IAF SPACE EXPLORATION SYMPOSIUM (A3)
Mars Exploration – missions current and future (3A)

Author: Mr. Simone Centuori
Elecnor Deimos, Spain, simone.centuori@deimos-space.com

Mr. Pablo Hermosin
Deimos Space SLU, Spain, pablo.hermosin@deimos-space.com
Mr. Javier Martín
Deimos Space S.L., Spain, javier.martin@deimos-space.com
Mr. Gabriele De Zaiacomo
Deimos Space S.L., Spain, gabriele.dezaiacomo@deimos-space.com
Dr. Colin Stroud
Lockheed Martin UK, United Kingdom, colin.a.stroud@lmco.com
Mr. Alexander Godfrey
Lockheed Martin UK Ampthill, United Kingdom, alexander.godfrey@lmco.com
Mr. Myles T. Johnson
Lockheed Martin UK Ampthill, United Kingdom, myles.t.johnson@lmco.com
Ms. Holly Johnson
MDA, Robotics and Automation, Canada, holly.johnson@mdacorporation.com
Mr. Tej Sachdev
MDA Corporation, Canada, Tej.Sachdev@mdacorporation.com
Mr. Rohaan Ahmed
MDA, Robotics and Automation, Canada, Rohaan.Ahmed@mdacorporation.com

# MARS SAMPLE RETURN ARCHITECTURE ASSESSMENT STUDY

**Abstract**

The current paper aims to present the results of the ESA funded activity "Mars Sample Return Architecture Assessment Study": its objective is to identify the critical parameters of the MSR mission, perform the rele-vant trade-offs at both mission and system level, evaluate different mission scenarios and select the best can-didates to be then furtherly. The study has been carried-out by an industrial consortium composed by DEIMOS Space S.L.U. as prime contractor and responsible for the mission design, Lockheed Martin UK Ampthill for the system design, mass budget and risk analysis and MDA Corporation for the payload mechanisms. Mars Sample Return is a joint collaborative project of ESA and NASA aimed at bringing to Earth several surface samples from the Red Planet. The mission is considered a major milestone to enable Mars human exploration, because it will allow scientists to better understand the characteristics of Mars and, based on this information, to design the infrastructure that will receive the first astronauts travelling to the Red Planet. Such complex objective envisages several mission phases, from the Earth-Mars transfer to the Mars orbital phase, the descent and landing on the Martian surface, the ascent from the Red Planet, the inbound leg towards Earth and the entry in the terrestrial atmosphere followed by the landing on our planet of the capsule containing the astrobiological sample. Several trade-offs of all the mission design parameters have been studied during the course of the activity in order to evaluate the mission feasibility and its sensitivity to the most critical design drivers: the combination of candidate propulsion systems (1 chemical and 4 electrical) together with the consideration of all possible staging scenarios and the possibility of performing a full or partial aero-braking for Mars

orbit acquisition, leaded to the analysis of more than 500 mission scenarios. An extensive analysis has then been conducted at both mission and system level to verify the fulfilment of the mission goals including: the full definition of the transfer trajectories and Rendezvous operations, the entry corridor in the Earth return together with the dispersion at Earth landing site, the mission risk assessment and the payload mechanisms definition. The most promising options foresee full chemical propulsion or a mixed system joining the chemical thrusters with the powerful ARM electrical engine. In both cases the mission will rely on the use of aero-braking and staging to reduce the spacecraft wet mass.