SPACE PROPULSION SYMPOSIUM (C4)
Propulsion System (1) (1)

Author: Dr. Salvatore Borrelli
CIRA Italian Aerospace Research Centre, Italy, s.borrelli@cira.it

Mr. Pier Paolo de Matteis
CIRA Italian Aerospace Research Centre, Italy, p.dematteis@cira.it
Mr. Antonio Schettino
CIRA Italian Aerospace Research Centre, Italy, a.schettino@cira.it
Mr. Francesco ferrigno
CIRA Italian Aerospace Research Centre, Italy, f.ferrigno@cira.it

SYMPOSIUM KEYNOTE: THE HYPROB PROGRAM: MASTERING KEY TECHNOLOGIES, DESIGN AND TESTING CAPABILITIES FOR SPACE TRANSPORTATION ROCKET PROPULSION EVOLUTION

Abstract

The Italian program HYPROB has been kicked-off in 2010 to support the development of the space propulsion asset at national level. The program is carried out under contract by the Italian Ministry of University and Research (MIUR), as contribution to the National Aerospace Research Program (PRORA), in coherence with the long-term vision of the Italian Space Agency on Space Propulsion.

The strategic objective of the Program is to consolidate the national background on rocket engine systems for future space applications, with specific reference to liquid oxygen-methane (LOX/LCH4) and hybrid technologies based on paraffin (LOx/Wax or LN2O/Wax), where Italy can rely upon a significant heritage from previous RD activities. In this respect, the program Road Map pursues a short-term goal, in a 4 year time frame (2013), related to the assessment of system capabilities and technologies at demonstration level, based on a technology-push approach, and a mid-term goal, in a 6-year time frame (2015), devoted to a specific application, thus based on a system-driven approach. In the mid-term perspective, for both liquid and hybrid developments, the focus is put on:

- development of technology demonstrators, including intermediate breadboards;
- development of RD activities in relevant technology areas;
- improvement of testing capabilities.

At system level, the mid-term objective is to design, manufacture and test, in a relevant facility, technology demonstrators of suitable class of thrust, namely 30-50 KN, with the main scope of validating critical design and technology features and then to assess technology readiness level of potential solutions for future engines. The LRE demonstrator will be specifically designed to implement regenerative cooling based on the use of the propellant (methane) as refrigerant, and innovative manufacturing and welding technologies. The hybrid demonstrator will have a similar class, the main feature being the combination of paraffin, as a potential candidate for solid propellant in alternative to HTTP, with either liquid oxygen or a nitrogen-based oxidizer. In the framework of RD activities, the focus is put on CFD combustion modelling, thermo-mechanical modelling, materials and manufacturing processes at both system and components level. Specifically in the methodology field, the main scope is to enhance the capabilities of simulating the complex combustion and thermo-mechanical processes, characteristic of both liquid and hybrid propulsion, as a fundamental step to improve the design processes for future applications. The

models will be validated through extensive testing activities at small-scale level in either newly designed or up-graded test benches.