SOLAR ONE
IN PERSPECTIVE

1039

The facility we dedicate today is a vital stepping stone to world commercialization of sunlight to produce electricity. A world desperately dependent upon uncertain oil and gas supplies will learn from Solar One much about the promise of alternative and renewable resources whose implications are enormous.

William R. Gould

Chairman of the Board and Chief Executive Officer
Southern California Edison Company
Solar One Dedication
November 1, 1982

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This brochure is based in part on the report **Solar One in Perspective** prepared for Sandia National Laboratories by Jerome Weingart and Peter B. Bos of Polydyne, Inc., San Mateo and Berkeley, California.

Solar One is the nation's first and the world's largest solar central receiver power plant. After a decade of dedicated research and development, Solar One has demonstrated the practicality of generating electricity from the sun's energy. This successful integration of advanced solar technologies with conventional steam power generation equipment points the way to the development of full-size solar thermal power plants in the near future.

With Solar One, a basis for a major renewable and environmentally attractive energy option now exists.

PERSPECTIVES

POWER GENERATION FROM THE HEAT OF THE SUN – THE CENTRAL RECEIVER OPTION

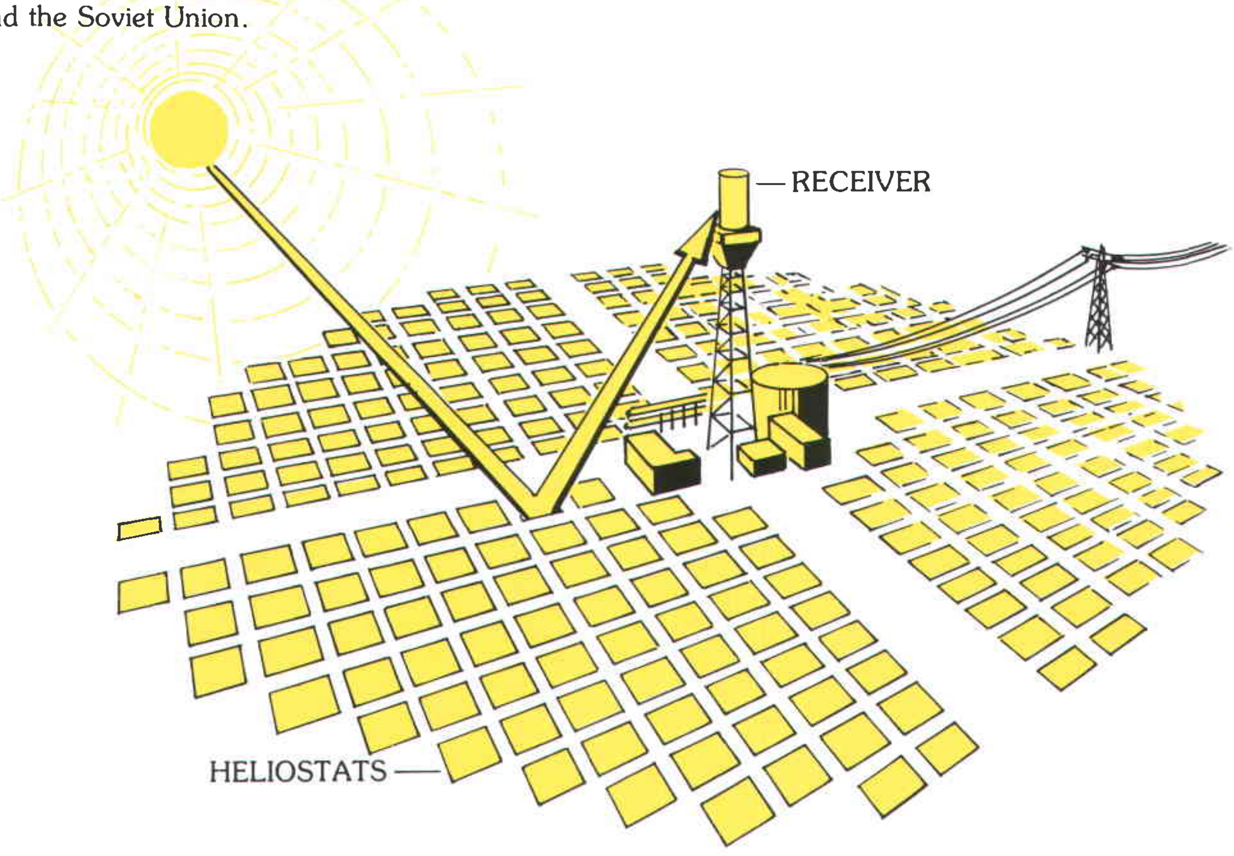
People continue to explore ways to capture the heat of the sun. Since ancient times, mirrors have been used to ignite fuels. In the mid-1800s, the first solar steam engines were developed. During the first decades of this century, engineers built small experimental solar thermal engines for pumping water and performing light industrial tasks.

However, these solar engines never generated electric power. Although some were well engineered and operated successfully, the rapid growth of the petroleum and gas industries eclipsed commercial interest in solar-generated power. Academic interest in solar thermal systems was kept alive though principally in the United States, Western Europe, Japan, and the Soviet Union.

During the 1970s, rapidly increasing fuel prices and the demand for cleaner environments gave impetus to advanced technologies suitable for harnessing the sun to generate electric power. Investigative studies identified the central receiver concept as one of the most promising options for electricity generation on a large scale.

In a central receiver system, a field of sun-tracking mirrors or "heliostats" focuses reflected sunlight on a boiler or "receiver" mounted on top of a tall tower. Within the receiver, the solar energy is converted to high-temperature thermal energy that drives a steam turbine to produce electricity.

Most central receiver system designs include a thermal energy storage system that can operate the plant for several hours after sunset or during cloudy weather. Thus, central receiver power can deliver electrical energy during periods of peak demand. Thermal storage also provides the heat necessary for starting up the plant in the morning and keeping selected portions of the plant warm when the plant is idle.



NEW TECHNOLOGY FOR AN OLD IDEA

Initial Central Receiver Studies

The first documented study of a central receiver power system was conducted in the USSR in the 1950s. In this study, large tilting mirrors were to have been mounted on railroad carriages; these carriages would have moved on semicircular tracks around a tower holding a steam boiler. The mirrors were to be periodically tilted and moved slowly on the tracks. In this way, sunlight was to be constantly focused on the boiler, producing steam for a turbine-generator. Only a crude, manually operated prototype heliostat was ever constructed. No further central receiver technology was developed until more than a decade later.

Solar Furnace at Odeillo

First Central Receiver Plants

The first carefully engineered, central receiver system experiments were built in the 1960s in Italy by Professor Giovanni Francia of the University of Genoa. In 1965, he constructed a solar steam generator that relied on the solar energy collected from 121 small heliostats. Two more plants soon followed. The last one, built in 1969, produced high-temperature steam. This plant was the basis for the design of a similar facility—the Advanced Components Test Facility—which was built in Italy and installed in 1977 at the Georgia Institute of Technology. The Advanced Components Test Facility has over three times the steam producing capacity as the original plant.

Modern Heliostat Technology

Meanwhile, high-temperature solar furnaces were operating in Europe and the United States. The pace-setting French program culminated in the unprecedented 1 MW solar thermal furnace at Odeillo in the eastern Pyrenees. This innovative facility was designed and is still used for experiments requiring extremely high temperatures (up to 4000°C) in exceptionally clean environments.

The Odeillo facility was the first solar thermal facility to produce electricity while connected to a utility grid. It was also the first facility to use a field of free-standing heliostats operating under automatic control. The development of this heliostat array was a significant step in the evolution of central receiver systems.

Proof of Concept Experiments

These early successes supported the emerging view in the scientific community that the solar central receiver concept was technically sound. It became clear that the next important step in the central receiver programs in the United States, Europe, and Japan should be the construction of experimental plants.

In Western Europe and Japan, there soon began work on five solar thermal central receiver pilot plants that ranged in size from 500 kWe to 2 MWe. In 1975, the United States with the support of the US Department of Energy began preliminary studies for another plant, a plant that would become the nation's first and world's largest solar central receiver plant: Solar One.

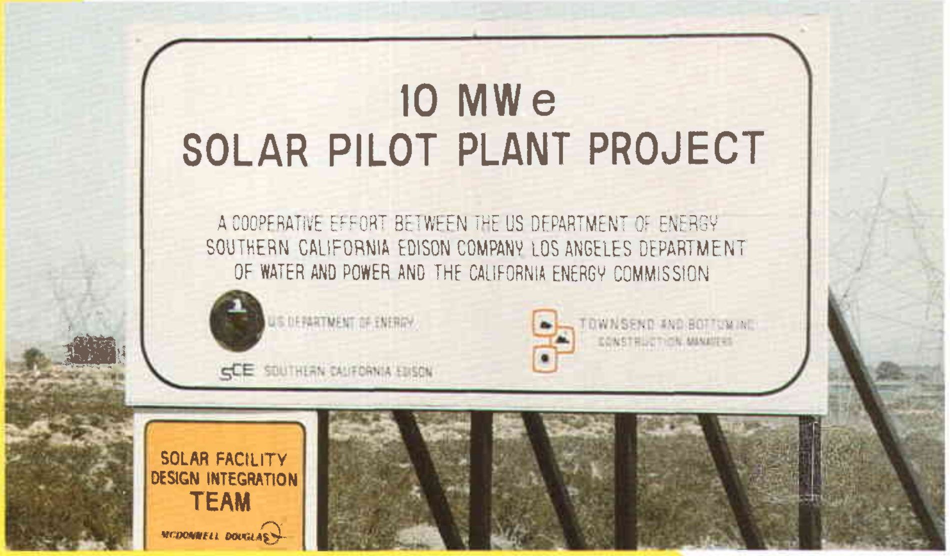
FROM DREAM TO REALITY

In 1976, the Department of Energy and the Associates—a group composed of the Southern California Edison Company, the Los Angeles Department of Water and Power, and the California Energy Commission—signed a Cooperative Agreement for Solar One. The Associates agreed to co-fund Solar One's construction, and with DOE the Southern California Edison Company agreed to operate and maintain the plant on a cost-shared basis for five years. A 130-acre site near the Barstow, California was chosen as the location for Solar One.

Major equipment manufacturers and contractors were soon selected. Martin Marietta Corporation was selected to fabricate and install the heliostats, the McDonnell Douglas Astronautics Company was chosen to provide design integration and supply the control system, and Stearns-Roger, under contract to McDonnell Douglas, was chosen to provide architect/engineering services. Also, Rocketdyne of Rockwell International was selected to design and fabricate the receiver panels and thermal storage components, General Electric was contracted to provide the turbine-generator, and Townsend and Bottom was chosen to provide construction management. The University of Houston provided computer modeling of the heliostat field.

Field construction began in September 1979 with the clearing and grading of the site. A year later, the first heliostat pedestal was installed. Mirror assemblies were added starting in February 1981, and by September of that same year all the heliostats were completely installed. A month later, the remainder of the major plant equipment—storage, receiver panels, turbine-generator, and computer hardware for the control system—were in place.

Testing began in February 1982. On April 12, 1982, the first electric generation took place when the plant was connected to the Southern California Edison utility grid. In less than three years, a major new solar thermal power generation test facility of unprecedented scale and design had been built and was operating successfully.



Sandia National Laboratories Livermore (SNLL) has played a key role as technical manager of Solar One. SNLL directed a two-year test and evaluation phase which began August 1, 1982. SNLL has continued tests and evaluations for DOE into Solar One's three year power production phase which began August 1, 1984.

GEOGRAPHIC FEATURES

Location:	Near Barstow, CA
Plant Size:	130 acres
Latitude:	34.87° North
Longitude:	116.83° West
Elevation:	1946 feet
Sunlight:	3600-4000 hrs/yr 9.8-10.9 hrs/day

UTILITY SUPPORT

Utilities have played a major role in the Solar One project since the start of the project in 1975. Two utilities—the Southern California Edison Company and the Los Angeles Department of Water and Power—were instrumental in the design, construction, startup, and operation of Solar One. Together with the California Energy Commission, they have worked in partnership with the Department of Energy, contributing money, land, engineering, and plant operating personnel. Southern California Edison provided the site and was responsible for the design and construction of the conventional power generation systems, including the specifications for the turbine-generator, feedwater system, and the cooling water system.

Construction of Solar One's Thermal Storage System

Southern California Edison also organized a technology transfer group of utility and industry representatives to insure periodic and detailed transfer of information from the Solar One project to the potential end users. During the construction of Solar One, the group met twice a year to review the detailed progress of the plant and provide opportunities for discussion between members of the group and the Solar One project engineers. The group continues to meet on a quarterly basis.

The Electric Power Research Institute (EPRI), a utility-funded organization to improve electric power production and its use, has sponsored a central receiver development program. EPRI has provided close coordination with the utility industry and developed guidelines for the eventual incorporation of central receiver plants into conventional utility grids. EPRI has supported a detailed utility-oriented review of technical lessons learned from the Solar One project, a review that is already aiding designers of the next generation of central receiver plants. A second EPRI project is an evaluation of Solar One's control and display systems and the effectiveness of the system in comparison with conventional power plant control systems.

The direct participation of the utility industry in the development of central receiver technology is expected to expand to large scale plants. As this option matures, utilities will be in a position to invest in the solar thermal option.

Mounting of Heliostat on Pedestal

SOLAR ONE—OPERATION

Solar One, currently the world's largest solar central receiver generating station, is a 10 MWe pilot plant. It is designed to provide in excess of 10 MWe net of electrical power (enough for 3500 homes) to the Southern California Edison utility grid for eight hours on the most favorable day (summer solstice) and four hours on the least favorable day (winter solstice). Solar One is made up of five main systems:

- Receiver
- Collector
- Thermal storage
- Power generation
- Master control

Receiver System

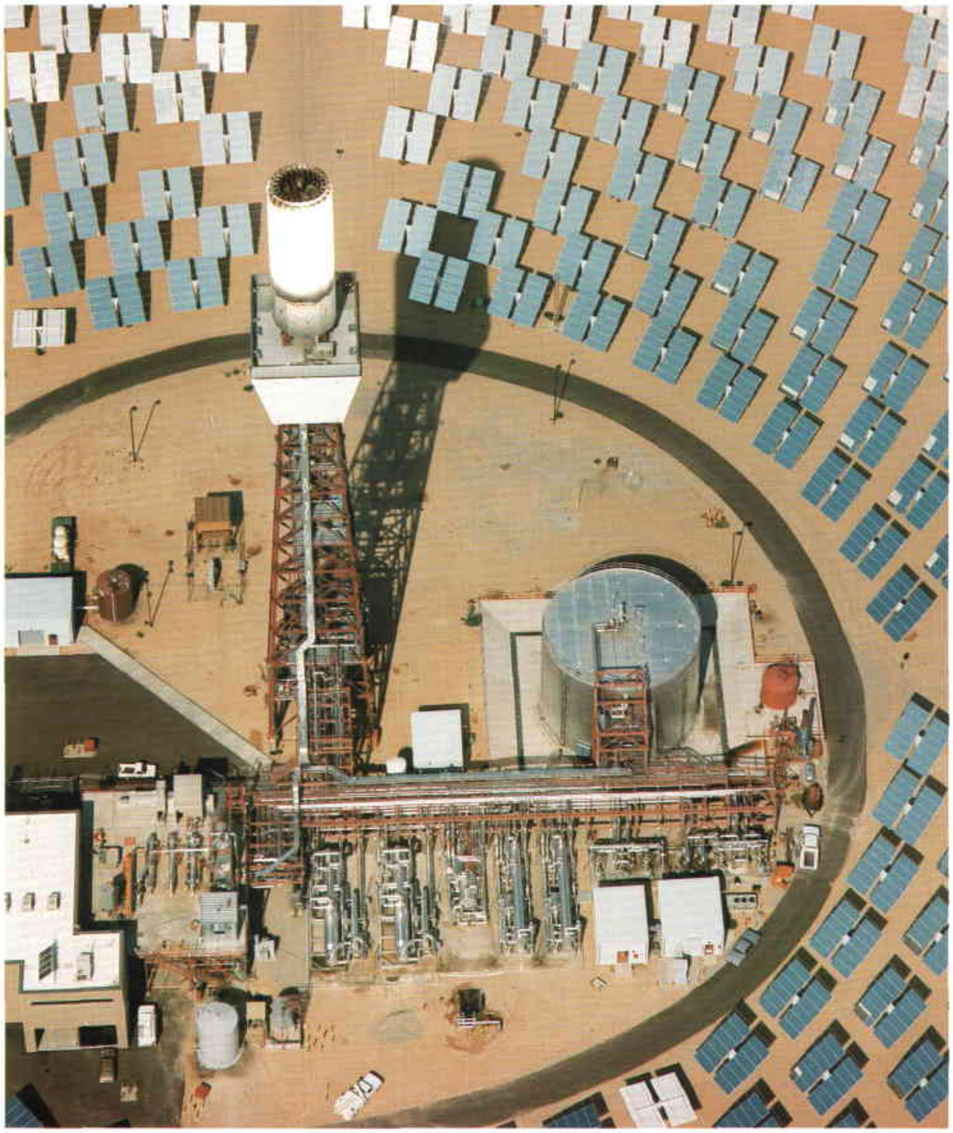
On top of the steel tower rests the cylindrical receiver: a superheat steam boiler that is 14 meters tall and 7 meters in diameter. This receiver weighs almost fifty tons and is positioned over twenty stories above the ground.

Feedwater is pumped to the bottom of the receiver, where it is vaporized to superheated steam in a single pass to the receiver's top. The steam is then piped to the turbine-generator at the foot of the tower. This steam can also provide heat to the thermal storage system.

Collector System

An oval-shaped field of 1818 heliostats, each about 39 square meters in area, surrounds a receiver mounted on a steel tower. Each heliostat contains twelve rectangular mirrors mounted on a tilting frame. These segments are made of silver-backed glass that is highly reflective. The heliostats track the sun and reflect its energy onto the receiver. Their complex arrangement in north and south fields was determined by a sophisticated computer program developed at the University of Houston; this arrangement optimizes field performance.

One of the more interesting aspects of the collector system is the control system for the heliostats. This control system consists of a microprocessor in each heliostat, a field control microcomputer for groups of up to thirty-two heliostats, and central computers for overall heliostat control. The sun position is calculated, rather than sensed, so that the heliostats can track the sun even when clouds briefly cover the sun. Heliostat beam pointing accuracy and quality can be measured and corrected using the Beam Characterization System.



Thermal Storage System

On a clear day, the receiver can generate sufficient steam to simultaneously operate the turbine and also deliver heat to the storage system. The thermal storage system can generate power in the evening or during periods of cloud cover. It also provides steam for starting up the plant in the morning and for keeping selected portions of the plant warm when the plant is not operating.

The steel-walled insulated storage tank has a capacity of 3.5 million liters and sits on lightweight insulating concrete. The tank is filled with sand, rocks, and a high-temperature thermal oil. Steam from the receiver is routed through heat exchangers to heat the thermal oil which is then pumped into the tank to heat the rock and sand. This stored thermal energy can then be transferred to the turbine generator for electrical power production.

Power Generation System

Solar One's turbine-generator, built by the General Electric Company under contract to Southern California Edison, is rated at 12.5 megawatts and is sized to handle the full plant system output plus all internal plantloads. The dual-admission turbine has a high-pressure steam inlet for steam produced by the receiver and a low-pressure inlet for steam produced from thermal storage. The rated turbine thermal-to-electric efficiency from receiver steam is 35%. The efficiency is 25% from the lower quality thermal storage steam.

Master Control System

Solar One is unique in the electric utility industry because it is automatically controlled by a Master Control System consisting of an Operational Control System computer which supervises the operation of the plant's two thousand microprocessors. Thus, Solar One is a showcase for modern digital control system technology. Information on plant operation is provided to the operator on color-graphic video displays.

In the morning the operator, through keyboard commands, positions the heliostats at standby operating points, begins water circulation in the receiver, and then issues a command to the Operational Control System (OCS) computer to start-up the plant. The OCS computer takes over and automatically directs heliostats to track the receiver. When receiver steam conditions are correct, steam is routed to the turbine. The operator then synchronizes the turbine to the electric grid. The plant operates for the rest of the day under the supervisory control of the OCS computer.

If conditions change, such as a cloud passing over, the control system automatically makes adjustments to keep the plant in the best operating state. If some abnormal event occurs, alarm messages tell the operator which parameters are out of normal operating range. The operator can at any time make changes in any plant operating condition.

While the pilot plant control system was designed for controlling a water-steam central receiver solar plant, the basic functions and operating philosophy are readily adaptable to other power plants.

ACHI

Solar One Performance

Solar One has exceeded many of its original design and performance specifications.

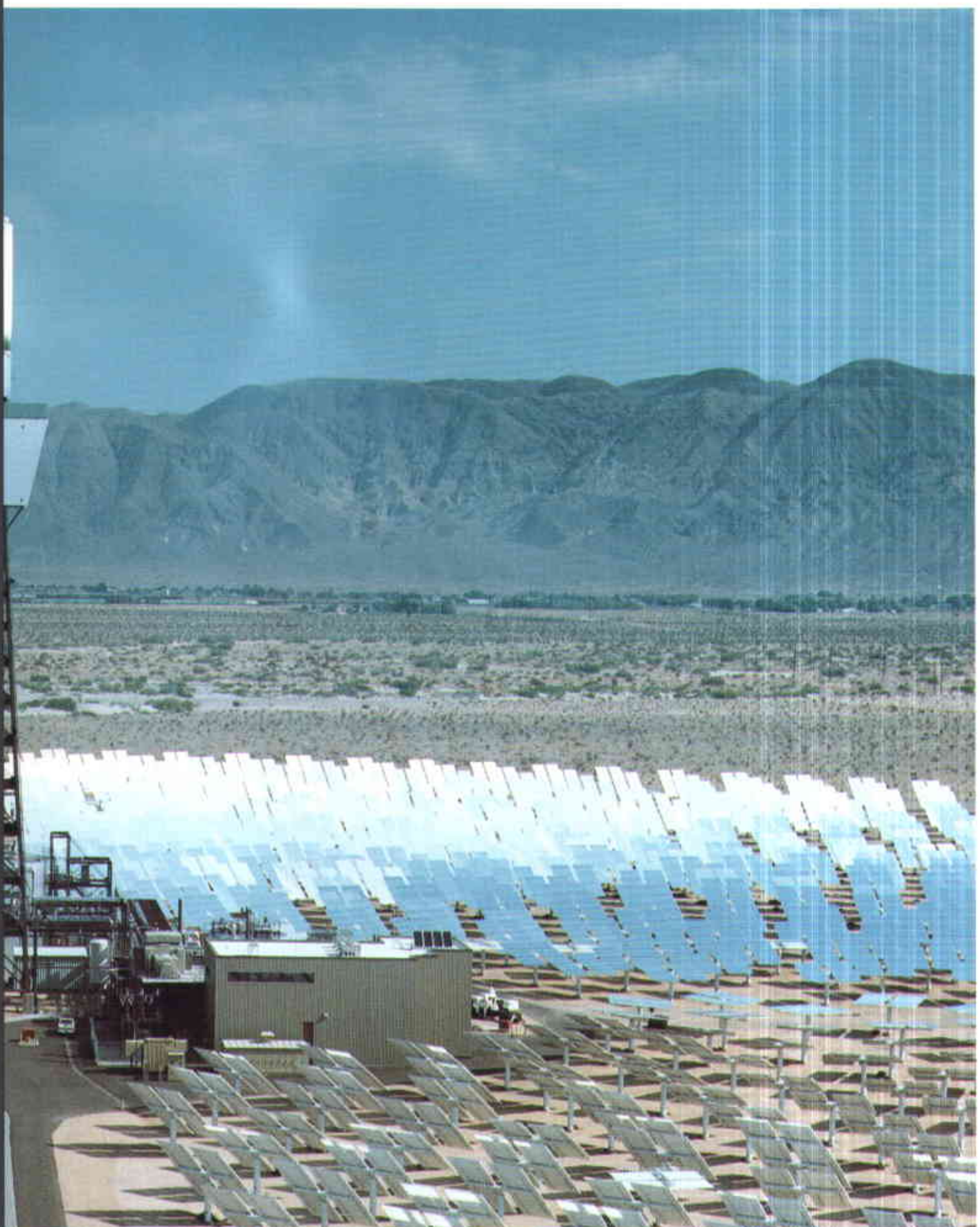
- The requirement for production of 10 megawatts-electric net was exceeded by a peak production of 12.1 megawatts. Similarly, the required 7 megawatts net generation from storage was exceeded by an output of 7.3 megawatts.
- The plant has also successfully operated down to 0.5 megawatts which is considerably lower than the designed minimum operating production level of 2 megawatts. The minimum sunlight threshold for operation was designed as 450 watts per square meter, yet the plant has operated in direct solar radiation levels as low as 300 watts per square meter.
- In an endurance test, the receiver and storage systems kept the turbine continuously on-line for 33.6 hours and generated 127 megawatt-hours net.

Solar One in Operation

PLANT P

	REQUIRED PERFORMANCE	ACHIEVED PERFORMANCE	
Peak Production	10 MWe	12.1 MWe	Minimum Operating Power Poi
Thermal Storage Output	7 MWe	7.3 MWe	Minimum Sunlight Threshold

EMENTS



- Solar One was designed to have 95% of the heliostats available at any one time. Between April 1982 and April 1983, 98% of the heliostats were available for operation. This percentage increased to 99% during April 1983.

- The establishment of the sharp thermal gradient (thermocline) needed for the storage system has been verified. Gradients of 49°C/meter have been measured. Equally important is the very low rate of heat loss from the storage tank. The tank heat loss has been measured at 1.3%/day.

- During its Experimental Test and Evaluation Phase, Solar One was successfully operated in all its steady-state operating modes. Transitions to and from each steady-state mode were accomplished, and, during the course of testing, significant improvements were made in the plant's start-up and shutdown times. Considering the first-of-a-kind nature of the plant and the high level of technology involved, Solar One has operated very well.

RMANCE

REQUIRED RFORMANCE	ACHIEVED PERFORMANCE		REQUIRED PERFORMANCE	ACHIEVED PERFORMANCE
2 MWe	0.5 MWe	Net Energy from Storage	28.0 MWe-hr	43.4 MWe-hr
50 W/m2	350 W/m2	Continuous Power Production	–	33.6 hours

ACHIEVEMENTS

New Technologies

With the Solar One program, the United States has integrated highly sophisticated technology into an operating solar pilot plant. The plant makes use of such technological advances as:

- High-temperature alloys
- Computer-based analysis of mechanical systems
- Dynamic simulation of solar power systems performance
- Computer-aided design
- Advanced digital control systems and color video displays
- Thermal storage system using only a single tank.

Major project innovations include microprocessor-controlled precision heliostats that can withstand 90 mile-per-hour winds, a high-temperature solar steam boiler based on rocket engine technology, and the nation's first computer-based digital power-plant control system.

Solar One Costs

The Department of Energy contributed $120 million to support the design and construction of all solar facilities including the heliostat field, the receiver, the thermal storage system, and the master control system. The total utility support of $21.5 million was shared on an 80%-20% basis by Southern California Edison and the Los Angeles Department of Water and Power.

When the pilot plant was completed, the costs were within 6% of the original budget estimate (when adjusted for inflation). This accomplishment is remarkable for a first-of-a-kind, large-scale energy project.

Some of the major plant costs for Solar One included:

- Engineering design (24%),
- Fabrication and construction of the heliostat field (28%),
- Fabrication and construction of the receiver (13%), and
- Program and construction management (12%).

Other costs for the plant included 8% for the thermal storage system, 5% for the turbine-generator, 4% for thermal transport, 3% for electrical plant including the master control system, and 3% for structures and improvements.

The estimated annual operation and maintenance cost for Solar One is about $3.2 million. These costs include the complex laboratory needs of Solar One, as well as the deployment of a large team of scientists and engineers and associated research and development equipment. The operating cost per kilowatt of installed capacity is expected to be considerably lower for commercial applications.

SOLAR ONE: IN HARMONY WITH ITS ENVIRONMENT

Solar thermal central receiver technology has distinct environmental advantages over the combustion of fossil fuels.

- No air pollution
- No water pollution
- No toxic wastes

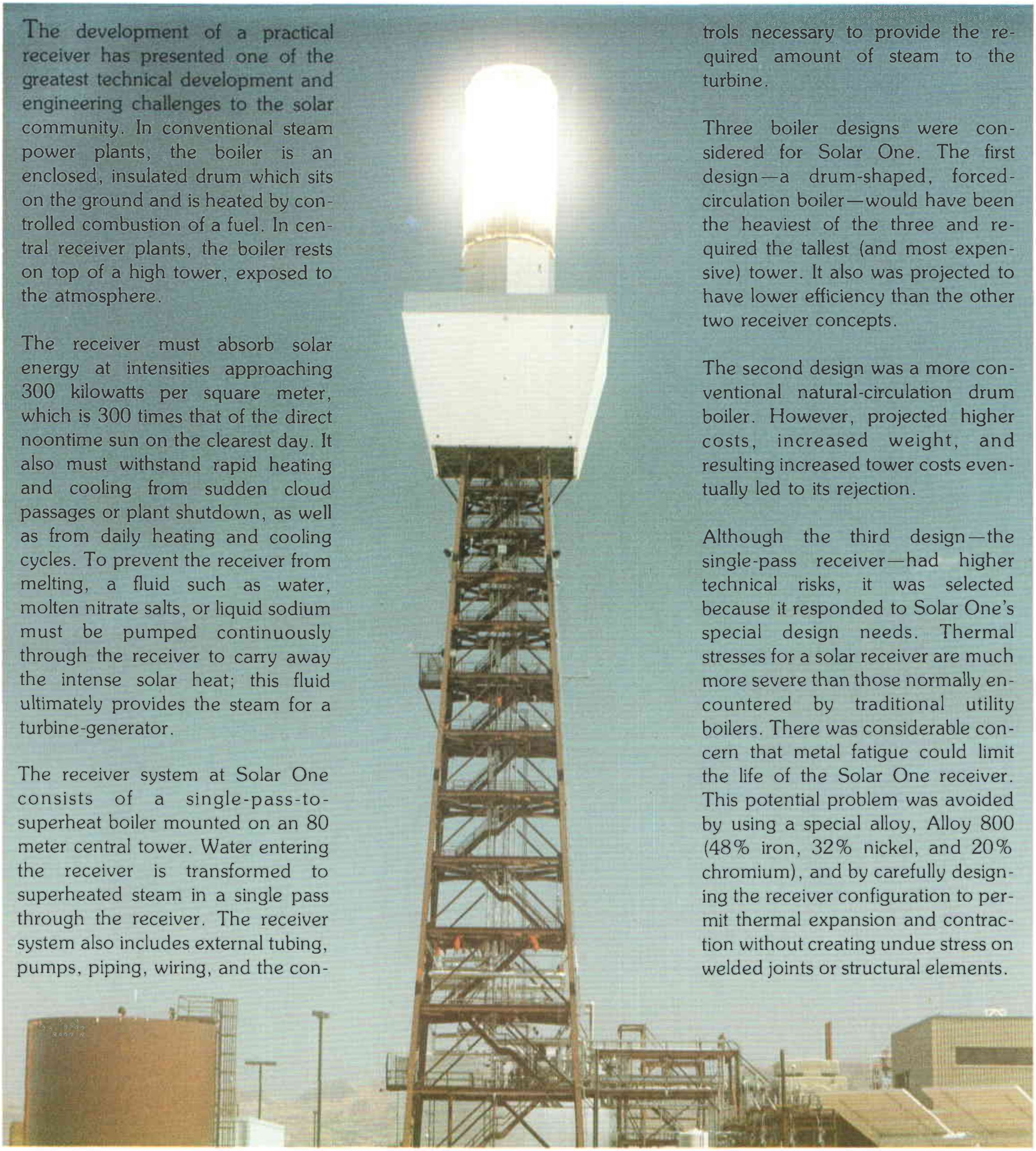
A number of US and European researchers have analyzed the potential impacts of central receiver plants on local weather and climate. Theoretical studies are not sufficient to predict the extent of such disruptions in detail, but to date the studies suggest that the impacts will not be significant, even for much larger commercial central receiver plants.

Standby Points Provide Safety for Airplane Pilots

When the plant starts up in the morning, the heliostat beams are first focused on one of four standby points located about 35 meters from the receiver. These bright standby points provide a safe location for the beams so that they do not converge in the airspace above the plant.

Since the beams converge at points near the receiver, pilots flying over the plant will only see flashes from individual mirrors which are not hazardous to the eyes and no more distracting than any other reflective surface.

SPACE-AGE TECHNOLOGY TRANSFORMS STEAM BOILERS INTO SOLAR RECEIVERS



The development of a practical receiver has presented one of the greatest technical development and engineering challenges to the solar community. In conventional steam power plants, the boiler is an enclosed, insulated drum which sits on the ground and is heated by controlled combustion of a fuel. In central receiver plants, the boiler rests on top of a high tower, exposed to the atmosphere.

The receiver must absorb solar energy at intensities approaching 300 kilowatts per square meter, which is 300 times that of the direct noontime sun on the clearest day. It also must withstand rapid heating and cooling from sudden cloud passages or plant shutdown, as well as from daily heating and cooling cycles. To prevent the receiver from melting, a fluid such as water, molten nitrate salts, or liquid sodium must be pumped continuously through the receiver to carry away the intense solar heat; this fluid ultimately provides the steam for a turbine-generator.

The receiver system at Solar One consists of a single-pass-to-superheat boiler mounted on an 80 meter central tower. Water entering the receiver is transformed to superheated steam in a single pass through the receiver. The receiver system also includes external tubing, pumps, piping, wiring, and the controls necessary to provide the required amount of steam to the turbine.

Three boiler designs were considered for Solar One. The first design—a drum-shaped, forced-circulation boiler—would have been the heaviest of the three and required the tallest (and most expensive) tower. It also was projected to have lower efficiency than the other two receiver concepts.

The second design was a more conventional natural-circulation drum boiler. However, projected higher costs, increased weight, and resulting increased tower costs eventually led to its rejection.

Although the third design—the single-pass receiver—had higher technical risks, it was selected because it responded to Solar One's special design needs. Thermal stresses for a solar receiver are much more severe than those normally encountered by traditional utility boilers. There was considerable concern that metal fatigue could limit the life of the Solar One receiver. This potential problem was avoided by using a special alloy, Alloy 800 (48% iron, 32% nickel, and 20% chromium), and by carefully designing the receiver configuration to permit thermal expansion and contraction without creating undue stress on welded joints or structural elements.

Advanced Solar Receivers

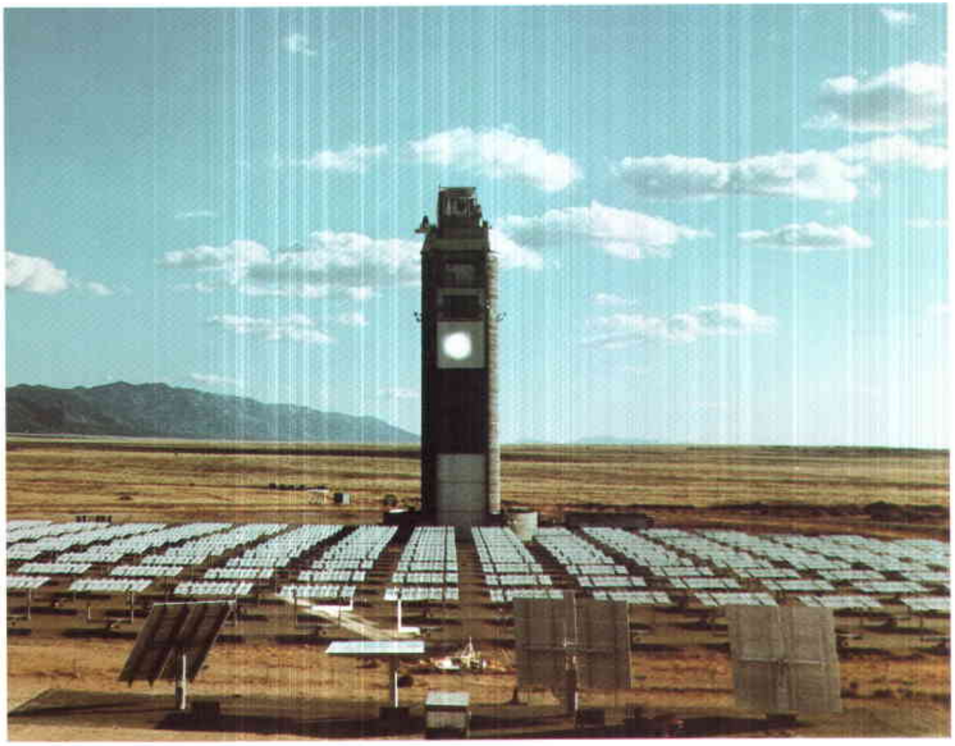
The Solar One project has advanced the state of the art of steam boilers. Moreover, from what has been learned at Solar One, a number of alternative receiver concepts are being explored and developed. Some of these alternatives have been built and tested both in model and full-scale configurations. Cavity-type and open receivers, as well as partial-cavity receivers, have all been studied.

Various working fluids (e.g., water-steam, molten salt, and liquid sodium) have been incorporated in systems designed to drive a conventional steam turbine. Helium and air receiver systems have also been designed for use with high-temperature central receiver systems; and experiments are ongoing to test the feasibility of using solid particles as the working fluid and storage medium.

The Central Receiver Test Facility

The Central Receiver Test Facility (CRTF), located in Albuquerque, New Mexico, is the largest facility specifically designed for testing central receiver components and subsystems. Since its completion in mid-1978, work at the CRTF has provided the extensive experience necessary for the development of Solar One.

At the CRTF, a 15-meter-diameter concrete-and-steel receiver tower rises 60 meters above the ground. Within the tower, three test bays at different levels are used for experiments. A huge elevator can transport equipment weighing as much as 100 tons to these test bays.



Central Receiver Test Facility in Albuquerque, New Mexico

Martin Marietta Corporation designed the heliostats especially to meet the demanding requirements of a test facility. When all 222 heliostats are focused on a receiver in one of the test bays, temperatures in excess of 2000°C can be generated. In practice, lower temperatures are used for receiver testing.

The CRTF has been used to test innovative receivers that use gas, liquid sodium, or molten nitrate salts for thermal transport. For example, the Molten Salt Electric Experiment (MSEE) used molten salt as the heat transport fluid and storage medium in an integrated central receiver system to produce an electrical power output of 750 kWe.

Moreover, the CRTF is associated with special test facilities such as the Radiant Heat Facility that has been used to demonstrate the solid particle receiver concept. At the facility, silica sand particles attained a temperature of 1000°C at a flux level comparable to most central receiver systems.

The Central Receiver Test Facility also is used to test advanced heliostats and solar thermal power plant instrumentation systems. Future work at the CRTF will include a broad class of scientific experiments that require its unique high-temperature, high heat-flux capabilities.

HELIOSTAT EXPERIENCE

The most expensive component of a central receiver plant is the heliostat field. Less than a decade ago, experience with the construction and operation of a field of heliostats was limited to the sixty-three heliostats at the solar furnace at Odeillo, France. The development of commercial heliostats able to meet stringent performance, lifetime, and cost requirements has been a significant achievement, one that is crucial for the development of central receiver technology.

In mid-1978, Martin Marietta and McDonnell Douglas received contracts to develop competitive heliostat designs and prototype hardware for Solar One. Two prototypes from each contractor were extensively tested, and Martin Marietta was subsequently awarded the contract to provide 1818 heliostats for Solar One. Installation took place in 1981.

From 1979 through 1981, a second generation of heliostats was built and tested by ARCO Power Systems, Boeing Engineering and Construction, Martin Marietta, and McDonnell Douglas. These new designs incorporated experience gained at Solar One and the Central Receiver Test Facility. These designs, characterized in the table below, have increased mirror area size and reduced weight. Each design also shows a 20-30% reduction in cost from the Solar One heliostats.

ARCO, Martin Marietta, and McDonnell Douglas have continued work on yet a third generation of heliostats with further design improvements and cost reductions.

Solar One Heliostats

	Solar One Heliostats	Second Generation Heliostats			
	Martin Marietta	**Boeing**	**Martin Marietta**	**McDonnell Douglas**	**ARCO**
Mirror Area (m^2)	39.1	43.7	57.4	56.9	52.9
Mirror Type (2nd Surface Silver Reflector)	Glass- Al honeycomb-steel sandwich	Glass-foam-glass-glass sandwich	Glass, steel-paper honeycomb-steel sandwich	Laminated fusion-float glass, steel hat sections	Glass, steel-steel channel-steel sandwich
Drive Type: Azimuth	Integrated spur gear	Planetary gear	Integrated spur gear	Harmonic	Worm/gear
Weight, kg/m^2 (lb/ft^2)	47 (9.6)	41.6 (8.5)	43 (8.8)	40.5 (8.3)	43 (8.8)

SOLAR HEAT STORAGE

The development of thermal storage technology for central receiver systems has presented a challenge as difficult as that facing receiver designers.

Initially, Solar One was to have a dual-tank storage system, in which there would be two separate tanks for hot and cold fluids. After considerable thermodynamic analysis and modeling, a unique single tank thermocline system was proposed.

When steam from the receiver is piped to the thermal storage heat exchanger, oil heats up as the steam is condensed to water. The hot oil then enters the top of the storage tank and transfers its heat to a bed of rock and sand. There is a steep thermal gradient (thermocline) between the hot rock at the top of the bed and the cooler rock below. As heat enters the storage tank, this thermocline, which can be thought of as an imaginary surface separating the hot and cold regions of the tank, gradually sinks until the entire storage system has reached its maximum temperature. The calculations that suggested this innovative approach have been supported by good performance.

This type of storage is more complex to control and operate than a high-temperature thermal storage system based on molten salts or liquid sodium. Solar One is providing considerable operating experience which will permit designers to develop less complex thermal storage systems for future larger central receiver plants.

COMPUTERIZED CONTROL SYSTEM

The control system at Solar One represents a major advance in power-plant control technology. The sophistication of this system is reflected in the degree of automation, the reliance on computer programs for development of control strategies, and the emphasis on digital controls and color video displays. As the nation's first distributed digital control system in a power plant, it has attracted major utility and industry interest.

The overall system provides for automatic control and coordination of major plant systems. Seven video displays and keyboards permit operators to monitor and control the plant, while teleprinters record plant operating data and status. Only the hard-wired backup controls for the turbine-generator and critical plant pumps are conventional. In addition, almost 2000 sensors measure temperature, pressure, fluid flow rates, water chemistry, strain and vibration in critical components, as well as monitor weather conditions.

The majority of the information displayed on the video screens is in the form of functional diagrams. Real time data are displayed near the graphics symbols which represent plant components such as pumps, valves, steam lines, etc. Plots of plant data can be displayed in real time and for the previous 24 hours. Process out-of-limit conditions are announced through the color-graphic displays rather than through dedicated annunciator panels which are common in conventional power plants.

Utility plant operators trained to operate Solar One have readily mastered the system. A special feature of this unique system is the ability of the operators to modify and expand the system's display capabilities. As a result, the operators have not only added considerable information and complexity to the video displays but have also learned to create new ones.

This new generation of power plant controls ultimately will benefit the entire utility industry.

BEYOND SOLAR ONE...

Since Solar One was designed in the late 1970s, significant advances have been made in solar thermal central receiver technology. Conceptual design studies and component tests have identified molten salt-cooled and liquid sodium-cooled receivers as attractive alternatives to the water/steam technology selected for Solar One. Moreover, heliostat technology has progressed with design improvements and cost reductions.

These advances along with the experience gained from Solar One provide a solid base for the next generation of central receiver plants.

Future commercial central receiver plants will probably use either molten nitrate salts or sodium as the receiver heat transfer fluid in order to achieve higher annual energy production. Several system experiments smaller than Solar One have been conducted; however, large system experiments will be required enroute to a commercial 100 MWe size plant.

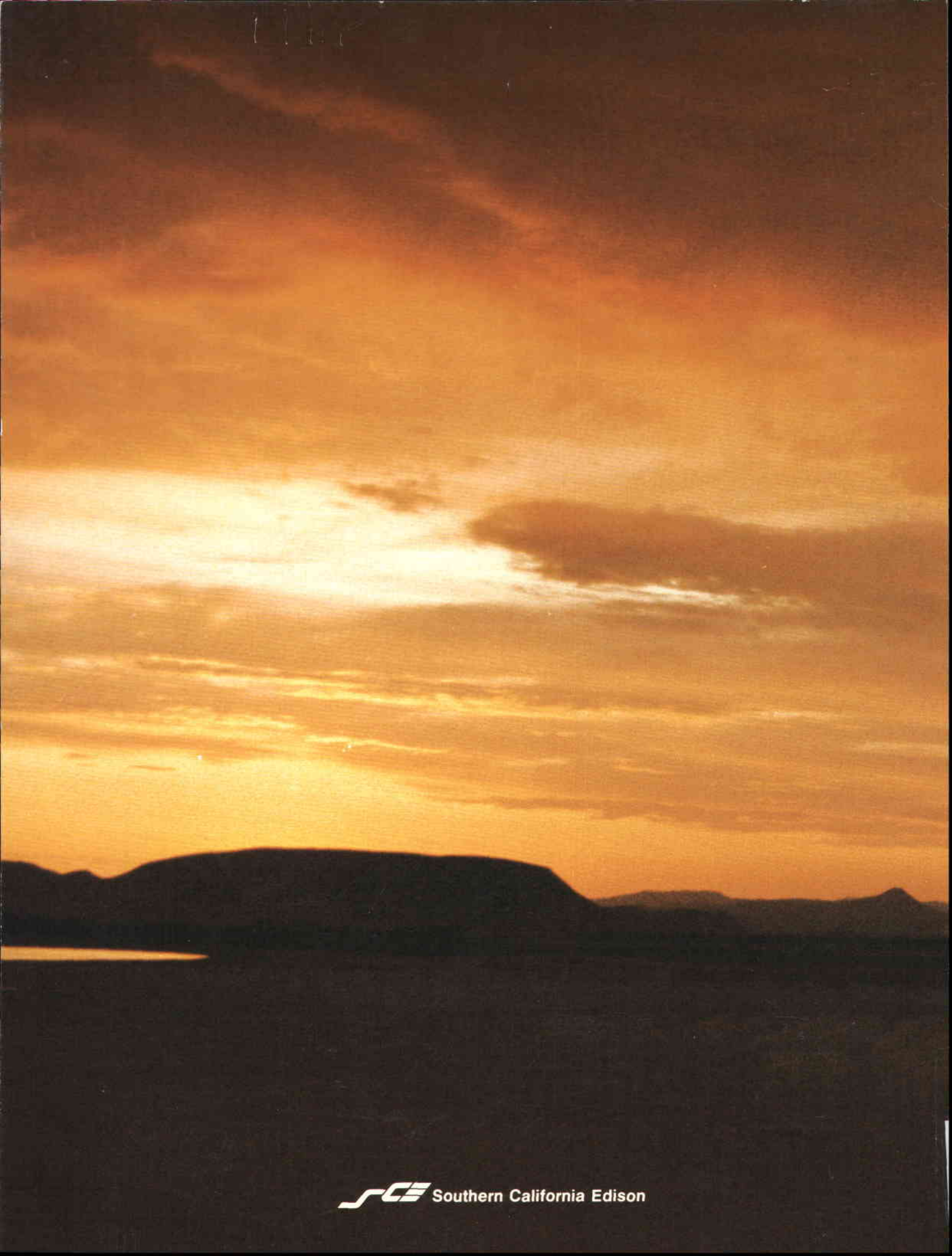
Financing and construction of a large system experiment will depend on many factors including the projected electric power demand, economic conditions, and availability of financing.

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
System Planning
Research Department
2244 Walnut Grove
Rosemead, California 91770



Southern California Edison