

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)  
Future Space Transportation Systems Verification and In-Flight Experimentation (6)

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DEVELOPMENT AND TESTING OF CERAMIC MATRIX COMPOSITE (CMC) THERMAL  
PROTECTION SYSTEM FOR THE IXV EUROPEAN ATMOSPHERIC RE-ENTRY  
DEMONSTRATOR.

**Abstract**

The Intermediate eXperimental (IXV) programme which aims at developing a demonstration vehicle that will give Europe a unique opportunity to increase its know-how in the field of advanced atmospheric re-entry technologies, has gained considerable momentum since the beginning of 2010 with the detailed design phase that has been concluded in 2011. The qualification phase has now been initiated, with the aim of producing qualification hardware that will be tested in representative environment

Snecma Propulsion Solide, SAFRAN Group, has performed the design of the Windward C-SiC Thermal Protection System (TPS), and has also been entrusted by ESA and Thales-Alenia Space with the design of the Nose Assembly of the vehicle. The two subsystems cover the largest part of the most heated areas of the vehicle during the re-entry. The Nose, designed on a common technological basis with the Windward TPS, presents in addition some unique features. Its outer shell is made of a one-piece C-SiC part with a width of almost 1.4 m, which places it well beyond the range of size of C-SiC TPS parts manufactured and tested during the Generic Shingle, FLPP Material and Structure, and even X-38 programmes.

The detailed design phase comprised extensive thermal and thermo-mechanical analyses, small-scale tests on the various components of the Windward and Nose Assemblies, and large scale prototypes manufacturing. Among those tests, some are specifically made to assess the behaviour of the TPS during re-entry:

- Insulation layers characterization,
- Active oxidation assessment of the CMC during re-entry,
- Catalycity of the CMC material aimed at measuring the difference between the heat flux applied on CMC samples and the heat flux actually assessed on the sample,
- Permeability, venting tests, and sneak-flow tests, aimed at characterizing the amount of hot air than can go through the insulation layers and seals

During the qualification phase, six full scale windward TPS and a complete full-scale nose assembly will be manufactured and will undergo both thermo-mechanical testing and plasma wind tunnel testing.

The present paper presents these upcoming activities and provides an up-to-date status of the development of both subsystems.