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TOWARDS A REUSABLE FIRST STAGE DEMONSTRATOR: CALLISTO – TECHNICAL PROGRESSES & CHALLENGES

Abstract

In order to investigate the capabilities of a reusable launch system, JAXA, CNES and DLR have jointly initiated the project CALLISTO ("Cooperative Action Leading to Launcher Innovation for Stage Tossback Operations"). The goal of this cooperation is to launch, recover and reuse a first stage demonstrator to increase the maturity of technologies necessary for future operational reusable launch vehicles (RLV) and to build up know-how on such vehicles under operational and developmental aspects.

As the project has now turned into the detailed design phase, several technical progresses have been made in definition, analysis and testing of systems and subsystems. The CALLISTO vehicle itself constitutes a subscale vertical take-off vertical landing (VTVL) stage with an overall length of 13 m and a take-off mass of 3600 kg, which is propelled by a throttleable LOX/LH2 engine. It is capable to perform approximately 10 consecutive flights during the planned flight campaign in French Guiana. Globally the development effort on this system is equally shared between the three project partners.

This paper presents the recent achievements in development of the key technologies and contributions under DLR's responsibility. Particularly this includes the Approach and Landing System, the Aerody-

namic Flight Control System, the Navigation System, the Guidance and Control System, the On-Board Computer and Software, the Liquid Hydrogen Tank and the Top Module Structures. While the design of these subsystems has reached PDR level, detailed analyses and first breadboard tests have been passed successfully. Additionally, the investigation of the vehicle Aerodynamics, Aerothermodynamics and Landing Dynamics has achieved major progresses at system level.

The results of the recent analyses and tests are presented and discussed within the perimeter of the CALLISTO development roadmap. Possible technical challenges are indicated and their resolution methods are examined. Finally, the upcoming development steps are described which are foreseen to move forward to the qualification and maiden flight campaign.