer operator.

## ENERGETICS CORPORATION

TIME		ENERGY BALANCE						EFFICIENCY	
JUL IAN	DAY	INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE		PIPING LOSSES -OPERA TIONAL	PARA STIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM
		DATE	MIL-BTU	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU	%
213	AUG 1	11.574	3.658	1.6894	1897.	0.196	0.444	31.6	14.6
214	AUG 2	15.550	3.905	3.2144	3358.	0.243	0.521	25.1	20.7
215	AUG 3	8.470	2.442	0.6248	765.	0.116	0.392	28.8	7.4
216	AUG 4	16.689	4.201	3.8395	3978.	0.245	0.560	25.2	23.0
217	AUG 5	3.318	1.919	0.0000	0.	0.000	0.263	57.8	0.0
218	AUG 6	12.696	3.753	2.2675	2463.	0.196	0.484	29.6	17.9
219	AUG 7	0.777	0.000	0.0000	0.	0.000	0.082	0.0	0.0
220	AUG 8	11.984	3.231	1.5486	1677.	0.162	0.515	27.0	12.9
221	AUG 9	1.135	0.737	0.0000	0.	0.000	0.163	64.9	0.0
222	AUG 10	1.083	0.000	0.0000	0.	0.000	0.045	0.0	0.0
241	AUG 29	0.552	0.000	0.0000	0.	0.000	0.049	0.0	0.0
242	AUG 30	1.245	0.041	0.0000	0.	0.000	0.123	3.3	0.0
243	AUG 31	0.981	0.000	0.0000	0.	0.000	0.097	0.0	0.0
TOTL/AVG		86.054	23.887	13.1842	14139.	1.157	3.738	27.8	15.3

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - AUG. 1983

ENERGETICS CORPORATION

TIME		ENERGY					DOLLARS		
JUL IAN	DAY	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
		MIL-BTU	MIL-BTU	MIL-BTU	BARRELS OIL	MCF NAT GAS	\$	\$	\$
213	AUG 1	2.601	0.444	2.157	0.416	2.157	8.92	2.26	6.66
214	AUG 2	4.947	0.521	4.426	0.854	4.426	16.97	2.65	14.32
215	AUG 3	0.961	0.392	0.569	0.110	0.569	3.30	1.99	1.31
216	AUG 4	5.906	0.560	5.346	1.032	5.346	20.26	2.85	17.41
217	AUG 5	0.000	0.263	-0.263	-0.051	-0.263	0.00	1.34	-1.34
218	AUG 6	3.489	0.484	3.005	0.580	3.005	11.97	2.46	9.51
219	AUG 7	0.000	0.082	-0.082	-0.016	-0.082	0.00	0.42	-0.42
220	AUG 8	2.383	0.515	1.868	0.361	1.868	8.17	2.62	5.55
221	AUG 9	0.000	0.163	-0.163	-0.031	-0.163	0.00	0.83	-0.83
222	AUG 10	0.000	0.045	-0.045	-0.009	-0.045	0.00	0.23	-0.23
241	AUG 29	0.000	0.049	-0.049	-0.009	-0.049	0.00	0.25	-0.25
242	AUG 30	0.000	0.123	-0.123	-0.024	-0.123	0.00	0.63	-0.63
243	AUG 31	0.000	0.097	-0.097	-0.019	-0.097	0.00	0.49	-0.49
TOTAL		20.287	3.738	16.549	3.195	16.549	69.59	19.01	50.58

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - AUG. 1983

Table 5. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - August 1983

Maintenance

Scheduled - Clean	Hours	4
Collectors	Avg \$/h	<u>10.00</u>
	Labor Cost (\$)	<u>40.00</u>
	Materials (\$)	
	Total (\$)	<u>40.00</u>
	Hours	
	Avg \$/h	
	Labor Cost (\$)	
	Materials (\$)	
	Parts (\$)	
	Total (\$)	
	Hours	
	Avg \$/h	
	Labor Cost (\$)	
	Materials (\$)	
	Parts (\$)	
	Total (\$)	
Total		<u>\$ 40.00</u>

Operation and Fixed Cost

Property Taxes (\$)		
Insurance (\$)		<u>154.92</u>
Parasitic Energy	kWh Used	<u>322</u>
	\$/kWh	<u>.059</u>
	Total (\$)	<u>19.01</u>
Total		<u>\$ 173.93</u>
<b>TOTAL COST</b>		<u>\$ 213.92</u>

Fossil Fuel Savings

MIL-BTU (natural gas)	<u>20.29</u>	
\$/MIL-BTU	<u>3.43</u>	
Total		<u>\$ 69.59</u>
<b>TOTAL SAVINGS</b>		<u>\$ 69.59</u>
<b>NET SAVINGS</b>		<u>( \$144.34 )</u>

a 65% burner efficiency assumed.

Table 1. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - September, 1983

Julian Day	Date	Status Code	Weather	Remarks
244	9/1	3		
245	9/2	3		
246	9/3	3		
247	9/4	2	F	System tripped on low oil level
248	9/5	3		
249	9/6	3		
250	9/7	3		
251	9/8	3		
252	9/9	3		
253	9/10	1	C	Washed Collectors
254	9/11	1	C	" "
255	9/12	2		Note 2
256	9/13	2		"
257	9/14	2		"
258	9/15	2		"
259	9/16	2		"
260	9/17	2		"
261	9/18	2		"
262	9/19	2		"
263	9/20	2		"
264	9/21	2		"
265	9/22	2		"
266	9/23	2		"
267	9/24	2		"
268	9/25	2		"
269	9/26	2		"
270	9/27	2	P	"
271	9/28	2	P	
272	9/29	2	C	Note 7
273	9/30	2	R	Note 7

F: Fair

1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

$$A = \frac{1, 3, 4, 6}{1 \text{ thru } 6} \times 100\% \quad U = \frac{(1, 4)}{(1, 3, 4, 6)} \times 100\%$$

Note 2: Texas Energetics staff on site to perform piping upgrade and electrical changes.

Note 3: Solar system not turned on - no operator.

Note 7: DAS failed to record.

### III. OPERATING EXPERIENCE

The system did not operate in the month of September mainly due to shutdown for piping upgrade.

The DAS continued to function throughout September except several days of data were lost due to the DAS cassette tape not recording.

Construction: The system was shut down on September 12, 1983 for piping upgrade. Insulation and jacketing were removed as needed from the collector field and the equipment room piping. Valves on each end of collector rows were closed off to prevent receiver tube drainage. Heat transfer oil (HTO) was then drained from the system at the expansion tank, the Y-Strainers and the 2 inch pipe headers in the collector field. Almost 5 drums of HTO were recovered for reuse.

Valves, flanged pipe sections, the existing HTO pumps and filling drum were removed from the equipment room before the welder arrived. Field piping was cut and removed in preparation for the piping changes. Approximately 1 barrel of oil was lost during the piping removal.

Energetics personnel cleaned up the equipment room, installed the new centrifugal pump and laid out the prefabricated piping components. Welders completed the equipment room and collector field piping installation per Energetics supervision in about 3 days. Welds were visually inspected, alignments and supports checked and preparations were undertaken for pressure testing and refilling.

A pneumatic pressure test was performed on the HTO piping system on September 20, 1983. Preparations for this included filling the shaft seal section of the pump with HTO (per vendor directions) and closing valves to isolate the expansion tank. Flanged fittings were wrapped with masking tape and a hole punched in the top to aid in bubble testing. The welder provided an air compressor and the system was charged to 100 psig. All welds were checked by soap solution bubble testing. No leaks were observed in either welds or flanged connections except at a Y-strainer gasket. This gasket was replaced and HTO was pumped back into the system at the expansion tank and collector field headers.

While awaiting receipt of the proper motor starter, the modified retainer assemblies with new seals were installed on row 6W. Pipe supports to the collector field were also modified several places to reduce heat losses.

Construction activities for the month were concluded on September 29 with the electrician installing the new motor starter and circuit breakers and rewiring from the circuit breaker box to the motor. The new starter was later modified for "hand-off-auto" operation and larger heater coils.

## ENERGETICS CORPORATION

TIME		ENERGY BALANCE					EFFICIENCY		
JUL IAN		INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE	PIPING LOSSES -OPERA TIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM	
		DAY	DATE	MIL-BTU	MIL-BTU	MIL-BTU LB/DAY	MIL-BTU	MIL-BTU	
244	SEP 1	0.869	0.000	0.0000	0.	0.000	0.072	0.0	0.0
245	SEP 2	0.924	0.000	0.0000	0.	0.000	0.077	0.0	0.0
246	SEP 3	0.890	0.000	0.0000	0.	0.000	0.084	0.0	0.0
247	SEP 4	0.912	0.000	0.0000	0.	0.000	0.054	0.0	0.0
248	SEP 5	0.697	0.000	0.0000	0.	0.000	0.059	0.0	0.0
249	SEP 6	0.647	0.012	0.0000	0.	0.000	0.058	1.9	0.0
250	SEP 7	0.691	0.000	0.0000	0.	0.000	0.061	0.0	0.0
251	SEP 8	0.541	0.000	0.0000	0.	0.000	0.072	0.0	0.0
252	SEP 9	0.699	0.003	0.0000	0.	0.000	0.058	0.4	0.0
253	SEP10	0.637	0.000	0.0000	0.	0.000	0.058	0.0	0.0
254	SEP11	0.193	0.000	0.0000	0.	0.000	0.032	0.0	0.0
255	SEP12	0.151	0.000	0.0000	0.	0.000	0.036	0.0	0.0
256	SEP13	0.277	0.000	0.0000	0.	0.000	0.031	0.0	0.0
259	SEP16	0.553	0.000	0.0000	0.	0.000	0.022	0.0	0.0
260	SEP17	0.679	0.000	0.0000	0.	0.000	0.038	0.0	0.0
261	SEP18	0.677	0.000	0.0000	0.	0.000	0.035	0.0	0.0
262	SEP19	0.652	0.000	0.0000	0.	0.000	0.038	0.0	0.0
263	SEP20	0.396	0.000	0.0000	0.	0.000	0.036	0.0	0.0
264	SEP21	0.384	0.000	0.0000	0.	0.000	0.032	0.0	0.0
265	SEP22	0.547	0.000	0.0000	0.	0.000	0.025	0.0	0.0
266	SEP23	0.539	0.000	0.0000	0.	0.000	0.040	0.0	0.0
267	SEP24	0.510	0.000	0.0000	0.	0.000	0.040	0.0	0.0
268	SEP25	0.555	0.000	0.0000	0.	0.000	0.040	0.0	0.0
269	SEP26	0.530	0.000	0.0000	0.	0.000	0.040	0.0	0.0
270	SEP27	0.087	0.000	0.0000	0.	-0.007	0.020	0.0	0.0
271	SEP28	0.017	0.000	0.0000	0.	0.000	0.020	0.0	0.0
TOTAL/AVG		14.253	0.015	0.0069	1.	-0.007	1.209	0.1	0.0

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - SEP. 1983

## ENERGETICS CORPORATION

TIME		ENERGY					DOLLARS		
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
		MIL-BTU	MIL-BTU	MIL-BTU	BARRELS OIL	MCF NAT GAS	\$	\$	\$
244	SEP 1	0.000	0.072	-0.072	-0.014	-0.072	0.00	0.37	-0.37
245	SEP 2	0.000	0.077	-0.077	-0.015	-0.077	0.00	0.39	-0.39
246	SEP 3	0.000	0.084	-0.084	-0.016	-0.084	0.00	0.43	-0.43
247	SEP 4	0.000	0.054	-0.054	-0.010	-0.054	0.00	0.28	-0.28
248	SEP 5	0.000	0.059	-0.059	-0.011	-0.059	0.00	0.30	-0.30
249	SEP 6	0.000	0.088	-0.088	-0.017	-0.088	0.00	0.45	-0.45
250	SEP 7	0.000	0.061	-0.061	-0.012	-0.061	0.00	0.31	-0.31
251	SEP 8	0.000	0.072	-0.072	-0.014	-0.072	0.00	0.37	-0.37
252	SEP 9	0.000	0.058	-0.058	-0.011	-0.058	0.00	0.29	-0.29
253	SEP10	0.000	0.058	-0.058	-0.011	-0.058	0.00	0.30	-0.30
254	SEP11	0.000	0.032	-0.032	-0.006	-0.032	0.00	0.16	-0.16
255	SEP12	0.000	0.036	-0.036	-0.007	-0.036	0.00	0.18	-0.18
256	SEP13	0.000	0.031	-0.031	-0.006	-0.031	0.00	0.16	-0.16
257	SEP16	0.000	0.022	-0.022	-0.004	-0.022	0.00	0.11	-0.11
260	SEP17	0.000	0.038	-0.038	-0.007	-0.038	0.00	0.20	-0.20
261	SEP18	0.000	0.035	-0.035	-0.007	-0.035	0.00	0.19	-0.19
262	SEP19	0.000	0.038	-0.038	-0.007	-0.038	0.00	0.19	-0.19
263	SEP20	0.000	0.036	-0.036	-0.007	-0.036	0.00	0.18	-0.18
264	SEP21	0.000	0.032	-0.032	-0.006	-0.032	0.00	0.16	-0.16
265	SEP22	0.000	0.025	-0.025	-0.005	-0.025	0.00	0.13	-0.13
266	SEP23	0.000	0.040	-0.040	-0.008	-0.040	0.00	0.20	-0.20
267	SEP24	0.000	0.040	-0.040	-0.008	-0.040	0.00	0.20	-0.20
268	SEP25	0.000	0.040	-0.040	-0.008	-0.040	0.00	0.20	-0.20
269	SEP26	0.000	0.040	-0.040	-0.008	-0.040	0.00	0.20	-0.20
270	SEP27	0.011	0.020	-0.009	-0.002	-0.009	0.04	0.10	-0.06
271	SEP28	0.000	0.020	-0.020	-0.004	-0.020	0.00	0.10	-0.10
TOTAL/AVG		0.00	1.208	-1.208	-0.235	±1.208	0.00	6.14	-6.14

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - SEP. 1983

ENERGETICS CORP.

Table 5. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - September 1983

Maintenance

Hours	4
Avg \$/h	<u>10.00</u>
Labor Cost (\$)	<u>40.00</u>
Materials (\$)	<u></u>
Total (\$)	<u>40.00</u>
Hours	<u></u>
Avg \$/h	<u></u>
Labor Cost (\$)	<u></u>
Materials (\$)	<u></u>
Parts (\$)	<u></u>
Total (\$)	<u></u>
Hours	<u></u>
Avg \$/h	<u></u>
Labor Cost (\$)	<u></u>
Materials (\$)	<u></u>
Parts (\$)	<u></u>
Total (\$)	<u></u>
Total	<u>\$ 40.00</u>

Operation and Fixed Cost

Property Taxes (\$)	<u></u>	
Insurance (\$)	<u>154.92</u>	
Parasitic Energy	kWh Used	104
	\$/kWh	.059
	Total (\$)	<u>6.14</u>
Total	<u>\$ 161.06</u>	
TOTAL COST	<u>\$ 201.06</u>	

Fossil Fuel Savings

MIL-BTU (natural gas)	<u>-0-</u>
\$/MIL-BTU	<u>3.43</u>

Total	<u>\$ -0-</u>
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TOTAL SAVINGS	<u>\$ -0-</u>
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NET SAVINGS	<u>(\$ 201.06)</u>
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a 65% burner efficiency assumed.

Table 1. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - October 1983

Julian Day	Date	Status Code	Weather	Remarks
274	10/1	2	-	Note 2,7/
275	10/2	2	-	Note 2,7
276	10/3	2	C	Note 2,7 cleaned glass tubes, washed 1,2,3W
277	10/4	2	P	Note 2,7
278	10/5	2	F	Note 2,7
279	10/6	2	-	Note 2,7
280	10/7	2	-	Note 2,7
281	10/8	2	-	Note 2,7
282	10/9	2	-	Note 2,7
283	10/10	2	P	Note 2,7 washed 1E, 2E, 3E mirrors
284	10/11	2	F	Note 2,7 pump motor overload at hi flow
285	10/12	2	F	Note 2,7 ODAS repairs, turned pump impeller
286	10/13	1	F	Note 7, 6W not tracking, flow switch malfunc.
287	10/14	1	P	6W down
288	10/15	1	-	Note 3
289	10/16	3	-	Note 3
290	10/17	3	C	6W down
291	10/18	1	C	" "
292	10/19	1	C	" "
293	10/20	1	C	" "
294	10/21	1	F	6W down
295	10/22	3	-	Note 3
296	10/23	3	-	Note 3
297	10/24	1	F	Repair 6W - afternoon
298	10/25	1	C	Insulated new piping in mech. room.
299	10/26	1	P	
300	10/27	1	C	Search mode tracker operational on 4W
301	10/28	1	C	
302	10/29	1	F	Weekend operator started
303	10/30	1	C	
304	10/31	1	C	

F: Fair

1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

$$A = \frac{1, 3, 4, 6}{1 \text{ thru } 6} \times 100\% \quad U = \frac{(1, 4)}{(1, 3, 4, 6)} \times 100\%$$

Note 2: Continuation of piping upgrade site work

Note 3: Solar energy system not turned on - no operator

Note 7: DAS failed to record

III. OPERATING EXPERIENCE (See table 1)

The system was restored to operational status on October 13th, 1983. Start up problems associated with the piping upgrade were encountered and resolved early in the month.

As a result of several weeks of shutdown, some collector drive units did not resume operation properly. After some operation time and cycling of the hydraulics, all units did resume operation. The tracker head on row 6W had a damaged cable. The drive unit was down until October 24th before the problem was identified and repaired.

The DAS system failed to record on the cassette tape for approximately the first two weeks in October. This operation problem was repaired on October 12th and data gathering resumed.

IV. PERFORMANCE

A. Monthly Summary (See tables 2 and 3)

The availability of the solar system was 61% and the utilization factor was 79%. Calculations for energy collected and collector array efficiency have been revised to accomodate the piping upgrade (see figure 1 for new configuration). Downtime for the piping upgrade contributed to the low utilization.

The monthly performance report is summarized in tables 2 and 3. These figures show a gross savings of 31.3 MBTU of natural gas savings by the system. Gross fossil fuel savings were \$117.37 using a boiler efficiency of 65% (including idle and line losses) and a revised natural gas cost of \$3.75 per million BTU.

Construction: Insulation was completed in the mechanical equipment room. Site cleanup was completed and the unneeded pumps, motors, starters and valves were given to Southern Union Refinery for use in an oil reclamation project.

Summary

System operation, data acquisition and reporting resumed with steam production on October 13, 1983. Some startup problems were encountered but these have been resolved with the system now producing steam on a regular basis. Performance seems improved and will be characterized in more detail in next month's report.

ENERGETICS CORPORATION

TIME		ENERGY BALANCE						EFFICIENCY	
JUL IAN		INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE		PIPING LOSSES -OPERA TIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM
		DAY	DATE	MIL-BTU	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU
285	OCT12	0.026	0.000	0.0000	0.	0.000	0.101	0.0	0.0
286	OCT13	13.661	0.000	0.0000	0.	0.176	0.165	0.0	0.0
287	OCT14	14.355	0.377	3.0457	2990.	0.176	0.231	2.6	21.2
288	OCT15	0.313	0.000	0.0000	0.	0.000	0.087	0.0	0.0
289	OCT16	0.306	0.000	0.0000	0.	0.000	0.081	0.0	0.0
290	OCT17	0.104	0.000	0.0000	0.	0.000	0.082	0.0	0.0
291	OCT18	0.209	0.000	0.0000	0.	0.000	0.153	0.0	0.0
292	OCT19	0.049	0.000	0.0000	0.	0.000	0.117	0.0	0.0
293	OCT20	0.106	0.000	0.0000	0.	0.000	0.092	0.0	0.0
294	OCT21	17.191	3.813	3.7919	3675.	0.183	0.139	22.2	22.1
295	OCT22	0.291	0.000	0.0000	0.	0.000	0.197	0.0	0.0
296	OCT23	0.261	0.000	0.0000	0.	0.000	0.195	0.0	0.0
297	OCT24	17.201	4.210	4.3812	4317.	0.213	0.209	24.5	25.5
298	OCT25	0.001	0.000	0.0000	0.	0.000	0.025	0.0	0.0
299	OCT26	9.175	1.647	1.2364	1232.	0.089	0.164	18.0	13.5
300	OCT27	0.190	0.000	0.0000	0.	0.000	0.159	0.0	0.0
301	OCT28	0.197	0.000	0.0000	0.	0.000	0.218	0.0	0.0
302	OCT29	15.604	4.305	4.0384	4084.	0.215	0.184	27.6	25.9
303	OCT30	0.113	0.000	0.0000	0.	0.000	0.158	0.0	0.0
304	OCT31	0.170	0.000	0.0000	0.	0.000	0.229	0.0	0.0
TOTL/AVG		89.524	14.352	20.3415	20132.	1.052	2.985	16.0	22.7

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - OCT. 1983

## ENERGETICS CORPORATION

TIME		ENERGY				DOLLARS			
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
		MIL-BTU	MIL-BTU	MIL-BTU	BARRELS OIL	MCF NAT GAS	\$	\$	\$
285	OCT12	0.000	0.101	-0.101	-0.019	-0.101	0.00	0.51	-0.51
286	OCT13	5.919	0.165	5.754	1.111	5.754	22.20	0.84	21.36
287	OCT14	4.686	0.231	4.455	0.860	4.455	17.57	1.17	16.40
288	OCT15	0.000	0.087	-0.087	-0.017	-0.087	0.00	0.44	-0.44
289	OCT16	0.000	0.081	-0.081	-0.016	-0.081	0.00	0.41	-0.41
290	OCT17	0.000	0.082	-0.082	-0.016	-0.082	0.00	0.42	-0.42
291	OCT18	0.000	0.153	-0.153	-0.030	-0.153	0.00	0.78	-0.78
292	OCT19	0.000	0.117	-0.117	-0.023	-0.117	0.00	0.60	-0.60
293	OCT20	0.000	0.092	-0.092	-0.018	-0.092	0.00	0.47	-0.47
294	OCT21	5.834	0.139	5.695	1.099	5.695	21.88	0.71	21.17
295	OCT22	0.000	0.197	-0.197	-0.038	-0.197	0.00	1.00	-1.00
296	OCT23	0.000	0.195	-0.195	-0.038	-0.195	0.00	0.99	-0.99
297	OCT24	6.741	0.209	6.532	1.261	6.532	25.28	1.06	24.22
298	OCT25	0.000	0.025	-0.025	-0.005	-0.025	0.00	0.13	-0.13
299	OCT26	1.903	0.164	1.739	0.336	1.739	7.14	0.83	6.31
300	OCT27	0.000	0.159	-0.159	-0.031	-0.159	0.00	0.81	-0.81
301	OCT28	0.000	0.218	-0.218	-0.042	-0.218	0.00	1.11	-1.11
302	OCT29	6.213	0.184	6.029	1.164	6.029	23.30	0.94	22.36
303	OCT30	0.000	0.158	-0.158	-0.031	-0.158	0.00	0.80	-0.80
304	OCT31	0.000	0.229	-0.229	-0.044	-0.229	0.00	1.16	-1.16
TOTAL		31.296	2.985	28.310	5.465	28.310	117.37	15.18	102.19

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - OCT, 1983

Table 5. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - October, 1983

Maintenance

Hours	4
Avg \$/h	10.00
Labor Cost (\$)	40.00
Materials (\$)	
Total (\$)	40.00
Hours	
Avg \$/h	
Labor Cost (\$)	
Materials (\$)	
Parts (\$)	
Total (\$)	
Hours	
Avg \$/h	
Labor Cost (\$)	
Materials (\$)	
Parts (\$)	
Total (\$)	
Total	\$ 40.00

Operation and Fixed Cost

Property Taxes (\$)	
Insurance (\$)	154.92
Parasitic Energy	kWh Used
	257
	\$/kWh
	.059
	Total (\$)
	15.18
Total	\$ 170.10
TOTAL COST	\$ 210.10

Fossil Fuel Savings	MIL-BTU (natural gas)	31.30
	\$/MIL-BTU	3.75
Total		\$ 117.37
TOTAL SAVINGS		\$ 117.37
NET SAVINGS		(\$92.72)

a 65% burner efficiency assumed.

Table 1. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - November 1983

Julian Day	Date	Status Code	Weather	Remarks
305	11/1	1	P	1E, 1W, 3E & 5E not tracking accurately
306	11/2	1	C	
307	11/3	1	C	
308	11/4	1	C	
309	11/5	1	C	
310	11/6	1	C	
311	11/7	1	F	1W down, leaking hydraulic fluid
312	11/8	1	F	
313	11/9	1	F	
314	11/10	1	F	
315	11/11	1	F	
316	11/12	1	F	
317	11/13	1	F	
318	11/14	1	P	Auto shut down - high wind, note 7
319	11/15	1	P	Note 7
320	11/16	1	F	Note 7
321	11/17	1	P	1W down, low hydraulic fluid, note 7
322	11/18	1	P	High winds prevent operation, 1W down
323	11/19	1	R	1W down
324	11/20	3	-	Note 3
325	11/21	1	F	1W down, windy
326	11/22	3	-	Note 3
327	11/23	3	-	Note 3
328	11/24	3	-	Note 3
329	11/25	3	-	Note 3
330	11/26	1	R	1W down, note 7
331	11/27	1	C	1W down, note 7
332	11/28	1	F	Note 1
333	11/29	1	F	Note 1
334	11/30	1	F	Note 1

F: Fair

1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

$$A = \frac{1, 3, 4, 6}{1 \text{ thru } 6} \times 100\% \quad U = \frac{(1, 4)}{(1, 3, 4, 6)} \times 100\%$$

Note 1: Row 1E &amp; 1W shut down for receiver assembly upgrade installation

Note 3: Solar system not turned on

Note 7 DAS failed to record

# ENERGETICS CORPORATION

## III. OPERATING EXPERIENCE (See table 1)

With most problems associated with piping upgrade resolved in October, the solar energy system operated on a seven day week basis in November. All collector drive units were operational with the exception of Row 1W which developed an intermittent leak of hydraulic fluid. This unit was refilled and is being observed to determine the leakage source.

The DAS failed to record data on several days in November. Although this data was not recorded on cassette tape, items such as hourly steam production and weather were manually recorded by the DAS operator and the energy saved on those days was recorded.

Installation of the receiver upgrade modification was initiated on Row 1 at the end of October. Completion of this activity will be accomplished in December, 1983.

## IV. PERFORMANCE

### A. Monthly Summary (See tables 2 and 3)

The availability of the solar system was 100% and the utilization factor was 83%. Calculations for energy collected and collector array efficiency have been revised to accomodate the piping upgrade (see figure 1 for new configuration).

The monthly performance report is summarized in tables 2 and 3. These figures show a gross savings of 55.7 MBTU of natural gas savings by the system. Gross fossil fuel savings were \$208.91 using a boiler efficiency of 65% (including idle and line losses) and a revised natural gas cost of \$3.75 per million Btu.

Construction - Site repairs and plumbing to improve the manual blowdown on the SSG were performed in early November. Receiver upgrade with modified supports and removal of receiver tube spiral flow ribbons commenced on November 28, 1983.

### Summary

Operation and Data Acquisition continued through November while receiver upgrade activities commenced. Some data reduction problems related to software or instrumentation have been noted and will result in some delay of the monthly performance report pending resolution. Receiver upgrade activities are proceeding nearly on schedule and will be completed in early December, 1983.

ENERGETICS CORPORATION

TIME ENERGY BALANCE								EFFICIENCY	
JUL IAN		INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE	PIPING LOSSES -OPERA TIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY		SYSTEM
DAY	DATE	MIL-BTU	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU	%	%
305	NOV 1	0.000	0.000	0.0000	0.	0.000	0.008	0.0	0.0
306	NOV 2	0.104	0.000	0.0000	0.	0.000	0.090	0.0	0.0
307	NOV 3	0.108	0.000	0.0000	0.	0.000	0.070	0.0	0.0
308	NOV 4	0.140	0.000	0.0000	0.	0.000	0.056	0.0	0.0
309	NOV 5	0.156	0.000	0.0000	0.	0.000	0.274	0.0	0.0
310	NOV 6	0.247	0.000	0.0000	0.	0.000	0.275	0.0	0.0
311	NOV 7	16.865	6.545	4.0076	3956.	0.224	0.837	38.8	23.8
312	NOV 8	14.870	5.973	4.0732	4062.	0.178	0.722	40.2	27.4
313	NOV 9	17.884	5.898	4.9672	4793.	0.193	0.838	33.0	27.8
314	NOV10	17.005	5.948	4.8071	4717.	0.235	0.821	35.0	28.3
315	NOV11	15.686	5.984	4.5665	4584.	0.228	0.649	38.1	29.1
316	NOV12	15.757	6.585	4.3093	4336.	0.222	0.625	41.8	27.3
317	NOV13	-0.003	0.000	0.0000	0.	0.000	0.025	0.0	0.0
322	NOV18	0.117	0.000	0.0000	0.	0.000	0.118	0.0	0.0
323	NOV19	0.058	0.000	0.0000	0.	0.000	0.175	0.0	0.0
324	NOV20	0.104	0.000	0.0000	0.	0.000	0.175	0.0	0.0
325	NOV21	13.959	5.307	3.2409	3230.	0.180	0.624	38.0	23.2
326	NOV22	0.031	0.000	0.0000	0.	0.000	0.161	0.0	0.0
327	NOV23	0.075	0.000	0.0000	0.	0.000	0.177	0.0	0.0
328	NOV24	0.091	0.000	0.0000	0.	0.000	0.174	0.0	0.0
329	NOV25	0.073	0.000	0.0000	0.	0.000	0.163	0.0	0.0
332	NOV28	13.481	4.685	2.7441	2759.	0.194	0.520	34.8	20.4
333	NOV29	17.940	5.484	2.5271	2558.	0.189	0.676	30.6	14.1
334	NOV30	11.518	1.917	0.9749	913.	0.050	0.490	16.6	8.5
TOTL/AVG		156.267	54.326	36.2179	35907.	1.892	8.744	34.8	23.2

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - NOV, 1983

## ENERGETICS CORPORATION

TIME		ENERGY					DOLLARS		
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
		MIL-BTU	MIL-BTU	MIL-BTU	BARRELS OIL	MCF NAT GAS	\$	\$	\$
305	NOV 1	0.000	0.008	-0.008	-0.002	-0.008	0.00	0.04	-0.04
306	NOV 2	0.000	0.090	-0.090	-0.017	-0.090	0.00	0.46	-0.46
307	NOV 3	0.000	0.070	-0.070	-0.014	-0.070	0.00	0.36	-0.36
308	NOV 4	0.000	0.056	-0.056	-0.011	-0.056	0.00	0.28	-0.28
309	NOV 5	0.000	0.274	-0.274	-0.053	-0.274	0.00	1.40	-1.40
310	NOV 6	0.000	0.275	-0.275	-0.053	-0.275	0.00	1.40	-1.40
311	NOV 7	6.165	0.837	5.328	1.029	5.328	23.12	4.26	18.86
312	NOV 8	6.266	0.722	5.544	1.070	5.544	23.50	3.67	19.83
313	NOV 9	7.642	0.838	6.804	1.314	6.804	28.66	4.26	24.40
314	NOV10	7.395	0.821	6.574	1.269	6.574	27.73	4.18	23.55
315	NOV11	7.024	0.649	6.375	1.231	6.375	26.34	3.30	23.04
316	NOV12	6.629	0.625	6.004	1.159	6.004	24.86	3.18	21.68
317	NOV13	0.000	0.025	-0.025	-0.005	-0.025	0.00	0.13	-0.13
322	NOV18	0.000	0.118	-0.118	-0.023	-0.118	0.00	0.60	-0.60
323	NOV19	0.000	0.175	-0.175	-0.034	-0.175	0.00	0.89	-0.89
324	NOV20	0.000	0.175	-0.175	-0.034	-0.175	0.00	0.89	-0.89
325	NOV21	4.985	0.624	4.361	0.842	4.361	18.69	3.18	15.51
326	NOV22	0.000	0.161	-0.161	-0.031	-0.161	0.00	0.82	-0.82
327	NOV23	0.000	0.177	-0.177	-0.034	-0.177	0.00	0.90	-0.90
328	NOV24	0.000	0.174	-0.174	-0.034	-0.174	0.00	0.88	-0.88
329	NOV25	0.000	0.163	-0.163	-0.031	-0.163	0.00	0.83	-0.83
332	NOV28	4.221	0.520	3.701	0.714	3.701	15.83	2.64	13.19
333	NOV29	3.889	0.676	3.213	0.620	3.213	14.58	3.44	11.14
334	NOV30	1.500	0.490	1.010	0.195	1.010	5.63	2.49	3.14
TOTAL		55.716	8.744	46.973	9.068	46.973	208.94	44.47	164.47

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - NOV, 1983

Table B-5 SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE -  
November 1983Maintenance

Minor cleaning	Hours	4
	Avg \$/h	10.00
	Labor Cost (\$)	40.00
	Materials (\$)	
	Total (\$)	
	Hours	
	Avg \$/h	
	Labor Cost (\$)	
	Materials (\$)	
	Parts (\$)	
	Total (\$)	
	Hours	
	Avg \$/h	
	Labor Cost (\$)	
	Materials (\$)	
	Parts (\$)	
	Total (\$)	
Total		\$ 40.00

Operation and Fixed Cost

Property Taxes (\$)		
Insurance (\$)		154.92
Parasitic Energy	kWh Used	754
	\$/kWh	.059
	Total (\$)	44.47
Total		\$ 199.39
<b>TOTAL COST</b>		<b>\$ 239.39</b>

Fossil Fuel Savings		
	MIL-BTU (natural gas)	55.72
	\$/MIL-BTU	3.75
Total		\$ 208.94
<b>TOTAL SAVINGS</b>		<b>\$ 208.94</b>
<b>NET SAVINGS</b>		<b>(\$ 30.45)</b>

a 65% burner efficiency assumed.

Table 1. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - December 1983

Julian Day	Date	Status Code	Weather	Remarks
335	12/1	1	F	Note 8 - Row 4 down, Row 1 complete
336	12/2	1	-	Note 8 - Row 4 down
337	12/3	1	F	Row 4 down, high winds
338	12/4	1	F	Row 4 down
339	12/5	1	P	Note 8 - Row 4 down
340	12/6	1	F	Note 8 - Row 4 complete, Row 2 down
341	12/7	2	-	Note 8 - Row 2 & 3 down
342	12/8	2	-	Note 8 - Row 3 complete, Row 2 down
343	12/9	1	F	Note 8 - Row 2 complete, Row 5 down
344	12/10	1	F	Row 5 down
345	12/11	1	F	Row 5 down, high winds
346	12/12	2	-	Row 5 down
347	12/13	2	-	Note 8 - Row 5 down, Row 6 down
348	12/14	2	-	Note 8 - Row 5 complete, Row 6 down
349	12/15	2	-	Note 8 - Row 6 complete
350	12/16	1	-	
351	12/17	1	P	
352	12/18	1	S	
353	12/19	1	-	
354	12/20	1	-	
355	12/21	1	-	
356	12/22	1	-	
357	12/23	1	-	Note 7
358	12/24	1	C	"
359	12/25	3	-	Note 3, 7
360	12/26	1	-	Note 7
361	12/27	1	-	"
362	12/28	1	-	"
363	12/29	2	C	Note 2
364	12/30	2	-	Note 2
365	12/31	2	F	Note 2

F: Fair

1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

$$A = \frac{1, 3, 4, 6}{1 \text{ thru } 6} \times 100\% \quad U = \frac{(1, 4)}{(1, 3, 4, 6)} \times 100\%$$

Note 2: Feed water and domestic water piping froze and broke

Note 3: System not turned on - no operator

Note 7: DAS did not record

Note 8: Receiver upgrade site work

# ENERGETICS CORPORATION

## III. OPERATING EXPERIENCE (See table 1)

The system continued to operate during most of the receiver upgrade work in early December. Severely cold weather in late December resulted in frozen feedwater lines throughout the refinery. The domestic water inside the solar building froze and broke at the faucet. The solar feedwater line at the refinery was shut down disabling the feedwater freeze protection system. The frozen pipes broke at several locations late in December and repairs will be undertaken in early January.

ODAS data was not obtained from December 23 through December 29 due to extremely bad weather and holidays.

## IV. PERFORMANCE

### A. Monthly Summary (See tables 2 and 3)

The availability of the solar system was 71% and the utilization factor was .95%. Calculations for energy collected and collector array efficiency have been revised to accomodate the piping upgrade (see figure 1 for new configuration).

The monthly performance report is summarized in tables 2 and 3. These figures show a gross savings of 18.0 MBTU of natural gas savings by the system. Gross fossil fuel savings were \$67.62 using a boiler efficiency of 65% (including idle and line losses) and a revised natural gas cost of \$3.75 per million BTU.

Construction - 72 receivers and 144 glass tubes were disassembled. Spiral flow ribbons (144) were removed from the existing receiver tubes, unbroken glass tubes were cleaned, and all parts were reassembled utilizing the modified retainers and new seals. The system was recharged with HTO and this system was restored to full operation on December 15. Problems encountered were more broken glass tubes than originally anticipated and poor weather conditions for system checkout.

### Summary

Operation and data acquisition to measure upgrade results have been delayed in December by unusually bad weather conditions. The work completed for receiver upgrade should provide the second greatest improvement in performance.

The upgrade work completed to date has eliminated broken glass or leaks in the entire installation. The direct approach used for site installation work, the quality control measures implemented, and the design changes recommended by SNLA have resulted in minimal field installation problems and ultimately will result in a significant improvement in system performance.

## ENERGETICS CORPORATION

TIME		ENERGY BALANCE					EFFICIENCY		
JUL	IAN	INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE	PIPING LOSSES OPERA TIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM	
DAY	DATE	MIL-BTU	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU	%	%
335	DEC 1	7.280	5.510	1.6202	1659.	0.145	0.339	75.7	22.3
336	DEC 2	0.239	0.000	0.0000	0.	0.000	0.042	0.0	0.0
337	DEC 3	-0.062	0.000	0.0000	0.	0.000	0.070	0.0	0.0
338	DEC 4	9.963	6.647	1.2683	1286.	0.092	0.444	66.7	12.7
339	DEC 5	5.996	2.460	0.0000	6.	0.000	0.354	41.0	0.0
340	DEC 6	17.021	1.038	2.0762	2844.	0.192	0.634	6.1	16.9
341	DEC 7	0.129	0.000	0.0000	0.	0.000	0.090	0.0	0.0
342	DEC 8	0.893	0.000	0.0000	0.	0.000	0.274	0.0	0.0
343	DEC 9	2.116	6.042	2.6875	2605.	0.145	0.408	285.5	127.0
344	DEC 10	17.765	11.862	3.1179	3162.	0.184	0.673	66.8	17.6
345	DEC 11	5.525	2.579	0.1484	181.	0.047	0.302	46.7	2.7
346	DEC 12	0.057	0.000	0.0000	0.	0.000	0.098	0.0	0.0
347	DEC 13	0.526	0.000	0.0000	0.	0.000	0.106	0.0	0.0
348	DEC 14	-0.037	0.000	0.0000	0.	0.000	0.081	0.0	0.0
349	DEC 15	0.001	0.000	0.0000	0.	0.000	0.021	0.0	0.0
350	DEC 16	0.026	0.000	0.0000	0.	0.000	0.078	0.0	0.0
351	DEC 17	0.061	0.000	0.0000	0.	0.000	0.090	0.0	0.0
352	DEC 18	0.134	0.000	0.0000	0.	0.000	0.104	0.0	0.0
353	DEC 19	0.140	0.000	0.0000	0.	0.000	0.124	0.0	0.0
354	DEC 20	0.102	0.000	0.0000	0.	0.000	0.127	0.0	0.0
355	DEC 21	0.001	0.000	0.0000	0.	0.000	0.029	0.0	0.0
356	DEC 22	0.013	0.000	0.0000	0.	0.000	0.046	0.0	0.0
363	DEC 29	3.414	0.000	0.0000	0..	0.000	0.237	0.0	0.0
364	DEC 30	-0.030	0.000	0.0000	0.	0.000	0.136	0.0	0.0
365	DEC 31	-0.022	0.000	0.0000	0.	0.000	0.129	0.0	0.0
TOTL/AVG		71.252	36.138	11.7185	11742.	0.805	5.033	50.7	16.4

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - DEC, 1983

## ENERGETICS CORPORATION

TIME		ENERGY					DOLLARS		
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
		MIL-BTU	MIL-BTU	MIL-BTU	BARRELS OIL	MCF NAT GAS	\$	\$	\$
335	DEC 1	2.492	0.339	2.153	0.416	2.153	9.35	1.72	7.63
336	DEC 2	0.000	0.042	-0.042	-0.008	-0.042	0.00	0.21	-0.21
337	DEC 3	0.000	0.070	-0.070	-0.014	-0.070	0.00	0.36	-0.36
338	DEC 4	1.952	0.444	1.508	0.291	1.508	7.32	2.26	5.06
339	DEC 5	0.000	0.354	-0.354	-0.068	-0.354	0.00	1.80	-1.80
340	DEC 6	4.425	0.634	3.791	0.732	3.791	16.59	3.22	13.37
341	DEC 7	0.000	0.090	-0.090	-0.017	-0.090	0.00	0.46	-0.46
342	DEC 8	0.000	0.274	-0.274	-0.053	-0.274	0.00	1.40	-1.40
343	DEC 9	4.135	0.408	3.727	0.719	3.727	15.51	2.08	13.43
344	DEC 10	4.798	0.673	4.125	0.796	4.125	17.99	3.42	14.57
345	DEC 11	0.228	0.302	-0.074	-0.014	-0.074	0.86	1.53	-0.67
346	DEC 12	0.000	0.098	-0.098	-0.019	-0.098	0.00	0.50	-0.50
347	DEC 13	0.000	0.106	-0.106	-0.020	-0.106	0.00	0.54	-0.54
348	DEC 14	0.000	0.091	-0.081	-0.016	-0.081	0.00	0.41	-0.41
349	DEC 15	0.000	0.021	-0.021	-0.004	-0.021	0.00	0.11	-0.11
350	DEC 16	0.000	0.078	-0.078	-0.015	-0.078	0.00	0.40	-0.40
351	DEC 17	0.000	0.090	-0.090	-0.017	-0.090	0.00	0.46	-0.46
352	DEC 18	0.000	0.104	-0.104	-0.020	-0.104	0.00	0.53	-0.53
353	DEC 19	0.000	0.124	-0.124	-0.024	-0.124	0.00	0.63	-0.63
354	DEC 20	0.000	0.127	-0.127	-0.025	-0.127	0.00	0.64	-0.64
355	DEC 21	0.000	0.029	-0.029	-0.006	-0.029	0.00	0.15	-0.15
356	DEC 22	0.000	0.046	-0.046	-0.009	-0.046	0.00	0.24	-0.24
363	DEC 29	0.000	0.237	-0.237	-0.046	-0.237	0.00	1.20	-1.20
364	DEC 30	0.000	0.136	-0.136	-0.026	-0.136	0.00	0.69	-0.69
365	DEC 31	0.000	0.129	-0.129	-0.025	-0.129	0.00	0.65	-0.65
TOTAL		18.030	5.033	12.994	2.508	12.994	67.62	25.60	42.02

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - DEC, 1983

## ENERGETICS CORP.

Table 5.a. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - December 1983

Maintenance

Hours	
Avg \$/h	
Labor Cost (\$)	
Materials (\$)	
Total (\$)	
Hours	
Avg \$/h	
Labor Cost (\$)	
Materials (\$)	
Parts (\$)	
Total (\$)	
Hours	
Avg \$/h	
Labor Cost (\$)	
Materials (\$)	
Parts (\$)	
Total (\$)	
Total	\$ -0-

Operation and Fixed Cost

Property Taxes (\$)		
Insurance (\$)	\$ 154.92	
Parasitic Energy	kWh Used	434
	\$/kWh	.059
	Total (\$)	25.60
Total	\$ 180.52	
<b>TOTAL COST</b>	<b>\$ 180.52</b>	
Fossil Fuel Savings		
	MIL-BTU (natural gas)	10.03
	\$/MIL-BTU	3.75
Total	\$ 67.61	
<b>TOTAL SAVINGS</b>	<b>\$ 67.61</b>	
NET SAVINGS	(\$ 112.91)	

a 65% burner efficiency assumed.

Table 1. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - January 1984

Julian Day	Date	Status Code	Weather	Remarks
1	1/1	2		
2	1/2	2		
3	1/3	2		
4	1/4	2		Replace SSG gasket
5	1/5	2		Repaired frozen FW lines
6	1/6	2		Cleaned FW valve
7	1/7	1	F	
8	1/8	1	R	
9	1/9	3		Note 3
10	1/10	3		" "
11	1/11	3		" "
12	1/12	3		" "
13	1/13	3		" "
14	1/14	1	P	Changed tape, note 7
15	1/15	1	P	Note 7
16	1/16	2	P	System tripped on high H <sub>2</sub> O level
17	1/17	2	R	FW line frozen, note 7
18	1/18	2	R	" " " " "
19	1/19	2	P	" " " " "
20	1/20	2	C	" " " " "
21	1/21	2	C	" " " " "
22	1/22	2	P	" " " " "
23	1/23	2	P	FW thawed, note 7
24	1/24	1	F	Note 7
25	1/25	1	P	" "
26	1/26	1	P	5W down, windy, note 7
27	1/27	2	P	" " " " "
28	1/28	1	F	" " " " "
29	1/29	1	P	Repaired 5W & 2E oscillation
30	1/30	1	C	Cleaned all receiver tubes
31	1/31	1	P	Replaced damaged FW line insulation

F: Fair

1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

$$A = \frac{1, 3, 4, 6}{1 \text{ thru } 6} \times 100\% \quad U = \frac{(1, 4)}{(1, 3, 4, 6)} \times 100\%$$

Note 3: System not turned on - no operator

Note 7: DAS did not record

**III. OPERATING EXPERIENCE (See table 1)**

The broken feedwater line and water faucet were repaired in early January. The feedwater line froze again mid month due to insulation voids several places and a clogged feedwater protection valve. Several attempts to thaw the line were unsuccessful and feedwater flow was disabled for one week before normal operation was restored.

It is surmised that the first line freeze was due to feedwater valve shutdown by the refinery after observing water exiting from the solar equipment room. This turned out to be domestic water from a frozen faucet. In both cases, the primary cause of failure was loss of feedwater discharge for freeze protection. Prevention of this occurrence will be addressed as part of O & M procedures.

Additionally, an operational problem with the ODAS resulted in loss of some data. The source of this problem has been identified as equipment related and will be resolved next month.

Construction - Minor cleanup and repairs were performed. Outside air ducting was installed to the pump motor, a broken observation window to the equipment room was replaced and some insulating was performed.

Summary

Operation and data acquisition in January were hampered by frozen lines, bad weather, and system start up problems. All of these have been resolved and a problem with the ODAS identified. The system is now operating on a regular basis and improved performance data will be available in the February report.

ENERGETICS CORPORATION

TIME		ENERGY BALANCE						EFFICIENCY		
JUL IAN	DAY	DATE	INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE		PIPING LOSSES -OPERA TIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM
			MIL-BTU	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU	%	%
1	JAN 1	-0.001	0.000	0.0000	0.	0.000	0.059	0.0	0.0	0.0
2	JAN 2	0.108	0.000	0.0000	0.	0.000	0.108	0.0	0.0	0.0
3	JAN 3	0.033	0.000	0.0000	0.	0.000	0.113	0.0	0.0	0.0
4	JAN 4	0.223	0.000	0.0000	0.	0.000	0.123	0.0	0.0	0.0
5	JAN 5	1.398	0.000	0.0000	0.	0.000	0.234	0.0	0.0	0.0
6	JAN 6	1.100	0.000	0.0000	0.	0.000	0.071	0.0	0.0	0.0
7	JAN 7	7.033	1.284	2.4449	2357.	0.095	0.357	18.3	34.8	
8	JAN 8	0.053	0.000	0.0000	0.	0.000	0.082	0.0	0.0	0.0
9	JAN 9	0.014	0.000	0.0000	0.	0.000	0.084	0.0	0.0	0.0
10	JAN 10	0.016	0.000	0.0000	0.	0.000	0.066	0.0	0.0	0.0
11	JAN 11	0.000	0.000	0.0000	0.	0.000	0.090	0.0	0.0	0.0
12	JAN 12	-0.011	0.000	0.0000	0.	0.000	0.085	0.0	0.0	0.0
13	JAN 13	0.119	0.000	0.0000	0.	0.000	0.081	0.0	0.0	0.0
16	JAN 16	7.428	0.557	1.0189	985.	0.048	0.332	7.5	13.7	
29	JAN 29	4.694	0.475	0.7759	774.	0.045	0.215	10.1	16.5	
30	JAN 30	0.169	0.000	0.0000	0.	0.000	0.127	0.0	0.0	0.0
31	JAN 31	12.519	1.929	1.6126	1647.	0.142	0.666	15.4	12.9	
TOTL/AVG		34.894	4.245	5.8523	5764.	0.330	2.894	12.2	16.8	

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - JAN, 1984

## ENERGETICS CORPORATION

TIME		ENERGY					DOLLARS		
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL SAVINGS
		MIL-BTU	MIL-BTU	MIL-BTU	BARRELS OIL	MCF NAT GAS	\$	\$	\$
1	JAN 1	0.000	0.059	-0.059	-0.011	-0.059	0.00	0.30	-0.30
2	JAN 2	0.000	0.108	-0.108	-0.021	-0.108	0.00	0.55	-0.55
3	JAN 3	0.000	0.113	-0.113	-0.022	-0.113	0.00	0.57	-0.57
4	JAN 4	0.000	0.123	-0.123	-0.024	-0.123	0.00	0.63	-0.63
5	JAN 5	0.000	0.234	-0.234	-0.045	-0.234	0.00	1.19	-1.19
6	JAN 6	0.000	0.071	-0.071	-0.014	-0.071	0.00	0.36	-0.36
7	JAN 7	3.761	0.357	3.404	0.657	3.404	14.10	1.81	12.29
8	JAN 8	0.000	0.082	-0.082	-0.016	-0.082	0.00	0.42	-0.42
9	JAN 9	0.000	0.084	-0.084	-0.016	-0.084	0.00	0.43	-0.43
10	JAN 10	0.000	0.066	-0.066	-0.013	-0.066	0.00	0.33	-0.33
11	JAN 11	0.000	0.090	-0.090	-0.017	-0.090	0.00	0.46	-0.46
12	JAN 12	0.000	0.085	-0.085	-0.016	-0.085	0.00	0.43	-0.43
13	JAN 13	0.000	0.081	-0.081	-0.016	-0.081	0.00	0.41	-0.41
16	JAN 16	1.568	0.332	1.236	0.239	1.236	5.88	1.69	4.19
29	JAN 29	1.194	0.215	0.979	0.189	0.979	4.48	1.09	3.39
30	JAN 30	0.000	0.127	-0.127	-0.023	-0.127	0.00	0.64	-0.64
31	JAN 31	2.482	0.666	1.816	0.351	1.816	9.31	3.39	5.92
TOTAL		9.005	2.894	6.112	1.180	6.112	33.77	14.72	19.05

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - JAN. 1984

Table B5. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - January 1984

Maintenance

Scheduled - Replace SSG manhole gasket	Hours	2
	Avg \$/h	\$ 10.00
	Labor Cost (\$)	\$ 20.00
	Materials (\$)	\$ 10.76
	Total (\$)	\$ 30.76
	Hours	
	Avg \$/h	
	Labor Cost (\$)	
	Materials (\$)	
	Parts (\$)	
	Total (\$)	
	Hours	
	Avg \$/h	
	Labor Cost (\$)	
	Materials (\$)	
	Parts (\$)	
	Total (\$)	
Total		\$ 30.76

Operation and Fixed Cost

Property Taxes (\$)	
Insurance (\$)	\$ 154.92
Parasitic Energy	
	kWh Used
	\$/kWh
	Total (\$)
Total	\$ 169.64
<b>TOTAL COST</b>	<b>\$ 200.04</b>
<b>Fossil Fuel Savings</b>	
	MIL-BTU (natural gas) 9.00
	\$/MIL-BTU 3.75
Total	\$ 33.77
<b>TOTAL SAVINGS</b>	<b>\$ 33.77</b>
<b>NET SAVINGS</b>	<b>(\$ 166.63)</b>

a 65% burner efficiency assumed.

Table 1. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - February 1984

Julian Day	Date	Status Code	Weather	Remarks
32	2/1	1	F	High wind prevented operation
33	2/2	1	P	" " " "
34	2/3	1	F	" " " "
35	2/4	1	F	
36	2/5	1	C	
37	2/6	1	F	
38	2/7	1	F	Refinery down part of day
39	2/8	1	P	Note 8
40	2/9	1	P	Note 7
41	2/10	1	P	
42	2/11	1	P	
43	2/12	1	F	Note 8, windy
44	2/13	1	F	Note 8
45	2/14	2	P	System down for hyd/elec. upgrade
46	2/15	2	P	" " " "
47	2/16	2	F	" " " "
48	2/17	2	F	" " " "
49	2/18	1	P	
50	2/19	1	C	
51	2/20	1	P	2E will not go all the way to stow
52	2/21	1	F	Note 8
53	2/22	1	P	Field light switch not working
54	2/23	1	F	" " " "
55	2/24	1	F	
56	2/25	1	P	High winds prevent operation
67	2/26	1	C	
68	2/27	1	F	6W down
69	2/28	1	F	" "
60	2/29	1	F	" "

F: Fair

1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

$$A = \frac{1, 3, 4, 6}{1 \text{ thru } 6} \times 100\% \quad U = \frac{(1, 4)}{(1, 3, 4, 6)} \times 100\%$$

Note 7: DAS failed to record, however, operator's notes indicated that the system was operational and approximately 4000 lbs of steam were produced.

Note 8: Feedwater control valve failed to close.

### III. OPERATING EXPERIENCE (See table 1)

The sections of the frozen feedwater line repaired in January were reinsulated during February. Other insulation and repairs were also performed to reduce heat losses and improve reliability as part of the system upgrade activities. (See monthly status report upgrade activities.)

The feedwater solenoid valve failed to close during operation several times in February. This resulted in boiler overfill followed by system shutdown. Failure after operation has resulted in a large loss of feedwater on several occasions. This solenoid valve is scheduled to be replaced by a motor-controlled ball valve in March. This should result in improved long term reliability and a reduction in "water hammer" in the feedwater line.

Construction - Hydraulic electric upgrade was essentially completed in February. This work on all twelve drive pylons included:

(1) Installation of Sandia furnished Search Mode Boards, weather proof row control boxes and wiring harnesses with new magnetic limit switches. (2) Installation of industrial grade motor starters and new modified bypass valves (an operational problem was encountered with the bypass valves and will be corrected under warranty by SKI in March). (3) Leaks were repaired as needed, the accumulators were recharged with nitrogen, and pressure switches were adjusted to correct pressures. Additionally, SKI checked out the central control operation, adjusted the central light switch, and reprogrammed the microprocessor for Search Mode Operation.

Other site activities included insulation upgrade in the equipment room and on field piping anchors and supports.

With the exception of a feedwater valve replacement, this completes on site upgrade activity.

Operation and Maintenance Manual - O & M writeups were reviewed and rewritten. Revisions to SKI collector system O & M is in process.

#### Summary

Operation and data acquisition was the best ever in February (see performance report). The ODAS steam production data problem was corrected and it appears that the system will be ready for turnover to Southern Union on schedule in April.

Sincerely,



Lee E. Wilson  
Project Manager  
Texas Energetics Corporation

## ENERGETICS CORPORATION

TIME		ENERGY BALANCE						EFFICIENCY	
JUL IAN	DAY	INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE	PIPING LOSSES -OPERA TIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM	
		MIL-BTU	MIL-BTU	MIL-BTU	LB/DAY	MIL-BTU	MIL-BTU	%	%
32	FEB 1	17.922	5.130	5.5891	5547.	0.290	0.695	29.6	31.2
33	FEB 2	0.067	0.000	0.0000	0.	0.000	0.104	0.0	0.0
34	FEB 3	0.285	0.000	0.0000	0.	0.000	0.114	0.0	0.0
35	FEB 4	0.102	0.000	0.0000	0.	0.000	0.113	0.0	0.0
36	FEB 5	0.106	0.000	0.0000	0.	0.000	0.099	0.0	0.0
37	FEB 6	18.455	4.889	6.4837	6400.	0.235	0.737	26.5	35.1
38	FEB 7	8.612	0.632	0.5808	584.	0.048	0.499	7.3	6.7
39	FEB 8	12.853	2.514	3.0514	3000.	0.143	0.562	19.6	23.7
41	FEB10	-0.001	0.000	0.0000	0.	0.000	0.004	0.0	0.0
42	FEB11	6.314	1.883	2.7248	2648.	0.095	0.342	29.8	43.2
43	FEB12	17.121	4.445	2.6619	2632.	0.191	0.659	26.0	15.5
44	FEB13	17.871	5.138	6.7346	6534.	0.274	0.742	28.8	37.7
45	FEB14	0.059	0.000	0.0000	0.	0.000	0.068	0.0	0.0
46	FEB15	0.148	0.000	0.0000	0.	0.000	0.019	0.0	0.0
47	FEB16	0.156	0.201	0.0000	1.	0.000	0.436	128.6	0.0
48	FEB17	5.560	0.669	0.0000	1.	0.000	1.277	12.0	0.0
49	FEB18	7.128	3.621	3.0815	3041.	0.190	1.764	50.8	43.2
50	FEB19	1.717	0.280	0.0000	0.	0.000	0.201	16.3	0.0
51	FEB20	12.651	3.909	3.8116	3881.	0.295	0.751	30.9	30.1
52	FEB21	18.838	6.441	7.0136	6874.	0.280	0.749	34.2	37.2
53	FEB22	11.157	3.636	4.8525	4734.	0.138	0.389	32.6	43.5
54	FEB23	16.894	5.424	6.5906	6554.	0.333	0.694	32.1	39.0
55	FEB24	18.699	6.219	7.5188	7448.	0.323	0.755	33.3	40.2
56	FEB25	2.246	0.199	0.0000	0.	0.000	0.176	8.9	0.0
57	FEB26	0.093	0.000	0.0000	0.	0.000	0.077	0.0	0.0
58	FEB27	16.786	4.428	4.5243	4539.	0.291	0.710	26.4	27.0
59	FEB28	16.530	4.962	6.0967	6066.	0.345	0.667	30.0	36.9
60	FEB29	16.788	4.454	8.1237	7975.	0.283	0.746	26.5	48.4
TOTL/AVG		245.159	69.074	79.4396	78468.	3.744	14.149	28.2	32.4

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - FEB, 1984

## ENERGETICS CORPORATION

TIME		ENERGY				DOLLARS			
JUL IAN DAY	DATE	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
		MIL-BTU	MIL-BTU	MIL-BTU	BARRELS OIL	MCF NAT GAS	\$	\$	\$
32	FEB 1	8.598	0.695	7.903	1.526	7.903	32.24	3.54	28.70
33	FEB 2	0.000	0.104	-0.104	-0.020	-0.104	0.00	0.53	-0.53
34	FEB 3	0.000	0.114	-0.114	-0.022	-0.114	0.00	0.58	-0.58
35	FEB 4	0.000	0.113	-0.113	-0.022	-0.113	0.00	0.58	-0.58
36	FEB 5	0.000	0.099	-0.099	-0.019	-0.099	0.00	0.50	-0.50
37	FEB 6	9.975	0.737	9.238	1.783	9.238	37.41	3.75	33.66
38	FEB 7	0.894	0.499	0.395	0.076	0.395	3.35	2.54	0.81
39	FEB 8	4.695	0.562	4.133	0.798	4.133	17.61	2.86	14.75
41	FEB10	0.000	0.004	-0.004	-0.001	-0.004	0.00	0.02	-0.02
42	FEB11	4.192	0.342	3.850	0.743	3.850	15.72	1.74	13.98
43	FEB12	4.095	0.659	3.436	0.663	3.436	15.36	3.35	12.01
44	FEB13	10.362	0.742	9.620	1.857	9.620	38.86	3.77	35.09
45	FEB14	0.000	0.068	-0.068	-0.013	-0.068	0.00	0.34	-0.34
46	FEB15	0.000	0.019	-0.019	-0.004	-0.019	0.00	0.10	-0.10
47	FEB16	0.000	0.436	-0.436	-0.084	-0.436	0.00	2.22	-2.22
48	FEB17	0.000	1.277	-1.277	-0.247	-1.277	0.00	6.49	-6.49
49	FEB18	4.740	1.764	2.976	0.575	2.976	17.78	8.97	8.81
50	FEB19	0.000	0.201	-0.201	-0.039	-0.201	0.00	1.02	-1.02
51	FEB20	5.864	0.751	5.113	0.987	5.113	21.99	3.82	18.17
52	FEB21	10.791	0.749	10.042	1.939	10.042	40.47	3.81	36.66
53	FEB22	7.465	0.389	7.076	1.366	7.076	27.99	1.98	26.01
54	FEB23	10.140	0.694	9.446	1.824	9.446	38.03	3.53	34.50
55	FEB24	11.567	0.755	10.812	2.087	10.812	43.38	3.84	39.54
56	FEB25	0.000	0.176	-0.176	-0.034	-0.176	0.00	0.90	-0.90
57	FEB26	0.000	0.077	-0.077	-0.015	-0.077	0.00	0.39	-0.39
58	FEB27	6.961	0.710	6.251	1.207	6.251	26.10	3.61	22.49
59	FEB28	9.379	0.667	8.712	1.682	8.712	35.17	3.39	31.78
60	FEB29	12.498	0.746	11.752	2.269	11.752	46.87	3.79	43.08
TOTAL		122.216	14.149	108.067	20.862	108.067	458.33	71.96	386.37

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - FEB, 1984

ENERGETICS CORP.

Table B5 SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - February 1984

Maintenance

Hours	_____
Avg \$/h	_____
Labor Cost (\$)	_____
Materials (\$)	_____
Total (\$)	_____
Hours	_____
Avg \$/h	_____
Labor Cost (\$)	_____
Materials (\$)	_____
Parts (\$)	_____
Total (\$)	_____
Hours	_____
Avg \$/h	_____
Labor Cost (\$)	_____
Materials (\$)	_____
Parts (\$)	_____
Total (\$)	_____

Total -0-

Operation and Fixed Cost

Property Taxes (\$)	_____	
Insurance (\$)	\$ <u>154.92</u>	
Parasitic Energy	kWh Used	<u>1220</u>
	\$/kWh	<u>.059</u>
	Total (\$)	<u>71.96</u>
Total	<u>\$ 226.88</u>	
<b>TOTAL COST</b>	<u>\$ 226.88</u>	

Fossil Fuel Savings	
	MIL-BTU (natural gas) <u>122.22</u>
	\$/MIL-BTU <u>3.75</u>
Total	<u>\$ 458.33</u>
<b>TOTAL SAVINGS</b>	<u>\$ 231.45</u>
<b>NET SAVINGS</b>	<u>\$ 231.45</u>

a 65% burner efficiency assumed.

Table 1. SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - March 1984

Julian Day	Date	Status Code	Weather	Remarks
60	3/1	F	F	6W down
61	3/2	1	F	6W down
62	3/3	1	F	Feedwater Valve malfunctioned, 6W down
63	3/4	1	C	6W down
64	3/5	1	S	6W down
65	3/6	1	P	6W down
66	3/7	1	F	Repaired 6W
67	3/8	1	P	Cleaned row 6, 5, 4, 3. See note 8
68	3/9	2	F	Replaced tracker head on 6W
69	3/10	1	C	
70	3/11	1	C	
71	3/12	1	F	System tripped due to high steam press, restarted
72	3/13	1	C	Cleaned glass tubes automatically
73	3/14	1	C	
74	3/15	1	P	System tripped due to high steam press
75	3/16	2	C	See Note 9
76	3/17	1	F	" " "
77	3/18	2	P	" " "
78	3/19	2	-	System down
79	3/20	1	P	5W & 2W down
80	3/21	1	F	
81	3/22	1	P	System tripped due to high wind
82	3/23	1	P	System tripped on high steam press & high wind
83	3/24	1	F	System tripped due to high steam press., note 7
84	3/25	1	C	Note 7
85	3/26	1	C	Note 7
86	3/27	1	C	Acceptance test, windy, Note 7
87	3/28	1	P	" " "
88	3/29	1	P	" " "
89	3/30	1	P	Wind gust damaged, Row 1E, system down
90	3/31	2	-	System down

F: Fair

1: Solar system up/Plant up

P: Partly Cloudy

2: Solar system down/Plant up

C: Fog or Overcast

3: Solar system idle/Plant up

R: Rain

4: Solar system up/Plant down

S: Snow

5: Solar system down/Plant down

6: Solar system idle/Plant down

$$A = \frac{1, 3, 4, 6}{1 \text{ thru } 6} \times 100\% \quad U = \frac{(1, 4)}{(1, 3, 4, 6)} \times 100\%$$

Note 7: DAS failed to record

Note 8: Texas Energetics staff on site to replace boiler feedwater control valve.

Note 9: Solar Kinetics personnel on site to complete hydraulic/electric upgrade work.

III. OPERATING EXPERIENCE (See table 1)

The feedwater solenoid valve was replaced with an electric actuator and ball valve. Installation of this valve solved several operational problems. The water hammer associated with the solenoid valve was eliminated and the new valve will be less likely to fail open. Additionally, this valve can be throttled down by adjusting the actuator resulting in improved steam production recovery when cooler feedwater is injected.

Solar Kinetics personnel were on site in March to make hydraulic/electric upgrade adjustments. Final changes were made to the microprocesor software in the collector central control. Blinders were added to the central light switch to decrease operating time. This reduces unnecessary pumping losses and steam generator heat losses.

Personnel from ETEC and Sandia were on site for the acceptance test which was completed on March 28. The system was placed in fully automatic operation and refinery personnel were trained on March 29.

The following day, a gust of wind caused severe damage to collectors in row 1E. The collector casting broke where it is attached to the drive pylon. Also, several receiver tubes were damaged. This caused about 30 to 40 gallons of oil to be lost as the system was operational at that time. Solar Kinetics has observed the damage and will prepare a repair cost estimate.

Construction - The remaining activity of feedwater valve replacement was completed and checked out during operation.

O & M Manual - The O & M manual was presented to the refinery and training of refinery personnel was performed as required. Relevant "as built" drawings and component specifications will be inserted in the on-site manual and follow-up training will be completed in April.

## ENERGETICS CORPORATION

TIME		ENERGY BALANCE					EFFICIENCY	
JUL IAN	DAY	INCIDENT SOLAR ENERGY COLLEC PLANE	SOLAR ENERGY COLLECTED	SOLAR ENERGY DELIVERED TO REFINERY STEAM LINE	PIPING LOSSES -OPERA TIONAL	PARA SITIC ENERGY USED (SOURCE)	COLLECTOR ARRAY	SYSTEM
		DATE	MIL-BTU	MIL-BTU	MIL-BTU	MIL-BTU	MIL-BTU	%
					LB/DAY			
60	MAR 1	17.299	4.989	6.3683	6375.	0.257	0.688	28.8 36.8
61	MAR 2	13.463	3.798	4.2930	4324.	0.275	0.737	28.2 31.9
62	MAR 3	11.883	3.018	3.0919	3091.	0.227	0.528	25.4 26.0
63	MAR 4	0.351	0.000	0.0000	0.	0.000	0.116	0.0 0.0
64	MAR 5	0.191	0.000	0.0000	0.	0.000	0.072	0.0 0.0
65	MAR 6	17.543	5.149	6.1392	6038.	0.285	0.733	29.3 35.0
66	MAR 7	20.857	6.199	6.5716	6636.	0.318	0.855	29.7 31.5
67	MAR 8	0.317	0.000	0.0000	0.	0.049	0.093	0.0 0.0
68	MAR 9	15.670	5.236	5.5975	5516.	0.276	0.674	33.4 35.7
69	MAR 10	0.282	0.000	0.0000	0.	0.000	0.081	0.0 0.0
70	MAR 11	0.203	0.000	0.0000	0.	0.000	0.076	0.0 0.0
71	MAR 12	16.394	5.748	6.3568	6297.	0.270	0.660	35.1 38.8
72	MAR 13	4.156	0.692	0.4315	484.	0.086	0.312	16.7 10.4
73	MAR 14	4.864	1.059	0.4588	570.	0.074	0.336	21.8 9.4
74	MAR 15	10.627	2.166	2.2047	2199.	0.175	0.719	20.4 20.7
75	MAR 16	0.413	0.138	0.0000	0.	0.000	0.200	33.4 0.0
76	MAR 17	7.825	2.042	1.4506	1468.	0.178	0.719	26.1 18.5
77	MAR 18	0.657	0.000	0.0000	0.	0.000	0.103	0.0 0.0
78	MAR 19	0.383	0.000	0.0000	0.	0.000	0.092	0.0 0.0
79	MAR 20	11.189	2.595	2.4328	2440.	0.176	0.556	23.2 21.7
80	MAR 21	15.299	5.299	5.2117	5205.	0.254	0.742	34.6 34.1
81	MAR 22	1.427	0.179	0.0000	0.	0.000	0.283	12.5 0.0
82	MAR 23	13.705	4.102	3.7448	3747.	0.244	0.737	29.9 27.3
87	MAR 28	15.232	5.566	5.6219	5615.	0.229	0.629	36.5 36.9
88	MAR 29	13.481	5.649	5.3674	5300.	0.236	0.749	41.9 39.8
89	MAR 30	14.584	3.629	3.4151	4313.	0.174	0.629	24.9 23.4
90	MAR 31	0.000	0.000	0.0000	0.	0.000	0.003	0.0 0.0
TOTAL/AVG		228.293	67.253	68.7761	69675.	3.782	12.126	29.5 30.1

TABLE 2 - SURC MONTHLY PERFORMANCE TABLE - MAR. 1984

## ENERGETICS CORPORATION

TIME		ENERGY				DOLLARS			
JUL IAN	DAY	GROSS FOSSIL FUEL SAVED	PARA SITIC ENERGY USED (SOURCE)	NET FOSSIL FUEL SAVED			GROSS SAVINGS	COST OF PARASITIC ENERGY (AT SITE)	NET FOSSIL FUEL SAVINGS
		DATE	MIL-BTU	MIL-BTU	MIL-BTU	BARRELS	MCF	NAT	\$
60	MAR 1	9.798	0.688	9.110	1.759	9.110	36.74	3.50	33.24
61	MAR 2	6.604	0.737	5.867	1.133	5.867	24.77	3.75	21.02
62	MAR 3	4.757	0.528	4.229	0.816	4.229	17.84	2.69	15.15
63	MAR 4	0.000	0.116	-0.116	-0.022	-0.116	0.00	0.59	-0.59
64	MAR 5	0.000	0.072	-0.072	-0.014	-0.072	0.00	0.37	-0.37
65	MAR 6	9.445	0.733	8.712	1.682	8.712	35.42	3.73	31.69
66	MAR 7	10.110	0.855	9.255	1.787	9.255	37.91	4.35	33.56
67	MAR 8	0.029	0.093	-0.064	-0.012	-0.064	0.11	0.47	-0.36
68	MAR 9	8.612	0.674	7.938	1.532	7.938	32.30	3.43	28.87
69	MAR 10	0.000	0.081	-0.081	-0.016	-0.081	0.00	0.41	-0.41
70	MAR 11	0.000	0.076	-0.076	-0.015	-0.076	0.00	0.39	-0.39
71	MAR 12	9.781	0.660	9.121	1.761	9.121	36.68	3.36	33.32
72	MAR 13	0.664	0.312	0.352	0.068	0.352	2.49	1.59	0.90
73	MAR 14	0.706	0.336	0.370	0.071	0.370	2.65	1.71	0.94
74	MAR 15	3.392	0.719	2.673	0.516	2.673	12.72	3.66	9.06
75	MAR 16	0.000	0.200	-0.200	-0.039	-0.200	0.00	1.02	-1.02
76	MAR 17	2.233	0.719	1.514	0.292	1.514	8.37	3.66	4.71
77	MAR 18	0.000	0.103	-0.103	-0.020	-0.103	0.00	0.53	-0.53
78	MAR 19	0.000	0.092	-0.092	-0.018	-0.092	0.00	0.47	-0.47
79	MAR 20	3.743	0.556	3.187	0.615	3.187	14.04	2.83	11.21
80	MAR 21	8.019	0.742	7.277	1.405	7.277	30.07	3.78	26.29
81	MAR 22	0.000	0.283	-0.283	-0.055	-0.283	0.00	1.44	-1.44
82	MAR 23	5.761	0.737	5.024	0.970	5.024	21.60	3.75	17.85
87	MAR 28	8.650	0.629	8.021	1.548	8.021	32.44	3.20	29.24
88	MAR 29	8.257	0.749	7.508	1.449	7.508	30.96	3.81	27.15
89	MAR 30	5.254	0.629	4.625	0.893	4.625	19.70	3.20	16.50
90	MAR 31	0.000	0.003	-0.003	-0.001	-0.003	0.00	0.02	-0.02
TOTAL		105.815	12.126	93.693	18.087	93.693	396.81	61.67	335.14

TABLE 3 - SURC MONTHLY PERFORMANCE TABLE - MAR. 1984

Table B5 SOUTHERN UNION - SYSTEM OPERATION SUMMARY TABLE - March 1984

Maintenance

Hours	_____
Avg \$/h	_____
Labor Cost (\$)	_____
Materials (\$)	_____
Total (\$)	_____
Hours	_____
Avg \$/h	_____
Labor Cost (\$)	_____
Materials (\$)	_____
Parts (\$)	_____
Total (\$)	_____
Hours	_____
Avg \$/h	_____
Labor Cost (\$)	_____
Materials (\$)	_____
Parts (\$)	_____
Total (\$)	_____

Total	_____
	-0-

Operation and Fixed Cost

Property Taxes (\$)	_____	
Insurance (\$)	\$ 154.92	
Parasitic Energy	kWh Used	1045
	\$/kWh	.059
	Total (\$)	61.67
Total	\$ 216.59	
TOTAL COST	\$ 216.59	
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Fossil Fuel Savings	MIL-BTU (natural gas)	105.82
	\$/MIL-BTU	3.75
Total	\$ 396.81	
TOTAL SAVINGS	\$ 396.81	
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NET SAVINGS	\$ 180.22	

a 65% burner efficiency assumed.

\*U.S. GOVERNMENT PRINTING OFFICE 1984 746-081/10076 REGION NO. 4