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NUCLEAR PROPULSION TECHNOLOGY FOR EXPLORATION AND A SUSTAINABLE PRESENCE ON THE MOON, MARS AND BEYOND

Abstract

Aerojet Rocketdyne is working with NASA, Department of Energy (DoE), and other industry to define a more affordable path nuclear propulsion and power use for lunar, Mars and broader solar system exploration missions.

This paper discusses and provides background on the analysis and results from the work that is proceeding on developing a Low Enriched Uranium (LEU) Nuclear Thermal Propulsion (NTP) system. It is expected that this propulsion system can be used for lunar tugs, crewed and cargo missions to Mars and as a rapid transfer deep space upper stage.

Aerojet Rocketdyne (AR) recent work builds on the legacy design, analysis, and testing knowledge gained from the Rover/NERVA (Nuclear Engine for Rocket Vehicle Applications) to create a feasible LEU design that has been shown to provide high thrust capability (e.g., 25,000 lbf) for faster trajectories and higher specific impulse (Isp) (e.g., 850 to 900 seconds) that can be achieved with chemical propulsion (e.g., 460 seconds) systems. Evolving and modernizing NTP engine designs to use LEU reactor fuel has proven to be feasible and affordable approaches to manufacturing and testing are being pursued using an organized technology maturity plan (TMP) with NASA and DoE oversight. The paper will discuss the approaches used to achieve an affordable TMP and the LEU NTP engine system design activity.

LEU NTP engine and reactor development activity is proceeding in 2019 and architecture analysis is showing NTP will provide enabling benefits for multiple solar system missions. Making LEU NTP practical for use in Lunar and Mars missions is foremost the expected first use of the engine system. Later missions can evolve using the NASA Space Launch System (SLS) and LEU NTP stages where they can be used to send orbiters to the gas giants and to the interstellar medium.

Finally, design trades that have been performed to arrive at a highly capable LEU NTP design will be discussed.