Exploration of Mars (08)
Robotic Mars Exploration (1)

Author: Ms. Lisa Peacocke
Airbus Defence and Space Ltd, United Kingdom, lisa.peacocke@airbus.com

Mrs. Marie-Claire Perkinson
Astrium UK, United Kingdom, marie-claire.perkinson@airbus.com
Dr. Jaime Reed
Airbus Defence and Space Ltd, United Kingdom, jaime.reed@airbus.com
Mr. Nicolas Croisard
Airbus Defence and Space Ltd, United Kingdom, nicolas.croisard@airbus.com
Mr. Marco Wolf
EADS Astrium, Germany, Marco.Wolf@airbus.com
Mr. Tobias Lutz
EADS Astrium Space Transportation GmbH, Germany, tobias.lutz@airbus.com
Mr. Tran Philippe
EADS Space, France, philippe.tran@space.eads.net
Ms. Kelly Geelen
ESA, The Netherlands, kelly.geelen@esa.int

SYSTEM DESIGN OF A MARS PRECISION LANDER

Abstract

A Mars Precision Lander mission is currently being studied under ESA contract within the Mars Robotic Exploration Preparation Programme (MREP). A landing precision of 10km (3σ) is required, with a goal of 7.5km (3σ), which is significantly better than past Mars missions. A potential payload for the precision lander is a Sample Fetch Rover. This rover would retrieve the sample cache obtained by a prior caching rover and place it in an ascent vehicle within the overall Mars Sample Return mission architecture. A precise landing is non-trivial, and requires a highly accurate guided entry with a powered descent phase capable of surface hazard avoidance.

The mission architectures were analysed in detail, particularly for the critical terminal descent and landing phase where options included airbags, crushable structures and landing legs. After a full trade-off analysis, a 'DropShip' design similar to NASA's SkyCrane approach was selected for the baseline. This concept eliminates the mass of any landing and egress systems, landing the rover directly on its wheels. A DropShip has the added benefit of avoiding thruster plume and back-pressure issues associated with Viking-type landers.

The Mars Precision Lander composite comprises a carrier and a guided entry module, with the DropShip powered descent module and attached rover enclosed by the guided entry module aeroshell. The composite has a total wet mass of 1408 kg and would launch in Autumn 2023 from Kourou on a Soyuz-Fregat launch vehicle. A direct escape launch would be performed, with an Earth fly-by included to increase the useful mass delivered to Mars. After a 1.9 year transfer, the composite would approach Mars and the guided entry module would separate from the carrier to directly enter the Mars atmosphere. The guided entry would use thrusters through the backshell to control the entry and minimise errors. A Disk-Gap-Band parachute would then be deployed, followed by frontshield separation and DropShip separation from the backshell. The DropShip then fires its thrusters for the terminal descent braking and

hazard avoidance phase. When 20 m above the surface, the DropShip would lower the rover on a cable and winch system to touch down gently on the Martian soil. The cables would be cut, with the DropShip then manoeuvring away for a crash landing at a safe distance.

This paper will outline the Mars Precision Lander mission and spacecraft design in detail, to demonstrate the feasibility of a precise landing on the surface of Mars.