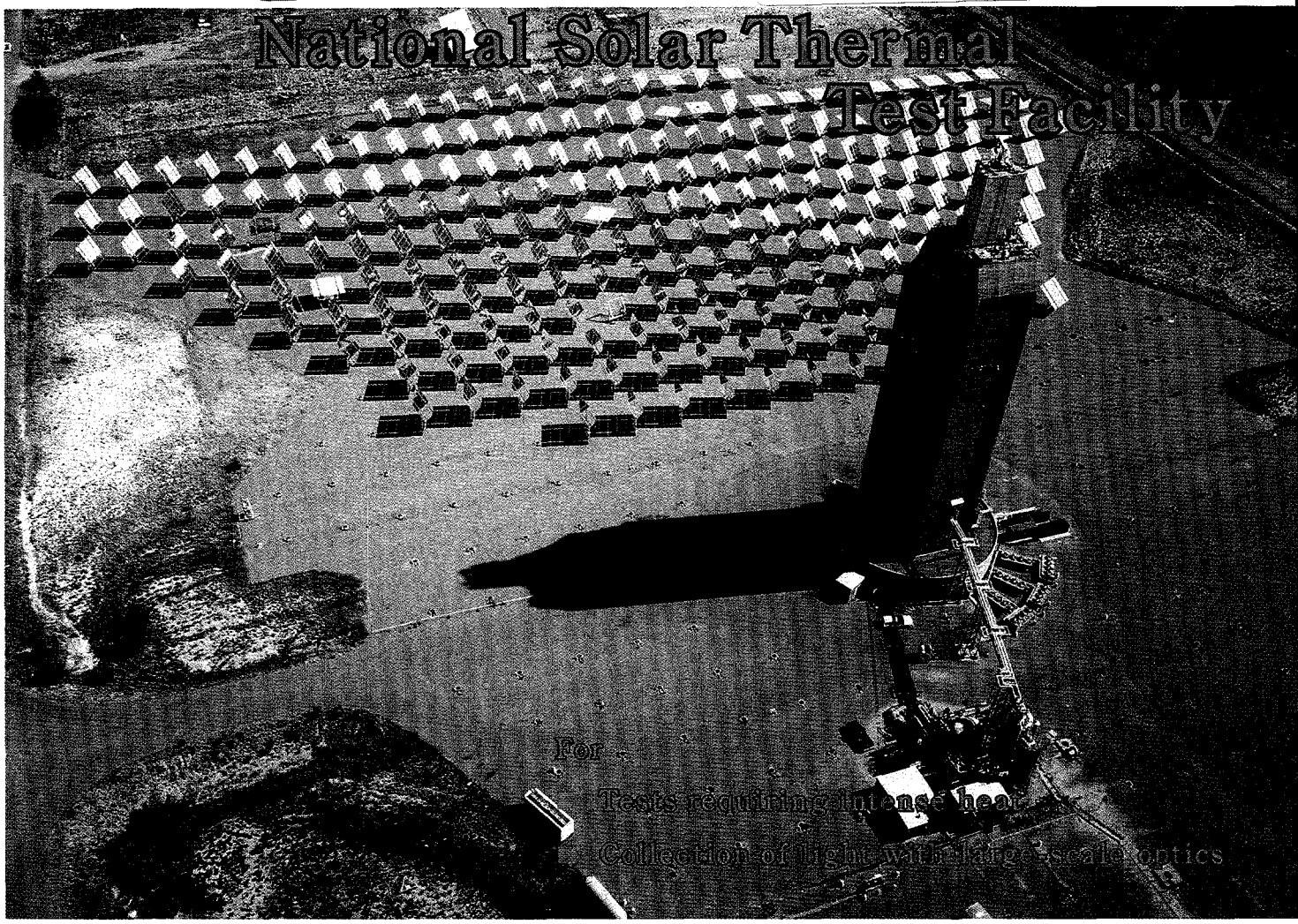
SAND--89-1691

OPN # 201

Sandia National Laboratories

National Solar Thermal Test Facility



The National Solar Thermal Test Facility is operated by Sandia National Laboratories for the U.S. Department of Energy. It is located on Kirtland Air Force Base in Albuquerque, New Mexico.

The facility can provide high-thermal flux for

- Simulation of nuclear thermal flash
- Measurements of the effects of aerodynamic heating on radar transmission
- Measurements of the thermal performance of components and materials
- Investigation of the thermophysical properties of materials
- Solar applications

It can also provide large-scale optics for

- Astronomical observations
- Atmospheric sounding with Lidar

Field of heliostats and receiver tower

Two hundred twenty-two computer-controlled heliostats reflect concentrated solar energy onto a tower that is 200 feet tall. Test objects can be placed at the top of the tower or in any of three test stations along its front. A wind tunnel is in the middle test station.

The heliostats and tower provide

- 5 MW total thermal power
- Peak flux to 260 W/cm^2
- Illumination of target areas up to 300 ft^2
- Time-dependent control of the thermal flux

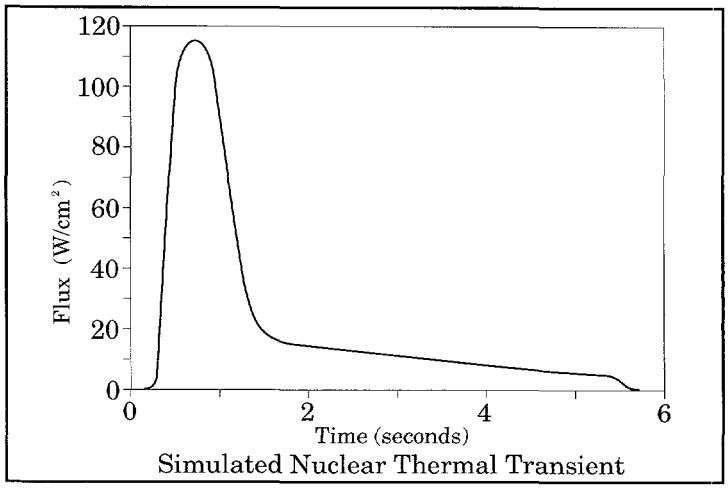
The tower's user-designed facilities include

- A windowed wind tunnel for nuclear hardness evaluation of flight surfaces
- A water-cooled radome mount for evaluating radar under simulated aerodynamic heating

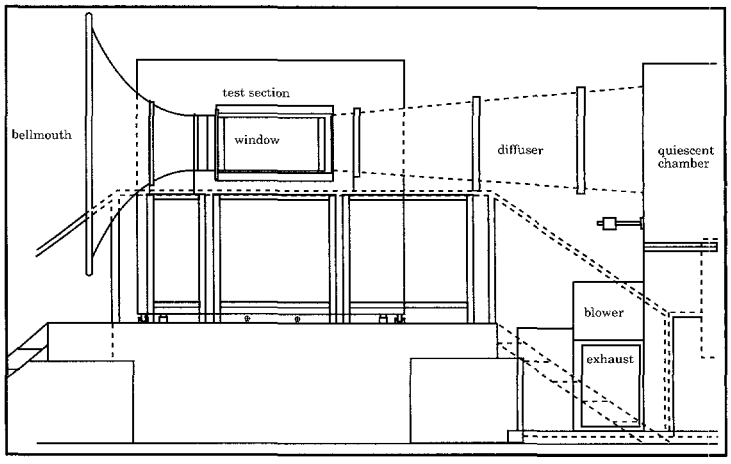
Applications include

- Nuclear thermal flash exposure of two- or three-dimensional targets up to 60 by 50 inches; for example, using thermal flash to test the effectiveness of cockpit windows and goggles that are designed to prevent flash-blindness
- Nuclear thermal flash exposure of flight surface samples in flight conditions
- Simulation of aerodynamic heating; for example, observing the survivability of nose cones and radar windows under such heating
- Photocatalytic reactions, including destruction of hazardous waste
- Materials processing, such as surface treating of metals
- Tests on materials, for example, finding the thermal failure threshold of ceramic insulation
- Tests on components, such as measuring the response of nuclear power plant instrumentation that may be exposed to heat from a hydrogen explosion
- Solar central receivers for process heat and generation of electricity

Water-cooled radome mount near the top of the solar tower.



The curve shows the capability of the system to simulate nuclear thermal flash.



Schematic of the wind tunnel.

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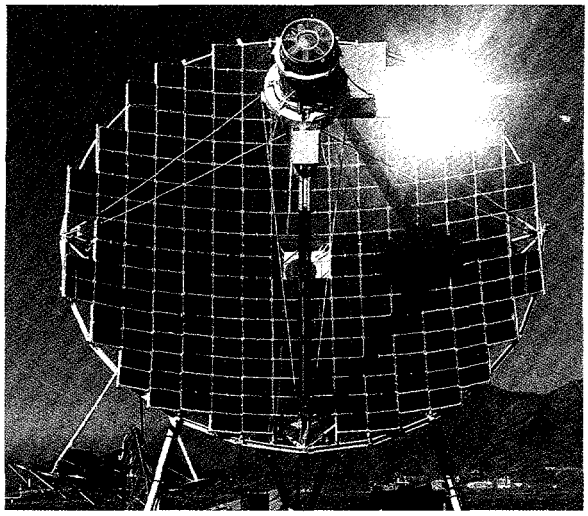
Point-focus parabolic dishes



One of two point-focus parabolic dishes at Sandia.

Parabolic dishes track the sun in two axes to provide very high concentrations of solar power over a small area.

The Test Facility has two 36-ft diameter parabolic dishes providing

- 75 kW total thermal power each
- Peak flux up to 1500 W/cm^2
- Tailoring of power level and flux distribution by varying the alignment of facets
- Square-wave transients from shutters mounted at the focal plane

Applications using these dishes include

- Testing heat engines connected to electrical generators at the focal point of the dish
- Measuring the thermophysical properties of materials
- Simulating aerodynamic heating, as would occur in re-entry vehicles
- Evaluating thermal and photocatalytic solar receivers
- Using the dishes as optical telescopes for astronomy
- Collecting light for atmospheric sounding with Lidar

Solar furnaces

A solar furnace uses a heliostat that tracks the sun to direct sunlight into a mirrored parabolic dish. Because the focal point of the dish does not move, it is simple to install experiments. The power level of the furnace is adjusted using an attenuator that works like a venetian blind located between the heliostat and the dish.

*The **Test Facility** has*
*A **small** solar furnace with*

- A dish that is 22 feet in diameter
- A heliostat that is 580 square feet

This furnace provides

- 16 kW total thermal power
- Peak flux up to 500 W/cm^2

*A **large** solar furnace with*

- A dish that is 36 feet in diameter
- A heliostat that is 1600 square feet

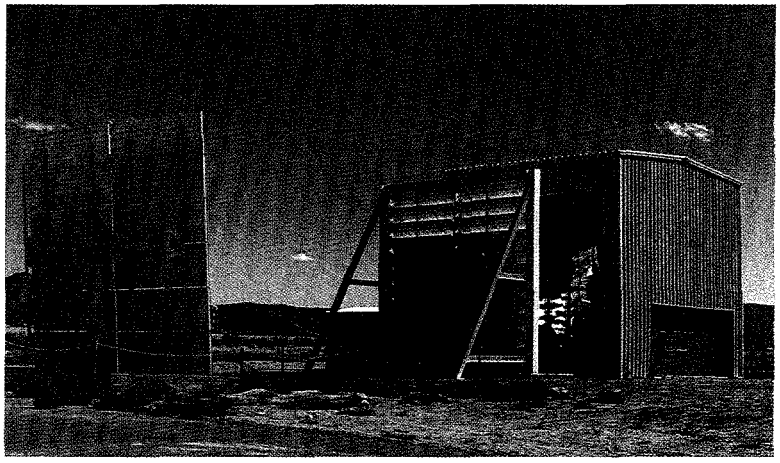
This furnace provides

- 65 kW total thermal power
- Peak flux up to 1000 W/cm^2

Both furnaces have power control to simulate nuclear and other thermal transients.

Applications include

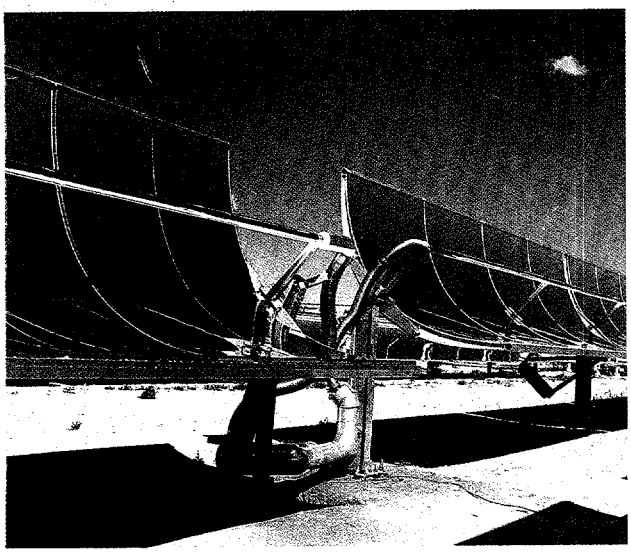
- Investigating the thermophysical properties of materials in concentrated sunlight, including thermal expansion, thermal conductivity and diffusivity, specific heat, mechanical properties, and spectral emissivity and absorptivity.
- Simulation of aerodynamic heating
- Simulation of thermal effects of nuclear explosions on materials and components
- Determining the performance and failure thresholds of high-temperature ceramic and refractory materials



The 16-kW solar furnace.

Line-focus parabolic troughs

Parabolic troughs track the sun in one axis to concentrate solar power in a line, usually on a tubular receiver.



The Test Facility has

- Four line-focus systems with a total of 12,500 square feet of surface
- A rotating platform and collector module for efficient two-axis tracking

These systems provide

- 800 kW total thermal power
- Peak flux up to 6 W/cm^2

These systems can be used for

- Destruction of dilute chemicals in water
- Generation of industrial process heat

Engine test laboratory

TheTest Facility has a laboratory in which solar energy components can be tested indoors, before being tested in a fielded system.

The laboratory has

- Two test cells
- An assembly bay
- A control/data room
- Thermal energy sources, such as electric heaters, propane-fired heat pipes, or solar simulators
- A dynamometer for shaft output power measurements

It can be used to test

- Heat engines
- Solar receivers

Support for experiments

In addition to the specific equipment and facilities outlined here, the Test Facility boasts excellent support for experiments being conducted on location. Some of the possibilities it offers are

- Modern data acquisition, control, and diagnostic systems
- Archiving data in standard PC formats
- High-speed photography of experiments as needed
- Elevator in tower that can carry heavy equipment
- Forklifts and aerial lifts for handling material
- Heat-rejection systems for removal of waste heat
- Assembly building measuring 50 by 150 feet

For further information

The facility is available to support any application that can benefit from its unique capabilities. For further information on using the National Solar Thermal Test Facility, please contact

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An experimenter's manual is available, and prospective users may arrange visits to the Test Facility.

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