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SnapShot

SAIC/STM Utility-Scale Joint Venture Project

Since its start in 1993, the Science Applications International Corporation/STM Corp. Utility-Scale Joint Venture Project (SAIC/STM USJVP) has achieved several notable milestones, including automated operation of the first solar and gas-fired dish/Stirling system, peak power production of 24 kW, and a significant reduction in the cost (20 to 30%) of a dish/Stirling system.

What is a dish/Stirling system?

A dish/Stirling system comprises a faceted parabolic concentrator (a dish), a thermal receiver, and a Stirling engine/generator (Figure 1). It operates by tracking the sun and reflecting the solar energy into the thermal receiver, where the heat is absorbed. This heat is transferred to the heater head of the Stirling engine/generator, which converts the heat into electrical power. The receiver also contains a natural-gas-fired burner that can be used to provide heat to the engine during periods of cloudy weather or at night (Figure 2). Dish/Stirling systems are modular, which allows for their assembly into units ranging in size from the basic module (approximately 25 kW) to tens of megawatts.

The USJVP

The project is intended to facilitate commercialization of modular dish/Stirling systems that can be used for grid-connected applications, for remote power generation, and for export to international energy markets. One very interesting potential market for dish/Stirling systems is the so-called green power market that is starting to develop domestically and in some foreign countries.

An important feature of the USJVP is involvement from the private sector in directing, funding, and implementing the initiative. The SAIC/STM team has provided at least 50% of the cost (approximately $9 million) of the program with the Department of Energy providing a matching $9 million. The SAIC/STM team defined the focus of their USJVP as the development of a dish/Stirling system for commercial power generation applications.

The project is divided into three phases. Phase 1 (November 1993 to July 1995) covered the detailed design and testing of components and fabrication of the first prototype system; Phase 2 (November 1995 to September 1999) includes developing the second-generation system design, building and deploying three prototype systems, operating the systems, and collecting performance and reliability data. Phase 3, which is yet to be defined, will be the pre-commercial deployment of about 1 MW of prototype dish/Stirling systems (40 to 50 systems) at a utility site for long-term testing and evaluation.

During Phase 1, components were designed and assembled into an operating dish/Stirling system that demonstrated more than 100 hours of on-sun operation. A number of needed design changes were identified, including

Figure 1. Dedication of the dish/Stirling system at the Pentagon in Washington, D.C. Shown in the picture are the concentrator and the STM 4-120 Stirling engine/generator package.

Concentrating Solar Power Program

increasing the area of the dish, upgrading the dish and engine control systems, and changing the mechanical connection between the engine and the generator. Also, as a direct result of input from Arizona Public Service Company (a partner in the development of the system as well as a potential customer), SAIC and STM decided to make the second-generation dish/Stirling system capable of hybrid operation. That is, the system would be able to operate on solar energy alone or burn natural gas at night and at times when solar energy is not available.

In the spring of 1998, the SAIC/STM team installed a Phase 2 dish/Stirling system at the Pentagon in Washington, D.C. Virginia Power provided the site and grid connection for the system, which was operated through November 1998 before being disassembled and shipped to the Arizona Public Service Company's STAR Test Facility in Tempe, Arizona, for long-term testing and evaluation. The Pentagon system operated well and is viewed as a major success in exposing congressional and Department of Energy staff members to dish/Stirling technology.

As of March 1999, the team has built and operated two Phase 2 systems: at Golden, Colorado, and at Phoenix, Arizona, where the Pentagon unit was moved. These systems have operated for a total of 1,342 hours (951 hours on sun and 391 hours on natural gas).

Specifications and Predicted Performance of the SAIC/STM Dish/Stirling System

Dish/Stirling System

System Height:	15 m (50 ft.)
Electrical Output:	23 kW at 1000 W/m^2 Insolation
Voltage:	480 V, 3 Phase, 50/60 Hz
Availability:	24 Hours/Day, Hybrid Operation
Solar-to-Electric Efficiency	
Annual:	18%
Peak:	23%

Concentrator

Type:	Stretched-Membrane Faceted Dish
Area:	114 m^2 (diameter 14 m)
No. of Facets:	16 (diameter 3 m)
Refl. Surface:	1.0 mm Low Iron Glass
Reflectivity:	> 90%
Focus:	Variable, Active
Stow:	Face Down

Stirling Engine

Type:	Generation III STM 4-120 Kinematic
Power/Speed:	30 kW/1800 rpm
Working Gas Temperature:	720°C (1325°F)
Thermal Efficiency:	42%
Power Control:	Variable Swashplate
No. of Cylinders:	4
Swept Volume:	120 cc (7.3 in^3)/Cylinder
Receiver:	Direct Irradiation Solar Receiver with Hybrid Burner

The Next Step …

In April 1998, Public Service Company of New Mexico (PNM) announced that the SAIC/STM team had been selected to supply about 2 MW of dish/Stirling solar power at a proposed plant in New Mexico. The results of contract negotiations were presented to the New Mexico Public Utilities Commission at hearings held during the summer and fall of 1998. The project is currently being held up while the new regulatory authority in New Mexico, the Public Regulation Commission, reviews the actions of the Public Utilities Commission. We are hopeful that some form of the original project can be initiated under Phase 3 of the USJVP.

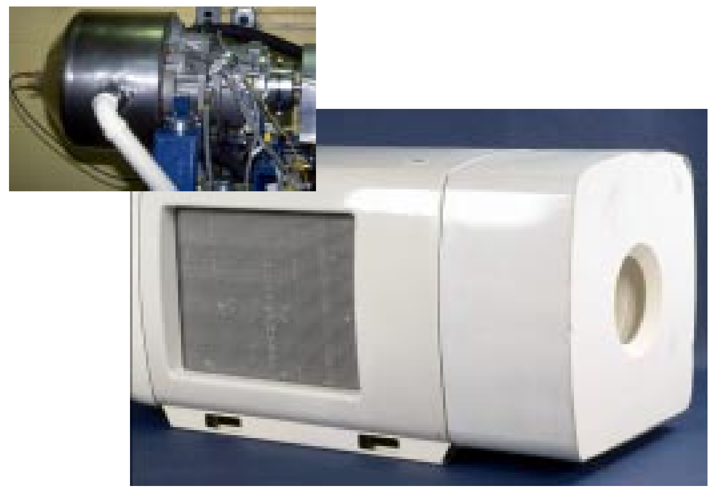

Figure 2. STM power conversion system package comprising the thermal receiver, the Stirling engine, and the generator. Solar energy enters the receiver through the aperture on the right side of the enclosure. The insert shows a gas-fired engine under test.

For on-line information about the U.S. Department of Energy's Concentrating Solar Power Program, please visit its web site: **http://www.eren.doe.gov/sunlab**

For more information on renewable energy or for additional copies of this brochure, contact the Energy Efficiency and Renewable Energy Clearinghouse (EREC): **1-800-DOE-EREC (363-3732)**

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