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NASA PROGRESS ON THE DEVELOPMENT AND QUALIFICATION OF A 12-KW HALL-EFFECT, SOLAR ELECTRIC PROPULSION THRUSTER

Abstract

I. Motivation and Background Beginning in 2014, the National Aeronautics and Space Administration (NASA) Space Technology Mission Directorate (STMD) began a project to increase the state of the art for the Hall-Effect Solar Electric Propulsion (SEP) technology. The resulting Advanced Electric Propulsion System (AEPS) project has developed a 12 kW Hall Current Thruster in support of the NASA mission to establish a permanent human presence in lunar orbit and to land the next American astronauts on the South Pole of the Moon. The project is led by the NASA Glenn Research Center, supported by the Jet Propulsion Laboratory and development, qualification flight hardware all provided by L3 Harris Aerojet Rocketdyne (AR). The AEPS project has completed the development testing of a high power, solar electric propulsion Hall Current thruster that will be used on the NASA Power Propulsion Element (PPE) of the Gateway space station. NASA initially built three Technology Development Units to understand key characteristics of the hall-effect rocket with magnetic shielding. The design led to development testing on two Engineering Test Unit Thrusters and multiple critical components. The project has begun production of the three flight thrusters and entered qualification testing at the component and thruster levels.

II. Approach NASA and AR teams completed all development phases of the project, including full development and integration testing of the Engineering Model hardware, Critical Design Review, and ground test equipment validation, as well as fabrication and acceptance testing of the initial qualification thruster. Qualification and verification of the environmental and life requirements of the AEPS design was initiated in the Fall of 2023 and will be accomplished on two thruster units and using a series of component-level tests during 2024 and 2025. Environmental testing will incorporate functional reference firings, shock, vibration, and Thermal Vacuum (TVAC) testing. Life verification will assess the thruster wear and performance over the lifetime of the Gateway spacecraft. Flight thrusters will complete assembly and acceptance testing and be delivered to the PPE program in early 2025.

III. Preliminary and Anticipated Results The program has completed the acceptance testing, including dynamic testing and hot fire characterization, of the first qualification thruster. This paper will present

an overview of the AEPS thruster project, thruster capabilities and flight design, preliminary results from the thruster acceptance and qualification testing, component life cycle testing and flight hardware status.