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Author: Dr. DAVID PALMIERI
ESA/NASA, Italy

Mr. DAVIDE NICOLINI
European Space Agency (ESA/ESRIN), Italy
Mr. PIER MICHELE ROVIERA
ESA, United States
Mr. Cetin Kiris
NASA Ames Research Center, United States
Mr. Michael Barad
NASA Ames Research Center, United States
Mr. Bruce Vu
NASA John F. Kennedy Space Center, United States
Mr. David Chesnutt
NASA John F. Kennedy Space Center, United States

DESIGN AND VALIDATION OF VEGA LAUNCH PAD MODIFICATIONS TO REDUCE PAYLOAD ACOUSTIC ENVIRONMENT AT LIFT-OFF

Abstract

After VEGA Launch Vehicle successful Qualification Flight in February 2012, other seven successful missions followed up to end of 2016. However, the acoustic levels measured inside the fairing resulted higher than expected, leading to more stringent payload qualification requirements. VEGA launch pad was not directly designed to optimize the acoustic environment at lift-off, being inherited from previous ELA1 site used by Ariane 1, Ariane 2 and Ariane 3 launchers. This paper describes the modifications of launch pad foreseen to be implemented and those still under assessment in order to mitigate the payload acoustic environment, with the aim of increasing the competitiveness of the launcher on the market. The first step of the activity consisted in the identification of acoustic sources on launch pad. This objective has been achieved by measuring the acoustic field generated at lift-off by means of a microphone array antenna installed on launch pad during the VEGA fifth flight, and following processing of recorded data through a deconvolution technique. Results showed that main acoustic sources originated from the pre-existing openings around the launch table and the open flame ducts. Different launch pad modifications aiming at reducing the acoustic environment at the fairing level have been then analysed by numerical simulations, performed by NASA AMES center in the frame of a cooperation agreement with ESA. The numerical model included the launch vehicle moving along its real ascent trajectory, as well as the whole geometry of launch pad and surrounding structures which could generate acoustic waves reflection towards the launcher. The acoustic field has been generated starting from the flow boundary conditions calculated at nozzle exit. In particular, the numerical results predict a good noise reduction on the fairing surface by covering the openings around the launch table. This solution is currently being implemented on launch pad through dedicated acoustically insulating plates in order to confirm its real effectiveness during VEGA tenth launch. In parallel, numerical simulations are still being performed to identify additional solutions further reducing the payload acoustic environment, also in view of the development of new VEGA-C launcher that will be operated from the same VEGA pad, and is expected to generate an acoustic field

during lift-off higher than VEGA due to the larger first stage mass flow rate. In particular, several configurations of coverage of the flame ducts are being assessed, including different shapes of the roof and its exit edge or resonating cavities.