

Advanced Stirling Convertor Technology Development

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Abstract. For decades, NASA has successfully used Radioisotope Power Systems (RPS) to enable some of the most significant space science discoveries and the most ambitious of future missions that cannot be completed with solar power will require new high efficiency RPS. NASA Glenn Research Center (GRC) and Sunpower Inc. have been developing the Advanced Stirling Convertor (ASC) for such future applications. As the ASC technology advanced, efforts transitioned from technology development to flight development as part of the Advanced Stirling Radioisotope Generator (ASRG) Integrated Federal Project that also included partners Department of Energy and system integrator Lockheed Martin Space Systems Company. The ASRG generator design incorporate a pair of ASC convertors each of which is integrated to a General Purpose Heat Source (GPHS). The high heat-to-electric conversion efficiency of the ASC reduced the ASRG fuel requirements by a factor of 4 compared to thermoelectric systems, minimizing the use of the U.S.'s limited plutonium fuel inventory. Evolution of the ASC started under a NASA contract with laboratory demonstrators and engineering units and transitioned to flight development under the DOE ASRG contract. The third generation engineering unit ASC-E3 convertors being built for NASA served as pathfinders and had the same specifications and design as the ASC-F flight units being built for DOE. At the height of ASC production, Sunpower was processing and testing three pairs of convertors at once and by Fall 2013 had delivered the first two pairs of ASC-E3 to NASA and had initiated early operational testing of the first ASC-F flight pair. At that time, due to budget constraints, the ASRG flight project was cancelled and the ASC-F flight convertors were secured and put into bonded storage at Sunpower. NASA continues to recognize the value and necessity of high efficiency Stirling conversion systems for RPS and is continuing investments in the technology. NASA and Sunpower continue production of the ASC-E3 convertors utilizing the design intended for flight. Sunpower completed and delivered the third Pair of ASC-E3 and continued production of the fourth pair. The delivered ASC-E3 convertors are being utilized at GRC to advance the technology and bolster the reliability database for the ASC flight-like design. Specifically, the first pair of ASC-E3 have been integrated into the GRC designed ASRG EU2 generator and has started an extensive suite of system level tests. The second and third pair of ASC-E3 convertors have completed independent performance verification testing and continue 24/7 extended operations. Additionally, some of the earlier demonstrator and engineering model ASC convertors continue extended operation as well. RPS Stirling development has been in reformulation and starting in FY2015 is part of the Stirling Cycle Technology Development (SCTD) Project. An overview of the Stirling Convertor Technology Maturation content will be presented.



Figure 1- Completed ASC-E3 Pair 3 Convertors

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