

Solar Trough Power Plants

Concentrating solar power plants have provided continuous power generation since 1984

In 1984, the first of the concentrating solar power plants (known as the Solar Electric Generating System, or SEGS) began converting solar energy into electricity in California's Mojave Desert. Using technology developed by the U.S. Department of Energy (DOE), private industry ultimately built nine SEGS power plants. With a combined rated capacity of 354 megawatts (MW), the nine plants generate enough power to meet the needs of about 500,000 people.

The SEGS plants range in capacity from 13.8 to 80 MW, and they were constructed to meet Southern California Edison Company's periods of peak power demand. The plants

operate for 80% of the summer mid-peak hours and 66% of the winter mid-peak hours. A natural gas backup system supplements the solar capacity and contributes 25% of the plants' annual output.

The SEGS plants use parabolic-trough solar collectors to capture the sun's energy and convert it to heat. In the SEGS design, the curved solar collectors focus sunlight onto a receiver pipe. Mechanical controls slowly rotate the collectors during the day, keeping them aimed at the sun as it travels across the sky. Synthetic oil flowing through the receiver pipe serves as the heat transfer medium. The collectors concentrate sunlight 30 to 60 times the normal intensity on the receiver, heating the oil as high as 735°F (390°C). The heated oil is routed through a heat exchanger to generate steam that drives an electricity-producing turbine.

Highlights

- **Nine solar power plants provide 354 MW total capacity, the largest solar thermal generating capacity in the world.**
- **Third-generation designs of trough plants produce power for \$0.08–\$0.1/kWh.**
- **Operating throughout the year helps the SEGS meet periods of peak demand.**
- **From 1992 to 1997, the U.S. Department of Energy helped KJC reduce operation and maintenance costs, improve plant efficiency, and reduce the cost of energy produced.**
- **Many plants attained record solar performance during summer 1997.**

The Office of Power Technologies is part of the Office of Energy Efficiency and Renewable Energy



Sandia CO 9-44; image 49; C90-826

With 354 MW of total capacity, the nine SEGS plants are the world's largest solar power facility.

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Many of the cost-reduction strategies developed for the SEGS plants can be applied to other solar thermal electric technologies, such as dish/engine systems and solar power towers.

In a program that ran from 1992 to 1997, DOE's Office of Power Technologies helped the KJC Operating Company of Kramer Junction, California, to reduce operation and maintenance (O&M) costs, improve plant efficiency, and reduce the cost of energy produced. KJC operates the SEGS III—VII plants, with a combined capacity of 150 MW. Working with DOE's Sandia National Laboratories in Albuquerque, New Mexico, KJC engineers developed cost-reduction strategies for O&M planning optimization, subsystem automation, collector alignment and cleaning, reliability improvement of components subjected to cyclic operation, and subsystem efficiency improvement. Many of the cost-reduction strategies developed for the SEGS plants can now be applied to other concentrating solar power technologies, such as dish/engine systems and solar power towers.

KJC estimated the cost savings resulting from a group of specific cost-effective O&M improvements. The net present value of these improvements is more than \$42 million and represents a 30% reduction in O&M costs.

Many of the cost-reduction activities also improve performance of the plants. In the summer of 1997, KJC reported record power output for a single day—2,071,000 kWh—enough to power more than 75,000 homes daily. This single-day electrical output also established a world record solar thermal-to-electric efficiency of 18%. KJC credited the O&M cost-reduction program as a key contributing factor.



Sandia CO 3179 Image 28

The O&M cost-reduction program developed innovative strategies for collector maintenance for solar power plants.

For More Information:

Visit DOE's Concentrating Solar Power Web site at:

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*Solar Forecasting for Operational
Support of SEGS Plants.*

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