

Launchers

The year was characterised by the implementation of the decisions taken by Ministers at the ESA Council at Ministerial Level in May 2003. The reorganisation of the Ariane launcher sector, the consolidation of the Recovery Plan activities and the carrying out of the EGAS Ariane programme constituted the major highlights for the Ariane Programme.

The landscape for the European launcher sector for the 2010 time frame has also progressed on two fronts. Firstly, the Soyuz at CSG programme, covering the construction of the launch facilities and the adaptation of the launcher to the conditions for its exploitation from Kourou, has been started as an Optional Programme within the ESA framework. Secondly, the Future Launcher Preparatory Programme (FLPP) has been drawn up to develop Europe's technological capabilities and enhance the long-term competitiveness of European launchers, whilst also permitting the progressive restructuring of the industrial organisation for the next-generation launcher. These endeavours in establishing a longer term perspective encompass the recognition of the Russian Federation as a prime partner in the long-term cooperation on access to space. Crucial cornerstones for its success have been successfully laid, leading to the successful negotiation and consequent signature (in early 2005) of the 'Agreement between ESA and the Russian Federal Space Agency on Long-Term Cooperation and Partnership in the Field of the Development, Implementation and Use of Launchers'.



The launch of Rosetta on 2 March on an Ariane-5 G+

Ariane

The year was an important one for the Ariane launcher with consolidation of the activities covered by the Recovery Plan - endorsed by the 2003 Council at Ministerial Level - and the ongoing qualification of the four new versions of Ariane-5:

- Ariane-5 ECA 'heavy-lift'
- Ariane-5 G+
- Ariane-5 GS (backup for the ECA version)
- Ariane-5 ES-ATV (for launching the Automated Transfer Vehicle).

All three Ariane-5 G+ launches in 2004 were successful, and the Ariane Research and Technology Accompaniment Programme (ARTA) wrapped up the year with the flawless test-firing of a modified Ariane-5 booster in November.

At management level, the implementation of the new launcher industrial structure has been initiated, and the EGAS (European Guaranteed Access to Space) Ariane Contract was signed in March.

Ariane-5 launch campaigns

The three successful launches of Ariane-5 G+ were the last for this particular configuration

of the vehicle. The first of them took place on 2 March, when flight L518 successfully lifted Rosetta into its interplanetary orbit. This required delayed ignition of the EPS upper stage, which marked an important milestone in the qualification of the re-ignition capability required for the future ATV launches. The second flight, L519 on 17 July, put Anik-F2, the heaviest commercial telecommunications satellite ever launched, into geostationary transfer orbit. By the end of the year, the race was on to see whether an Ariane-5 ECA or G+ would close 2004 with a successful launch. As some last verifications were still required on the ECA version, it was decided to go with the G+ version, which on 18 December inserted Helios-2A very precisely into its intended Sun-synchronous orbit position, as well as successfully releasing a set of six small satellites built by universities and research institutes.

Ariane-5 ECA

Implementation of the Recovery Plan and consolidation of the qualification activities continued, with major effort devoted to the successful closure of open qualification items, considerably reducing the number of open dossiers. Among the most prominent technical issues worked on at industry level and monitored through Qualification Reviews were:



The launch of Helios-2A on 18 December by an Ariane-5 G+ vehicle

- the reworking of the Vulcain-2 engine, particularly the nozzle extension, and the related qualification testing
- the qualification status of the ESC-A upper stage and HM7 engine
- investigations at system level, including the main-stage POGO effect
- the structural margins of the Vehicle Equipment Bay
- the risk of icing of the ESC-A upper-stage engine
- statistical evaluation of side loads during ignition of the Vulcain-2 engine.

These activities progressed well and the qualification activities were successively completed. A wet dress-rehearsal with L521 on 7 October demonstrated correct launch-vehicle performance, but highlighted some anomalies at operations level. Further in-depth inspection of the launcher was decided upon and as a consequence the Ariane-5 ECA L521 qualification launch was moved to 11 February 2005.

Vulcain-2

Rework activities and related qualification of the Vulcain-2 engine constituted a major element of the Ariane-5 ECA Recovery Plan. Analyses were accompanied by extensive testing on the P5 (DLR, Lampoldshausen) and P50 (SNECMA, Vernon) test stands. Another important test using the P5's new Load Simulation Device reproduced both near-real-flight conditions (reduced pressure profile during ascent, down to 200 mbar) and the ovalisation loads on the nozzle. Qualification of the re-worked Vulcain-2 nozzle was completed and the related Qualification Reviews were successfully performed in July after extensive qualification testing. A complementary Qualification Review took place in September to finally pronounce qualification of the re-worked Vulcain-2.

Vulcain-2 in the Load Simulation Device (LSD) at DLR in Lampoldshausen, Germany



Roll out of Ariane-5 ECA for the wet dress-rehearsal on 7 October

Ariane-5 GS

The Ariane-5 GS launcher represents the return to production of the Ariane-5 Generic version. It has been introduced after the L517 flight failure, to guarantee Ariane-5 launch continuity by taking advantage of the experience and successes achieved with that version. It is built around existing hardware available from the Ariane-5 G+ and Evolution (E) versions, and the return to production of the Vulcain-1B engine. The EPC stage taken from the Ariane-5 E has to be modified to cope with the use of the Vulcain-1 engine instead of the Vulcain-2.



Baseline missions for the Ariane-5 GS are double launches to GTO (Geostationary Transfer Orbit) and deliveries to SSO (Sun-Synchronous Orbit). The first launch foreseen in March 2005 is a double launch to GTO, and the second launch is scheduled for July 2005.

Ariane-5 ES-ATV

This launcher was confirmed in 2003 as the baseline version for carrying the ATV. Its development activities were therefore resumed at the end of that year with a very tight schedule. A launch strategy involving three EPS upper-stage ignitions has been chosen to reach the 260 km circular orbit with 51.6 deg inclination. Further Aestus upper-stage engine tests, lasting until summer 2005, are foreseen at DLR in Lampoldshausen to qualify the engine's re-start capability.

Ariane Adaptation for Launching Galileo Constellation

The Galileo satellites have no apogee engine, which means the launcher must put them directly into their circular MEOs (Medium Earth Orbits) at 23 616 km altitude, and thus must have an upper-stage re-ignition capability. ESA therefore foresees using an adaptation of the Ariane-5 ECA, with a launch dispenser on top of the upper stage. Technical investigations have confirmed the feasibility of this approach.

Ariane-5 ESC-B and Vinci

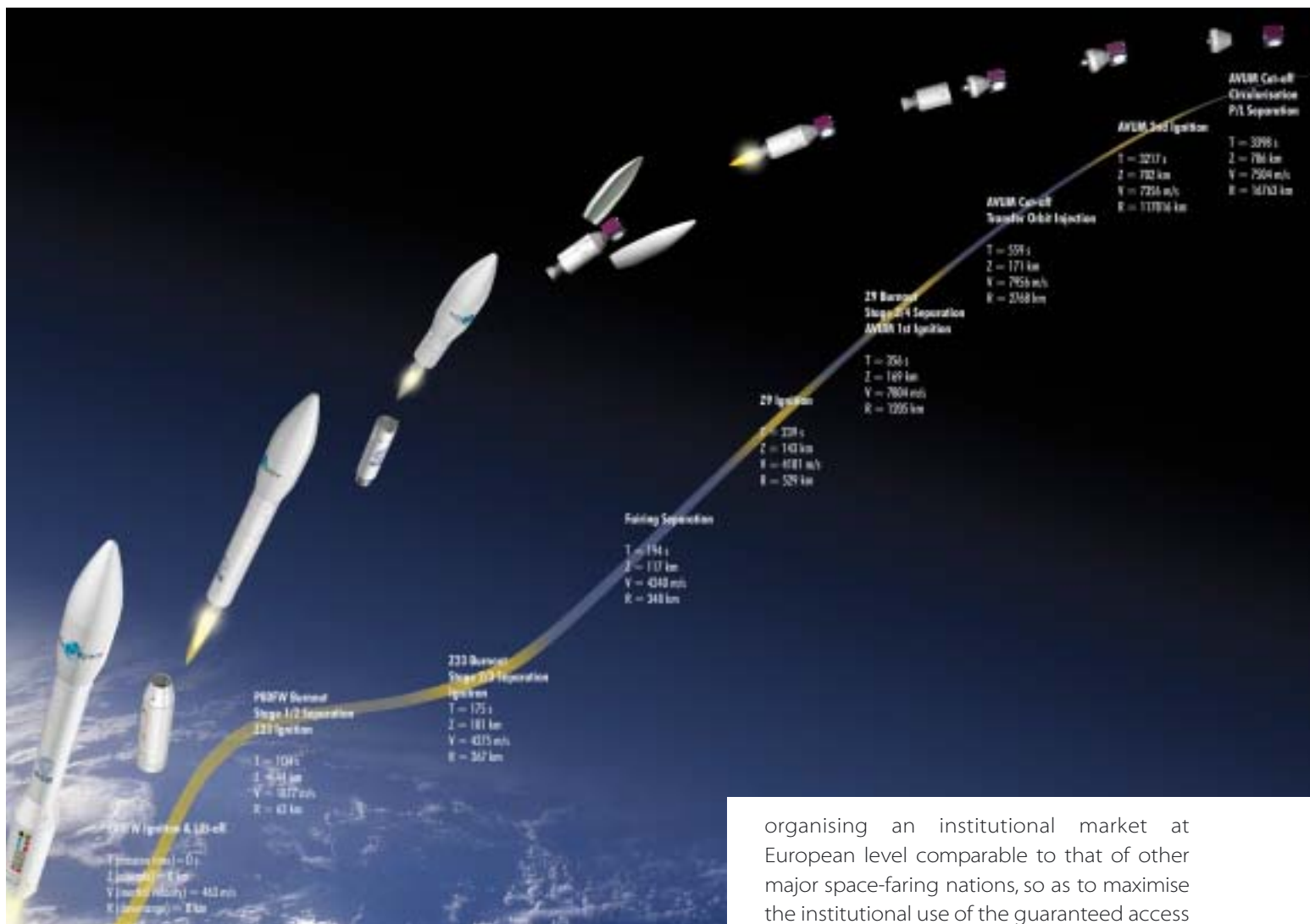
In line with the Recovery Plan, the span of these activities has been reduced as efforts concentrated on the Ariane-5 ECA launcher's qualification. Given the nature of the new technologies involved in the Vinci engine, which has been designed using the more efficient 'expander cycle', it was decided to advance its development through the integration of the first M-1 development motor and the performance of a short series of hot firing tests in the newly established P4.1 DLR test-facilities in Lampoldshausen, accumulating some 60 seconds of firing time in 2004.

Ariane-5 ARTA

It was a busy year for the ARTA programme, with the qualification efforts for restarting Ariane-5 GS production, qualification of the Vulcain-1 GS nozzle modifications, the ARTA-3 booster firing test, anomaly resolution, and the qualification of production transfer. A major achievement was the successful test-firing of the MPS ARTA-3 booster on 9 November. This test was of particular importance for the next batch of Ariane-5 launchers in PA configuration to fly in 2006, which includes cost-reduction and performance-improvement modifications.



The successful ARTA-3 booster firing test at CSG on 9 November



The Vega launch sequence

EGAS Ariane Programme

Following the Resolution on the Restructuring of the Ariane Launcher Sector adopted by the Ministerial Council on 27 May 2003, on 4 February 2004 the Potential Participants finalised the EGAS Ariane Programme Declaration and Implementing Rules. The latter were adopted by the ESA Council on the same day.

The main objective of the EGAS Ariane Programme is twofold:

- to provide Europe with guaranteed access to space, by securing the capability of providing reliable launch services for at least six launches per year, over a reference period of five years starting from completion of the current batch of P2.1 launches;
- to foster the creation of a European institutional market for the Ariane launcher, pending the setting-up of a legal framework

organising an institutional market at European level comparable to that of other major space-faring nations, so as to maximise the institutional use of the guaranteed access to space.

The EGAS Ariane contract between ESA and Arianespace was signed on 9 March. In line with the terms of the EGAS Ariane Programme Declaration, audit actions have been initiated with a view to automatically determining the initial contribution scale that will be used in the course of the programme. A final automatic adjustment of contributions will be performed upon completion of PA-batch production.

Vega and P80

The Launcher System Design Review, which took place from May to July, involved the participation of independent reviewers from ESA, CNES and other European organisations. It identified a number of important points for remedial action and agreed the way forward on all of them. A check on the status of all of these actions was held in December.

By the end of 2004, all but one of the main launcher development subcontracts had been finalised by ELV, the Vega prime contractor. All of the subsystem Preliminary Design Reviews had been held, and some items had already reached the Critical Design Review stage. The year also saw the manufacture and testing of the filament-wound cases for all of Vega's solid-propellant motors, including a first P80 technological model. The lessons learned with these prototypes have been introduced into the next models, manufacture of which started before the end of the year.

The P80 Inert Loading Model verification took place at CSG, with casting and compatibility tests with the Ariane SRM firing test-stand (BEAP). During the year, this test stand was modified (in synergy with other modifications necessary for the ARTA programme) to interface with the Vega first stage in time for its two planned firing tests.

The ground segment reached an important milestone with a contract proposal discussed at the ESA Industrial Policy Committee in June. The development contract for the Vega ground segment was awarded to Vitrociset (I) as prime contractor, leading a consortium of European companies responsible for the four main work packages for the new facility (covering civil engineering, mechanical engineering, fluids and general means, and the control bench). In July, the consortium was awarded an Authorisation to Proceed, and on 20 October the work site was opened at CSG. By the end of 2004, the first Industrial Preliminary Design Review had started.

Soyuz at Europe's Spaceport

The Declaration on the Soyuz at CSG Programme was drawn up by the Participating States on 4 February, and negotiations during the year on the Launcher Agreement between ESA and the Russian Federal Space Agency further paved the way for the exploitation of the Soyuz launcher from Europe's spaceport.

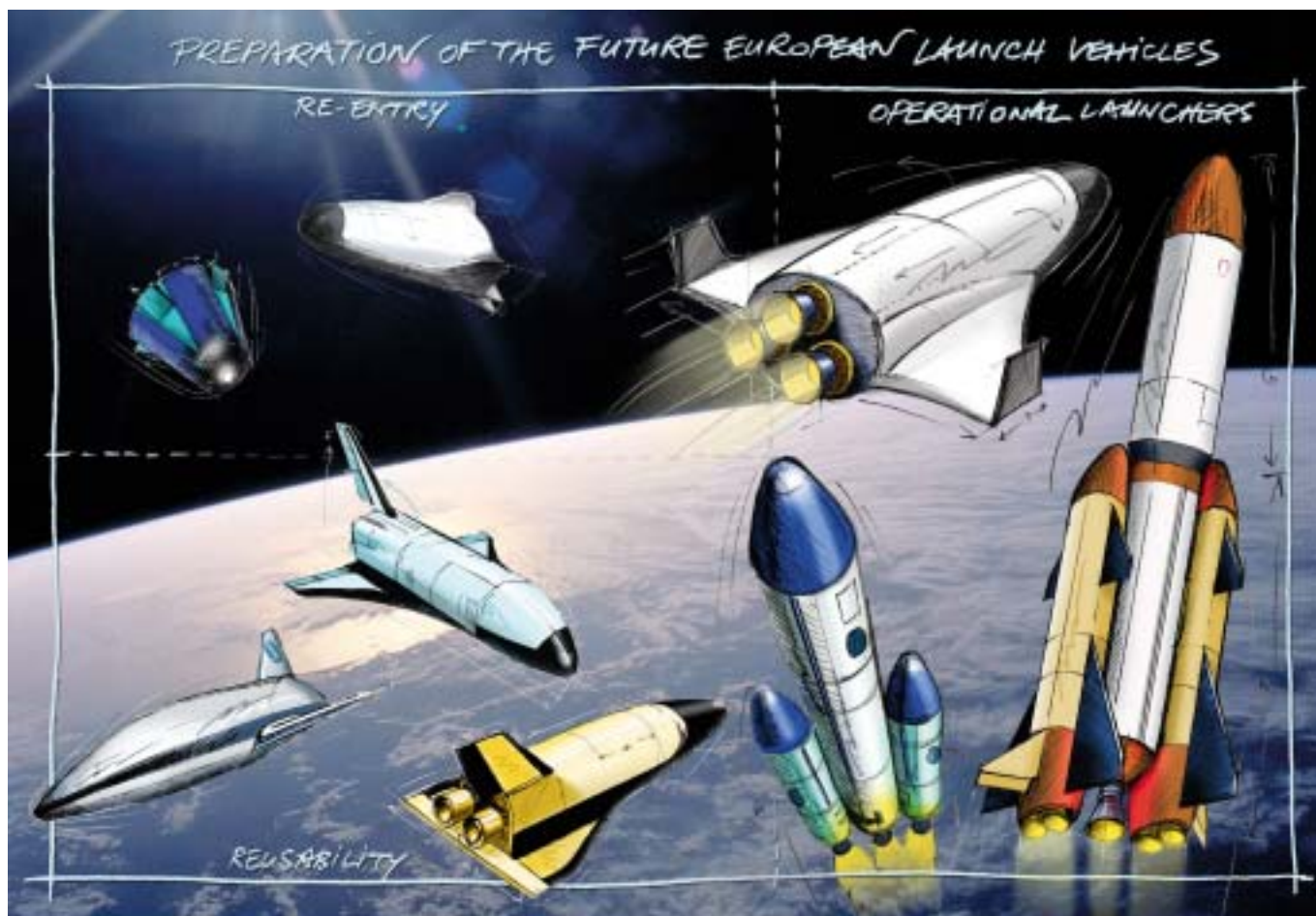
The Participating ESA Member States have committed to contribute to this project and



Artist's impression of a Soyuz launch from Kourou (D. Ducros)

Arianespace has accepted to provide a contribution of the order of one-third of the overall programme costs, via a loan from the European Investment Bank guaranteed by the French Government. In compensation, ESA has granted Arianespace exclusive exploitation rights for ten years to the infrastructure to be constructed within the scope of the programme. Further steps were made towards obtaining complementary funding from the European Union equivalent to 10% of the ESA programme's financial envelope, as preliminarily envisaged.

Excavation work was initiated in April, taking advantage of a weak rainy season in French Guiana in order to avoid stretching the already tight schedule. During the second quarter, agreement was reached on the final configuration of the launch zone between the different parties involved (ESA, CNES, Arianespace and Roskosmos). Following the



Artist's impression of some current FLPP concepts

concerns expressed by the Russian partners regarding the launcher acoustic environment and optimisation of the facility's exploitation by Arianespace, a new configuration with a mobile gantry was finally selected, thereby harmonising the upper-composite integration methods at the different launch pads (Ariane, Soyuz and Vega). The 53 m-high mobile gantry, weighing an estimated 1200 tons, will be moved back 60 m from the launch pad prior to the actual lift-off.

Due to the complexities inherent in the programme, ESA had to delay any contractual commitment until both the financial and overall programmatic situations had reached a satisfactory level of consolidation. This stage was reached at the beginning of December, and the ESA Council gave the Programme the necessary approval to proceed at its December meeting.

The Future Launchers Preparatory Programme

The Future Launchers Preparatory Programme (FLPP) was agreed upon and subscribed to in

February, with the aim of preparing the development of the Next Generation Launcher (NGL), to be operational from around 2020 onwards. The major objective for the coming two years will be the assessment of the value of reusability from the standpoints of launcher affordability and robustness.

Activities in 2004 focused mainly on the initiation of industrial activities and the necessary internal pre-conditions. Preliminary contractual coverage of the industrial prime contractor for system studies and the preparation of the in-flight experimentation was in place before the end of the year. The prime contractor for all NGL activities will be a new company, NGL Co., set up jointly by EADS and Finmeccanica and based in Turin, Italy.

At the inception of the FLPP programme, a number of cooperative activities in the RLV (Reusable Launch Vehicle) field have been identified, especially with Russia. The negotiation during 2004 and subsequent signature of the Launcher Agreement between ESA and the Russian Federal Space Agency enables this novel type of cooperation in joint developments in the field of future launchers

and related preparatory activities to be embarked upon. Negotiation of the Implementing Arrangement between ESA and the Russian Space Agency on cooperation in research and technology for future launchers is nearing completion. This Arrangement encompasses the first phase of cooperative preparatory activities to be carried out, without exchange of funds, in the field of reusable liquid engines, reusable liquid stages, and experimental vehicles.

Guiana Space Centre (CSG) - Europe's Spaceport

The anticipated downturn in the launcher market regulated the pace of launch operations at CSG in 2004. The three successful Ariane-5 G+ launches, carrying Rosetta to its Earth-escape trajectory, Anik-F2 to GTO, and Helios-2A to Sun-synchronous orbit, were different in nature but all equally important.

Work on the Vega launch site, formerly occupied by Ariane-1, was officially started on 20 October, paving the way for the first flight of Europe's new small launcher currently scheduled for 2007.

After adoption of the Soyuz at CSG programme in February, activities focussed on the pre-excavation works of deforestation, opening up of stone pits, opening up of access ways and safety studies. Confirmation of programme funding at the end of the year allowed the main excavation work on 35 hectares of land to start.

The internal reorganisation of the CSG structure continued throughout the year. This was a concerted exercise, led by a project team composed of key staff from ESA, CNES/CSG, Arianespace and EADS-ST, in full consultation with their industrial counterparts.

Europe's spaceport in Kourou, French Guiana

