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ADVANCING PHOEBUS, AN ARIANEGROUP & MT AEROSPACE COOPERATION FOR PREPARATOIN OF AN OPTIMIZED LIGHTWEIGHT LOW COST FUTURE UPPER STAGE

Abstract

In order to respond to the quick and challenging evolution of the space market demand, continued improvements to the competitiveness of the Ariane 6 launcher are under development. One significant increment for the Ariane 6 upper stage is the exploitation and verification of the use of composite materials and related technologies in particular for the cryogenic propellant tanks and other primary and secondary structures. ArianeGroup and MT Aerospace are combining their expertise to design and test the PHOEBUS ground demonstrator within ESA's Future Launchers Preparatory Programme (FLPP), in order to prepare the development of such a composite Upper Stage (ICARUS aka Black Upper Stage), enabling a significant performance increase and better access to new missions by reducing the mass and production cost.

The first step on the way to an Upper Stage with an increased share of CFRP materials and technologies is the definition of a suitable architecture. ArianeGroup aims at defining such an optimized architecture for future mission scenarios. A reduced set of requirements to the scope of both cryogenic tanks and their connecting structure is derived for the PHOEBUS target application. However, due to manufacturing capability, budgetary and time constraints a complete full scale prototype cannot be realized.

The PHOEBUS demonstrator LH2 tank diameter is adapted to a relevant 2/3rd-scale (3.5m vs. 5.4m), whereas the LOX tank is almost full scale (3.5m vs. 3.6m). Other components on PHOEBUS are fully tailored to the demonstrator needs, such as the connecting structure between both tanks.

The aim of the PHOEBUS project is to raise the TRL of the key technologies towards TRL 6 via manufacturing, assembly, integration and, finally, test of a ground demonstrator, partially representative of the target application. Compatibility with liquid oxygen and permeation of liquid hydrogen through the CFRP wall thickness are the two major challenges of ICARUS, with results being obtained within PHOEBUS.

The planned paper describes the activities and results obtained during the phase B/C/D1 of the project:

- Achievements in development process and maturity of overall project.
- Achieved and planned tests of innovative technological concepts.
- Achieved and planned tests of sub-scale demonstrator tank configurations.
- Further steps and maturation logic.

The transformation from an aluminium stage to a Black Upper Stage is challenging, but underway to optimize the performance of the next generations of European Launcher systems.