

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)  
Future Space Transportation Systems Technologies (5)

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ACHIEVEMENTS OF HX PROGRAMME ON MATURATION-DEMONSTRATION OF NEW KEY  
CRYOGENIC TECHNOLOGIES**Abstract**

Since 2007, CNES has initiated a technological programme HX, mainly focusing on technologies useful for future reignitable upper stages with new coasting phases up to 6 hours or even more. First possible application is on A5ME upper stage. HX programme has been organised as follows: HXT for technologies development and testing at component and subsystem level in order to reach TRL4. Main results have already been presented. Yet complementary activities on adaptation of camera and planar level sensors, for possible flight implementation in A5 ESCA LH2 tank, in order to validate key technologies fields as Propellant Thermal Management and their behaviour during ballistic phases, will be presented. A macrodemonstrator HXG, integrating HXT enhanced technologies and aiming to demonstrate TRL6 for each technology as well as interactions. 7 tests sequences in different conditions have been performed in order to cover 164 validation objectives, with about 300 measurements. HXG consists in 2 elongated A5 ESCA RLOX tanks separated by an insulated orthogrid common bulkhead which is also part of the demonstration. These tanks of 2.6m in diameter have been filled with LH2 for the upper one, whereas the lower one has received both LH2 and LN2 cryogenic fluids. The total height of the demonstrator is about 10m when installed in the vacuum test chamber. HXG has tested about 12 innovative technologies in representative environment on ground and in altitude simulation with solar fluxes. System aspects through interstages cavities have also been part of these objectives. This paper will concentrate on the HXG test campaign, the main results of exploitation and the technologies expertise.

HX programme is managed by CNES. The industrial team is led by AIR LIQUIDE and involves CRYOSPACE. HXG on ground demonstrator has been assembled and tested in AIR LIQUIDE facilities.