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A HIGHLY EFFICIENT CARGO TRANSPORTATION SYSTEM FOR FLEXIBLE PATH HUMAN EXPLORATION MISSIONS

Abstract

NASA has announced sweeping changes in the approach to its plans for human exploration beyond low earth orbit (LEO). A new strategy of developing capability that enables cost effective exploration across a range of destinations is the guiding principle. As a result of this new direction, technology development for advanced in-space propulsion has been given a high priority. Aerojet has many years of experience developing and transitioning electric propulsion technologies to operational missions. We believe it is possible through partnering with the key NASA centers to develop and demonstrate a series of progressively more powerful solar electric propulsion (SEP) cargo tugs. This paper describes our approach is to work out system level operations on a near-term (2014) demonstration at power levels consistent with high thruster and power system TRLs. Then, as component technologies are matured, to take the next step of demonstrating a 100 kW system by 2018. This stepping stone approach leads to a 500 kW SEP tug in the 2020's capable of providing logistics support for human missions to Near Earth Objects (NEOs), Libration points, the Moon, and ultimately Mars. Along the way, the SEP tug development will provide opportunities for critical capability demonstrations such as on-orbit propellant transfer and autonomous rendezvous and docking. The background and heritage of the critical technologies that provide the basis for an SEP tug will be described, as well as a roadmap of the critical technology maturation steps to the end goal. The vehicle concept and preliminary systems design will also be discussed. Finally, some of the opportunities for utilization of this key in-space asset will be proposed and mission analysis results will be provided that show the logistics support payoff for various potential human exploration missions. Just as we use more efficient means such as ships and railroads here on earth to transport cargo and bulk commodities, the SEP cargo tug will provide for cost effective shipment of supplies and equipment in space. If we are truly to become a spacefaring people, it is necessary to recognize the importance of taking such a step. Such notable visionaries as Hermann Oberth, Robert Goddard, and Werner von Braun all did. And now, with NASA's bold new step, the power and propulsion systems technology are poised to convert their vision to reality.