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ADVANCE IN SYSTEM ENGINEERING FOR THE DEVELOPMENT OF THE VINCI ENGINE

Abstract

This publication provides an overview of the progress of the VINCI engine system engineering over the 2006-2008 period, during which important advances in system engineering and modelling were achieved, and gives the major development trends for the next three years. It also presents the major targets to be fulfilled for the next development phase. The VINCI engine is an 18-tons thrust upper stage cryogenic engine with capability of multiple firings and potential to perform a large array of missions. The VINCI engine is a cryogenic expander cycle engine combining the required features of this cycle, i.e. high performance chamber cooling and high performance hydrogen turbopump, with proven design concepts based on the accumulated experience from previous European cryogenic engines as HM7 and VULCAIN. The high performance of this engine and its restart capability offers potential applications on various types of future launcher upper stages as well as orbital spacecrafts. As first application, VINCI engine will be one of the key elements of the next Ariane 5 improvement, based on a new cryogenic reignitable upper stage. During the 2006-2008 period, in the frame of ESA Future Launcher Preparatory Programme, VINCI engine has been tested, and engineering activities have been performed to support improvement effort regarding design maturity. These system engineering activities have been mainly focused on mechanical items relevant to engine dynamic environment and nozzle deployment, and on engine ignition and re-start after a ballistic phase for multiple boosts missions. Regarding ballistic phase and re-start, a major contribution is anticipated from advanced modelling for thermal analysis, which might include effect of a low gravity environment on heat transfer and two-phase flow. Microgravity activities are focused on evaluating the effectiveness of a chill-down after a long duration ballistic phase.