14th HUMAN EXPLORATION OF THE MOON AND MARS SYMPOSIUM (A5)
Going beyond the Earth-Moon system: Human Missions to Mars, Libration points, and NEO's (4)

Author: Mr. Andrea Messidoro
Politecnico di Torino, Italy

Mr. Paolo Maggiore
Politecnico di Torino, Italy

FIRST HUMAN EXPEDITION TO A NEA: MISSION DEFINITION, ARCHITECTURE CONCEPTS PRESENTATION, SELECTION AND ASSESSMENT

Abstract

An intermediate and incremental step along the way towards the human exploration of Mars is represented by a manned mission to a Near-Earth Asteroid (NEA). It would bring a large suite of benefits: high scientific return, operational experience on human space exploration missions beyond LEO, test of technologies and assessment of human factors for future long-duration expeditions, evaluation of In-Situ Resource Utilization (ISRU) and, nevertheless, test of asteroid collision avoidance techniques. Starting from the mentioned mission objectives a mission definition is performed including mission top-level requirements and constraints, target selection (asteroid 1999 AO10), total ΔV evaluation (7.23 [km/s]), crew (3 astronauts) needs and resources assessment, instrumentation and top-level functions definition. Consequently, basing on few boundaries and a common end-of life configuration of 3 S/C modules, 3 concepts for the space system and mission architecture are proposed and analyzed; thought a main trade-off only one is selected. The chosen concept 2TL foresees a space system modular architecture composed of 5 modules: 1 NASA Orion-like Command Module (CM), 1 Mission Habitation Module (MM) and 3 Propulsions Modules (PM1, PM2 and a Service Module SM) that use chemical cryogenic propulsion for the main orbital maneuvers. The S/C is able to send in 2025-2026 3 astronauts to the asteroid 1999 AO10 in a space mission lasting 165 days and bring them back safely to the Earth. The whole 5 modules space system of almost 210 [t] in total will be launched separately by 2 similar Crew and Cargo Heavy Lift Launch Vehicles of around 110 [t] each one, still to be developed. The 2TL concept is then assessed in terms of mission phases and scenarios, functions allocation in the S/C modules and preliminary S/C subsystems definition. The S/C preliminary power and mass budgets and a preliminary mission cost estimation represent the final results of the 2TL concept assessment. The human mission the asteroid 1999 AO10 would be the first human expedition to an interplanetary body beyond the Earth-Moon system and the first human exploration mission outside LEO since nearly 40 years. The challenge of increasing the interest of the international community on the human spaceflight and inspiring the new generations about science, technology and space has been accepted.