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CONTRACTOR REPORT

SAND81-7086/7
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MASTER

**Intermediate Photovoltaic
System Application Experiment
Operational Performance Report**

**Volume 7
for Newman Power Station
El Paso, TX**

Boeing Computer Services, Inc
Seattle, WA 98124

SAND--81-7086/7

DE82 008621

Prepared by Sandia National Laboratories Albuquerque, New Mexico 87185
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FOREWORD

Although we are now receiving and publishing site event reports, they sometimes arrive after the date when the monthly performance reports are generated. (The goal is to generate the reports within seven working days after the end of the month.) A site event report, which explains the cause of the missing data between December 25 and December 30, was received too late to be included in the following computer-generated report sections. The event report is summarized below.

The HP9845 desk-top computer, which controls data acquisition, malfunctioned on Christmas eve, but the problem was not noticed until December 28. Some of the service technicians were on vacation during the holidays, and the computer could not be repaired until December 30.

Index of Available Reports
for Photovoltaic System at EL Paso Electric Co.--
Newman Station

I. General

Report	Contents
1. DOE/ET/23062-1	Final contractor report, initial design
2. SAND81-7086/1	Project description, list of participants, system specifications

II. Monthly Performance Reports

1. SAND81-7086/2	Data for June 1981
2. SAND81-7086/3	Data for February through July 1981 (except June)
3. SAND81-7086/4	Data for August 1981
4. SAND81-7086/5	Data for Sept. & Oct. 1981
5. SAND81-7086/6	Data for November 1981
6. SAND81-7086/7	Data for Dec. 1981

III. Executive Summaries

1. SAND81-7100/1	Data for June 1981
2. SAND81-7100/2	Data for February through July 1981 (except June)
3. SAND81-7100/3	Data for August 1981
4. SAND81-7100/4	Data for Sept. & Oct. 1981
5. SAND81-7100/5	Data for November 1981
6. SAND81-7100/6	Data for Dec. 1981

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Photovoltaic Monthly Report

Report Module No. 3 :PV Array System

Utility
El Paso, Texas
December, 1981

1. Electrical energy: Total electrical energy produced by PV array field during the month	1984. kWh
2. Thermal energy: Total thermal energy produced by PV array field during the month	Not Applicable
3. Solar energy: Total measured incident solar energy in the plane of the collector during the month	33389. kWh
4. Solar energy: Total measured direct normal solar energy during the month	Not Available
5. Array efficiency: Average PV array field efficiency for the month; as a ratio of array electrical output energy to total measured incident plane-of-array solar energy	5.94%
6. Array efficiency: Average PV array field efficiency for the month, as a ratio of array electrical output energy to total measured direct normal solar energy	Not Applicable
7. Parasitic energy: Energy used by the control, tracking, and cooling subsystems during the month	0
8. Percentage parasitic loss: As a ratio of system parasitic energy (control, tracking, and cooling subsystems) to total power conditioning unit output energy	Not Applicable

Photovoltaic Monthly Report

Utility
El Paso, Texas
December, 1981

PLOT 3.0: DATA ACQUISITION MODE AND RECORDING INTERVAL PLOT

Photovoltaic Monthly Report

Utility
El Paso, Texas
December, 1981

PLOT 3.1: DAILY PV ARRAY FIELD ELECTRICAL ENERGY PRODUCTION
COMPARED WITH INCIDENT PLANE-OF-ARRAY SOLAR ENERGY

Photovoltaic Monthly Report

Utility
El Paso, Texas
December, 1981

— (A) BASED ON PLANE-OF-ARRAY SOLAR ENERGY

- - - (B) EFFICIENCY ADJUSTED TO OPTIMUM CELL TEMPERATURE OF 28°C

PLOT 3.2: DAILY PV ARRAY FIELD EFFICIENCY

Photovoltaic Monthly Report

Utility
El Paso, Texas
December, 1981

PLOT 3.3: PV ARRAY FIELD ENERGY PRODUCTION AS A FUNCTION OF
POWER LEVEL FOR THE MONTH

Photovoltaic Monthly Report

Utility
El Paso, Texas
December, 1981

PLOT 3.4: PV ARRAY FIELD ENERGY PRODUCTION AS A FUNCTION OF
PV ARRAY FIELD VOLTAGE FOR THE MONTH

Photovoltaic Monthly Report

Utility
El Paso, Texas
December, 1981

PLOT 3.5: VARIATION OF PV ARRAY FIELD ENERGY PRODUCTION
WITH CELL TEMPERATURE DURING THE MONTH

Photovoltaic Monthly Report

Utility
El Paso, Texas
December, 1981

PLOT 3.6: TOTAL MONTHLY PV ARRAY FIELD ELECTRICAL ENERGY
PRODUCTION COMPARED WITH AVERAGE HOURLY INCIDENT SOLAR
ENERGY DURING THE MONTH (LOCAL STANDARD TIME)

Photovoltaic Monthly Report

Report Module No. 8 : System Relationships

Utility
El Paso, Texas
December, 1981

1. PV system-load energy: Total electrical energy supplied by the PV system to the load during the month	1984. kWh
2. Grid-load energy: Total electrical energy used by the load that was drawn from the local utility grid during the month	Not Available
3. PV system-grid energy: Total electrical energy supplied by the PV system to the local utility grid during the month	0. kWh
4. PV system efficiency: As a ratio of total PV system output energy to total measured incident plane-of-array solar energy during the month	Not Applicable
5. PV system efficiency: As a ratio of total PV system output energy to total measured direct normal solar energy during the month	Not Applicable
6. Dollar value: Of electrical energy supplied by the PV system to the load during the month	Not Available
7. Dollar value: Of net electrical energy supplied by the PV system to the local utility grid during the month	Not Available
8. Dollar value: Of thermal energy produced by the PV system during the month	Not Applicable
9. Dollar value: Of the base load peak demand supplied by the PV system to the load and grid during the month	Not Available
10. Capacity factor: As a ratio of the monthly PV array field output energy to the rated system capacity during the month	Not Available

Photovoltaic Monthly Report

Utility
El Paso, Texas
December, 1981

PLOT 8.1: COMPARISON OF ENERGY RELATIONSHIPS BETWEEN THE PV SYSTEM, THE LOAD AND THE LOCAL UTILITY GRID ON A DAILY BASIS DURING THE MONTH

Photovoltaic Monthly Report

Utility
El Paso, Texas
December, 1981

PLOT 8.2: DAILY PV SYSTEM AVAILABILITY DURING THE MONTH

Photovoltaic Monthly Report

Report Module No. 9 : Meteorological Data

Utility
El Paso, Texas
December, 1981

1. Solar insolation: Monthly average solar insolation incident on a horizontal surface during the month during daylight hours	329. W/m ²
2. Solar insolation: Monthly average plane-of-array insolation during the month during daylight hours	503. W/m ²
3. Solar insolation: Monthly average direct normal insolation during the month during daylight hours	309. W/m ²
4. Solar insolation: Long term average horizontal insolation for the month during daylight hours	342. W/m ²
5. Solar insolation: Long term average direct normal insolation during daylight hours	0.
6. Heating need: Total actual heating degree days for the month	Not Available
7. Cooling need: Total actual cooling degree days for the month	0.° C Days
8. Heating need: Long term average heating degree days for the month	Not Applicable
9. Cooling need: Long term average cooling degree days for the month	0.° C Days
10. Temperature: Average ambient temperature for the month	8.° C
11. Wind: Average wind speed for the month	2.1 m/sec
12. Number of freeze/thaw cycles during the month	13.

Photovoltaic Monthly Report

Utility
El Paso, Texas
December, 1981

PLOT 9.1: OPERATING ENVIRONMENT: AMBIENT TEMPERATURE,
CELL TEMPERATURE, WIND SPEED AND INCIDENT
SOLAR INSOLATION (LOCAL STANDARD TIME)

Photovoltaic Monthly Report

Utility
El Paso, Texas
December, 1981

PLOT 9.2: WIND DIRECTION DISTRIBUTION FOR THE MONTH

Photovoltaic Monthly Report

Report Module No. 10: Energy Summary

Utility
El Paso, Texas
December, 1981

1. Solar energy: Total measured direct normal solar energy during the month	Not Available
2. Solar energy: Total measured incident solar energy in the plane of the collector during the month	33389. kWh
3. Solar energy: Total measured incident solar energy on a horizontal surface during the month	22014. kWh
4. Solar energy: Long term average incident solar energy on a horizontal surface for the month	3.56 $\frac{\text{kWh}}{\text{m}^2\text{-day}}$
5. Electrical energy: Total electrical energy produced by PV array field during the month	1984. kWh
6. Thermal energy: Total thermal energy produced by PV array field during the month	Not Applicable
7. Power conditioning unit output: Total energy output from the power conditioning unit(s) during the month	Not Applicable
8. Battery charge: Total energy supplied to charge batteries during the month	Not Applicable
9. Battery discharge: Total energy withdrawn from batteries during the month	Not Applicable
10. PV system-load energy: Total electrical energy supplied by the PV system to the load during the month	1984. kWh
11. Grid-load energy: Total electrical energy supplied to the load by the local utility grid during the month	Not Available
12. PV system grid energy: Total electrical energy supplied by the PV system to the local utility grid during the month	Not Available
13. Energy use: Total load energy consumption during the month	

Photovoltaic Monthly Report

Report Module No. 11 : Efficiency Summary

Utility
El Paso, Texas
December, 1981

1. Array efficiency: Average PV array field efficiency for the month, as a ratio of array electrical output energy to total measured incident plane-of-array solar energy	5.94 %
2. Array efficiency: Average PV array field efficiency for the month, as a ratio of array electrical output energy to total measured direct normal solar energy	Not Applicable
3. Power conditioner efficiency: As a ratio of power conditioner output to input energy for the month	Not Applicable
4. Battery efficiency: As a ratio of total discharge energy to charge energy for the month	Not Applicable
5. PV system efficiency: As a ratio of net PV system output energy to total measured incident plane-of-array solar energy during the month	Not Applicable
6. PV system efficiency: As a ratio of net PV system output to total measured direct normal solar energy during the month	Not Applicable

Photovoltaic Monthly Report

Utility
El Paso, Texas
December, 1981

—— (A) BASED ON PLANE-OF-ARRAY SOLAR ENERGY

----- (B) EFFICIENCY ADJUSTED TO OPTIMUM CELL TEMPERATURE OF 28°C

PLOT 11.1: DAILY PV ARRAY FIELD EFFICIENCY

SITE EVENT REPORT SUMMARY

Utility
El Paso, Texas
December 1981

1. DATE 12/01/81
EVENT TYPE Problem Failure Report
CAUSE/PURPOSE Technical
SUBSYSTEM INVOLVED ODAS
CHARACTERIZATION ODAS line busy during the process of routine data collection.

PROBLEM IS Monitored
TIME OF OCCURRENCE 1100 on 11/30/81
DURATION 26.5 hrs
SYSTEM DOWNTIME None
ACTION TAKEN System was cold started, auto start was not operational. Depress auto start and cold start again. System came up with no errors.

LABOR USED 2 person-hour
2. DATE 12/10/81
EVENT TYPE Maintenance
CAUSE/PURPOSE Adjust latitude angle on solar tracker.
SUBSYSTEM INVOLVED Weather station
CHARACTERIZATION No valid direct normal insolation readings since 11/29/81.

PROBLEM IS Resolved
TIME OF OCCURRENCE 1200
DURATION 30 min
SYSTEM DOWNTIME None
ACTION TAKEN Change angle on arm solar tracker. Instrument was tracking an estimated 5 to 8° low.

LABOR USED 0.5 person-hour

SITE EVENT REPORT SUMMARY

Utility
El Paso, Texas
December 1981

3. DATE	12/10/81
EVENT TYPE	Problem Failure Report
CAUSE/PURPOSE	Repair/fix
SUBSYSTEM INVOLVED	Controller
CHARACTERIZATION	Array tripping off in open circuit voltage condition. Required manual reset.
PROBLEM IS	Investigated. There is no record of manual reset. A log entry for each reset is now required of the SAE operators.
TIME OF OCCURRENCE	1100
DURATION	15 min
SYSTEM DOWNTIME	Problem occurred on 11/27, 11/30, 12/10, and unconfirmed on 11/26.
ACTION TAKEN	Set over-voltage timer from 10 to 15 seconds.
LABOR USED	0.25 person-hour

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