Inflatable Solar Thermal Concentrator Delivered

Space-based solar thermal power systems are very appealing as a space power source because they generate power efficiently. However, solar thermal (dynamic) systems currently incorporate rigid concentrators that are relatively heavy and require significant packaging volume and robust deployment schemes. In many ways, these requirements make these systems less appealing than photovoltaic systems. As an alternative to solar thermal power systems with rigid concentrators, solar thermal power systems with thin-film inflation-deployed concentrators have low cost, are lightweight, and are efficiently packaged and deployed. Not only are inflatable concentrators suitable for low Earth orbit and geosynchronous orbit applications, but they can be utilized in deep space missions to concentrate solar energy to high-efficiency solar cells.

1.7- by 2.7-m inflatable concentrator designed and built by SRS Technologies, Inc.

The objective of this Small Business Innovation effort with SRS Technologies, Inc., was to design, build, demonstrate, and characterize a thin-film, inflatable concentrator that has interfaces for solar thermal power systems. The actual concentrator, which was delivered to the NASA Lewis Research Center in late October 1998, is a 2.0- by 3.0-m off-axis parabolic concentrator with a 90° tilt angle and 30° half angle. The ultimate goal of this effort is to demonstrate, through testing, that inflatable concentrators for power generation are both a viable and desirable alternative to the rigid concentrator designs that are currently being used. Lewis has been working closely with the U.S. Air Force, Edwards Air Force Base, to finalize contractual agreements and test requirements to support joint testing.

The objectives of the test are to (1) quantify the thermal performance and optical performance of the test article in the simulated space environment that is provided by

Lewis' Tank 6 Solar Simulator and (2) use the test data to qualify analytical computer models. This will be the first in a series of several planned space environmental tests that Lewis and the Air Force are planning as part of a technology road map for an inflation-rigidized concentrator flight experiment that is currently scheduled for 2001. During the test, thermal performance will be measured via thermocouples on the surface of the inflated concentrator and the support torus. Optical performance will be characterized via flux intensity measurements at the focal plane via a charge-coupled discharge (CCD) camera. Additional performance data will be collected on the catenary strain, torus and canopy pressure, and make-up gas requirements.

Major activities for the Tank 6 test include

1. Setup of the test article and test support equipment
2. Integration of the instrumented test article with Tank 6 data collection equipment and the Thiokol inflation controller
3. Calibration and verification of data collection, evacuation of the chamber, and thermal cycling and data collection
4. Repressurization of the chamber, removal and storage of test articles, and restoration of Tank 6 to pretest status
5. Data reduction

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