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CONCEPT OF A SHORTCUT CREATION OF MULTIPURPOSE ORBITAL TRANSPORT MODULE BASED ON KM-10 HALL-EFFECT THRUSTER

Abstract

The concept of a shortcut creation of a transport module with a 50 kW electric propulsion system (EPS) based on KM-10 Hall thruster with wide throttle ratio is presented. The transport module combined with Launch Vehicles (LV) of heavy (Angara-A5) and medium (Soyuz-5) classes will provide significantly cheaper delivery to the lunar orbit of payloads weighing 5...23t for the assembly of the Lunar Orbital Station (LOS) in comparison with the traditional liquid propellant systems (LPS). The concept includes 3 stages. At the first stage, it is proposed to carry out a space test with a small and relatively inexpensive demonstrator, created on the basis of the Express-2000 (15 kW energy capacity) and EPS based on three KM-10 operating with a power of 4,5 kW, discharge voltage of 300 V and specific impulse of 1800 s. The test is aimed at the in-space KM-10 operating, flight to the Lunar orbit using EPS, docking with a LOS simulator, and deployment of a promising low-power flexible solar array (< 2kW). The flight will take about 0.5 years. In practical use, the demonstrator combined with the Angara-A5 LV and the DM-03 upper stage can deliver up to 5,6t of payload to the LOS per 1.6 years with a cost profit about 19 % compared to LPS. At the second stage, it is proposed to replace the platform's planar solar arrays with promising flexible solar arrays with a power of 50kW and increase the number of KM-10 thrusters to 10 with a power of 5kW, discharge voltage of 300 V and specific impulse of 1900 s. Together with the Angara-A5 LV the module can deliver 12t of payload to the LOS with a < 1,8 years flight duration and 1,75 times cost profit in comparison with interorbital LPS. At the third stage, the same EPS, but in the operating mode with a discharge voltage of 500V and specific impulse of 2600 s, will deliver from the ISS orbit to Lunar orbit the Russian Science and Power module (NEM) weighing 21t with more than 3 times cost profit compared to LPS. Similar efficiency could be achieved on the basis of unpressurized NEM equipped with 50kW rigid planar power supplies. The assembly of the module, rigid solar arrays and the payload in the head fairings of the considered LV is shown.