

THE INTERPLANETARY TRANSPORT SYSTEM OF “SPACE X” REVISITED

Dr Pierre-André Haldi¹

Critical analysis of the Interplanetary Transport System (ITS) architecture presented by Elon Musk (SpaceX) at the 2016 and 2017 International Astronautical Congresses; proposal of a somewhat different concept, aiming in particular at improving the safety/reliability of the whole system.

Key words: SpaceX Mars Project, Interplanetary Transport System Concept, Planet Mars Colonization

1. Strengths and weaknesses of the ITS architecture presented by SpaceX in 2016 (updated in 2017)

Like any fan of space exploration in general and that of Mars in particular, I followed with the greatest interest the fascinating presentation by Elon Musk of the SpaceX ITS project at the International Astronautical Congress in Mexico in September 2016. The proposed design of a massive launch vehicle and huge interplanetary spaceship were really impressive. Moreover, many innovative ideas such as a the full-reusability of all the components of the system and the concept of refueling the spaceship in orbit offer good and powerful perspectives for a more rapid colonization of the red planet than up to now considered. However, as an engineer (physicist) - although not a specialist in astronautics but with a good experience in risk analyses in particular - some aspects of this project looked at first sight rather puzzling to me, closer in fact to a science-fiction series like "Star Trek" than a realistic design of a spacecraft intended to transfer a hundred people from the Earth to the red planet, ... and beyond (Jupiter and Saturn satellites)! This moved me to make a more thorough critical analysis of this proposal in order to identify what were in my opinion its strengths and weaknesses (e.g.: the too massive and “monolithic” conception of the system, the too high number of engines at the first stage of the launcher, the absence of a dispositive to create an artificial gravity during the flight, etc.), results of which I will present and discuss during this conference.

2. Proposal of an ITS of a somewhat different design aiming at improving in particular the safety/reliability as well as the flexibility of the original system

Identifying possible weaknesses, or maybe even conceptual flaws, of a system design is one thing, but suggesting possible corrective counterproposals is of course better. I tried therefore to think of a somewhat different, and for me better, concept. The basic idea was to divide roughly by three the sizes of the main components of the originally proposed system, thus diminishing the development requirements and reducing in the same proportion the importance of the possible losses should an accident occur at launch time or during the interplanetary transfer. Instead of a “monolithic” spaceship, moreover fully integrated with the second stage of the launcher, I propose a more modular, and therefore flexible, system composed of six different component types, the last two being tripled: 1/ a booster-launcher more or less of the Saturn V or SLS class (i.e. 3-4 times less powerful than the original BFR of SpaceX) but reusable (RBL), 2/ an orbit-transfer propulsion module (TPM), 3/ an orbit-transfer energy module (TEM), 4/ an interconnection module (ICM), 5/ space habitation modules (SHM, 3x), ascent-descent vehicles (ADV, 3x, which could be reduced to one but at the expense of redundancy). The different modules will be assembled in space (and remain there, excepting for the RBL and ADVs), the connected (SHM-ADV)s in a 3 pointed-star configuration rotated to create an artificial gravity during the flight, More details on this ITS proposal will be provided during the conference.

References

- Elon Musk's address to the 2016 *International Astronautical Congress* (IAC) in Guadalajara, Mexico, Sept. 27th 2016
- "Making Humans a Multi-Planetary Species", Elon Musk; Mary Ann Liebert, Inc., Vol. 5 No. 2 2017 NEW SPACE
- "The Case for Mars", Robert Zubrin; A Touchstone Book, ISBN-10: 0-684-83550-9, 1997
- "Entering Space", Robert Zubrin; Penguin Putnam Inc., ISBN: 1-58542-036-0, 2000

¹ Retired EPFL (“Ecole Polytechnique Fédérale de Lausanne”) engineer-physicist, senior research scientist and lecturer; former director of the EPFL Post-graduate Course in Energy; former vice-president of the Mars Society Switzerland.