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SPACE PROPULSION SYMPOSIUM (C4)
New Missions Enabled by New Propulsion Technology and Systems (6)

Author: Mr. Claude Joyner
Pratt Whitney Rocketdyne, United States

EXPANDED SOLAR SYSTEM CAPABILITY VIA SMALL NUCLEAR PROPULSION STAGE

WEST PALM BEACH, FLORIDA, UNITED STATES OF AMERICA
DR. TIMOTHY S. KOKAN (CO-AUTHOR) DANIEL LEVACK (CO-AUTHOR)

Abstract

Recent exploration architectures are considering capability based approaches that use various propulsion technologies that need flight qualification. Exploration missions with sample returns and missions to the outer planets need high performance, rapidity of mission flight time and minimization of the number of flight elements to reduce risk and cost. Nuclear thermal propulsion (NTP) is a technology that enables rapidity of transit and minimizes the number of spacecraft systems and launch vehicles to enable robust exploration. NTP has been proven scientifically and many engineering challenges have been addressed in past ground testing. The final validation and verification that still remains is to prove NTP in a flight demonstrator. Current design efforts are focused on small fission systems that are no bigger than current cryogenic upper stages flown today. Pratt Whitney Rocketdyne has been working on a propulsion and power system design of a small NTP with scalability to human exploration spacecraft systems. Studies performed in 2011 identified both the design approach for a small NTP and a bi-modal power and propulsion approach. This concept can be launched on current Delta IV, Atlas V, Ariane 5 and the envisioned Falcon 9H for robotic missions. Several missions from the NASA Decadal Study have been examined with the small NTP proving nearly 2X the performance of current stages used on the Delta IV and Atlas V. The use of a Bi-model NTP on these missions provides several major payoffs; performing robotic exploration with increased payload, shorter mission times direct to the planet without gravity assist, and the capability to provide 5 to 15-kWe power. This paper will provide an overview of the small NTP concept and stage design that can deliver greater mission payload capability and provide power for robotic missions to Mars and beyond.