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MASSIVE: A FUEL PRODUCTION MISSION IN THE FRAMEWORK OF MARTIAN ISRU

Abstract

Mars Automated Supply System via ISRU for Venture Expeditions (MASSIVE) is a preliminary mission design in the framework of planetary ISRU aimed to consolidate fuel production technologies to support future manned mission to Mars. MASSIVE is designed to produce the required propellant to power a 3 astronauts MAV from surface up to LMO. The plant is designed to be operational for more than 5 years, the time during which the propellant production will continue with the simultaneous further characterization of the landing area. The mission is designed to fit the full system into one single SLS launcher with a proposed launch date in 2035 to touchdown in Gusev Crater in Jan 2036. The launch configuration is conceived as a single cylindric lander containing the elements composing the Mars surface segment and the 1.4 tons spacecraft attached to the lander. The separation between the spacecraft and the lander takes place 3 days before the atmospheric entry when the lander continues its impact trajectory to Mars while the spacecraft will perform a Mars Orbit Injection maneuver to reach its operational orbit around the planet. The lander touches down with a vertical final descent, after being slowed down by an IAD and a subsonic parachute. During the plant deployment, the spacecraft performs scientific investigations on the landing site to study the H2O concentration, while acting as a relay between MOC and lander. The operational configuration on the surface consists of an excavation rover and the plant. The rover is deployed by a ramp from the lander, and in its nominal daylight operations, it will excavate

and bring the regolith to the plant, where it will also be recharged between the working cycles. The regolith is processed in a microwave oven, which dehydrates it collecting the H2O while a pump collects the CO2 from the atmosphere. A microchannel Sabatier and an H2O electrolyzer will then take CO2 and H2O as reagents to produce O2 and CH4, which are cryocooled and stored in a liquid state in the tanks. The full system is expected to produce up to 38 tons of propellant within 2040, when the first manned missions to Mars are planned. This paper details the mission design with subsystem specifications and concept of operations from launch to disposal, providing an insight into its feasibility and current limitations.