IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Interactive Presentations - IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (IPB)

Author: Mr. Jose Cavero
University of Leicester, Spain, jose.cavero95@gmail.com

Mr. Nihar Modi
University of Leicester, United Kingdom, niharmodi21@gmail.com
Mr. Thomas Lovell
University of Leicester, United Kingdom, thomasdaniellovell@gmail.com
Mr. Sedat Izcan
University of Leicester, United Kingdom, izcansedat@gmail.com
Ms. Asnate Plocina
University of Leicester, United Kingdom, ap786@student.le.ac.uk
Mr. Alexander Smith
University of Leicester, United Kingdom, atps1@student.le.ac.uk
Mr. Parin Vyas
University of Leicester, United Kingdom, ppv2@student.le.ac.uk
Mr. AMIT BHOYAR
Politecnico di Torino, India, ahbhoyar@gmail.com
Mr. Federico Giraldo
Politecnico di Torino, Italy, fede.giraldo97@gmail.com
Mr. Lokdeep Kalaiselvam
Politecnico di Torino, India, lokdeepk.seeds@gmail.com
Mr. Riccardo Moro
Politecnico di Torino, Italy, s305160@studenti.polito.it
Mr. Matteo Nobili
Politecnico di Torino, Italy, nblmtt@gmail.com
Mr. Leonardo Ricci
Politecnico di Torino, Italy, s305093@studenti.polito.it
Mr. Baptiste Rubino-Moyner
Politecnico di Torino, France, baptiste.rubino-moyner@ipsa.fr
Ms. Angela Tosti
Politecnico di Torino, Italy, s305129@studenti.polito.it
Mr. Vincent Bourinet
ISAE-Supaero University of Toulouse, France, vincentbourinet@live.fr
Mrs. Pauline Carpi
ISAE-Supaero University of Toulouse, France, pauline.carpi@student.isae-supaero.fr
Mr. Ryan Dahoumane
ISAE-Supaero University of Toulouse, France, ryandahoumane@yahoo.fr
Mr. Nicolas Pironnet
ISAE-Supaero University of Toulouse, France, nicolas.pironnet@outlook.com
Mr. Louis Plard
ISAE-Supaero University of Toulouse, France, plard.louis@gmail.com

Mr. Julien Rondey
ISAE-Supaero University of Toulouse, France, jrondey@gmail.com
Mr. Timothée Simon
ISAE-Supaero University of Toulouse, France, timothee.simon.2021@utt.fr
Mr. Sacha Sylvestre
ISAE-Supaero University of Toulouse, France, sacha.sylvestre@hotmail.com
Mr. Guillaume Truong–Allié
ISAE-Supaero University of Toulouse, France, guillaume.truong–allie@student.isae-supaero.fr
Mr. Jialian Yu
University of Leicester, United Kingdom, yu1508lian@gmail.com

DESIGN OF AN IN-SPACE TRANSPORTATION VEHICLE FOR A HUMAN EXPLORATION MISSION OF MARS

Abstract

The exploration of space and the expansion of human presence in our solar system is the main goal of many international space agencies as recognised in the International Space Exploration Coordination Group (ISECG) Global Exploration Roadmap (GER), with the common objective being the human exploration of Mars. Recognising that the importance of studying Mars is vital to our understanding of the origin and evolution of planetary systems will help us understand our place in the universe. Evidence of ancient water suggesting that Mars' climate was once capable of hosting ecosystems and potentially life makes the human exploration to look for biosignatures an interesting and challenging mission but one which unlocks greater flexibility and increases scientific capabilities. To make such an endeavour successful, a complete setup of systems is required including Human Transfer Vehicle, launch systems, Mars entry, descent and ascent vehicle, and a human base on the surface. This study will focus its attention on the design of a Human Transfer Vehicle focusing on safety and comfort of the astronauts. The design of the Human Transfer Vehicle will be completed as part of an international collaboration of students from the University of Leicester (UK), Institut Supérieur de l'Aéronautique et de l'Espace (France), and Politecnico di Torino (Italy) as part of the SpacE Exploration Development Systems programme (SEEDS).

The key concepts that have led to the preliminary design of the Human Transfer Vehicle are summarised in this paper. Considering the methodology followed, the sections are the definition of the mission scenario, the requirements, and the identification of design challenges, such as the ones listed in the Global Exploration Roadmap Critical Technology Needs which shows a pathway for the development of new capabilities and technologies, critical to advance global mission scenarios. Subsequently, different potential solutions are introduced, discussed, and assessed for the protection against radiation, the Extravehicular Activity System, the Habitation Module, and each of the subsystems.

Finally, the paper will present the results and conclusions of the study describing the preliminary design of each subsystem (Thermal Control Subsystem, Propulsion Subsystem, Communications Subsystem, Electrical Power Subsystem, Attitude and Orbit Control Subsystem, Environmental Control and Life Support Subsystem, Structure Subsystem, and Command and Data Handling Subsystem), the Habitation Module, the EVA System, the Radiation Protection System, reasoning the logic behind each decision.