HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)
Human Lunar Exploration (1)

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LARGE SOLAR ELECTRIC TRANSFER STAGES FOR LUNAR EXPLORATION

Abstract

Both robotic and human lunar exploration are receiving increased attention of agencies world-wide as recently reflected in the "Global Exploration Roadmap" by the International Space Exploration Coordination Group, ISECG. Common to all lunar exploration scenarios, especially the manned scenarios, is the need of significant infrastructure on the moon; power plants, mobility vehicles and scientific equipment. These infrastructural elements can be transported by a solar electric propulsion stage into a low lunar orbit.

In the paper several stage designs for such an electric propulsion stage are presented following a top level requirements matrix. The main two parameter of the matrix are: payload mass which ranges from 5 t to 15 t and mission duration which ranges from half a year to one year. For each combination of the two parameter a technical architecture will be presented. The main characteristics of the architectures are firstly the type of the high power electric propulsion subsystem (Hall Effect vs. Gridded Ion) and secondly the layout of the energy and power subsystem (solar cell type and power management type). The high power demand of the engines (several 100 kWs) poses challenges that demand for a careful analysis and innovative solutions. This is also true for the large solar arrays; they challenge the accommodation into the launcher fairing, the deployment and orientation mechanism as well as the attitude control of the spacecraft. New technologies will be assessed like Direct Drive Units and traded against conventional solutions with power processing units.

This system study follows a holistic approach; stage design and launcher performance in terms of payload capability, volume constraints and injection orbit are entangled and require a combined discussion to achieve a consistent design. Re-usability would be a major asset, therefore, system requirements, performance figures and a technical risk assessment of re-usable stages will also be subject of the presentation. A fleet of standardised electrical transfer stages could be the work-horses that deliver elements of a future lunar base to pave the way for sustainable manned space exploration.