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NUCLEAR PROPULSION FOR HUMAN EXPLORATION: THE MARS AND MOON CASE

Abstract

Human space exploration beyond the earth low orbit is going to become the most important program in the next decades. Its strategic targets are mainly aimed to increase the knowledge of the solar system and to verify the conditions for future colonization. The aforementioned can be realized by identifying and exploiting the wide range of new technologies needed for this historical milestone. In particular, the current robotics survey campaign to Mars is going to be the technology test-bed and should confirm that this planet could meet our exploration expectations.

To improve and realize this “human dream”, all the participating Space Agencies should involve their proper academic, industrial and commercial Parties, with the purpose to concentrate and get synergy of all kind of resources, establishing on around the forth decade of this century the date of the effective start for the first crew towards the red planet.

The architecture of the human mission to Mars has numerous proposal and options, going from “low-cost” flights to the “long-train”. From the technology viewpoint it is needed to develop the following:

- modularity of systems, including a next generation avionics;
- nuclear Propulsion (NP), to allow affordable duration and safe Earth-Mars round-trips.
- crew transfer mode among spacecrafts during the trip;
- outpost locations (low earth orbit, Mars orbit, Mars surface) to provide a viable mission architecture.

The results of the design of a Mars mission are here presented. This work assumes long duration stay on Mars surface.

This paper analyzes in detail and defines two Mars mission architectures: chemical (LOX/LH2) and NP thermal. Detailed mass, power and volume sizing are presented and compared, showing that NPT propulsion has a clear advantage over chemical. An identical short analysis is given for the manned Moon mission. By adopting some form of NP in some experimental Lunar trip within the frame of the NASA Lunar Exploration Program may increase preliminary experience of this technology, already tested in the past.