Abstract EUCASS

Title: Preparing technologies for enabling European restartable cryogenic upper stages

Authors: A. Sirbi, J. Kauffmann, G. Pilchen, T. Renk, M. Guethler, A. Ferrarese, P. Behruzi, C. Roettger, B. Szelinski, S. Bianchi, B. Huermann, M. Bruenger, M. Rossmann

The general objective of the Future Launchers Preparatory Programme (FLPP) and in particular of Cryogenic Upper Stage Technologies (CUST) is to reach a sufficient maturity level for all technologies that were identified as beneficial for re-ignition preparation and cryogenic propellant conservation during long ballistic phases.

By performing an important technological step forward, targeting a Technology Readiness Level of 5/6, the development risk, development cost and time are strongly reduced for a new launcher development.

In this context a technologies identification process was performed in 2008. Details on the selection logic will be presented together with a short description of technologies shortlisted and potential added value at upper stage level.

The selected technologies can be grouped in two area:

1. Technologies linked to propellant handling during different launcher mission sequences
2. Technologies related to thermal aspects of the cryogenic tanks, as consequence of long ballistic phases imposed by target orbit and de-orbitation

A number of these technologies were starting in 2009 a development process to reach a TRL5/6. This activity ended in December 2012. The development logic, technical challenges, analysis and the most important tests performed will be addressed. The following launcher's upper stage technologies will be covered by this paper:

1. The Versatile thermal insulation, which has as main goal to protect the liquid hydrogen tank from the external heat fluxes, on ground, during ascent and during long ballistic phases.
2. The Sandwich Common Bulkhead, which has to comply with a design, and mechanical loads representative to Ariane 5ME (the reversed common bulkhead), and has to reduce to minimum the heat exchange between the Oxygen and Hydrogen liquid storage tanks,
3. Propellant Management Devices, which shall ensure liquid gas free propellant in good temperature conditions at the outlet of the tank, towards the engine.
4. Gas Port Phase Separator, which shall ensure the process of pressure stabilisation or depressurisation of the tank during ballistic phase, by expulsion of liquid free gas
5. Propellant preconditioning which by means of pressure control, shall ensure sub-cooled propellant in sufficient quantity to cover the launcher needs for mission completion.

A sounding rocket flight carrying two payloads that simulate LOX and LH2 PMD technologies was performed with the goal to increase the technology readiness level. The technology scaling and the outcome of the flight in support to the development of technology will be presented and will be discussed.

The paper will conclude with the lessons learnt at ESA and Industry level and will provide an overview on the upcoming developments.