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CERAMIC MATRIX COMPOSITE THERMAL PROTECTION SYSTEMS FOR LARGE-SCALE DEMONSTRATION ON IXV

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Abstract

The development of reusable thermal protection systems for atmospheric re-entry has represented a continuous effort in the European space community for many years, through different national and ESA programmes. The most ambitious demonstration in this field will be achieved through the launch and re-entry of the Intermediate eXperimental Vehicle (IXV). The spacecraft will indeed integrate a large amount of CMC-based Thermal Protection Systems, that will cover integrally the most critical areas, providing long-awaited data on the actual performance of such systems.

Herakles, Safran Group, has been entrusted since 2008 with the development and qualification of two of the most critical TPS subsystems of the vehicle : the nose and the panels covering the major part of the windward side, two of the most heated areas during re-entry. After a successful CDR outcome in 2011, these subsystem are now in the middle of the qualification and flight model manufacturing phase.

The technology developed for these applications combines a high-temperature resistant C-SiC outer shell, mechanically fastened to the structure of the vehicle, and internal lightweight insulation layers. These systems have to comply with a set of very strict requirements due to the harsh environment of atmospheric re-entry, combined with aerodynamic shape control and mass objectives. Consequently, a large number of test campaigns have been performed throughout the detailed design phase, addressing the different components of the subsystems, with particular focus on C-SiC parts and on integrated subsystem performance.

The paper gives an insight of these development activities, and provides an overview of the current development status, including the manufacturing activities maturation through testing of subscale and prototype CMC parts. Finally, it presents the up-to-date status of the preparation of the qualification tests, that will comprise dynamic tests, and thermal and mechanical tests. These tests will be performed on a series of full-scale parts, representing the nose of the vehicle and the most critical areas of the windward TPS.