11 AEROSPACE AMERICA DECEMBER 2010

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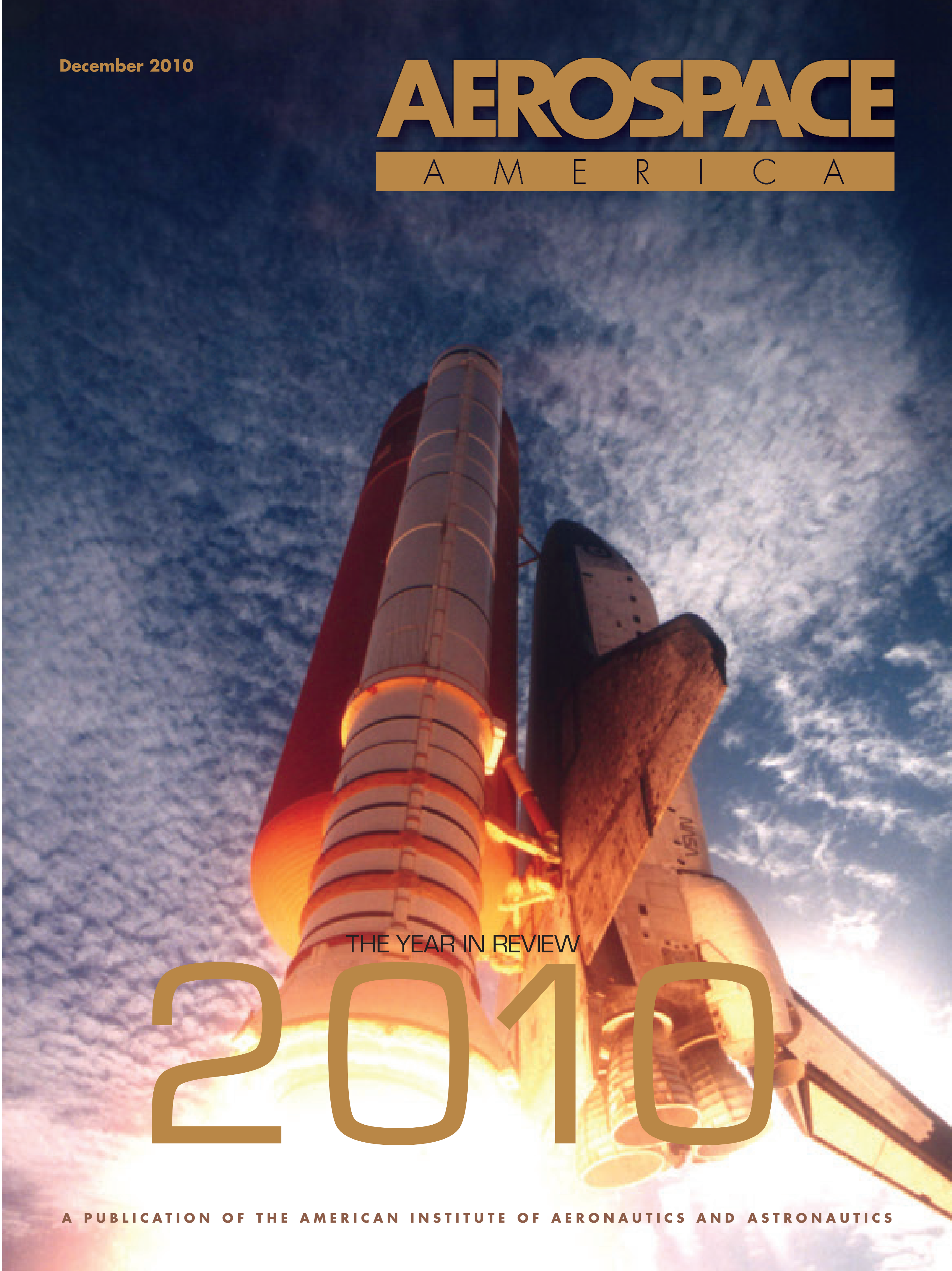

THE YEAR IN REVIEW

2010

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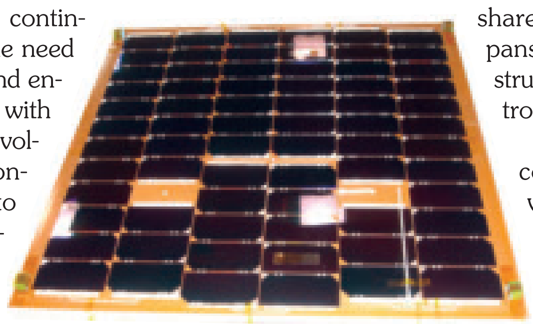
AIAA

Aerospace power systems



Mars Science Laboratory has successfully completed testing of a new solar array qualification coupon.

Power system technology continues to advance to meet the need for higher performance and enable high-power missions with reduced mass and stowed volume for launch. AFRL continued its research into high-efficiency, flexible applications using inverted metamorphic (IMM) solar cells to achieve efficiencies of over 32% with a "thinned" multijunction cell. Current efforts focus on applying these advanced cells to space arrays using an integrated blanket interconnect system. AFRL's array initiatives for incorporating the IMM cell include Boeing's high-performance solar array, ATK's ultraflex array, the DSS roll-out solar array, and MicroSat Systems' folded integrated thin-film stiffener array.

DARPA's Fast Access Spacecraft Testbed (FAST) program aims at developing an ultralightweight high-power-generation system that can generate up to 175 kW. The goal of the program is to demonstrate a suite of critical technologies, including high-efficiency solar cells, sunlight-concentrating arrays, large deployable structures, and ultralightweight solar arrays. These technologies enable lightweight, high-efficiency, high-power satellites. When combined with electric propulsion, FAST will lay a foundation for future self-deployed high-mobility spacecraft to perform ultrahigh-power communications, space radar, satellite transfer, and servicing missions.

Modular solar panels promise improved cost, standardization, and qualification traceability compared to today's customized technology. DR Technologies' MOSAIC modules are sized as a single string of standard high-efficiency cells and integrate into body-mounted and deployable panel configurations; a flight on FalconSat 6 is planned. SpaceQuest has provided its modules for FASTSAT, a joint activity of NASA and the Dept. of Defense.

NASA and the Dept. of Energy continue to conduct research and subsystem testing aimed at enabling fission power in space or on planetary surfaces. This year nearly all planned subsystems technology readiness demonstrations were completed. The subsystems included a no-moving-parts electromagnetic annular linear induction pump for controlled flow of liquid metal NaK at 525 C, a prototype NaK-to-NaK heat exchanger built by Advanced Methods and Materials, and a pair of Sunpower 1-kWe Stirling engines with thermodynamically coupled shared working fluid expansion space to reduce structural weight and control complexity.

Development also continues on the advanced Stirling radioisotope generator (ASRG) for potential use in NASA's Discovery 12 mission in 2015. The ASRG reduces Pu-238 requirements by a factor of four over current RTG (radioisotope thermoelectric generator) systems. The ASRG engineering unit has been in extended testing at NASA Glenn, accumulating over 13,000 hr of extended operation and supporting controller development with Lockheed Martin, DOE's ASRG system integrator. NASA Glenn has also received four pairs of next-generation advanced Stirling convertors. These are hermetically sealed and include all the necessary interfaces. Testing of these devices includes extended (24 hours a day) operation to provide additional data on life, reliability, and durability and to enable further controller development.

NASA is improving battery performance and safety for human missions. This effort includes development of "non-flow-through" proton-exchange-membrane fuel cells and electrolyzers, coupled with low-permeability membranes for high pressure operation; high-energy battery cells using lithiated mixed-metal-oxide of NMC (Ni-Mn-Co) cathodes; electrolytes that are both high-voltage stable and flame resistant; cathode coatings to reduce exothermic reactions; and a reversible thermal switch for overtemp conditions. For the NASA extravehicular mobility unit, ABSL delivered four long-life battery assemblies for integration into astronaut spacesuits designed for use on the ISS. Each battery assembly has an energy density in excess of 180 Wh/kg.

Mars Science Laboratory (MSL), scheduled to launch in the fall of 2011 and land on the red planet in August 2012, includes the largest rover ever sent to Mars. MSL has successfully completed the integration and test of upgraded power system electronics, testing of a new solar array qualification coupon, and fabrication of the first EM lithium-ion battery assembly with the new higher capacity rover battery assembly unit containing two 43-amp-hr batteries.

by the **AIAA Aerospace Power Systems Technical Committee**