Title:

"Options for Staging Orbits in Cis-Lunar Space"

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Abstract

NASA has been studying options to conduct missions beyond Low Earth Orbit, but within the Earth-Moon system, in preparation for deep space exploration including human missions to Mars. Referred to as the *Proving Ground*, this arena of exploration activities will enable the development of human spaceflight systems and operations to satisfy future exploration objectives beyond the cis-lunar environment. One option being considered includes the deployment of a habitable element or elements, which could be used as a central location for aggregation of supplies and resources for human missions in cis-lunar space and beyond. Characterizing candidate orbit locations for this asset and the impacts on system design and mission operations is important in the overall assessment of the options being considered. The orbits described in this paper were initially selected by taking advantage of previous studies conducted by NASA and the work of other authors.

In this paper orbits are assessed for their relative attractiveness based on various factors. A set of constraints related to the capability of the combined Orion and SLS system to deliver humans and cargo to and from the orbit are evaluated.   Deployed assets intended to spend multiple years in the Proving Ground would ideally require minimal station keeping costs to reduce the mass budget allocated to this function. Additional mission design drivers include eclipse frequency, potential for uninterrupted communication with deployed assets, thermal, attitude control, communications, and other operational implications. Also the ability to support potential lunar surface activities and excursion missions beyond Earth-Moon space is considered. The results of the characterization and evaluation of the selected orbits indicate a Near Rectilinear Orbit (NRO) is an attractive candidate as an aggregation point or staging location for operations. In this paper, the NRO is further described in terms which balance a number of key attributes that favor a variety of mission classes to meet multiple, sometimes competing, constraints.