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Going beyond the Earth-Moon system: Human Missions to Mars, Libration points, and NEO's (4)

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CONCEPT FOR A MANNED MISSION TO MARS

Abstract

The last NASA design reference architecture (DRA) for manned missions to Mars is complex, expensive and risky [2]. The main problems are the number of launches and the entry descent and landing (EDL) on Mars with heavy spacecrafts [1]. In order to minimize the risks and the complexity of the scenario, we propose several simplifications. First of all, two astronauts can live onboard the spacecraft instead of six. The payload and size of the rocket would be highly reduced and the EDL stage would be simpler and more secure. Second, in order to produce propellant for the return by means of a small chemical unit, huge solar arrays can be used instead of a nuclear reactor. In the DRA report, such an option has not been seriously examined because it is very difficult to deploy and maintain large solar arrays robotically [2]. However, they can be easily deployed with the help of astronauts. We therefore suggest coming back to the all-up strategy and taking the chemical unit and the solar arrays in the same spacecraft. Without any backup, that scenario would be risky. The third important point of our scenario is a full duplication of the mission as it was originally proposed by Von Braun [3]. Two spacecrafts would therefore be sent to Mars at the same time. They would land in the same region and each of them would serve as a backup vehicle for the other crew. On the surface of Mars, the four astronauts can cooperate and work together. At the end of the stay, the two spacecrafts would be launched at the same time. The concept is called two-four-two because they are two in each vehicle, then four on the surface of Mars and two once again for the return. Moreover, at all time, there are always two astronauts ready to help the two others (two for two). This paper focusses on human factors aspects of the mission.

[1] R.D. Braun and R.M. Manning: Mars Exploration Entry, Descent and Landing Challenges. Proceedings of the IEEE Aerospace Conference, 2006, 1-18.

[2] B.G. Drake ed., Mars Architecture Steering Group, Human Exploration of Mars, Design Reference Architecture 5.0 (and addendum), NASA Johnson Space Center, 2009. (DRA 5.0)

[3] D. Portree, Humans to Mars: Fifty Years of Mission Planning, 1950 - 2000, NASA Monographs in Aerospace History Series, no 21, February 2001.