A HIGH-POWER ELECTRIC PROPULSION TEST PLATFORM IN SPACE

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ABSTRACT

This paper will describe the results of the preliminary phase of a NASA design study for a facility to test high-power electric propulsion systems in space. The results of this design study are intended to provide a firm foundation for subsequent detailed design and development activities leading to the deployment of a valuable space facility. The NASA Exploration Systems Mission Directorate is sponsoring this design project. A team from the NASA Johnson Space Center, Glenn Research Center, the Marshall Space Flight Center and the International Space Station Program Office is conducting the project. The test facility is intended for a broad range of users including government, industry and universities. International participation is encouraged.

The objectives for human and robotic exploration of space can be accomplished affordably, safely and effectively with high-power electric propulsion systems. But, as thruster power levels rise to the hundreds of kilowatts and up to megawatts, their testing will pose stringent and expensive demands on existing Earth-based vacuum facilities. These considerations and the human access to near-Earth space provided by the International Space Station (ISS) have led to a renewed interest in space testing. The ISS could provide an excellent platform for a space-based test facility with the continuous vacuum conditions of the natural space environment and no chamber walls to modify the open boundary conditions of the propulsion system exhaust.

The test platform could take advantage of the continuous vacuum conditions of the natural space environment. Space testing would provide open boundary conditions without walls, micro-gravity and a realistic thermal environment. Testing on the ISS would allow for direct observation of the test unit, exhaust plume and space-plasma interactions. When necessary, intervention by on-board personnel and post-test inspection would be possible. The ISS can provide electrical power, a location for diagnostic instruments, data handling and thermal control. The platform will be designed to accommodate the side-by-side testing of multiple types of electric thrusters. It is intended to be a permanent facility in which different thrusters can be tested over time. ISS crews can provide maintenance for the platform and change out thruster test units as needed.

The primary objective of this platform is to provide a test facility for electric propulsion devices of interest for future exploration missions. These thrusters are expected to operate in the range of hundreds of kilowatts and above. However, a platform with this capability could also accommodate testing of thrusters that require much lower power levels. Testing at the higher power levels would be accomplished by using power from

storage devices on the platform, which would be gradually recharged by the ISS power generation system.

This paper will summarize the results of the preliminary phase of the study with an explanation of the user requirements and the initial conceptual design. The concept for test operations will also be described. The NASA project team is defining the requirements but they will also reflect the inputs of the broader electric propulsion community including those at universities, commercial enterprises and other government laboratories. As a facility on the International Space Station, the design requirements are also intended to encompass the needs of international users.

Testing of electric propulsion systems on the space station will help advance the development of systems needed for exploration and could also serve the needs of other customers. Propulsion systems being developed for commercial and military applications could be tested and certification testing of mature thrusters could be accomplished in the space environment.