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IRENE TECHNOLOGY FOR THERMAL PROTECTION SYSTEMS

**Abstract**

The Paper describes the activities funded by ASI and ESA in the IRENE (Italian ReEntry Nacelle) program, 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 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. European Space Agency is now funding the current phase of the program called MIFE "MINI-IRENE Flight Experiment". MINI IRENE, the Demonstrator of IRENE, has been designed and manufactured to demonstrate, with a suborbital flight

and with a Plasma Wind Tunnel (PWT) test campaign, the functionality of the deployable heat shield. The Flight Demonstrator shall be included as a secondary payload in the interstage adapter of a VSB-30 Sounding Rocket that should 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 application of IRENE technology, ALI has proposed the “Small Mission to Mars” (SMS) project. SMS is a low-cost system suitable for the entrance and the operations in Mars. The SMS feasibility study was funded by the European Space Agency (ESA) in 2016. In the Paper also are 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.