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THE EXPLOITATION OF THE IRENE TPS TECHNOLOGY FOR RE-ENTRY MISSIONS.

Abstract

The paper describes the activities of the IRENE (Italian Re-Entry NacellE) program, funded by the Italian Space Agency (ASI) and European Space Agency (ESA), which are aimed to develop, an innovative deployable (umbrella-like) heat shield concept developed by ALI S.c.a.r.l., CIRA and University of Naples. IRENE is a capsule with a variable geometry, "umbrella-like" deployable heat shield that reduces the capsule ballistic coefficient, leading to acceptable heat fluxes, mechanical loads and final descent velocity. The feasibility study of the IRENE has been carried out in 2011. The Thermal Protection System (TPS) materials have been tested in the SPES hypersonic wind tunnel at the University of Naples, and in the SCIROCCO Plasma Wind Tunnel at CIRA in 2011 and in 2018. Thanks to the promising results of the first activities, ASI and ESA decided to fund, in the frame of a GSTP the current phase of the program

called MIFE "MINIIRENE Flight Experiment". MINI IRENE, the Demonstrator of IRENE, has been designed and manufactured to demonstrate by means of a suborbital re-entry flight and a Plasma Wind Tunnel (PWT) test campaign, the suitability of the deployable heat shield to the space environment and the re-entry condition. The aim of this test campaign is to achieve a qualification up to TRL6. The Flight Demonstrator will be included as a secondary payload in the interstage adapter of a VSB-30 Sounding Rocket that will be launched from the ESRANGE, Sweden, launch base, then ejected during the ascent phase of the payload section, perform a 15-minutes ballistic flight, re-enter the atmosphere and hit the ground. As an application of IRENE technology, ALI has proposed the "Small Mission to Mars" (SMS) project. SMS is a low-cost system suitable for the entrance in the atmosphere and the operations on the ground of Mars. The SMS feasibility study was funded by the European Space Agency (ESA) in 2016. In the paper are also illustrated the results of the feasibility study of SMS, including a description of the mission profile, launch and escape phases, interplanetary trajectory, Mars approach, entry, descent and landing (EDL), and payload deployment and operations.