

Implementation Options for the PROPEL Electrodynamic Tether Demonstration Mission

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The PROPEL (“*Propulsion using Electrostatics*”) flight demonstration mission concept will demonstrate the use of an electrodynamic tether (EDT) for generating thrust, which will allow the propulsion system to overcome the limitations of the rocket equation. The mission concept has been developed by a team of government, industry, and academia partners led by NASA Marshall Space Flight Center (MSFC). PROPEL is being designed for versatility of the EDT system with multiple end users in mind and to be flexible with respect to platform. Previously, we reported on a comprehensive mission design for PROPEL with a mission duration of six months or longer with multiple mission goals including demonstration of significant boost, deboost, inclination change, and drag make-up activities.

To explore a range of possible configurations, primarily driven by cost considerations, other mission concept designs have been pursued. In partnership with the NASA’s Office of Chief Technologist (OCT) Game Changing Program, NASA MSFC Leadership, and the MSFC Advanced Concepts Office, a mission concept design was developed for a near-term EDT propulsion flight validation mission. The Electrodynamic Tether Propulsion Study (ETPS) defined an EDT propulsion system capable of very

large delta-V for use on future missions developed by NASA, DoD, and commercial customers.

To demonstrate the feasibility of an ETPS, the study focused on a space demonstration mission concept design with configuration of a pair of tethered satellite busses, one of which is the Japanese H-II Transfer Vehicle (HTV). The HTV would fly its standard ISS resupply mission. When resupply mission is complete, the ISS reconfigures and releases the HTV to perform the EDT experiment at safe orbital altitudes below the ISS. Though the focus of this particular mission concept design addresses a scenario involving the HTV or a similar vehicle, the propulsion system's capability is relevant to a number of applications, as noted above. The ETPS builds on prior work on long-life, failure-resistant, conducting tethers and includes an instrument suite with demonstrated heritage capable of performing necessary diagnostics to measure performance against predictions for a given system size (to be determined) and boost rate.

Mission designs in other configurations and launch vehicle options are being developed such that the system can be demonstrated should a flight opportunity be identified. We will report on past and ongoing implementation options for PROPEL.