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SYSTEM ENGINEERING PRESENTATION OF THE EUROPEAN STAGED COMBUSTION DEMONSTRATOR SCORE-D

Abstract

The intent of this publication is to provide an overview of the system engineering of the European staged combustion demonstrator SCORE-D. The SCORE-D is a staged combustion cycle Engine demonstrator of 140 tons nominal vacuum thrust. It is a cryogenic hydrogen-oxygen engine as a baseline, compatible with existing European test stands. A methane-fuelled version is also studied in parallel. SCORE-D is designed and will be tested in the frame of the ESA Future Launchers Preparatory Programme (FLPP). The engine preliminary concept was defined at an Architecture Key Point held in April 2010. Its basic features are a serial staged combustion cycle architecture, a single pre-burner, turbines in parallel, a control strategy based on the use of the pre-burner oxygen valve and a hot gas valve downstream of the pre-burner for throttling and mixture ratio trimming.

This publication is focused on the presentation of the engineering activities which are taking place at system level in order to prepare the System Requirement Review to be held at the beginning of 2011 before the start of the engine preliminary design phase. It also presents the concept choices and preliminary design of the major sub-systems.

Functional and mechanical models of the engine were initiated in order to perform the numerical simulations which are necessary to establish the engine and the sub-system technical specifications.

The functional steady state model is used to derive the demonstration operating envelope and issue sub-system performance requirements. The transient model is an essential tool to establish valve and control device requirements. The engine mechanical lay-out is defined taking into account the robustness including the verification of proper dynamic behaviour

SCORE-D shall be designed in order to be as representative as possible of the future flight engine to be developed in the continuation of its testing.

In addition to testing a staged combustion demonstrator, a strong focus is placed on improving the maturity level of technologies which will become increasingly important for space propulsion such as health monitoring and the all-electric engine control. Throughout the design and testing of SCORE-D, introducing new technologies and monitoring the progress of their maturity is a prime objective of the demonstration.

The SCORE-D program is an essential element in the preparation of the development decisions for a high thrust engine of a New Generation Launcher and provide potential technology spin-offs for the evolutions of existing launcher first stages propulsion or liquid booster applications.