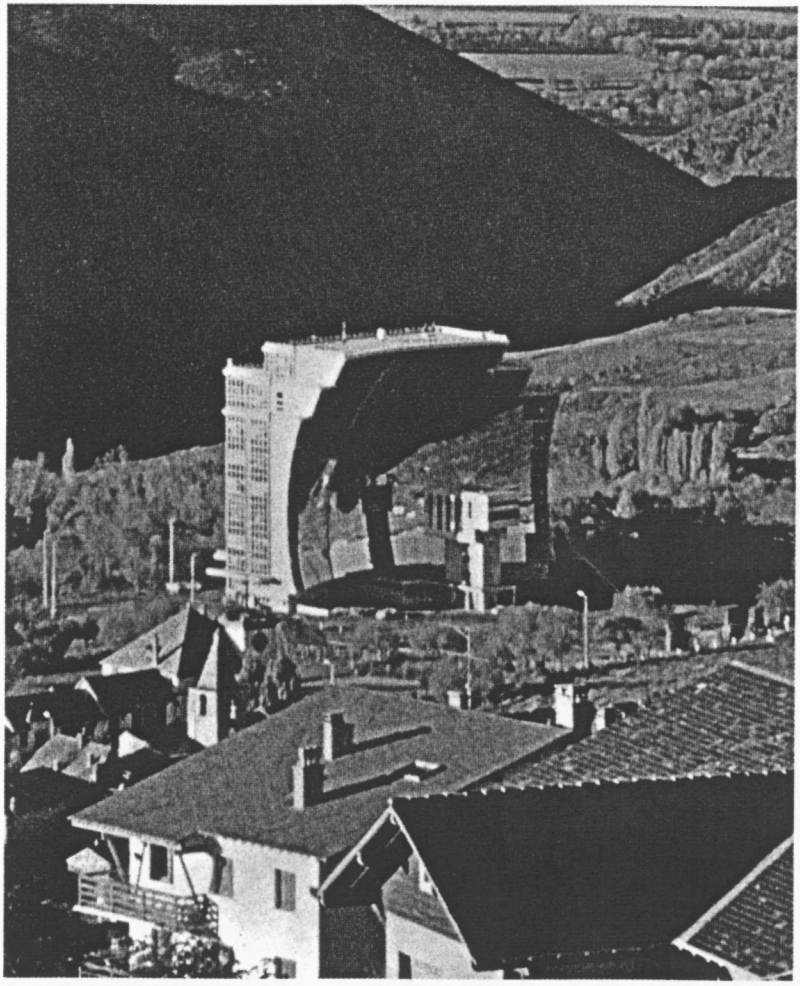
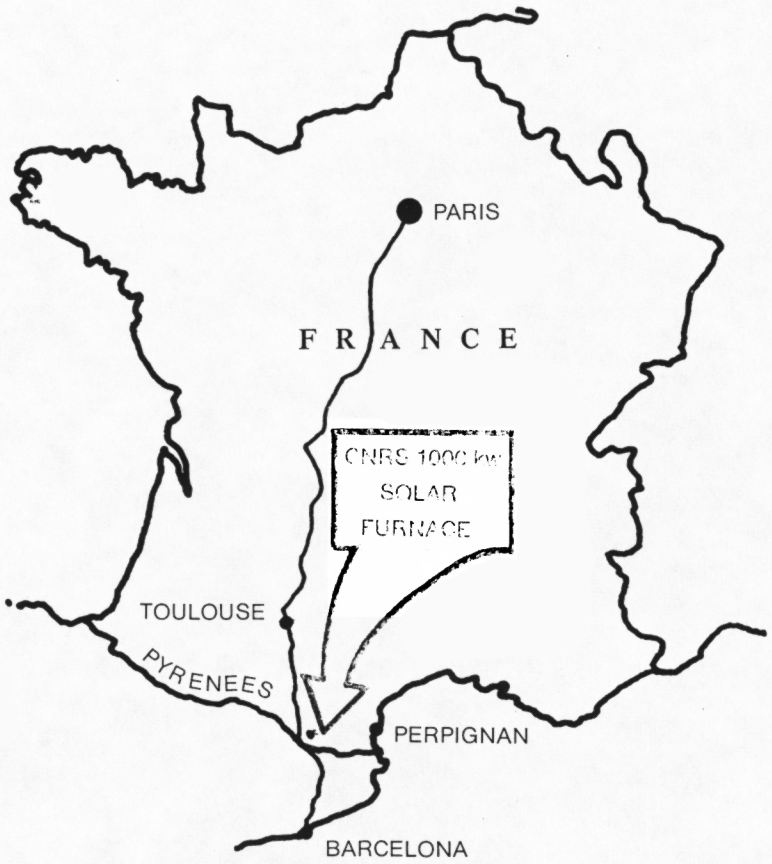
HIGH TEMPERATURE SOLAR ENERGY



CENTRE NATIONAL DE LA RECHERCHE
SCIENTIFIQUE (CNRS), FRANCE
AND
ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GEORGIA, U.S.A.



Cover—CNRS 1000 kw Solar Furnace

HTMD-CNRS AN INTERNATIONAL SOLAR ENERGY RESEARCH ENTERPRISE

The High Temperature Materials Division (HTMD) of the Engineering Experiment Station at Georgia Tech and the Centre National de la Recherche Scientifique (CNRS) France, are collaborating in a research program to study the properties of materials in the high temperature thermal energy environment of the CNRS 1000 kw Solar Furnace at Odeillo, France. This work is being conducted under a Research Services Agreement between Georgia Tech and CNRS. In this collaboration, research programs are conducted under the supervision of

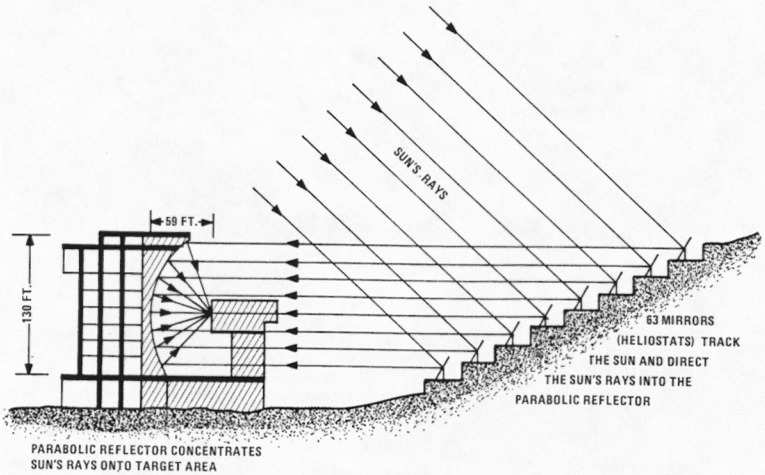
the Director of Solar Energy Laboratory of French National Center of Scientific Research (F. Trombe), and

the Chief of the High Temperature Materials Division of the Engineering Experiment Station (J. D. Walton, Jr.)

In addition to providing the necessary high temperature radiant energy environment required for the studies, the CNRS solar furnace is uniquely suited for, 1) the evaluation and development of materials and prototype components to be used in the dynamic conversion of high temperature solar energy into electrical energy, 2) the determination of the high temperature dielectric properties of ceramics, 3) processing ultra high-purity refractory materials, 4) the determination of the electrical performance at high temperatures, of hypersonic radomes and electromagnetic windows, and 5) the evaluation of materials in the high energy thermal radiation environment associated with nuclear devices.

THE FRENCH CNRS SOLAR FURNACE

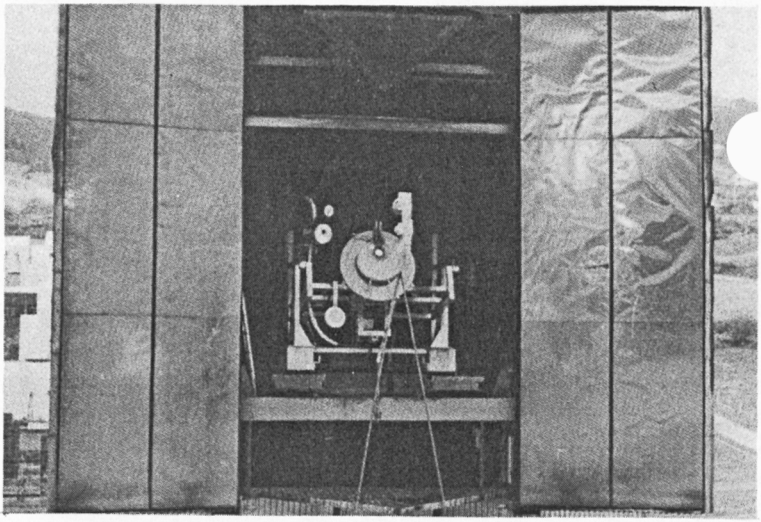
The French solar furnace is located in the Pyrenees at Odeillo-Font Romeu (altitude, 5900 feet), about 20 miles east of Andorra. At this location the sun shines as many as 180 days a year and solar intensities as high as 1000 watts per square meter are common. The solar furnace was completed in 1970 at a cost of about $2,000,000.



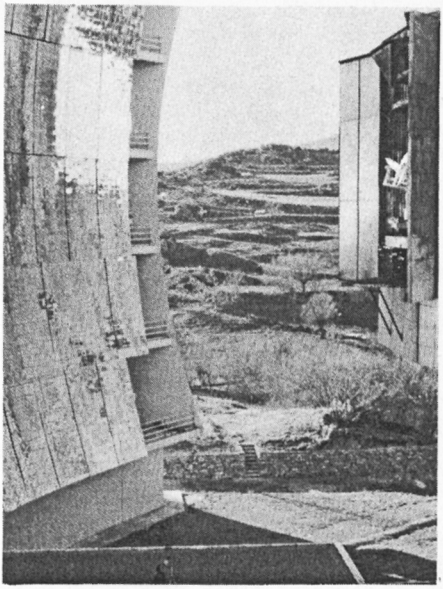
Schematic of 1000 kw Solar Furnace

The parabolic reflector has a focal length of 59 feet, is 130 feet high and 175 feet wide and is composed of 9500 mirrors 17.7 inches by 17.7 inches. Since the parabolic reflector is too large to track the sun, 63 smaller mirrors (heliostats) set in eight tiers are used to follow the sun and reflect its ray in parallel beams onto the parabola. The heliostats are 24.6 by 19.7 feet and each is composed of 180 mirrors 19.7 inches by 19.7 inches.

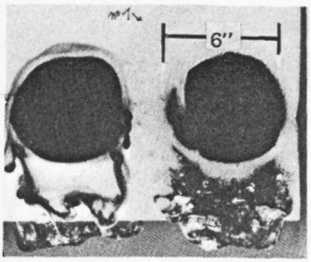
HTMD-CNRS SOLAR FURNACE RESEARCH



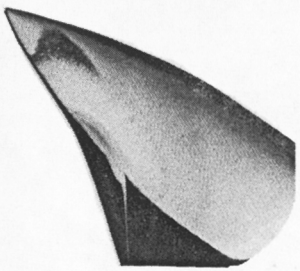
Thermal shock-electromagnetic evaluation of dielectric materials



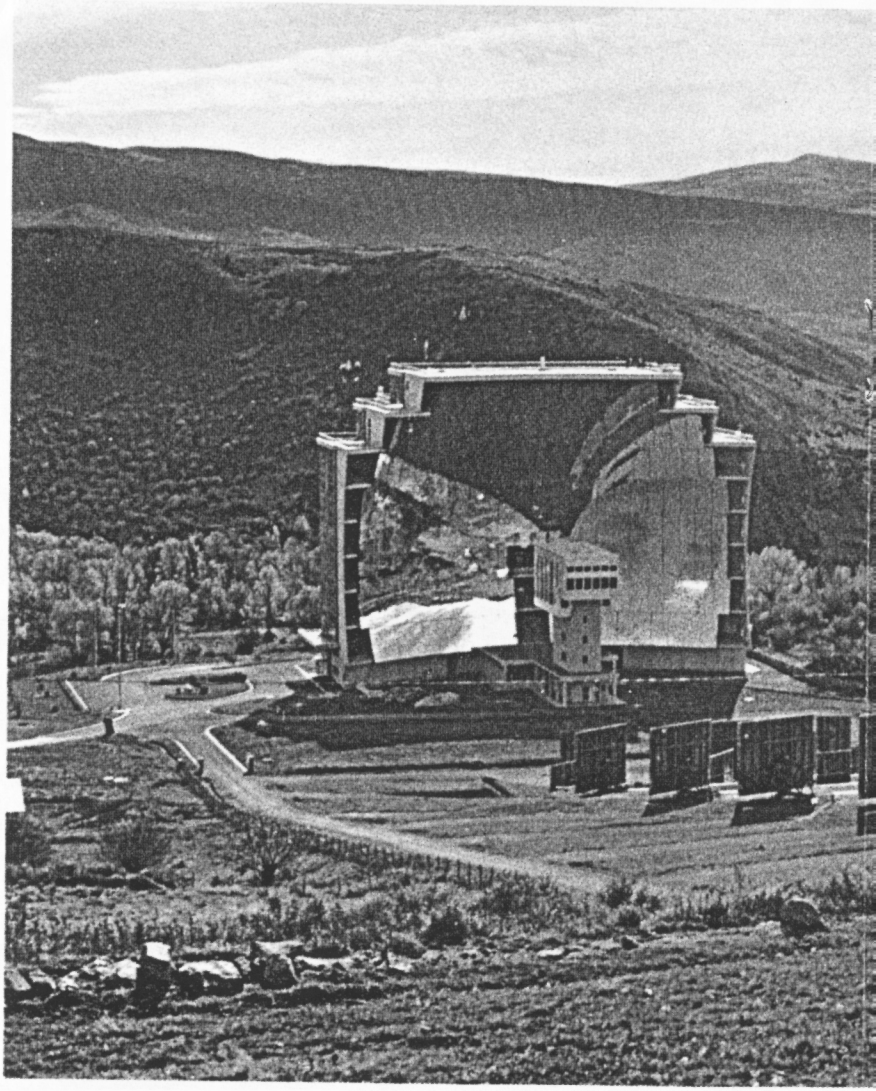
High temperature evaluation of ceramic radome



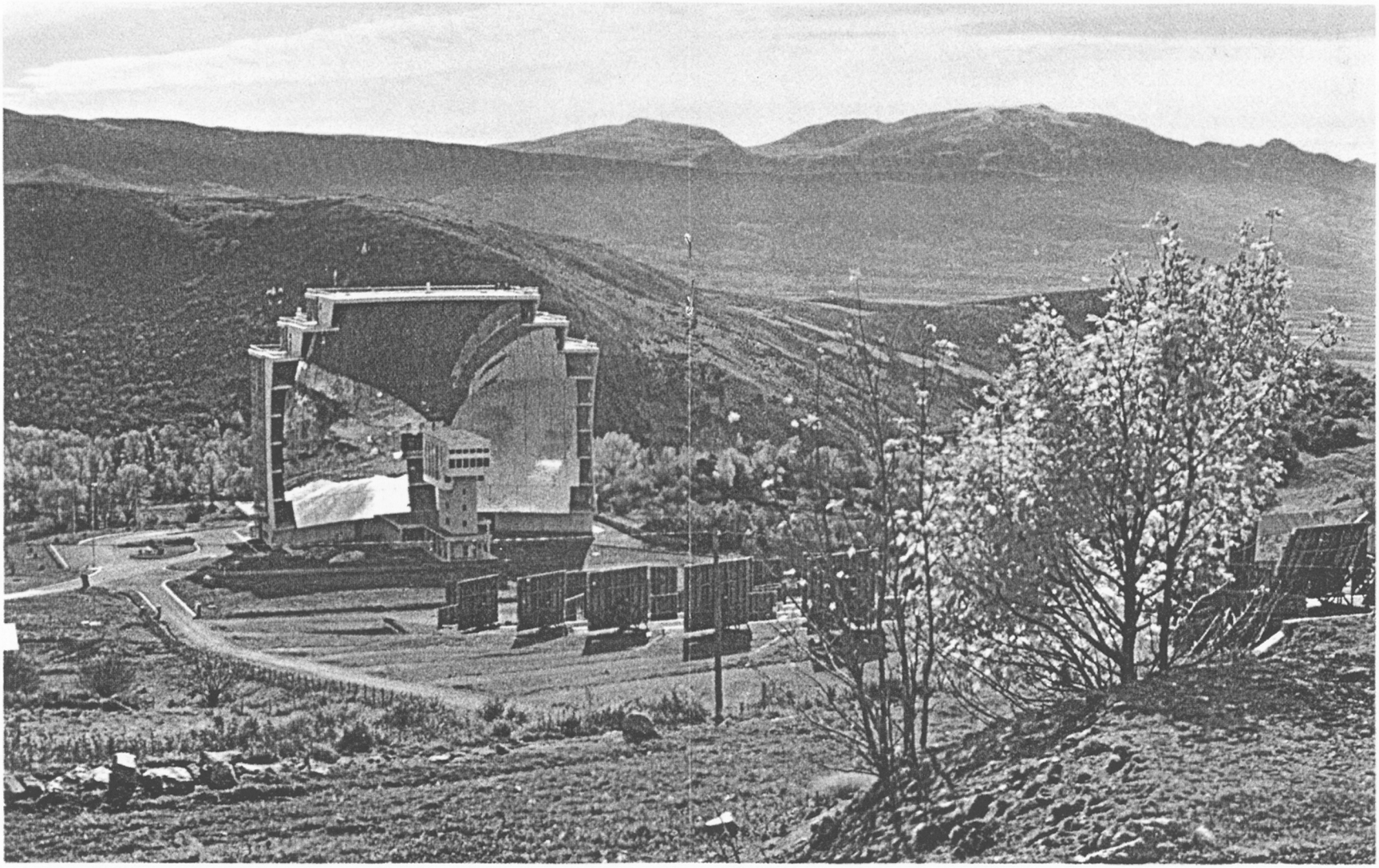
3000°F ceramic after two 60 sec. exposures



Ceramic radome after 60 sec. exposure



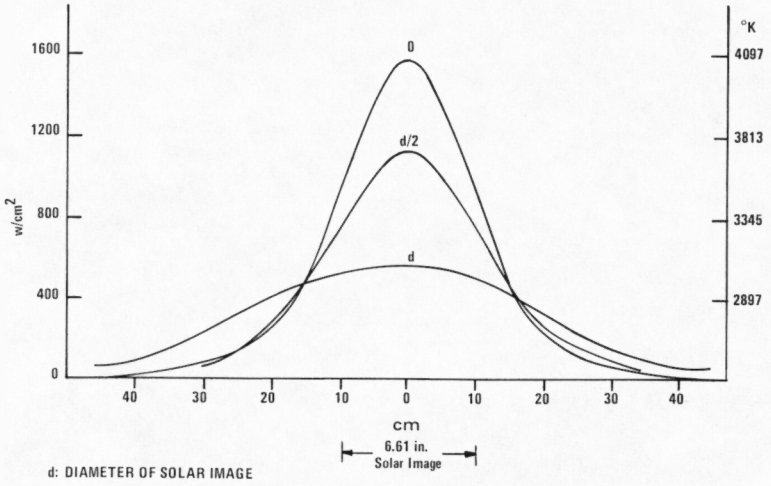
CNRS Solar Energy Laboratory at Font-Romeu Odeillo



CNRS Solar Energy Laboratory at Font-Romeu Odeillo

SOLAR FURNACE CHARACTERISTICS

The solar energy incident on an area of about 23,000 square feet is concentrated by the parabolic reflector into an area about two feet in diameter. Sixty percent of the total thermal energy (about 600 kilowatts) is concentrated in an area one foot in diameter at the center of the focal plane of the parabola.



Diameter of
Solar Image

Heat flux in the focal area and black body temperature are presented graphically in the figure above. Curve 0 represents the heat flux and temperature at the focal plane. Curve d/2 shows these data for a plane removed one-half the diameter of the solar image (about 3.3 inches) behind the focal plane. Curve d is for a plane removed one diameter of the solar image (6.6 inches) behind the focal plane.

OTHER SOLAR ACTIVITIES AT ODEILLO

In addition to the 1000 kw solar furnace, the CNRS Solar Energy Laboratory at Odeillo is equipped with numerous smaller solar concentrators for various laboratory-scale high temperature experiments. These experiments can be carried out in various atmospheres (hydrogen, argon, nitrogen, etc) or in vacuum. It is also possible to utilize the thermal energy of the 1000 kw solar furnace in certain controlled atmospheres other than air. Other solar research includes the design, construction and evaluation of solar heated houses, radiation cooling and solar refrigeration.

OTHER HIGH TEMPERATURE ACTIVITIES AT HTMD

In addition to its internationally recognized pioneer work in the development of sintered fused silica for hypersonic radomes and reentry electromagnetic windows, and for tooling for forming and brazing metals, the HTMD has made noteworthy research contributions in the areas of heat transfer, thermal shock, design with brittle materials, arc-plasma sprayed refractory coatings and ceramic materials for surgical implants. Other activities include the development of facilities and techniques for producing mixed-oxide powders from ceramic precursors, determining the high temperature dielectric properties of electromagnetic materials, and simulating high velocity raindrop impact under transient heating conditions.

GROWING INTEREST IN A VERY OLD ENERGY SOURCE

As a result of the energy crisis and because of the associated pollution problems, Georgia Tech anticipates a growing interest in research programs directed toward the utilization of high temperature solar energy. In order to provide this research capability, the High Temperature Materials Division is expanding its solar energy research activities with the personnel of the CNRS Solar Energy Laboratory and in the utilization of the 1000 kw solar furnace. However, the realization of significant advances in the utilization of solar energy may depend upon interdisciplinary research efforts which will require expertise outside of the Georgia Tech Family, or the CNRS. Therefore, the High Temperature Materials Division is interested in exploring the possibility of developing such programs and in learning of interest that may exist in other agencies or institutions. If you are interested in contributing to the development of such programs, or would like further information concerning the activities of Georgia Tech or of CNRS in this field, let us hear from you.

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