Design-to-Cost & parallel engineering applied for GSE of the Lox/Methane Rocket Propulsion of a Spaceplane

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ABSTRACT

LOX/Methane is currently regarded worldwide as a propellant combination, not only for future expendable and reusable low cost launch vehicles, but has been also primarily studied by ASL (starting by Astrium) for highly reusable vehicle capable to safely transport paying passengers in space on a sub-orbital flight. This is the case for the ASL rocket propulsion system of the Airbus DS (previously Astrium) SpacePlane.

The paper will shortly present the architecture of the Lox/Methane Rocket Propulsion System (RPS) inside the SpacePlane fuselage.

The main stakes of this project are the mandatory safety level, for ground phases (when passengers are on board, in particular) and all flight phases, with a design relevant of aeronautic like certification, and the maximum flight ticket price, or a maximum total cost allocation per flight from design specification point of view. Combined with other critical high level requirement for this vehicle, ASL had engaged a system engineering approach highly structured by concurrent engineering for achieving “design-to-objectives”, as in particular Design-to-Safety and Design-to-Cost. This has been applied for the design of RPS ground operation, and related Ground Support Equipment (DSEs), at the same time as the RPS design choices were progressing.

The paper will present the main aspects of his design approach, related to the operation method and tools determination, together with the progress of RPS design.

The important and early engineering effort put on the identification of an “operational concept”, to take into account the challenge of a confined reusable propulsion system operation scheme, within a given cost target, will be stressed out, and the type of obtained results and influences on RPS design will be emphasised.

Some typical lay-out design steps will be used to illustrate this approach, together with the particular engineering tools which had been used.

The conclusion will be driven from the benefits obtained, in this project, through this system engineering approach, encompassing in parallel the design of the propulsion system and its lay-out, and of the design of the “ground operations” with their GSEs.