Paper ID: 35365
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SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Upper Stages, Space Transfer, Entry and Landing Systems (3)

Author: Dr. Gianluca Ascanio
OHB Italia SpA, Italy

Mr. Carlo Tuninetti
OHB Italia SpA, Italy
Dr. Davide Nicolini
European Space Agency (ESA), Italy
Mr. Roberto Aceti
OHB Italia SpA, Italy

VENUS: AN ELECTRIC ORBIT RAISING STAGE FOR VEGA

Abstract

VEGA successful maiden flight in February 2012 and the following successful flights opened new opportunities for the European space industry. Europe has now at its disposal a flexible small launcher able to inject payloads from 300 to 2500 kg into a wide range of LEO orbits, from equatorial to sun-synchronous. In the frame of a strategic effort to in performance enhancement, costs reduction and adaptation to evolving market needs, a highly autonomous module based on electric propulsion, namely VEnUS, VEGA Electric propulsioN Upper Stage, has been thought as an add-on of VEGA launcher, with the purpose of extending the launcher mission from its current capability up to a new and wider set of final orbits beyond LEO, currently comprising MEO, GEO and highly elliptic orbits, although missions up to the Lagrange points of the Sun-Earth system could be considered. VEnUS can be thought as an upper stage of the launcher, that is connected to the VEGA mechanical and electrical I/Fs, while carrying atop the P/L satellite that will be injected into orbit, to which VEnUS provides a set of mechanical and electrical I/Fs as well. The VEnUS mission can be summarized as follows:

1. VEGA injects into a LEO parking orbit the upper composite formed by VEnUS plus the P/L
2. VEnUS is commissioned and starts providing to the P/L (kept in safe and stowed mode) survival power and a datalink for P/L housekeeping data monitoring
3. VEnUS starts the orbit transfer by means of a low thrust orbit raising manoeuvre. GNC functions, as well as telemetry and attitude control are executed autonomously by the module avionics for the achievement of payload final orbit
4. VEnUS releases the P/L into its final orbit, performs an avoidance manoeuver, a disposal manoeuver (de-orbiting or re-boost to graveyard, depending on the target orbit), then passivates.

Phase A of the program has been successfully accomplished on February 2016, demonstrating the technical, programmatic and economic feasibility of the mission. A trade-off effort has been spent in order to define the configuration, mainly focusing on:

- S/C architecture
- Integrated Electric Propulsion S/S
- AOCS sensors and actuators
- On-board autonomy and concept of operations

Moreover, a complete design loop has been accomplished, including mission analysis, thermo-structural and power design. Within the paper, an overview of the VEnUS mission and space segment design will be provided.