Boeing Space Experiment Passes Major Design Review

A Boeing space experiment, sponsored by the Air Force Research Laboratory, has passed a major U.S. Air Force design review. Boeing is developing the Solar Orbit Transfer Vehicle Space Experiment (SOTVSE) to meet an Air Force need for a low-cost vehicle to transfer payloads from one orbit to another.

"The Interim Design Review (IDR) was a major milestone in the development of the SOTV," said Tom Kessler, Boeing Phantom Works SOTV program manager.

"We have shown that our system design meets the requirements stipulated to us by the Air Force Research Laboratory (AFRL). We believe it supports the U.S. Air Force Space Command long-range plan objectives. The space experiment will be an end-to-end integrated demonstration of the whole bimodal solar thermal propulsion and power concept."

Jim Wanchek, AFRL program manager, said, "The magnitude of the propulsion performance improvement over today's systems, being achieved by this concept, represents a true revolution in space propulsion and in the missions which can be accomplished."

The program will review one more element of the system on April 26 and 27. At that time, Boeing will conduct a detailed review of the concentrator and tracking system options being investigated for the SOTVSE. It will include a review of the design status of both the inflatable and rigid concentrator and tracking system options.

"Many development efforts currently under way are focused on reducing the cost of delivering payloads from Earth to Low Earth Orbit [LEO]," Kessler said. "SOTV is one of a handful that are focusing on low-cost delivery from LEO to all the other high-energy orbits such as GEO [geosynchronous equatorial orbit]. And that is where the vast majority of satellites need to go."

The Boeing vehicle is unique in that it will use a Boeing Rocketdyne-designed advanced solar thermal propulsion engine with roughly twice the propulsion efficiency of chemical stages to provide the thrust to move the vehicle to GEO. Because of the relatively low thrust of the engine, travel from low-earth orbit to GEO will require 20 to 30 days - longer than vehicles using chemical stages. Kessler said that while travel time is slower than chemical stages, it is still quick enough for most commercial or military customers and is three to 10 times quicker than other solar-electric options under study.

"The integrated specific impulse, or ISP, for SOTV is roughly 750-850 seconds - about double that of the highest efficiency chemical engines such as the Space Shuttle SSME which is about 452 seconds. [ISP is a measure of how much thrust is produced per pound of propellant.] With this high-propulsion efficiency, SOTV offers 50 to 100 percent greater payload lift capability to the same orbit than traditional cryogenic upper stages," Kessler continued.

"What makes SOTV truly different from chemical stages, however, is that once on orbit, the same system used for propulsion could provide tens of kilowatts of electrical power for the life of the satellite. This could provide a cost-effective alternative for extremely high-power satellites such as Space Based Radar or advanced Direct Broadcast Satellites.

"The Boeing vehicle is fundamentally simpler to design, build and operate than a traditional upper stage vehicle. It has only a single propellant, no intertank structure, no pumps, no purges, no complex rocket engine cooling jackets. The simplicity of the design leads to cost-per-pound savings approaching 50 percent," Kessler said. Because of its extensive maneuverability in space, this innovative technology has a variety of potential applications including on-orbit servicing, reusable orbit transfer vehicles, power and maneuverability packages for satellites and, in the long term, propulsion for manned planetary missions.

Boeing leads a nationwide team of companies in the development of the SOTV Space Experiment:

BWX Technologies, Inc., Lynchburg, Va. - The high-temperature receiver, absorber, converter to be flown on the SOTVSE and associated technology; General Atomics, San Diego, Calif. - Thermionic electric power converter technology; Harris Corp, Melbourne, Fla. - Rigid concentrator and tracking system technology; Lockheed Martin, Pomona, Calif. - Thermionic electric power converters; SRS, Huntsville, Ala., and Thiokol, Brigham City, Utah - Partners in development of inflatable concentrator and tracking system technology which is baselined for the SOTVSE.

The four-year, $48 million contract awarded to Boeing Phantom Works by the Air Force Research Laboratory, Kirtland Air Force Base, N.M., calls for the design, development, integration and demonstration of an operational SOTV space experiment by 2003.

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