VEGA: Status of the Development Activities

M. LOPEZ:

VEGA Launcher Manager

ESA

VEGA Launch System at a Glance

• **Vega complements the European Space Agency family of launchers in order to cover the whole range of possible missions, targeting the small payload in low Earth orbit' segment of the market, to guarantee Access to Space for many institutional satellites performing a wide range of missions (science, earth observation, exploration...).**

• **The Vega program is funded by several European States: Belgium, France, Italy, The Netherlands, Switzerland, Spain and Sweden.**

VEGA Reference lift capability

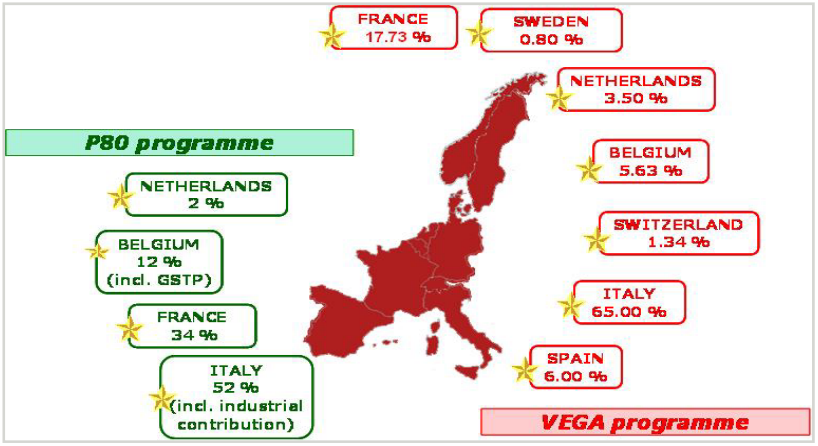
The Reference Performance of the VEGA launch vehicle launched from **Kourou** is:

1 500 kg at 700 km in circular polar orbit

Flexibility: a wide mission range

From equatorial to polar & SSO orbit (5.2° - 102°)
From 300 km to 1 500 km altitude
From 300 kg to 2 500 kg

Reliability: 0.98



VEGA "The new ESA-developed launcher"

VEGA
New European Launcher programme

Launcher dedicated to small payloads in LEO
- Wide range of customer requirements and missions
- Market: ESA payloads already identified for Vega as from 2008

Vega is composed of the following programmes
- Small launcher development programme including launcher and ground development
- P80 programme as solid propulsion technology demonstrator
- VERTA for exploitation preparation

Industrial investment
- Launcher qualification flight
- P80 development: Avio investment

European Space Agency

Technologies for VEGA

- Wide reutilization of existing and proven technologies
- New key technologies for solid boosters and TVCs
- Continuity of Italian investment in solid propulsion from Ariane to Vega
- Italian leadership in the field of solid propulsion

European Space Agency

VEGA "The new ESA-developed launcher"

Management of VEGA

• Development programme under ESA management and execution responsibilities, with the support of the National Agencies (ASI,CNES)
• Exploitation phase will be managed by Arianespace

Institutional organisation

- ESA management
- Integrated team (ESA, ASI and CNES) in ESRIN
- Support from European technical centers (ESA/ESTEC, CNES/EVRY)
- Support from Italian centers (e.g.CIRA) and Universities

Industrial organisation

- New prime contractorship in Italy with system and management capabilities
- More than 40 major aerospace companies from 12 countries
- Use of Ariane industrial background and facilities

European Space Agency

VEGA industrial organisation

VEGA Launch Vehicle Programme

ELV S.p.A. (70% Avio Spa and 30% ASI), located in Colleferro, Italy- is the prime contractor for the launcher development and production.

P80 Demonstrator Programme

Avio S.p.A. is prime contractor for the P80 with a programme management delegation to **Europropulsion**, France.

Ground Segment

VITROCISET is prime contractor of the Ground Segment.

VEGA industrial partners

VEGA Launch Vehicle Programme

- CASA, CRISA, INTA, SENER, GTD (E)
- ELV, AVIO, Galileo, OCI, Vitrociset, Datamat (I)
- SABCA (B)
- Contraves (CH)
- Dutch Space (Fokker), APP, TNO (NL)
- SAAB (S)
- ASTRIUM, SPS, Arianespace, Thales, Pyroalliance, ONERA, SAFT (F)

P80 Demonstrator Programme

- Europropulsion (I/F), AVIO (I), REGULUS (I/F), SPS (F), SABCA (B) and APP (NL)

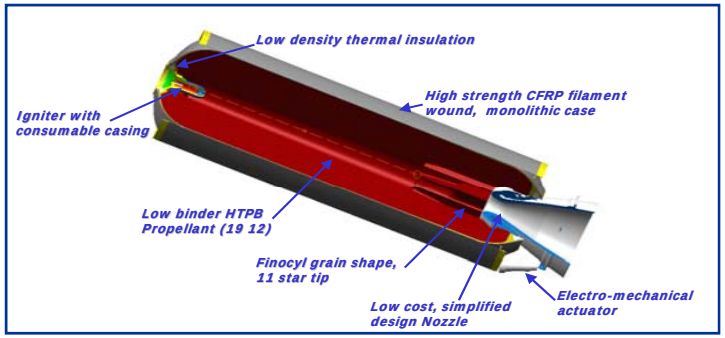
Ground Segment

- Vitrociset, Carlo Gavazzi Space, Peyrani, OCI, Gruppo Rossi, Dataspazio, (I)
- Cegelec, Thales, Nofrayane (F)
- Axima (B)
- GTD (E)

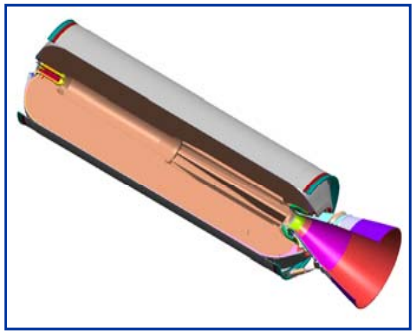
VEGA Launcher

- **Overall Length: ~ 30 m**
- **LV mass at lift-off: ~ 139 ton**

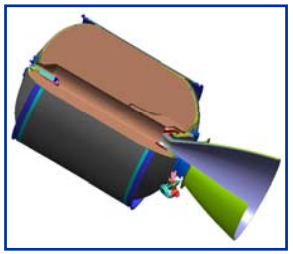
- **VEGA LV Configuration:**
  - First Stage: P80 FW SRM
  - Second Stage: Zefiro 23 SRM
  - Third Stage: Zefiro 9 SRM
  - Fourth Stage: AVUM liquid upper module
  - Upper Composite (payload adapter & fairing)



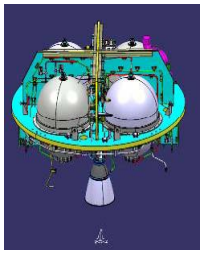
P80



Zefiro23



Zefiro9

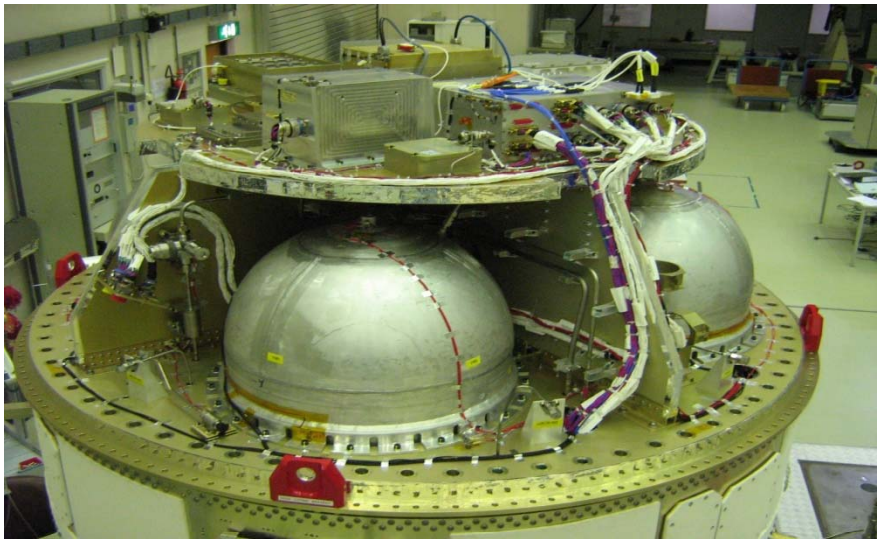


AVUM

Avionics and Upper Composite

Avionics functions are distributed among Hardware items and On-Board Software. They are split into the following three subsystems:

The **GNC** (Guidance, Navigation and Control) Subsystem
The **SAS** (Electric Safeguard Subsystem
The **TMS** (Telemetry subsystem



Ground segment

- Location : Centre Satial Guyanais (European Spaceport) , French Guiana, reusing the former Ariane 1 launch Pad which has been refurbished and upgraded for VEGA
- Synergy with A5 means (eg statellite preparation facilities, ground tracking stations, storages areas) and operational teams. The Vega Control Bench facilities will be located in CDL3 (next to Ariane 5).

Main functions of the VEGA Ground Segment:

• transport and storage of the payload, stages (P80, Z23, Z9, AVUM) and related equipments in French Guyana (CSG);
• final integration and acceptance tests of the first stage (P80);
• integration and verification of the VEGA launcher;
• preparation of the payload and its integration in the Launch Vehicle;
• preparation of the Launch Vehicle and of the launch pad facilities up to the lift-off.
• tracking, monitoring and control of the launch vehicle during the flight;
• post-flight analysis.

Launcher System activities

Programmatic milestones:

- Qualification Loop activities well advanced.
- Qualification Reviews completed for many subsystems and units : Zefiro 23 and Zefiro 9 Solid Rocket Motors, inter-stage 0/1 , inter-stage ½, AVUM structure, fairing, ignition and separation pyrochains, On-Board Computer, Safety units…

Major systems tests performed:

- Upper Composite Mechanical environment testing, sine vibration and acoustic testing in ESTEC facilities.
- The 3rd stage /4th stage separation and Fairing horizontal separation system (HSS) testing in EADS-CASA facilities (Spain) have been performed.
- Launcher vehicle bending modes and structural damping characterisation has been carried out at IABG (Germany) with the integration of all the Launch vehicle subassemblies except the first stage (P80 plus inter-stage 0/1).

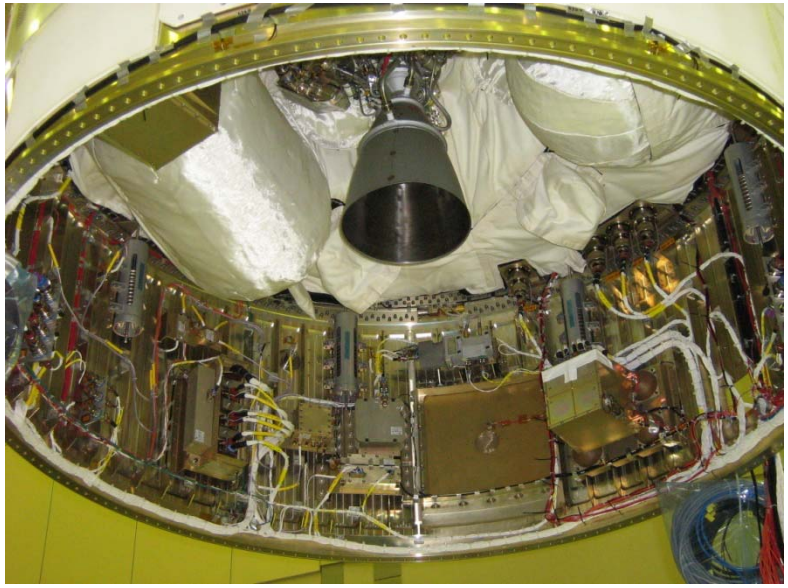
Status of the Development

Major systems tests performed:

- Electromagnetic compatibility tests have been performed and completed successfully in Colleferro and in INTA (Spain).
- The qualification of the avionics has made significant steps ahead with the set up of the Hardware in the loop (HWIL) facility, now finalized, and the completion of the first validation campaigns of the Safeguard subsystem (SAS) and Communication subsystem and the start of the Flight Programme Software validation with real hardware and in “flight representative” configuration.

Ongoing Launch Vehicle system activities for 2009

- closure of the major actions resulting from the development activities and previous reviews,
- completion of all the remaining subsystems qualification reviews, and acceptance of the flight units.
- preparation of the ground qualification review of the launch system, scheduled to start by end 2009.
- Preparation of Launcher integration activities for the combined tests in Kourou.



Status of the Development

Solid Rocket Motors and Stages

P80 Qualification SFT

The P80 Solid Rocket Motor – the 1st stage motor successfully completed its qualification firing test in December 2007, one year after the firing test of the development model, confirming the predicted performances and behavior.

Z23 Qualification SFT

in March 2008, at Italian Air Force Range of Salto di Quirra (Italy, Sardinia), the Z23 Solid Rocket Motor – the 2nd stage motor – completed also its functional qualification with a successful second firing test.

Status of the Development

Solid Rocket Motors and Stages

Z9A 1st Qualification SFT

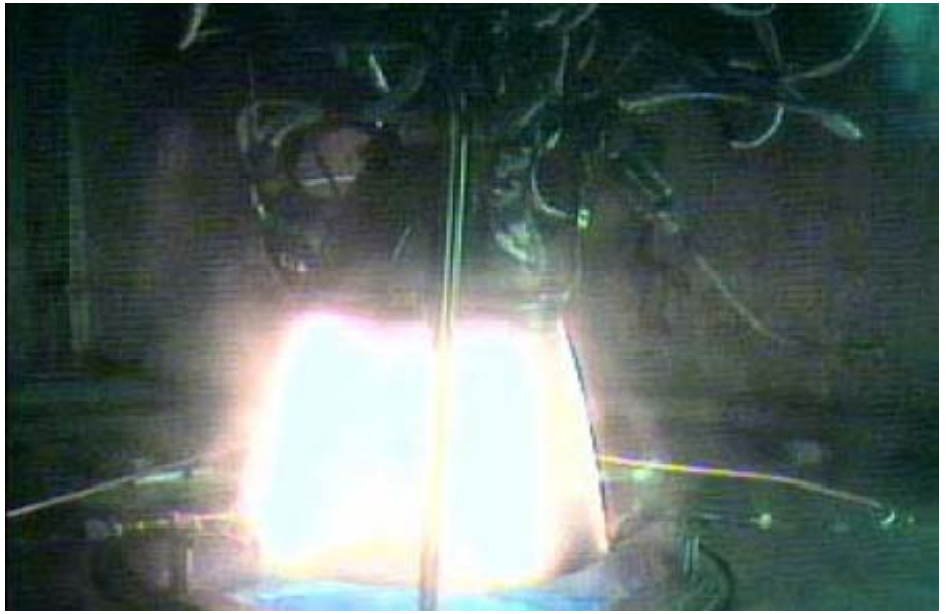
Following the failure of the nozzle during the qualification firing test of the Z9 Solid Rocket Motor in March 2007, a redesign of the nozzle has been carried out and improvements of the Z9 loading has been introduced. The new configuration has been tested successfully in October 08.

Z9A 2nd Qualification SFT

in April 2009, at Italian Air Force Range of Salto di Quirra (Italy, Sardinia), the second firing test of the Z9A Solid Rocket Motor has been completed successfully.

Liquid Propulsion System (LPS)

The Vega 4th stage engine, a slightly modified version of the Ukrainian RD-869, has already successfully undergone several test campaigns with two qualification models.
The firing test campaign at subsystem level (complete Liquid propulsion subsystem in the flight configuration) are nearly completed in Lampoldshausen (Germany).



Ground Segment

- The Vega ground segment has entered in its validation phase with the start of the integrated tests in Kourou

Launch System

Activities at Launch System Level are now focused at the preparation of the **Combined Test Campaign**. These tests will allow validating all the processes from the delivery of subassemblies in Europe, their transportation to Kourou, their storage, their integration on the launch table and the final preparation of the Launch Vehicle as for flight, which includes the propellant loading and the validation of the countdown phase.

After completion of the combined tests and of the ground qualification review, the flight readiness review will enable the start of the Qualification Flight campaign that will complete the preparation of the maiden flight.

The launch readiness review will give the green light for the maiden flight that will be followed by a detailed exploitation of the flight results and by the flight qualification review.

Qualification flight

The qualification flight mission has been defined taking into consideration the launcher qualification objectives, safety constraints, passenger needs.

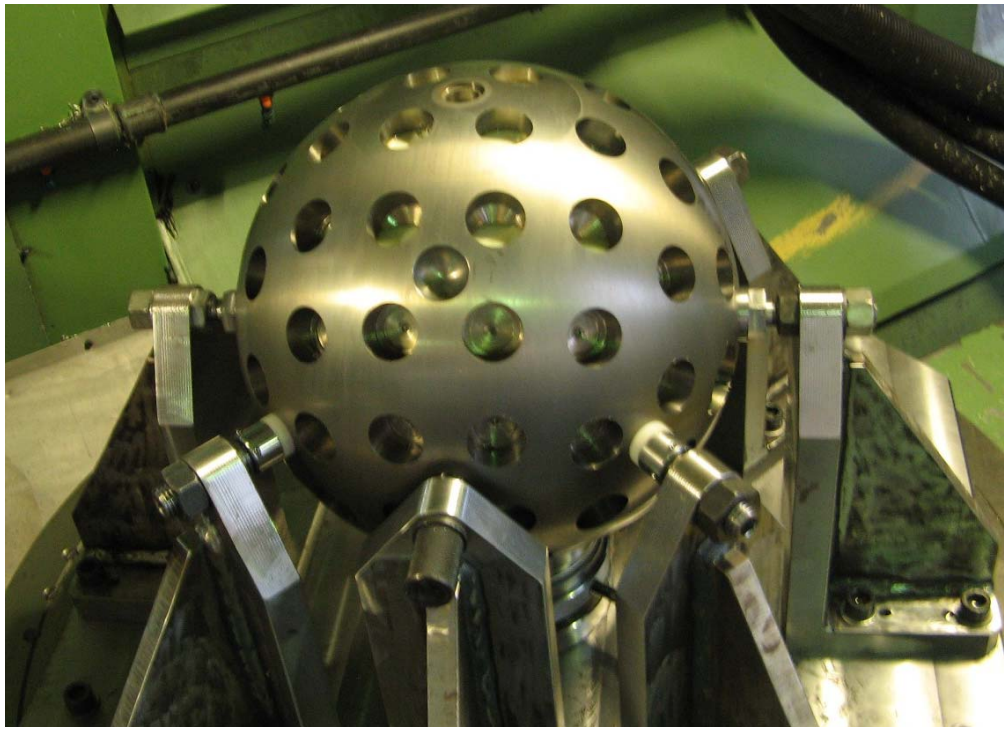
The selected trajectory is

- altitude: 1450 km
- Inclination : 71°
- Payload total mass : 700 kg

The main passenger of the maiden flight is the **LARES** experiment developed by ASI.

This spacecraft is a satellite laser ranging (SLR) experiment.

Educational small payloads are foreseen as secondary passengers of the maiden flight.



From development to exploitation: VERTA

- The VERTA programme has been approved at the December 2005 Ministerial conference.

1. Procurement of 5 launchers for ESA missions (ESA→AE→ELV)
   - VERTA flights (Aeolus, Swarm, LISA PF, Proba 3, IXV Demonstrator)
2. Customer service improvement (ESA→ELV)
   - Multiple launch, Low shock, Satellite Navigation preliminary works…
3. Production accompaniment (ESA→ELV)
   - SRM and AVUM firing tests, production sampling, cost reduction…

- Arianespace : Launch service operator.
- ELV : Launcher provider.

VERTA missions and objectives

- Exploring the qualification domain, demonstrating the Launch vehicle flexibility and validating the multiple payload configuration (time frame 2008-2010).

1. Opportunity mission under selection
2. AEOLUS : 1400 kg, SSO mission at 400 kms
3. SWARM : multiple payload configuration (3 payloads, different orbital planes)
4. Lisapathfinder : mission to Lagrange Point 1 region (flight strategy based on equatorial elliptical orbit)
5. IXV : ESA demonstrator for re-entry applications, weighing around 1850 kg, to be de-orbited by the Vega upper stage before starting its re-entry phase at 120 km altitude.

Conclusions

- Vega is a key element of the European launcher strategy for access to space
- Vega is completing its Ground qualification activities
- The Qualification flight will take place in 2010
- The preparation of the exploitation phase has been initiated with the VERTA program, allowing a smooth transition between development and exploitation
- Preliminary trade-off activities for a Vega Launcher potential evolution are on-going