IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems Verification and In-Flight Experimentation (6)

Author: Ms. Olga Diaz Lopez
Centre National d'Etudes Spatiales (CNES), France, olga.diazlopez@cnes.fr

Mr. Sergio Lopez Moreno
Centre National d'Etudes Spatiales (CNES), France, sergio.lopezmoreno@cnes.fr
Mr. Jean Desmariaux
Centre National d'Etudes Spatiales (CNES), France, jean.desmariaux@cnes.fr

CALLISTO PROJECT – MECHANICAL ARCHITECTURE AND STRUCTURAL DESIGN CHALLENGES IN THE FRAME OF A REUSABLE FIRST STAGE DEMONSTRATION VEHICLE

Abstract

In the frame of future launchers preparation, CNES, JAXA and DLR are working all together to develop a reduced-scale vehicle named CALLISTO (Cooperative Action Leading to Launcher Innovation in Stage Toss-back Operations). The aim of the project is to demonstrate first stage recovery, revalidation and reuse capabilities. The vehicle uses a reusable LH2/LOX engine and it has a diameter of around 1 meter, a total length of around 13 meter and a total mass of around 4 tons. Launcher structures are designed and sized in order to optimize mass while respecting a system reliability requirement. In order to do so, safety factors and margin policy are used in structural sizing. Since CALLISTO vehicle is a demonstrator, reliability requirement is not the same that for operational launchers. However, this vehicle is faced to an additional challenge: reusability. A compromise is needed between structural design for mass optimization, damage tolerance and demonstrator reliability requirement, assuring in any case that structures do not jeopardize the demonstration. Additionally, for most of the structures, since a single specimen will be manufactured, we could take benefit of material real characteristics instead of material statistical allowable used for the design for consolidating the margin of safety budget in order to bring growth potential for further demonstration purposes. On this paper, a focus of the main design challenges for the LH2 tank and the equipment bay is done. Since the vehicle has a reduced size, different issues regarding thin structures are faced such as manufacturing capabilities or crack propagation and NDI means for space applications.