

SPACE PROPULSION SYMPOSIUM (C4)
Propulsion Technology (1) (3)

Author: Mr. Jean-Noel CARUANA
European Space Agency (ESA), France

Mr. Jerome BRETEAU
European Space Agency (ESA), France

PROPULSION DEMONSTRATORS IN ESA FLPP 3 SERVING THE COMPETITIVENESS OF
EUROPEAN LAUNCHERS**Abstract**

The Future Launchers Preparatory Programme is since 2005 the technology prospective and maturation programme of the ESA Launchers Directorate. In propulsion, it manages integrated demonstrators up to hot-fire testing, to mature technologies in a system-driven project frame and a representative engine environment. Moreover, such demonstrator projects are laboratories for possible future industrial organisations, where the contractors are incited to try more cost-efficient work methods and new cooperation schemes.

As the European launcher sector is poised to embrace short and affordable developments intended for competitiveness, the propulsion demonstrators in FLPP strive to assemble consistent sets of technologies into integrated demonstrator engines designed as prototypes. Thereby the technologies reach TRL6 fully embedded in engine systems, ready to be transferred to turnkey developments and flight qualifications.

Relying on a permanent assessment of the launcher market trends, the FLPP devises specifications maximising the interest and likelihood of future applications. Thorough launcher system studies spot design solutions being both attractive and fairly independent of market and programmatic unknowns. The interest of technologies is gauged against criteria addressing production cost and lead time, lean operations, mass, reliability, specific impulse, injection accuracy, or environmental footprint. The likelihood of application is enhanced by the anticipation of market trends (for instance satellites without chemical propulsion) and synergies among the European launcher family.

The engine demonstrators in FLPP focus currently on upper stage propulsion, accompanied by projects in hybrid and solid propulsion. The reflection is structured around a cryogenic upper stage optimised for delta-V and a storable kick stage for assuring versatility. This approach looks best for cost reduction, potential synergies and robustness to market unknowns. Cryogenic re-ignition is also possible.

A cryogenic expander-cycle demonstrator has been started in 2013, aiming at hot-firing campaigns in 2016-2018 in Germany. It is designed for low cost, light weight and high specific impulse, demonstrating technologies pertaining to additive manufacturing, improved materials, regenerative nozzle, laser ignition, innovative injectors, electric actuators, or engine control system. Regarding storable propulsion, an engine demonstrator has been designed in the 5 kN thrust category, embedding such technologies as NTO regenerative cooling, fuel film cooling, improved injector design, or seamless metallic nozzle; it is tested in 2014-2015 in Germany.

The propulsion projects in FLPP are coordinated to provide a large, robust and consistent range of solutions to the European launchers in 2025 and beyond. They build on a long and successful experience background, and will help the European launchers remain a world-class reference.