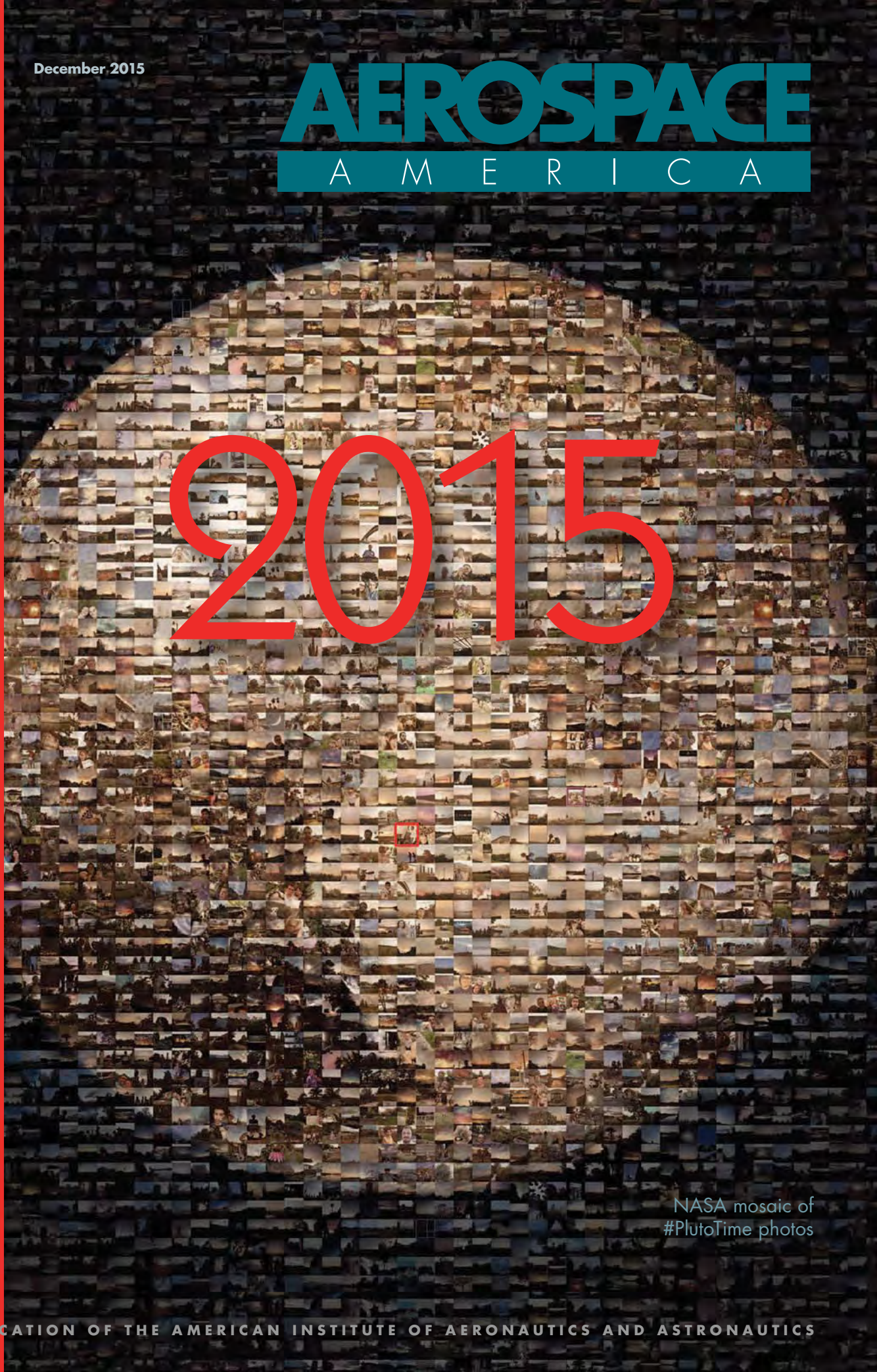
December 2015

AEROSPACE AMERICA

in review

2015



NASA mosaic of #PlutoTime photos

A PUBLICATION OF THE AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS

Electric power shines in New Horizons, Messenger missions

By Barbara McKissock and Gregory Carr

*The **Aerospace Power Systems Technical** Committee focuses on the analysis, design, test or application of electric power systems or elements of electric power systems for aerospace use.*

Significant 2015 milestones in aerospace power systems included the New Horizons spacecraft's flight through the Pluto system in July. That journey came after a very long cruise that began with the probe's launch in 2006. The spacecraft was powered by a general-purpose heat source **radioisotope thermoelectric generator** producing about 200 watts at the time of the encounter with Pluto. New Horizons is performing well and sending data to Earth while on its way to the next target in the Kuiper Belt. The Johns Hopkins University Applied Science Physics Laboratory designed, built, and operates the spacecraft for NASA.

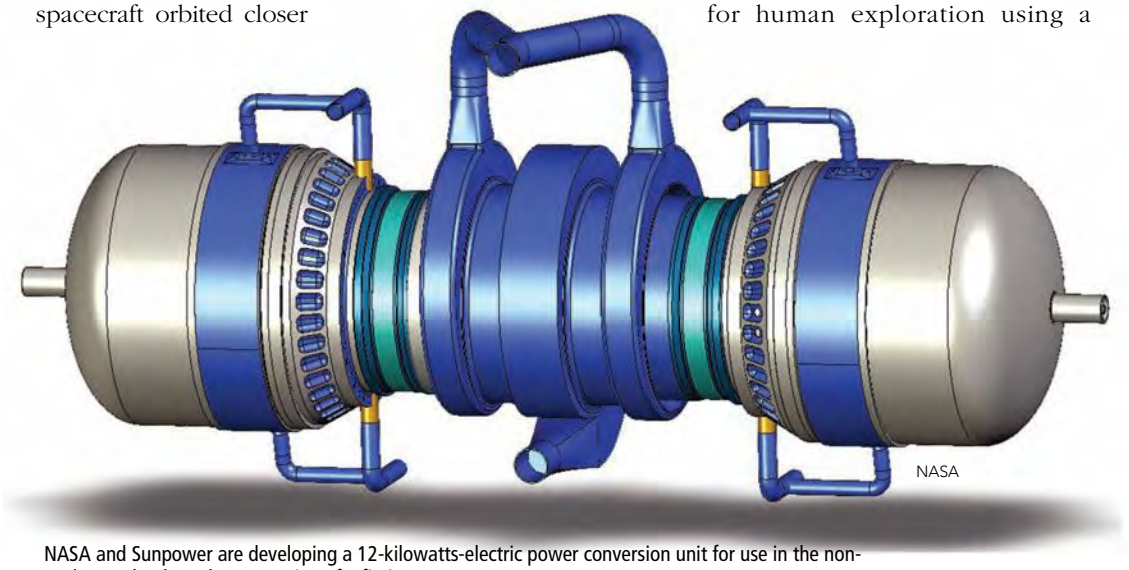
NASA's Messenger mission came to an end when the APL-built spacecraft impacted the planet Mercury on April 30 as planned. Messenger was launched in August 2004 and went into orbit around Mercury in March 2011. The spacecraft was powered by a high-temperature solar array that survived the extreme temperature and radiation environment. The temperatures on the array reached a maximum above 200 degrees Celsius as the spacecraft orbited closer to the surface of the planet.

NASA released the **Nuclear Power Assessment Study** in June, a report on a sustainable strategy for safe, reliable, and affordable nuclear power systems for space exploration. After examining the agency's goals for the next 20 years, NASA concluded that there will be a need for radioisotope power systems and their development well into the 2030s. The study also considered the extensibility of the technology to human exploration and operation mission goals.

NASA this year discontinued work on the **Advanced Stirling Radioisotope Generator**, ASRG, for flight application because of budget constraints. NASA continues to recognize the need for high-efficiency Stirling power conversion for radioisotope power systems and continues investment in the technology including production of the Advanced Stirling Convertor ASC-E3 design by Sunpower Inc. of Athens, Ohio.

The ASRG configuration featured a pair of ASC convertors mounted dual-opposed. In total, NASA Glenn Research Center has tested over 40 Stirling convertors under the Radioisotope Power Systems Program, accumulating over 760,000 hours of operation. The Stirling generator would use only one-quarter of the **plutonium dioxide fuel** needed by comparable radioisotope thermoelectric generators to produce a similar amount of power, thus extending the limited national supply of plutonium-238.

Work continued on a non-nuclear technology demonstration of a large fission reactor power system for human exploration using a 12-kilowatts-electric Stirling Power Conversion Unit under development by Sunpower. The Power Conversion Unit features a unique **sodium-potassium heat exchanger** that allows it to be integrated with an electrically heated reactor simulator developed by NASA Marshall Space Flight Center in Alabama that includes a pumped sodium-potassium heat transfer loop. The power conversion unit is comprised of two, 6-kilowatts-electric free-piston Stirling engines. The unit was delivered in August 2015 and testing was completed.



NASA and Sunpower are developing a 12-kilowatts-electric power conversion unit for use in the non-nuclear technology demonstration of a fission reactor power system.