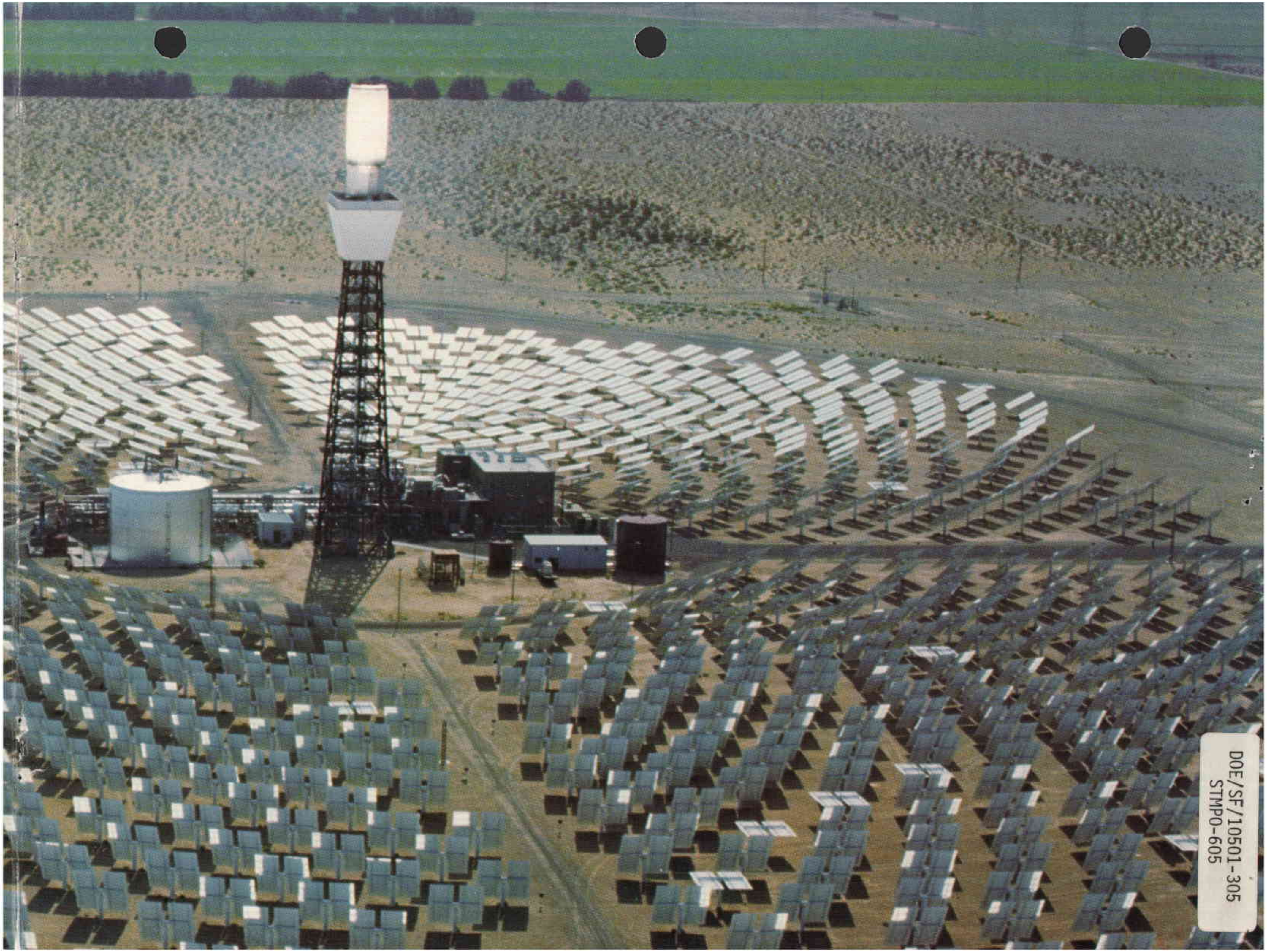


DOE/SF/10501-305
STMPO-605

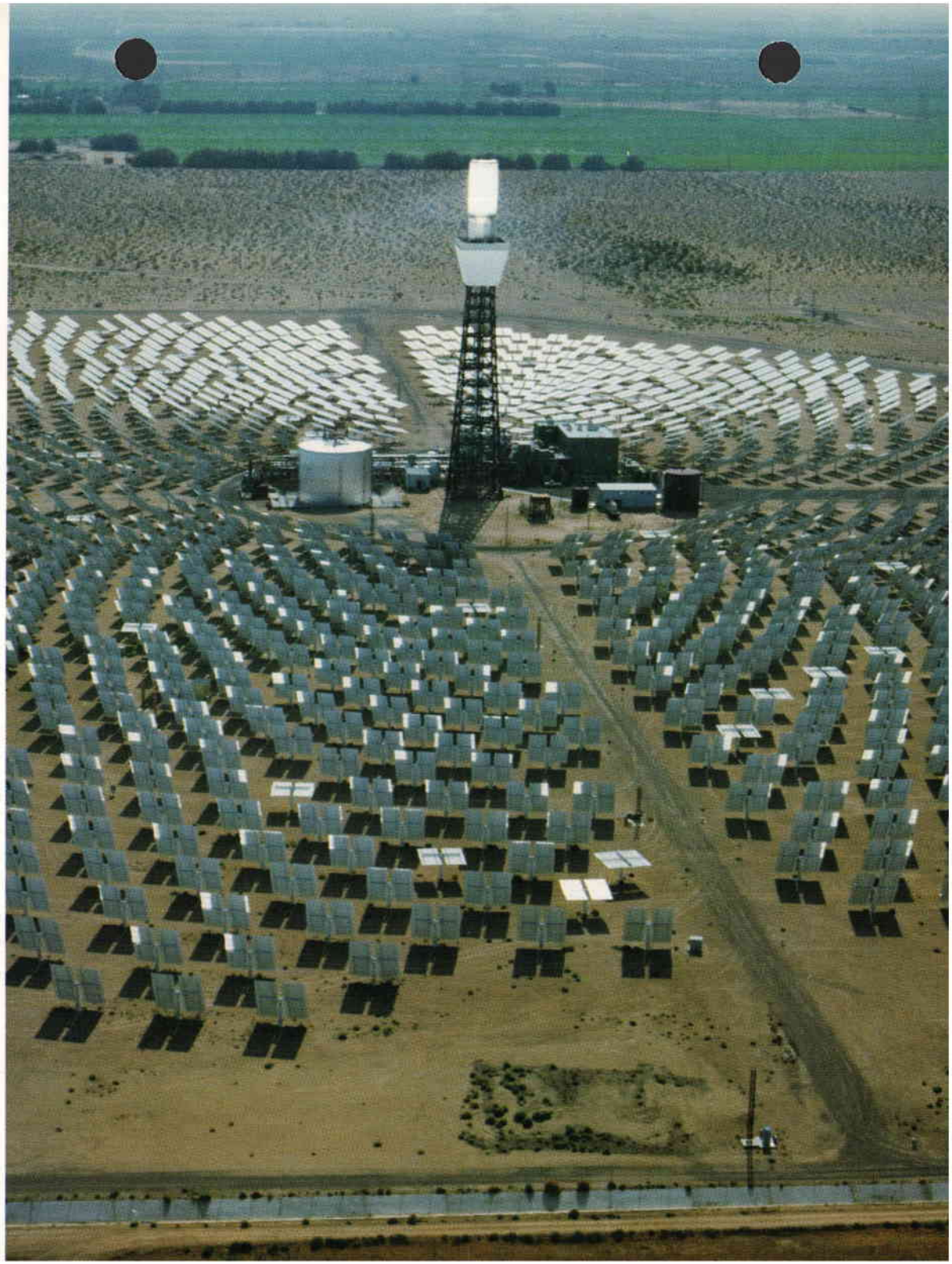
Introduction

One of our national energy goals is to increase the use of domestic renewable energy resources. With the Solar Energy Research, Development, and Demonstration Act of 1974, Congress established the "production of electricity from a number of alternate energy power plants, on the order of one to ten megawatts each," as an objective. The 10 MWe Solar Thermal Central Receiver Pilot Plant near Barstow, California, is one example of how this objective is being met.

The Barstow pilot plant, also known as Solar One, is a scale model of a 100-megawatt electric generating plant. Although Solar One can supply the electric requirements for a community of 6000, its major purpose is to provide information and data for future power plants and other users of high-quality energy. As a research and development facility, it will move solar-powered electric generation plants closer to operational feasibility.

Solar One relies on both old and new technology. Certain features not found in typical commercial generating plants allow great flexibility in plant operation. Several different types of solar central receiver plants can be simulated within this one project.

Solar energy has the potential to provide a significant portion of the nation's energy. This brochure describes research at Solar One today that will help us meet our energy needs tomorrow.



Concept

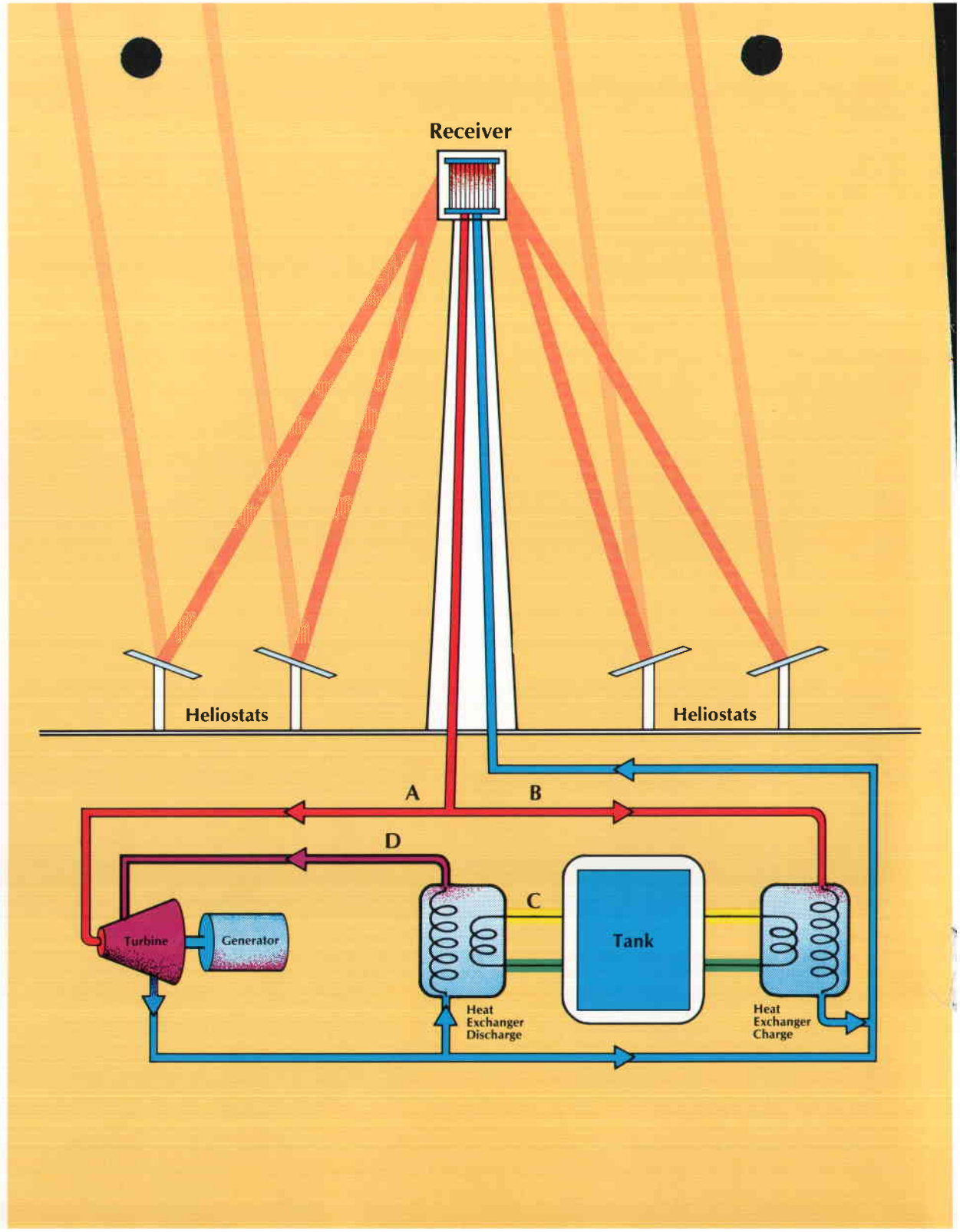
At Solar One, 1818 computer-controlled mirrors (heliostats) form a circular array around a central tower. The word "heliostat" is formed from the Greek words "helio" (sun) and "stat" (stationary). The heliostats reflect and concentrate the solar energy incident on the earth to a stationary receiver or boiler on top of the tower.

Within the receiver, the solar energy is transformed into high-temperature thermal energy in a water-steam heat transport fluid. The thermal energy can be converted to electric power immediately or stored to extend plant operation.

The collected solar energy is most efficiently put to work as receiver steam to power a turbine-generator (path A). If the energy is to be stored, receiver steam follows path B and heats oil that is routed to and from the thermal storage tank. Energy is discharged from storage by using hot oil from the tank — path C — to generate steam, which is then sent to the turbine along path D.

The thermal storage system uses oil as both a thermal storage media and a heat transport fluid. The maximum operating temperature of the storage system is 575°F (300°C). As a result, electricity is generated less efficiently than when 960°F (515°C) receiver-supplied steam is used directly in the turbine.

The operating temperature of the storage system simulates steam generation conditions in industrial plants and the chemical processing industry. Furthermore, because storage-supplied heat can supplement solar-supplied energy, Solar One can simulate a plant that uses both conventional fuels and solar energy.



Heliostats

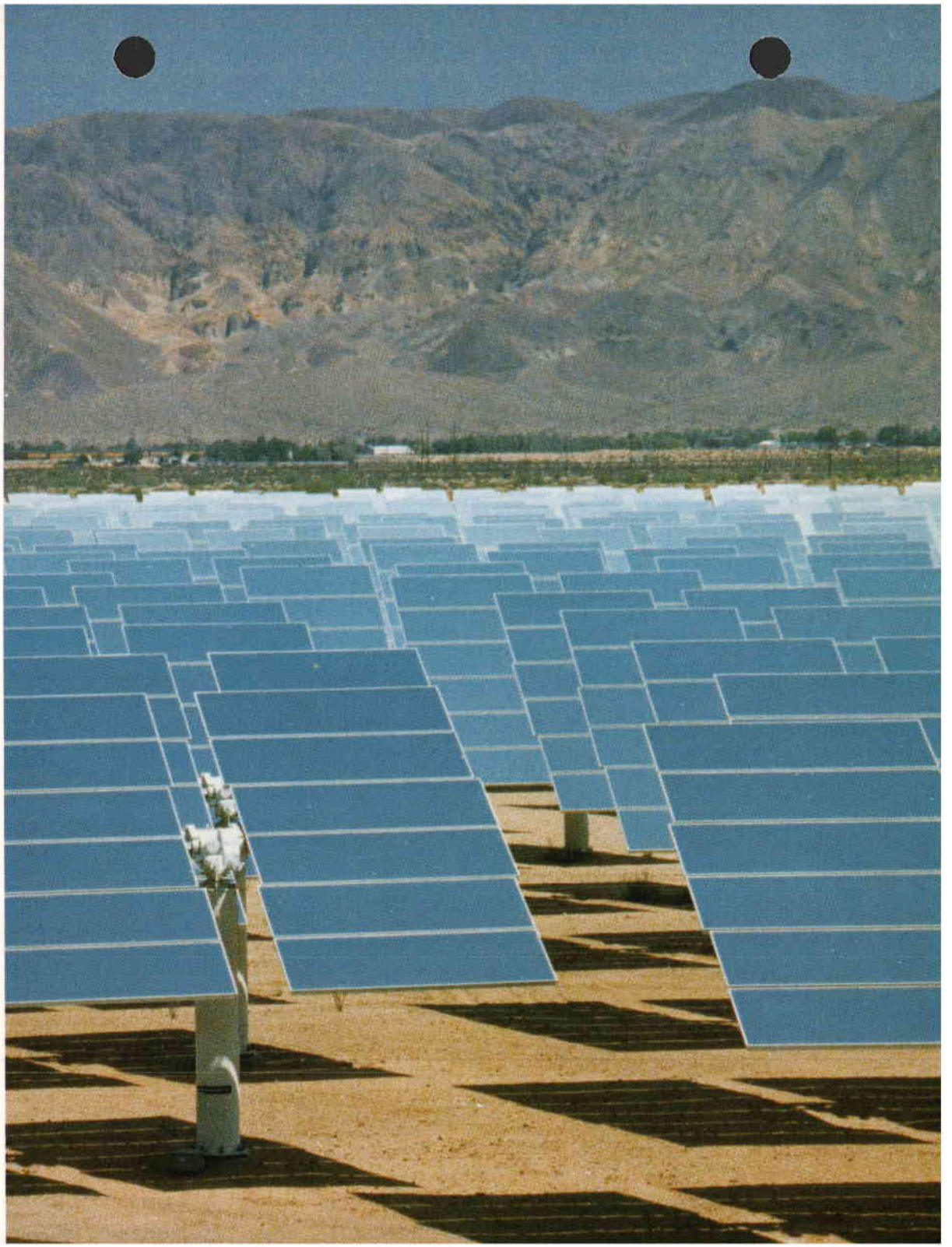
Construction of the 1818 heliostats for the pilot plant demonstrated that prototype designs can be successfully produced in volume quantities with conventional manufacturing techniques.

Each heliostat has a reflective area of 430 square feet (39.3 square meters). The heliostat glass is specially formulated to contain a minimum amount of impurities. As a result, 91 percent of the incident sunlight can be reflected when the mirror surface is clean.

The vertical and horizontal movement of the heliostats is directed by a control system — a microprocessor in each heliostat, a controller to regulate groups of up to 32 heliostats, and a central computer. Over 97 percent of the heliostats are available more than 98 percent of the time.

Operation of the heliostats has suggested areas for further research and development. For instance, rain water may be sufficient to maintain the cleanliness of the mirrors; mechanical rinsing may be required only in the dry months.

An operations and maintenance history will be developed at Solar One to help improve future heliostats.

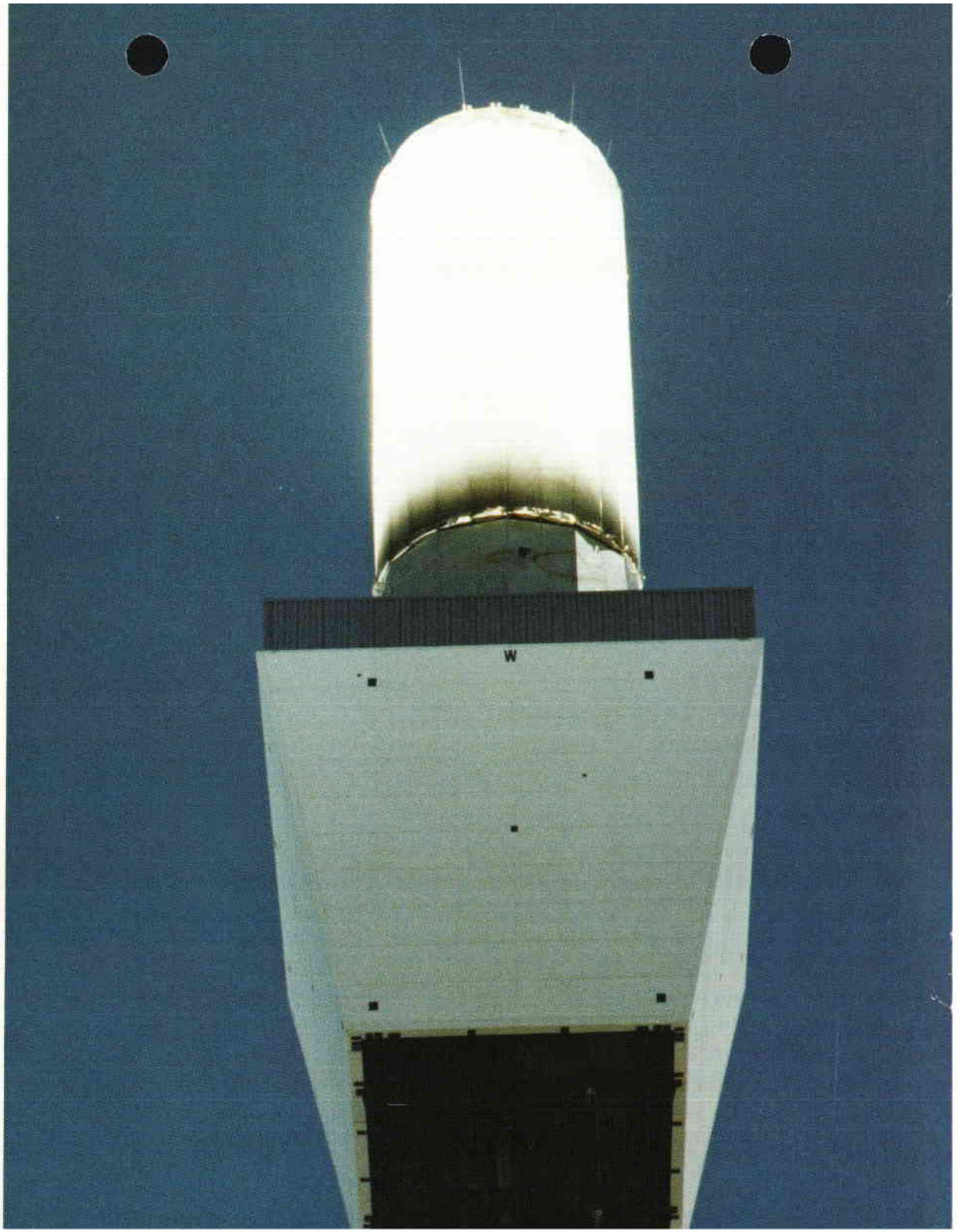


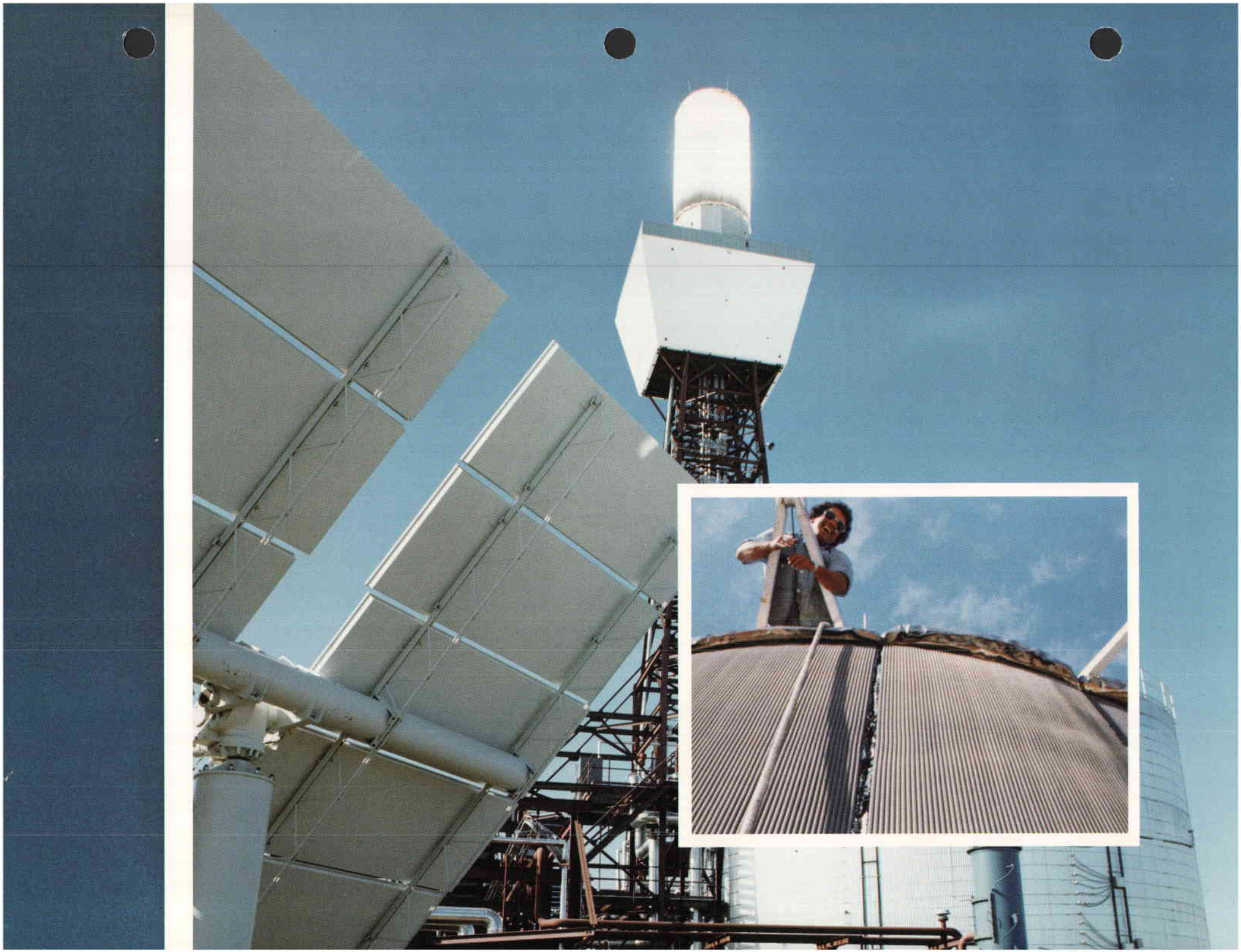
Receiver

On top of the central tower, a receiver absorbs the solar energy that is reflected by the heliostats. The receiver system provides the steam required to operate the turbine-generator. The maximum metal temperature of the receiver is about 1175°F (635°C).

Receiver performance is directly dependent on the amount of solar radiation that the receiver absorbs. However, the overall thermal efficiency of the receiver and turbine-generator combination is a compromise between the efficiencies of the two systems. In general, receiver efficiency decreases with operating temperature; turbine efficiency increases with the temperature of the steam. Optimization studies determined the combination of efficiencies that produces the best results, given variables such as ambient temperature, wind velocity, and mass flow of the steam working fluid.

Research is being performed to clarify the processes involved in heat transfer and the convective losses experienced by the receiver.





Thermal Storage

Energy absorbed by the receiver can be stored in the thermal storage system. The plant can thus generate electrical power during cloudy periods and at night. Storage is a key advantage of central receiver technology; the plant's output can be better matched to the utility's demand.

The thermal storage system at Solar One operates on the thermocline principle. A single tank contains gravel, sand, and heat transfer oil. Cold thermal storage oil at the bottom of the tank is heated in a heat exchanger; this hot oil is then pumped back into the top of the tank. Thermal energy is stored in the rock and sand. When the system is discharging, hot oil is pumped from the top of the tank through another heat exchanger to boil water, and the cold oil is returned to the bottom of the tank.

Studies are determining the performance of the thermocline boundary. Heat losses from the tank to the air and soil are also being examined. Future research will explore the best way to produce power and accommodate variations in the sun's energy.

Master Control

Digital computer and control systems have been incorporated at Solar One to minimize operator involvement with routine tasks. For example, the heliostats move automatically and position the sun's image on the receiver. Similarly, six preheat panels and eighteen receiver boiler panels automatically provide steam at specified conditions. When the plant's automatic control capabilities are complete, operating efficiency can be optimized and plant operation can be supervised by one person.

Master control of the plant not only lessens the routine work but also provides important information for decision-making. Data are provided in color graphic displays on monitors in the control room.

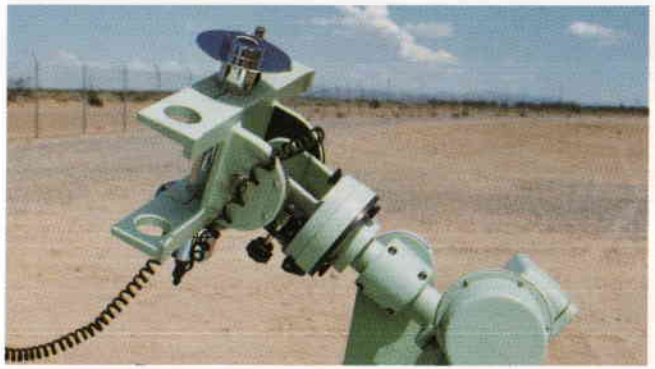
Such automation in a commercial utility plant for both monitoring and control is unique. The results of these experiences are relevant to fossil and nuclear power plant applications.

Supporting Instrumentation

Extensive data-gathering and recording systems support the research and development tasks at Solar One and supplement normal control systems. Over 3000 instrument readings are available for plant evaluation.

Data-gathering capabilities at Solar One include:

- A complete meteorological system
- Several stations to record solar radiation data
- Instrumented heliostats to measure wind loading and power consumption
- Extensive receiver instrumentation to record metal and steam temperature and incident redirected solar energy
- A beam characterization system to automatically evaluate the quality of the heliostat image on the receiver
- Rapid data scan and archiving of instrumentation values for post-analysis



The 10 MWe Solar Thermal Central Receiver Pilot Plant operates under a Cooperative Agreement between the U.S. Department of Energy and the Associates (a group composed of Southern California Edison, which acts as principal; the Los Angeles Department of Water and Power; and the California Energy Commission).

For more information about the technical aspects of central receiver systems and Solar One, write to:

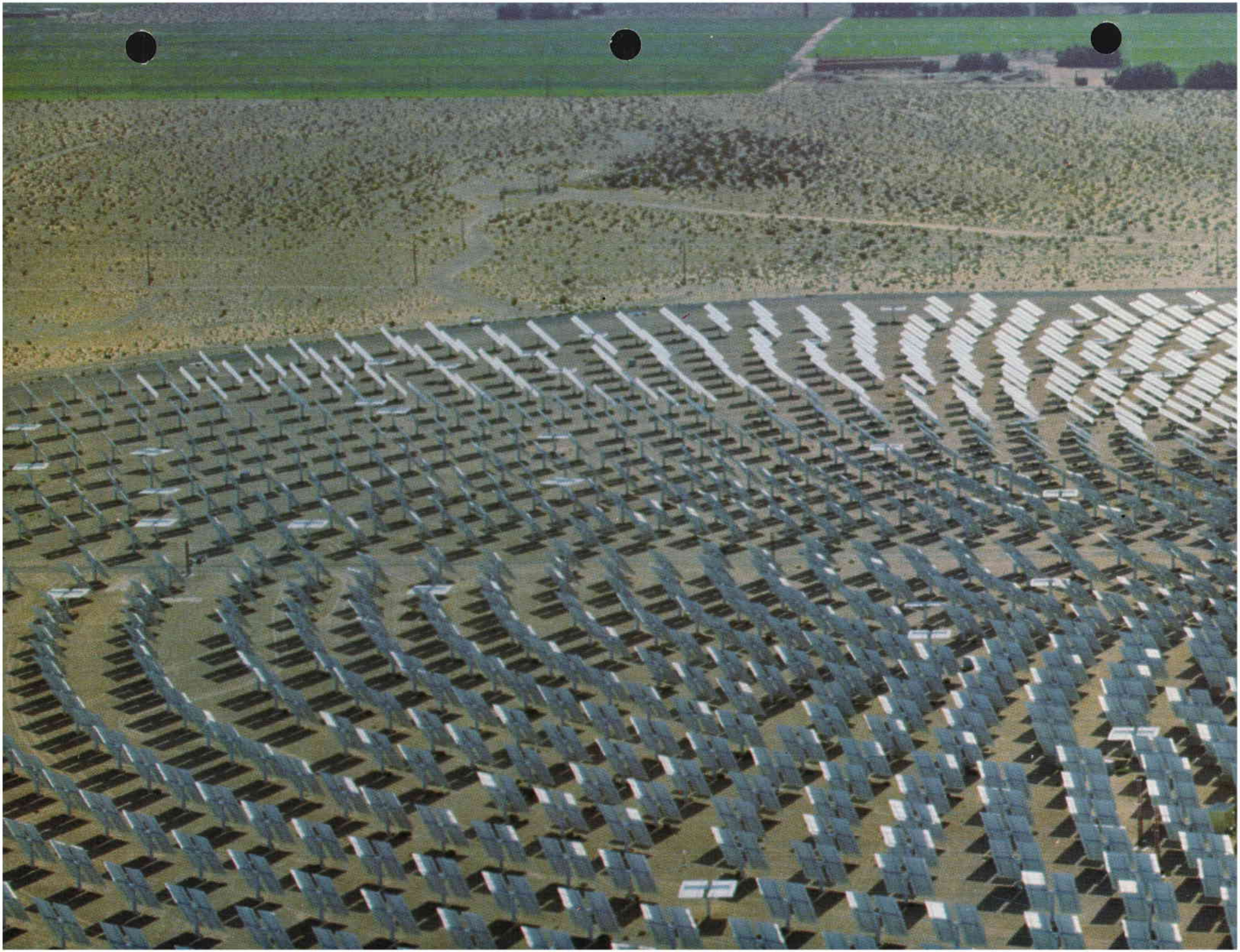
Solar Central Receiver Department, 8450
Sandia National Laboratories
Livermore, California 94550

For more information about the operational aspects of Solar One, write to:

Southern California Edison Company
Advanced Engineering Department
2244 Walnut Grove
Rosemead, California 91770

SCE

Southern California Edison Company



Technical Milestones

First generation of net electrical power to the commercial grid	April 1982
Start of two-year Test and Evaluation phase	August 1982
First generation of power from storage	August 1982
Initial generation of 10 megawatts net from receiver-supplied steam	October 1982
Generation of 1 million kilowatt-hours net while on line (cumulative)	December 1982
Generation of 7 megawatts net from thermal storage-supplied steam	February 1983
Generation of 43 megawatt-hours net from storage	May 1983
End of Test and Evaluation phase	July 1984
Start of continuous power production	August 1984

Department of Energy
San Francisco Operations Office
1333 Broadway
Oakland, California 94612

Reply to:
DOE Site Office
Post Office Box 366
Daggett, CA 94612
(619) 254-2672

Mr. William D. Matheny
Chief, Control Branch
Document Control & Evaluation Division
DOE Technical Information Center
Post Office Box 62
Oak Ridge, TN 37830

JAN 0 9 1984

Submission of 10-MWe Pilot Plant ("Solar One") Project Documentation under Cooperative Agreement DE-FC03-77SF10501, for TIC/NTIS Archiving and Announcement

Dear Mr. Matheny:

Enclosed is another shipment of Solar One project documents, including:

	Document No.	Secondary No.	Title	Date
1.	DOE/SF/10501-137	STMPO-737	Solar One Visitor Center Report	July 1983
2.	DOE/SF/10501-138	STMPO-738	Solar One Visitor Center Report	Aug. 1983
3.	DOE/SF/10501-139	STMPO-739	Solar One Visitor Center Report	Sep. 1983
4.	DOE/SF/10501-140	STMPO-740	Solar One Visitor Center Report	Oct. 1983
5.	DOE/SF/10501-141	STMPO-741	Solar One Visitor Center Report	Nov. 1983
6.	DOE/SF/10501-142	STMPO-742	Solar One Visitor Center Report	Dec. 1983
7.	DOE/SF/10501-304	STMPO-604	"Solar One" Leaflet	Nov. 1980
8.	DOE/SF/10501-305	STMPO-605	NONE (Color Brochure)	Jan. 1984
9.	DOE/SF/10501-003	STMPO-063	Final Impact Assessment & Report	June 1978

Nos. 7 and 9 are old documents that never got into the system; the restare current ones. Nos. 7 and 8 are distributed through the Visitors Center operated for us by Southern California Edison. Again, any feedback on this process you wish to provide will be gratefully received.

Sincerely yours,

Dacy Elliott

S. D. Elliott, Jr., Director,
DOE Project Office, Barstow

cc: R. Gaither, SAN/OPC
D. Holz, SAN/ISEA
R. Hughey, SAN/FGS
C. Lopez, SCE R&D

DOE Form RA-426
(10/80)

U.S. DEPARTMENT OF ENERGY

OMB NO. 038-R0190

DOE AND MAJOR CONTRACTOR RECOMMENDATIONS FOR ANNOUNCEMENT AND DISTRIBUTION OF DOCUMENTS

See Instructions on Reverse Side

1. DOE Report No.	2. Contract No.	3. Subject Category No.
DOE/SF/10501-305 (STMPO-605)	DE-FC03-77SF10501	UC-62

4. Title
(UNTITLED 8-PAGE COLOR BROCHURE W/ENCLOSED TECHNICAL MILESTONE SUMMARY)

5. Type of Document ("x" one)
- ☐ a. Scientific and technical report
- ☐ b. Conference paper: Title of conference _____
  Date of conference _____
  Exact location of conference _____ Sponsoring organization _____
- ☒ c. Other (specify planning, educational, impact, market, social, economic, thesis, translations, journal article manuscript, etc.) Information Brochure

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- ☐ a. Normal handling (after patent clearance): no restraints on distribution except as may be required by the security classification.

Make available only ☐ b. To U.S. Government agencies and their contractors. ☐ c. within DOE and to DOE contractors. ☐ d. within DOE. ☐ e. to those listed in item 13 below.

- ☒ f. Other (Specify) Archive/issue on request; Proj. Office has made initial distribution w/additional copies thru Visitors' Center.

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- ☒ a. Normal procedure may be followed. ☐ b. Recommend the following announcement limitations:

9. Reason for Restrictions Recommended in 7 or 8 above.
- ☐ a. Preliminary information. ☐ b. Prepared primarily for internal use. ☐ c. Other (Explain)

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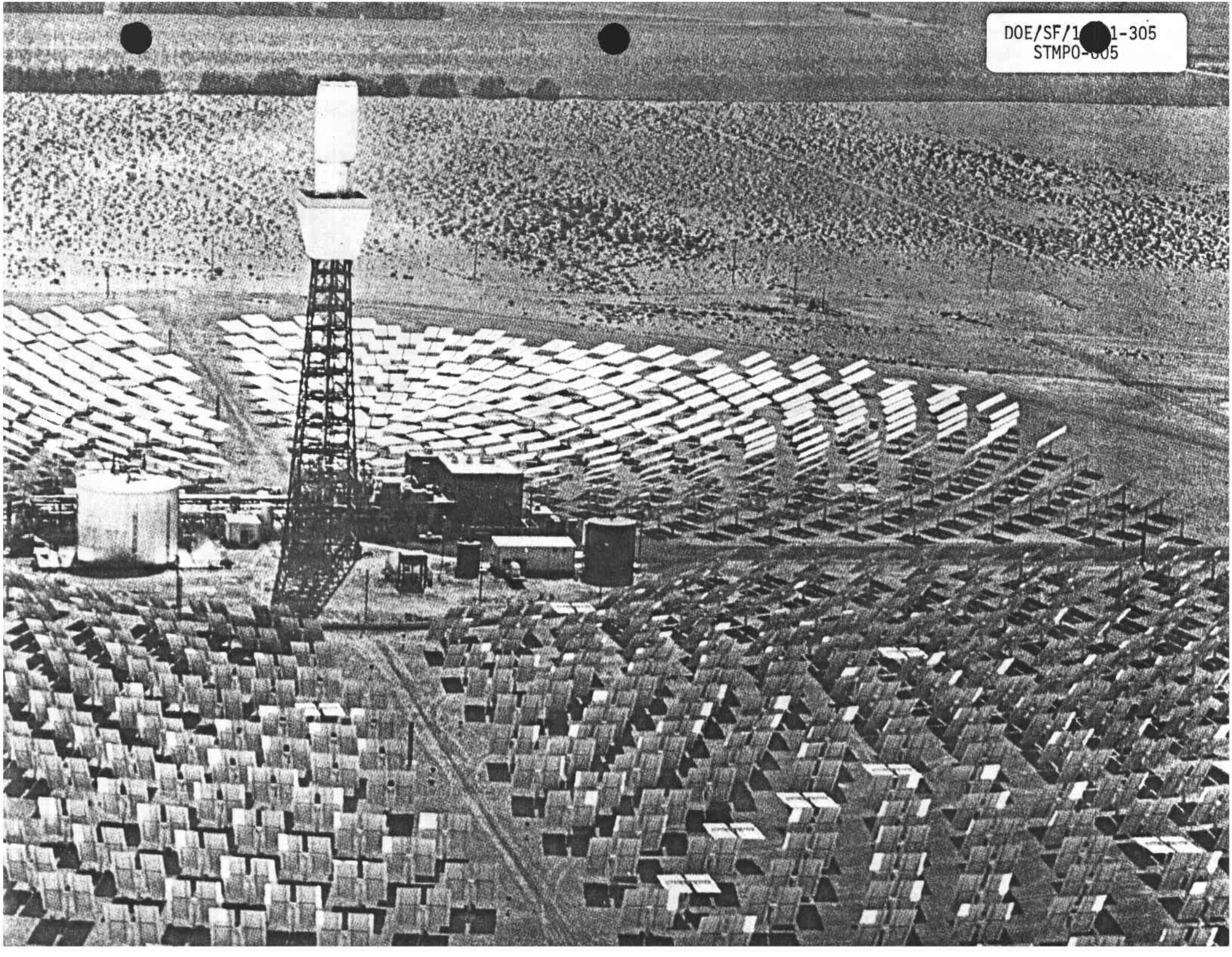
S. D. Elliott, Jr., Director, DOE Project Office, Barstow

Organization

Post Office Box 366, Daggett, CA 92327 (619) 254-2672

Signature _____ Date JAN 09 1984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(7-79)

U.S. DEPARTMENT OF ENERGY

memorandum

DATE: JAN 0 9 1984

REPLY TO ATTN OF: Doug Elliott, DOE Project Office, Barstow

SUBJECT: Submission of 10-MWe Pilot Plant ("Solar One") Documents under Cooperative Agreement DE-FC03-77SF10501 for Patent Clearance

TO: Roger Gaither, OPC

Enclosed are nine documents, with accompanying SAN Form 70's signed by the SCE R&D Site Manager, for clearance by the SAN Office of Patent Counsel:

Primary Doc. No.	Secondary No.	Title
DOE/SF/10501-137	STMPO-737	Solar One Visitor Center, July 1983
DOE/SF/10501-138	STMPO-738	Solar One Visitor Center, Aug. 1983
DOE/SF/10501-139	STMPO-739	Solar One Visitor Center, Sep. 1983
DOE/SF/10501-140	STMPO-740	Solar One Visitor Center, Oct. 1983
DOE/SF/10501-141	STMPO-741	Solar One Visitor Center, Nov. 1983
DOE/SF/10501-142	STMPO-743	Solar One Visitor Center, Dec. 1983
(all of the above on a single Form 70)		
DOE/SF/10501-304	STMPO-604	"Solar One" Leaflet (Nov. 1980)
DOE/SF/10501-305	STMPO-605	NONE (Solar One Brochure, Jan. 1984)
DOE/SF/10501-003	STMPO-063	Final Impact Assessment/Report, June 1978

Two additional copies of each of these reports are being forwarded directly to the DOE Technical Information Center for archiving, microfiching and distribution on request by TIC and NTIS. Please review these reports to insure that no patentable material is included, and advise TIC as appropriate. The feedback copy of the SAN Form 70 should be sent to me at the Project Office; I will forward it to SCE.

When review is completed, please transmit your copies to Bob Hughey, SAN/FGS; M+R copies have already been supplied. (FGS has received a request for the EIA/EIR, and this will avoid our having to make an additional copy of this bulky item.)

Doug Elliott

S. D. Elliott, Jr., Director,
DOE Project Office, Barstow

cc: Bob Hughey, DOE/SAN (FGS)
Don Holz, DOE/SAN (ISEA)
W. D. Matheny, DOE/TIC
C. W. Lopez, SCE R&D

DEPARTMENT OF ENERGY
SAN FRANCISCO OPERATIONS OFFICE

CONTRACTOR REQUEST FOR PATENT CLEARANCE
FOR RELEASE OF UNCLASSIFIED DOCUMENT

Prime Contract No.	DE-FC03-77SF10501
Subcontract No.	N/A
Report No.	DOE/SF/10501-305 (STMPO-605)
Date of Report	January, 1984
Name & Phone No. of DOE Technical Representative	S. D. Elliott, Jr. (619) 254-2672

TO: Roger S. Gaither, Asst. Chief for Prosecution
Office of Patent Counsel/Livermore Office
P.O. Box 808, L-376
Livermore, California 94550

FROM: DOE Project Office, Barstow
Post Office Box 366
Daggett, CA 92327

1. Document Title:
NONE (Solar One 10-MWe Pilot Plant Pictorial Brochure)

2. Type of Document: ☐ Technical Report, ☐ Conference Paper, ☐ Journal Article, ☐ Abstract or Summary, ☐ Copy of Oral Presentation, ☒ Other (please specify): Informational Brochure

3. In order to meet a publication schedule or submission deadline, patent clearance by _____ would be desired.

SENDER IS TO CHECK BOX #4 OR #5 BELOW.

XX 4. I have reviewed (or have had reviewed by technically knowledgeable personnel) this document for possible inventive subject matter (Subject Inventions) and that no inventions or discoveries (Subject Inventions) are deemed to be disclosed in this document except as stated below:

a. Attention should be directed to pages _____ of this document.

b. This document describes matter relating to an invention:

i. Contractor Invention Docket No. _____.
ii. A disclosure of the invention was submitted to DOE on _____ (date)
iii. A disclosure of the invention will be submitted shortly _____ (approximate date)
iv. A waiver of DOE's patent rights to the contractor:
☐ has been granted, ☐ has been applied for; or ☐ will be applied for _____ (date)

☐ 5. This document is being submitted, but no review has been made of this document for possible inventive subject matter.

6. Remarks:

Reviewing/Submitting Official: Name (Print/Type) Charles W. Lopez
Title SCE R&D Site Manager
Signature Charles W. Lopez Date Jan 6, 1983

TO: INITIATOR OF REQUEST

FROM: ASSISTANT CHIEF FOR PROSECUTION
Office of Patent Counsel/Livermore Office

☐ No patent objection to above-identified release.

☐ Please defer release until advised by this office.

Signed _____ Date Mailed _____

DEPARTMENT OF ENERGY
SAN FRANCISCO OPERATIONS OFFICE

CONTRACTOR REQUEST FOR PATENT CLEARANCE
FOR RELEASE OF UNCLASSIFIED DOCUMENT

Prime Contract No.	DE-FC03-77SF10501
Subcontract No.	N/A
Report No.	DOE/SF/10501-305 (STMPO-605)
Date of Report	January, 1984
Name & Phone No. of DOE Technical Representative	S. D. Elliott, Jr. (619) 254-2672

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Office of Patent Counsel/Livermore Office
P.O. Box 808, L-376
Livermore, California 94550

FROM: DOE Project Office, Barstow
Post Office Box 366
Daggett, CA 92327

1. Document Title:
NONE (Solar One 10-MWe Pilot Plant Pictorial Brochure)

2. Type of Document: ☐ Technical Report, ☐ Conference Paper, ☐ Journal Article, ☐ Abstract or Summary,
☐ Copy of Oral Presentation, ☒ Other (please specify): Informational Brochure

3. In order to meet a publication schedule or submission deadline, patent clearance by _____ would be desired.

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6. Remarks:

Reviewing/Submitting Official: Name (Print/Type) Charles W. Lopez
Title SCE R&D Site Manager
Signature Charles W. Lopez Date Jan. 6, 1983

TO: INITIATOR OF REQUEST

FROM: ASSISTANT CHIEF FOR PROSECUTION
Office of Patent Counsel/Livermore Office

☒ No patent objection to above-identified release.

☐ Please defer release until advised by this office.

Signed Harold M. Dixon Date Mailed 1/13/84

2

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