

SPACE

ARIANE: RISING TO THE CHALLENGE OF SPACE ACCESS

To maintain its competitiveness in the commercial launch market, the Ariane rocket has to change, as it already has several times in the past. Safran, as the lead contractor for Ariane's propulsion systems, will play a major role in all upcoming programs.

On February 16, 2011, the Ariane rocket lofted Europe's ATV cargo supply vessel to the International Space Station, some 160 miles (260 km) above the Earth. Not only was this mission technically flawless, it also had a highly symbolic meaning, as Cédric Goubet, assistant to Safran's Deputy CEO, and COO, explains: "It was the 200th Ariane mission, and the 41st successful launch in a row of Ariane 5."

"Kicking off this long success story was Europe's determination to achieve independent access to space," continues Goubet. "In fact, a number of strategic technologies and businesses depend on space, including telecommunications, GPS, telephony and television, not to mention military intelligence, prevention of natural disasters and monitoring of our agricultural resources."

This quest for independence in space is still front page news, as shown by the recent launch of Galileo, Europe's own satellite positioning system that will eventually involve a constellation of 30 satellites.

A FIERCELY COMPETITIVE MARKET

However, as necessary as it is, this independence is also very delicate. Access to space is expensive. To amortize the cost, Europe needs Ariane rockets to carry out commercial satellite launches, including five to seven dual launches a year, plus one or two governmental missions for science, defense, etc. Without the commercial missions, the latter would become prohibitively expensive. Furthermore, a drop in the launch rate could harm the dependability and capability of the production system, which brings together a number of partners in a dozen European countries.

Two major factors could threaten this delicate balance, starting with the advent of new



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→ ANTONIO FABRIZI



Director of Launchers, European Space Agency (ESA)

Staying competitive

"ESA has launched several initiatives to maintain Ariane's competitiveness in the commercial market. In the short term, we

initiated a performance improvement plan to improve Ariane 5 ECA's payload capacity, adding

several hundred kilos here and there. In the medium term we will go further with the Ariane 5 ME, involving the complete redesign of the upper stage, with a new fairing and a new restartable engine, Vinci. With this new upper stage, we can better meet the needs of our customers, whose satellites are getting heavier and heavier. We can also more easily combine large

and small satellites, to optimize Ariane 5 launch scheduling. Furthermore, the introduction of the Vinci engine will allow us to manage all types of launches using a single version of Ariane, whereas today the ATV missions require a special version. Our aim for the moment is to introduce Ariane 5 ME without increasing launch costs."

Nearly **12** metric tons boosted into geostationary transfer orbit (GTO) by Ariane 5 ME

44 successful launches in a row by Ariane 5 (as of May 2011)

competitors in a small market, amounting to about 20 commercial satellites a year. Ariane's main rival for the moment is Proton, a Russian launcher originally developed during the Soviet era. But in the next few years, Ariane may also be facing competitors from the American companies SpaceX and Orbital, which have won support from the American government in order to reduce the costs of their own launches, for the moment dominated by the Delta and Atlas launchers – both very costly.

Another emerging player is China. With its family of Long March launchers, it already has solid experience in the market, and could eventually be a contender. There is also a once and future competitor, namely the international consortium Sea Launch, which operates the Russian-Ukrainian Zenith launcher. After temporarily suspending operations due to various difficulties, it could shortly be on the market again.

In short the situation is difficult: demand is stable, but the supply is increasing. And Ariane is also penalized by the current euro/dollar exchange rate, which makes its services more expensive.

HEAVIER PAYLOADS

Another challenge facing Ariane is the general increase in the weight of commercial satellites, which makes the dual launches for which Ariane 5 was designed more difficult. The member-States in the European Space Agency (ESA) therefore decided to kick off

→ MICHEL EYMARD



Director of Launchers, CNES (French space agency)

Ariane 6 on the horizon

"The competitive landscape for launch services will change greatly in the coming years. We have to prepare right now by making decisions for medium-term upgrades to Ariane 5 (towards 2016), and move forward quickly on our R&D programs for the new-generation launcher, which could enter service towards 2025. Several initiatives have therefore been launched at the

same time, mainly ESA's Future Launcher Preparatory Program (FLPP), and Ariane 6, which also benefits from French government support via the Future Investment Plan. The decisive success factor for the new launcher will be its operating cost. A target has been set to decrease the cost per kilo into orbit by 40%, which will require several technological

breakthroughs. The choice of the propulsion systems (liquid or solid or both) will also play a major role in meeting this target. Wide-ranging R&D work has already started on propulsion systems. For example, Safran has shown that the number of parts in the hydrogen turbopump on the Vulcain main-stage engine can be cut in half. Work is also under way on solid propulsion systems, in particular to make one-piece solid rocket motors for the boosters (today, they are made of three segments). At stake for Europe in all of these activities is nothing less than our ability to maintain long-term independent access to space."



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an upgrade program, dubbed Ariane 5 Midlife Evolution (ME), adding a new upper stage to increase payload capacity by nearly two metric tons. This new version should enter service in 2016 (see the interview with Antonio Fabrizi on page 33).

Looking further ahead, ESA is also gearing up for a next-generation launcher to replace Ariane 5 ME, towards 2025 or 2030. When French President Nicolas Sarkozy visited Snecma's Vernon plant* at the end of 2010, he announced that the new Ariane program would receive some 250 million euros in funding from the country's Future Investment Plan. A first payment of 82.5 million euros

has already been authorized. Among the different concepts being examined is a single-payload launcher that could decrease the cost per kilo into orbit by 40% in relation to the current model.

PROPULSION BY SAFRAN

Ariane 5's propulsion is based on two solid boosters (see the interview with Philippe Schleicher on page 35), the Vulcain 2 main-stage engine and the HM7B upper-stage engine. On Ariane 5 ME, the latter will be replaced by Vinci, a new restartable cryogenic engine being developed by a Safran-led team. "This new engine will increase our payload

The strap-on solid boosters (above), the future Vinci upper-stage engine (top right) and the Vulcain main-stage engine (bottom right) are all part of Ariane 5's propulsion system.



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capacity, and also give Ariane's customers a broader choice of orbits," says Martin Sion, head of Snecma's Space Engine division. During recent tests, the third Vinci prototype met all objectives in terms of performance, thrust (nearly 40,000 lb), reignitability and endurance. "Our M3 engine racked up total burn time in these tests equal to nine times the length of a typical mission," says a pleased Martin Sion.

Roles on the next-generation launcher have yet to be defined. "Our top priority," says Sion, "is to retain our dependability, which is an advantage over competitors. Secondly, we must continue to reduce costs, as we have

→ PHILIPPE SCHLEICHER



Chairman and CEO of SME, Safran group

Synergies for Ariane 5

"Safran recently consolidated the solid propulsion businesses of SNPE and its own subsidiary Snecma Propulsion Solide (SPS). In addition to the attendant benefits for solid rocket motors on tactical and strategic missiles, in the space propulsion sector this merger will bring the Group closer to its Italian partner in two complementary French-Italian companies involved in the production of

solid rocket motors for Ariane 5: Europropulsion (50% Avio, 50% Safran), and Regulus (60% Avio, 40% Safran). The latter company joined Safran when we purchased the SNPE subsidiary SME and its 40% stake in Regulus. At the launch site in Kourou, French Guiana, Europropulsion assembles the three segments making up each solid rocket motor on Ariane 5, along with its nozzle

and igniter. Each of these solid boosters stands 25 meters tall (82 ft) and weighs nearly 270 metric tons, including 230 metric tons of solid propellant. Europropulsion also operates the solid booster integration building at the launch site. It's a neighbor of Regulus, which is in charge of casting the propellant in the two main segments on each booster. During each casting operation (seven per year on average), Regulus sends a team of about 20 staff to Kourou for two to three weeks to help out. Consolidating the companies in charge of "content" and "container" will undoubtedly generate new synergies."

always done. For instance, a Vulcain engine now costs half as much as it did at the beginning of the Ariane 5 program. Furthermore, we teamed up with French space agency CNES, Volvo and fellow Group company Techspace Aero on a technology demonstration program, enabling us to lower the cost of critical engine components by 40%. And we're also working on a high-thrust engine demonstrator for ESA." ■

* The Vernon plant in Normandy consolidates most of Safran's space propulsion business, including cryogenic liquid propellant engines and plasma thrusters.