Operation of a Thin-Film Inflatable Concentrator System Demonstrated in a Solar Thermal Vacuum Environment

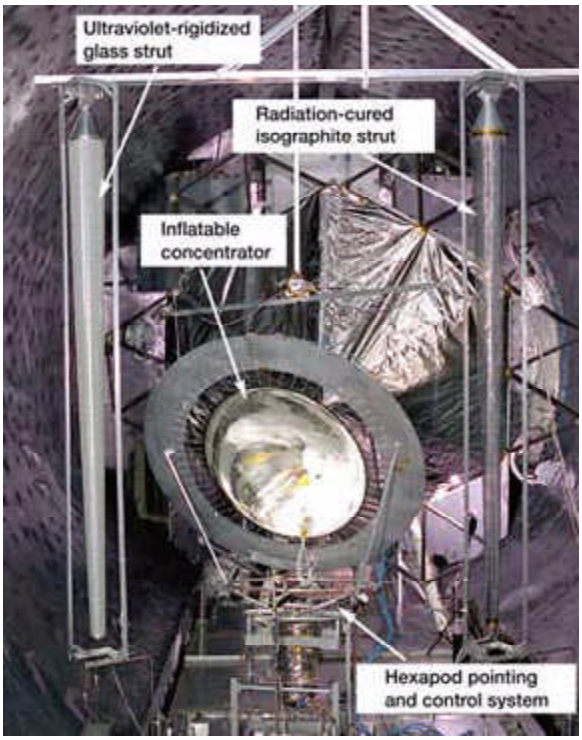
Thin-film inflatable solar concentrators offer significant advantages in comparison to state-of-the-art rigid panel concentrators, including low weight, low stowage volume, and simple gas deployment. From June 10 to 22, 2001, the ElectroMagnetic Radiation Control Experiment (EMRCE) Team used simulated solar energy to demonstrate the operation of an inflatable concentrator system at NASA Glenn Research Center's Tank 6 thermal vacuum facility. The joint Government/industry test team was composed of engineers and technicians from Glenn, the Air Force Research Laboratory, SRS Technologies, and ATK Thiokol Propulsion. The research hardware consisted of the following:

1. **A thin-film inflatable concentrator.** This concentrator made of CP-1, a NASA-developed, flight-qualified polyimide material, was designed and fabricated by SRS Technologies as part of a Glenn Small Business Innovation Research Phase II contract. The concentrator has a front clear canopy film and a rear aluminum-coated reflector film. The two films are seamed at the edges and are held to the support ring using a network of catenaries. For the EMRCE test, a rigid aluminum ring was used to decouple the effects of the inflatable concentrator with that of the usual inflatable, thin-film torus support structure. The concentrator is elliptical to account for the diverging beam from the solar simulator.

2. **The hexapod pointing and focus control system**. The concentrator struts are mounted on this 6-degree-of-freedom, electrical-actuator-driven, remote-controlled base. The hexapod system was developed by ATK Thiokol Propulsion.

3. **Two rigidized support struts using two candidate technologies--ultraviolet-rigidized glass and radiation-cured isographite**. In space, the struts would be gas deployed and would only require pressurization until rigidization was complete. For this test, the struts developed by ATK Thiokol Propulsion were not attached to the other hardware so that their behavior could be isolated.

With 1-sun illumination, the 1-m-class inflatable concentrator throughput power was measured to be 685 W, within 10 percent of predictions. Other objectives achieved include the first demonstration of the hexapod focus and pointing control system in a thermal vacuum environment, thermal and geometric response characterization of the inflatable concentrator as well as the thin-film rigidized support struts, and shape measurement photogrammetry of the concentrator during the test.



Inflatable solar concentrator, rigidized struts, and hexapod pointing and focus control system setup inside Glenn's Tank 6 Solar Thermal Vacuum Facility.

EMRCE is an industry cost-shared Air Force Research Laboratory (AFRL) Dual Use Science & Technology project managed by AFRL/Wright-Patterson Air Force Base, with technical oversight by AFRL/Edwards Air Force Base. The research conducted at Glenn is the culmination of the first year of the 3-yr EMRCE project. Other partners in the EMRCE team are the NASA Marshall Space Flight Center, the Boeing Company, and the AFRL/Kirtland Air Force Base.

Find out more from Glenn's Thermo-Mechanical Systems Branch.
http://www.grc.nasa.gov/WWW/tmsb/

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