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CIS-LUNAR TRANSFER VEHICLE: MISSION ANALYSIS FOR AN ESA TRANSFER VEHICLE TO THE GATEWAY

Abstract

In 2018, the International Space Exploration Coordination Group proposed international agreements on space exploration: expand human presence into the Solar System, with the surface of Mars as a common driving goal and prepare for space exploration missions beginning with the ISS and continuing to the lunar vicinity, the lunar surface, then on to Mars. The development and deployment of a lunar orbital platform gateway concept, called the Gateway, has been proposed as an intermediate step towards deep space travel. The Gateway would be placed in a Near Rectilinear Halo Orbit (NRHO) which has been identified as a suitable orbit for fulfilling the various mission requirements. The Gateway would, for instance, host crews on their way to the Moon surface or serve as an assembly point for the various elements of lunar landers.

In order to fulfil some of these exploration objectives, the study of a Cis-Lunar Transfer Vehicle (CLTV) concept has been performed at Airbus Defence and Space under the supervision of the European Space Agency: in its initial configuration, the CLTV is an unmanned expendable space transport vehicle designed for logistic servicing of the Gateway. It provides the capabilities of delivering pressurized and unpressurized cargoes to the Gateway and serves for the Human Landing System Refuelling. The CLTV uses the ARIANE 6 EVO launch services for the launch and then performs the transfer to the Gateway's NRHO. Once this orbit is reached, the CLTV performs autonomously all the operations until docking to the Gateway.

This study investigates the available Earth to NRHO transfer options with the objective of providing useful information for a mission architecture and system trade-off between the different launch and transfer options in order to define one or more transfer baseline. In particular, 1) the launch options – launch into Lunar Transfer Orbits or into Earth bounded orbits such as GTO, launch inclination and 2) transfer types – from short transfers to the NRHO with and without powered gravity assist to long low-energy transfers are optimized and assessed in a high-fidelity model. The feasibility and robustness of these options under

realistic operational requirements are analysed and the overall mission performance (payload delivery, transfer duration, launch window, etc ...) is assessed and traded providing a broad scope of future transfer options from Earth to the Gateway.