MW-Class Electric Propulsion System Designs

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Electric propulsion systems are well developed and have been in commercial use for several years. Ion and Hall thrusters have propelled robotic spacecraft to encounters with asteroids, the Moon, and minor planetary bodies within the solar system, while higher power systems are being considered to support even more demanding future space science and exploration missions. Such missions may include orbit raising and station-keeping for large platforms, robotic and human missions to near earth asteroids, cargo transport for sustained lunar or Mars exploration, and at very high-power, fast piloted missions to Mars and the outer planets. The Advanced In-Space Propulsion Project, High Efficiency Space Power Systems Project, and High Power Electric Propulsion Demonstration Project were established within the NASA Exploration Technology Development and Demonstration Program to develop and advance the fundamental technologies required for these long-range, future exploration missions. Under the auspices of the High Efficiency Space Power Systems Project, and supported by the Advanced In-Space Propulsion and High Power Electric Propulsion Projects, the COMPASS design team at the NASA Glenn Research Center performed multiple parametric design analyses to determine solar and nuclear electric power technology requirements for representative 300-kW class and pulsed and steady-state MW-class electric propulsion systems. This paper describes the results of the MW-class electric power and propulsion design analysis. Starting with the representative MW-class vehicle configurations, and using design reference missions bounded by launch dates, several power system technology improvements were introduced into the parametric COMPASS simulations to determine the potential system level benefits such technologies might provide. Those technologies providing quantitative system level benefits were then assessed for technical feasibility, cost, and time to develop. Key assumptions and primary results of the COMPASS MW-class electric propulsion power system study are reported, and discussion is provided on how the analysis might be used to guide future technology investments as NASA moves to more capable high power in-space propulsion systems.

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