Aerospace power

NASA's Messenger spacecraft, built by Johns Hopkins University's Applied Physics Laboratory, completed its flyby of Earth in August. It will orbit Mercury after two Venus and three Mercury flybys. Because it must handle a wide range of solar intensity, the spacecraft is maintained behind a sunshade, the solar cell strings are placed between strings of optical solar reflector mirrors, and the panels are tilted to reduce their operating temperatures.

Other specialized solar arrays being qualified and flown include those developed by ATK Space Systems. The second electrostatically clean solar array was qualified and delivered for NASA's THEMIS spacecraft, while the first was being readied for a flight late this year on the AFRL C/NOFS mission. Both missions use this technology to prevent electrostatic charging and magnetic fields from disturbing sensitive scientific instruments. ATK's CellSaver reflective concentrator, which reduces cost and mass compared to high-efficiency rigid panel arrays, continues to perform well in a GEO flight experiment aboard a Space Systems/Loral commercial satellite. Ultraflex, an ultralightweight flexible blanket array providing over 200 W/kg specific power at the array level, is being built for the Mars Phoenix mission and the ST8 technology test-bed spacecraft.

These arrays, together with many other conventional arrays being delivered for flight, incorporate the latest triple bandgap cells from Spectrolab and Emcore, with production conversion efficiencies routinely exceeding 28%.

Thin-film photovoltaic technology was advanced with the qualification of a two-wing amorphous silicon solar array for AFRL's TacSat-2/Roadrunner, scheduled for launch in 2006. Microsat Systems is integrating United Solar Ovonic's thin-film cells with its fold-integrated thin-film stiffener solar array deployment system. The experimental solar array will provide 120 W, while providing valuable flight data to validate the technology's ability to provide 150 W/kg specific power and low stowed volume.

Solar array technology insertion will be eased with approval of two new standards—AIAA S-111-2005, "Qualification and Quality Requirements for Space Solar Cells," and AIAA S-112-2005, "Qualification and Quality Requirements for Space-Qualified Solar Panels." A committee comprising members of the space industry, government, and The Aerospace Corporation approved the final documents after a year of coordinated effort.

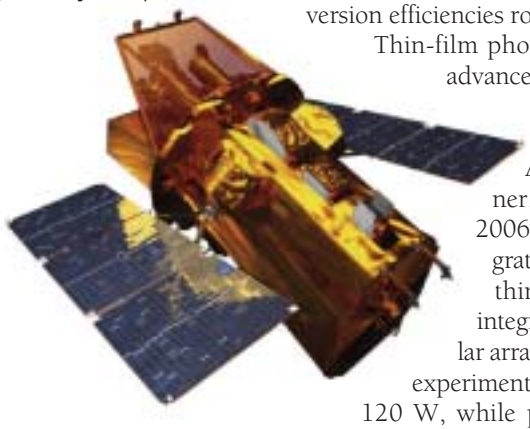
Space reactor power research progressed under Project Prometheus, even as its initial target mission, the Jupiter Icy Moons Orbiter, experienced cutbacks in funding and scope. Current activities are aimed at refocusing the reactor power system to support lunar surface missions. The establishment of the Center for Space Nuclear Research, part of the Idaho National Laboratory, is providing a focus for engaging university scientists in R&D of advanced space reactor and radioisotope power systems.

NASA Glenn is conducting thousands of hours of thermal vacuum life testing on Stirling engines that will provide improved electrical conversion efficiency for radioisotope generators.

NASA Glenn is conducting extended operation tests of Stirling engine technology to support the Dept. of Energy's Stirling Radioisotope Generator development. Lockheed Martin is the system integrator for this long-life, high-efficiency radioisotope generator, which could be used on future deep space or planetary surface missions. The engine tests at NASA Glenn have surpassed 18,000 hr of extended operation with an electrical conversion efficiency of over 25%, and power output over 60 W AC per converter.

Lithium-ion batteries have continued to penetrate the aerospace marketplace. Thanks to technology work led by NASA and AFRL, programs have adopted the low-mass rechargeable battery for the Mars Exploration Rovers, the B-2 bomber, and several satellite applications, including THEMIS. These programs are providing the confidence to expand lithium-ion technology into areas such as UAVs, battlefield air operations, and directed-energy weapons. Complementing the aircraft high-energy-density storage, AFRL has demonstrated new coils made with yttrium barium copper oxide coated conductor. The high-temperature superconducting material provides an enabling technology for future compact, high-power airborne generators.

Stiff, low-inertia, high-efficiency solar array wings built by ATK Space Systems support the SWIFT spacecraft capability to turn and rapidly acquire gamma-ray burst phenomena.



by **Ted Stern** and the AIAA Aerospace Power Systems Technical Committee