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HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)
Human Exploration of Mars (2)

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CHEMICAL PROPULSION AND SPLIT OPTION FOR AN AFFORDABLE MANNED MISSION TO MARS

Abstract

An affordable manned Mars mission architecture is presented. Taking into account the constraint of one SLS flight per year, it takes advantage of a split strategy to send important assets to Mars before the manned flight. Several authors highlighted the risks and complexity of the entry, descent and landing systems and procedures, which grow with the size and mass of the landing vehicles. In order to minimize that complexity, we propose to reduce the mass of the landers to the strict minimum and to choose the same mass and shape for all of them. In most mission architectures that have been proposed so far, a key element is the MAV (Mars ascent vehicle) with heavy propellant tanks. It is possible to use the atmosphere and the soil of Mars to manufacture part of it. Another option is to send part of the propellant in another landing vehicle with rovers in charge of its transportation to the right place. The different steps of the proposed split architecture are: A. Before the manned flight, within 2 launch windows 1) L1: Optional SLS launch for cargo 1, complementary propellant tanks sent to the surface of Mars. 2) L1: SLS launch for cargo 2, WPM (wet propulsion module) with unmanned Orion sent to Mars orbit. These modules are required for the return. 3) L2: SLS launch for cargo 3, MAV partially fueled sent to the surface of Mars. With ISRU if 1) removed. 4) L2: SLS launch for cargo 4, DSH2 (deep space habitat for return) module sent to Mars orbit, junction with WPM to assemble the ERV (Earth return vehicle). B. Manned flight, only when phase A completed. The MAV and the ERV must be ready for takeoff. 5) SLS launch for DUDSH (dual use deep space habitat) and propulsion for interplanetary flight. 6) SLS launch with Orion (crew of 3 astronauts) and propulsion system. Junction with DUDSH and transfer of crew. Orion returns to Earth unmanned. 7) DUDSH is sent to Mars orbit, 5-6 months. 8) DUDSH lands on Mars (dual use of the habitat). After 500 days on the surface, the crew enters the MAV and joins the ERV in Mars orbit for the inbound trip. The initial mass in LEO is on the order of 700 tons, which outperforms the NASA reference mission. The advantage of our approach is a very limited need for new developments before the Mars mission.