The Launchers: 
Vega 

a winning project
Capability, Opportunities and Future Prospective

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(CEO ELV)
Scope of the mission Vega VV02

- Mission for the Multi payload configuration of the vehicle: it is equipped of a special Payload Composite (Vespa) that allows the independent deployment of a primary payload (Proba-V on the top bay) and of several secondary Payloads (VNREDSat-1 and a Cubesat on the bottom bay).

- The mission lasted about 9000s (more than twice than the Maiden Flight). The Flight Program Software FPS-A was the Multi Payload version, entirely developed in ELV.

- Proba-V is an Earth Observation satellite built by Qinetic space Belgium for ESA. Incorporating a star tracker, GPS receivers, magnetometer and magneto-torquers. Star trackers - as well as the Vegetation instrument payload

- VNREDSat-1 is Vietnamese government Satellite, monitor and study the effects of climate change, predict and take measures to prevent natural disasters, and optimize the management of its natural resources.

- ESTCUBE-1: Satellite per la dimostrazione della tecnologia satellitare, l'Università di Tartu in Estonia. Il suo compito principale è quello di testare la potenza del vento solare
VEGA VV01 Qualification and VV02 Flight Outcomes

The trajectory is consistent with the specification taking into account the dispersions of the propulsion systems.

The in-orbit conditions are very good in terms of accuracy.

Vega qualification flight

Vega VV02 Flight

<table>
<thead>
<tr>
<th></th>
<th>Semi-major axis (km)</th>
<th>Eccentricity</th>
<th>Inclination (deg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liras Requirements</td>
<td>7828.137</td>
<td>0.0</td>
<td>69.5</td>
</tr>
<tr>
<td>Prediction based on as build LV data</td>
<td>7828.280</td>
<td>0.00186</td>
<td>69.4998</td>
</tr>
<tr>
<td>VV01 PL Injection Accuracy</td>
<td>±1.045</td>
<td>0.00039</td>
<td>-0.058</td>
</tr>
<tr>
<td>VV01 PL Accuracy Requirement (3σ)</td>
<td>±30</td>
<td>0.005</td>
<td>±0.15</td>
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<tr>
<td>ProbaV Requirements</td>
<td>7198</td>
<td>0.00115</td>
<td>98.7304</td>
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<tr>
<td>VnRadsat Requirements</td>
<td>7041.4</td>
<td>0.00186</td>
<td>98.1396</td>
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<tr>
<td>ProbaV Injection Accuracy</td>
<td>0.28 NORAD</td>
<td>0.00024</td>
<td>-0.043</td>
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<tr>
<td>VnRadsat Injection Accuracy</td>
<td>-0.082 NORAD</td>
<td>-0.00014</td>
<td>-0.039</td>
</tr>
<tr>
<td>VV02 PL Accuracy Requirement (3σ)</td>
<td>±30</td>
<td>0.005</td>
<td>±0.15</td>
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</tbody>
</table>

Trajectory & Injection Accuracy from 10 to 100 time more
Vega LV, Configuration Management

- Vega LV architecture is as simple as possible, Four stages propulsion, solid and liquid.

- Avionics is based on a single chain GNC subsystem (less than 20 parts).

- Modular single chain telemetry subsystem.

- A part the Inertial Navigation System no sensor is functional for the flight.

- A Safeguard Subsystem fully redounded perform the main safeguard functions.

The main requirements were expressed in term of performance (1500 Kg of P/L in a reference polar orbit @700 Km),
- Flexibility for any LEO mission, versatility for Multi Payload missions,
- Payload Comfort, dependability, operations, principle of commonality and target cost.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height [m]</td>
<td>30</td>
</tr>
<tr>
<td>Maximum diameter [m]</td>
<td>3</td>
</tr>
<tr>
<td>Fairing diameter [m]</td>
<td>2.6</td>
</tr>
<tr>
<td>Mass at Lift-off [kg]</td>
<td>137000</td>
</tr>
</tbody>
</table>
Those structures are made by lightweight materials using different Carbon fiber materials:

- **Propulsion stages**, filament winding carbon fiber technology
- **Payload Faring**, Monocoque carbon fiber sandwich with aluminum honeycomb core.

Carbon Fiber technologies cover about 85% of the main launcher structures.
Full electric GNC System
HWIL configuration Laboratory

Launcher Vehicle: New Avionics Technologies For Navigation Control System
Launch Campaign Organization

- New launcher integration logical, subsystems pre-assembling in Europe.
- Launcher mock up pre-assembling validation and tests.
- Launch pad and launcher integrated team (ESA, AVIO, CNES, AE, VCS, RHI, Gavazzi).

**6 Maggio 2013**

**Success of the VV02 Flight**

- **2h48m** mission
- **22000Km/h** after **8min**

Integrated Team, Training, Motivation

Industrial Partners Selection
Which market for VEGA?

A growing Manifest in a booming sector

A new opportunity to access to the space for European community
Vega Launcher Evolution

Advanced new avionic technologies:
- TDRS,
- Hybrid navigation
- Electromechanical TVC,
- PW, TLM architecture

Vega
- AVUM Z9
- Z23
- P80
- 1500

Vega E1
- AVUM Z9
- Z23
- P120 Motor
- 2400

Vega E2
- Z40 Motor
- P120 Motor
- 3000
Vega Identified opportunities,

Versatility and orbital accuracy, possibility to tailor AVUM Upper stage for Special services,

Electric propulsion to broaden VEGA accessible orbits, From LEO to GEO in 6 Months

VEGA AVUM a system for in orbit maneuvering, low cost re-enter and ISS servicing

Es: Galileo launched by VEGA

Low cost Near Earth planet exploration
Venus 1000 days - 710Kg P/L
NEO 1050 days - 600Kg P/L
Moon 300 days - 1460Kg P/L
Phobos 1000 days - 650Kg P/L

Dead satellite removal

Low cost planet exploration, Large debris removal, Re-usable ISS servicing, Electric propulsion
Vega LV the drivers of a successful Innovation management

Integrated Team, Industrial and Agency (ESA,ASI,CNES,AE)
The market demand for small payloads is today confirmed as well as the strategic need to have European independent access to space for such small payloads.

The Vega Program represents for Europe and in particular for an outstanding opportunity to develop and benchmark innovation and new technologies, as well as to stimulate system background, aimed at improving the quality of life of European citizens on earth.

Europe needs to exploit these opportunities, launching the European satellites with European launchers.

Attentive to the concept of "buy european launch" ie European satellites must be designed to fly on Vega, Ariane, or in the future NGL avoiding not only to penalize European industry but to increase competition.