Space Transportation

Ariane Operational launches

Despite difficulties encountered in the first part of the year with delays in the delivery of satellites for launch due to solar-panel problems, Ariane-4 was launched successfully nine times in 1999, placing 11 spacecraft in orbit, and Ariane-5 successfully accomplished its first operational mission, putting ESA's XMM satellite, the largest X-ray space telescope ever made, into orbit.

With December a record month in itself, with two Ariane-4 launches and one Ariane-5 launch in the space of just three weeks, 1999 must be considered an excellent year for Ariane production and operations.

With flight V125 on 22 December, Ariane-4 achieved its 51st consecutive successful launch, chalking up a success rate of 96.8%.

Launches in 1999

Flight Number	Launch Date	Version	Passengers	Orbit	Payload kg
V116	26.02.99	44L	Arabsat 3a & Skynet 4E	GTO	4195
V117	02.04.99	42P	Insat 2E	GTO	2549
V118	12.08.99	42P	Telkom-1	GTO	2761
V120	04.09.99	42P	Koreasat 3	GTO	2799
V121	25.09.99	44LP	Telstar 7	GTO	3793
V122	19.10.99	44LP	Orion 2	GTO	3788
V123	13.11.99	44LP	GE-4	GTO	3909
V124	03.12.99	40	Helios 1B & Clémentine	SSO	2589
V119	10.12.99	A504	XMM	ELLIP.	3764
V125	22.12.99	44L	Galaxy XI	GTO	4484

The launch of Ariane-504

Ariane-5 Programmes

Ariane-5 Generic

Following the detailed analysis of the Ariane-503 flight (V112) conducted in the first part of the year, the Launcher Qualification Board, meeting on 22 June, declared the generic Ariane-5 launcher formally qualified. Subsequently, the vehicle began its operational life on 10 December (flight V119) with a flawless first commercial flight, delivering the XMM spacecraft into a highly accurate orbit. Meanwhile, the long-fairing separation test had been successfully performed at NASA's facility in Plumbrook on 22 July.

Ariane-5 Evolution

Despite an already tight schedule, the decision was made in 1999 to boost the Ariane-5 Evolution development programme and target an inaugural flight in December 2001 in order to satisfy the market needs with ever-increasing satellite masses. In the course of the year, the first series of Vulcain-2 cryogenic-engine ground tests were conducted. In particular, long-duration hot tests of the engine were successfully performed on 26 June and 21 December.

The welding of the booster casing for the Ariane-5 Evolution launcher is now totally defined, though its implementation might be deferred to the third production batch (in 2003).

The Vulcain-2 test firing at Lampoldshausen (D)

In conjunction with the Ariane-5 Plus Programme requirements, the Ariane-5 multi-programmes system review steering committee held in October decided to limit the number of launcher configurations being developed to the following:

- A5E/SV Ariane-5 Evolution with versatile storable propellants stage (EPSV)
- A5E/CA Ariane-5 Evolution with cryogenic upper stage version-A (HM7-B)
- A5E/CB Ariane-5 Evolution with cryogenic upper stage version-B (Vinci).

Ariane-5 Plus

Following the decision by Ministers at the Council Meeting in Brussels in May to commit to the second step of the Ariane-5 Plus Programme, the development activities progressed smoothly in 1999. This Programme aims at a first flight of the A5E/CA configuration at the end of 2001, and a maiden flight of the A5E/CB version at the end of 2005. A first procurement plan taking into account predefined industrial targets was presented to the Ariane Programme Board.

With launcher competitiveness in the commercial market being the main driver, priority has been given to the development of the new cryogenic upper stage version-A (ESC-A). This configuration will allow dual launches to be performed on Ariane-5 as early as 2002 (10 tonnes into GTO compared to the present generic launcher capacity of approx. 6 tonnes). This performance increase is required by the consistent growth in the masses of geostationary telecommunications satellites worldwide. The Critical Design Review kick-off meeting for ESC-A was held in mid-November.

Ariane Ground Facilities

Advantage was taken of the temporarily reduced Ariane-5 launch rate to uprate the launch facilities, in particular Ariane-5 launch complex No. 3 (ELA-3). The doors of both the Ariane-5 Assembly Building (Bâtiment d'Assemblage Final - BAF) and the Integration Building (Bâtiment d'Intégration Lanceur - BIL) were enlarged to allow passage of the future taller Ariane-5 Plus version ESC-B. In the Ariane-5 Launch Zone (ZL-3), the booster exhaust trenches were extended to reduce the acoustic noise experienced by satellites in the first seconds of flight.

New facilities have been built to cope with the imminent increase in Ariane-5 launch rate, in particular a booster storage building (Bâtiment de Stockage des Etages - BSE) able to handle four boosters, and a palette refurbishment building (Bâtiment de Revalidation Palettes - BRP) for the revalidation of booster support tables.

Again to cope with future requirements, a very large satellite-preparation complex (Ensemble de Préparation des Charges Utiles - EPCU 5) is under construction, which will be completed by end-2000.

A new mobile telemetry station has been developed to support specific Ariane-5 missions, which was used successfully for the first time for the Ariane-504 launch. This new equipment will play a key role in the future in supporting a variety of missions requiring flexibility in the location of the telemetry down-range station.

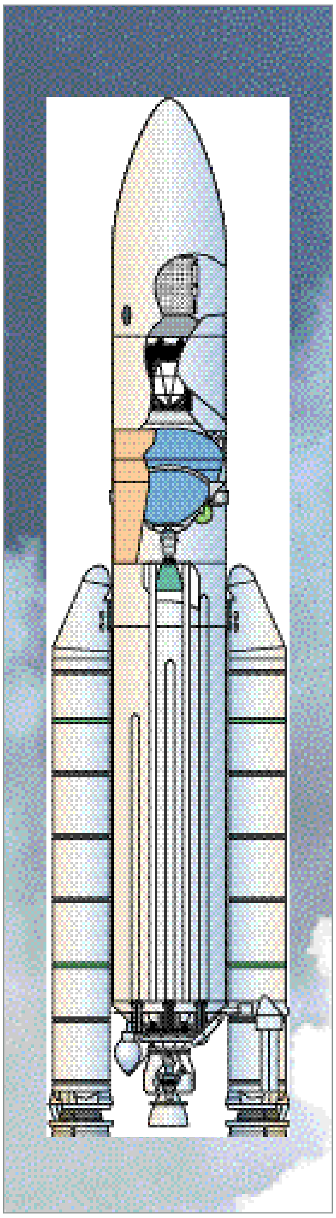
Guiana Space Centre

The Guiana Space Centre provided support services for the 10 Ariane launches in 1999: nine Ariane-4's and one Ariane-5. These activities, managed by CNES on behalf of ESA with European contractors, include co-ordination of overall launch-range operations, ground and in-flight safety, tracking and telemetry stations, meteorology, telecommunications, operations and maintenance for payload-preparation and logistical facilities.

ARTA Complementary Programmes

The Ariane-4 Research and Technology Accompaniment Programme (ARTA-4) covered Viking and HM7-B test campaigns. In the solid-propulsion domain, one booster was test-fired and qualification of the separation rockets with the new solid propellant was achieved. Flight-data from the Ariane-4 launches was analysed. All of these activities contributed to the successful operational exploitation of Ariane-4, which completed 1999 with its 51st consecutive successful launch.

One test campaign with the Vulcain engine was performed within the ARTA-5 Programme and another test campaign for the Aestus engine was started. Sampling tests were continued to verify the compliance of components of the cryogenic and upper storable stages with the qualified configuration. Flight-data analyses were performed for Ariane-5 flights A503 and A504.



Artist's impression of Ariane-5 ESC-B

The Vega Programme

After the approval in June 1998 of Step 1 of the Programme, the industrial setup was established to perform the associated definition and development activities. The overall Vega baseline was subject to a Conceptual Review, concluded early in 1999, which confirmed the validity of the technical and programmatic parameters supporting the proposed design.

Development of the Zefiro motor for the second stage reached an important milestone in June, when the second full test firing was successfully performed in Sardinia (I).

The political decision to approve the full development phase (Step-2) of Vega was discussed during the Ministerial Council Meeting in Brussels in May. The lack of consensus resulted in a postponement of the debate until December, in preparation for which several iterations were performed to investigate configurations, costs and the potential markets. Again, however, unanimity among the Participating States could not be achieved. Before concluding the Step-1 activities, further proposals will have to be developed by June 2000.

The Future Launchers Technologies Programme (FLTP)

In order to improve the understanding of launcher reusability, already investigated in the ESA FESTIP and several other national programmes, and to improve the level of related European technology, the Future Launchers Technologies Programme (FLTP) has been initiated, with the objectives of:

- confirming the interest of launcher reusability
- identifying, developing and validating the technologies required to enable the development of a new generation of cost-effective launchers
- elaborating a plan for the on-ground and in-flight experimentation and demonstrations required to achieve a sufficient level of confidence prior to the vehicle development phase and to progressively implement such demonstrations
- providing, through the analysis of candidate vehicle concepts and synthesis of the technology activities, elements in support of a possible programmatic decision regarding the initiation of a European development programme for the next generation of launchers, which is presently expected to be required around 2007.

Coherent with the FLTP objectives defined above, the Programme will include:

- analysis and definition of launch-vehicle concepts
- technology development work
- definition and progressive implementation of on-ground and in-flight experiments and demonstrations.

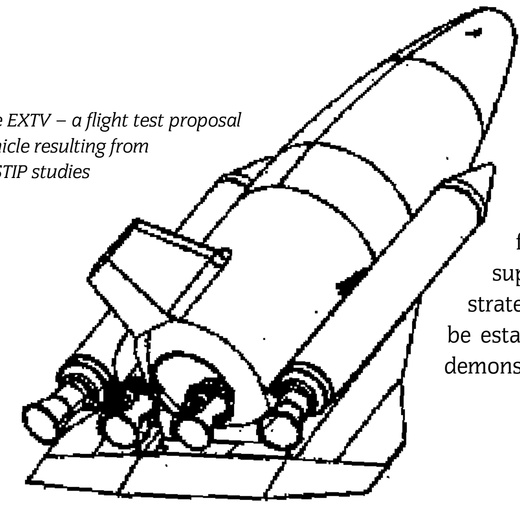
The development of reusable launchers requires major advances in key technologies such as structures and materials, aero-thermodynamics, and propulsion. In particular, new primary-propulsion developments are needed, including both the development of new, and the improvement of existing engines.

Significant advances in rocket propulsion have been achieved through the Ariane Programmes, but for new launcher concepts other types of engines delivering higher thrusts and/or higher specific impulses will be required and new propellant combinations may prove advantageous.

For reusable engines, reliability in flight and the possibility of rapid maintenance on the ground are essential. This necessitates a different design approach which greatly reduces the need for acceptance testing, relies on an integrated engine health monitoring system, and makes it possible to control or limit the effects of failures.

Initial work on the reusability aspects of rocket propulsion has been performed within FESTIP, as well as within national programmes. The desired goal is now to broaden European rocket primary propulsion knowhow, with complementary progress in engine reliability and reusability.

The technical and economic viability of reusable launch vehicles depends also on the availability of large lightweight, highly loaded, fully reusable and easily maintainable structures. To minimise mass and life-cycle cost, innovative concepts, adequate materials and manufacturing processes and refined analytical techniques are required for the major airframe structural components. A health-monitoring capability is also an essential issue for reusable launcher structures, in order to decrease margins and reduce turnaround times and maintenance costs.



The EXTV – a flight test proposal vehicle resulting from FESTIP studies

An important step towards mass reduction is provided by using new advanced metallic and composite materials for the different structural components. Several advanced structural components – e.g. an inter-tank structure, a thrust frame, a composite cryogenic tank, a leading edge, and a metallic rudder – will be designed, manufactured and tested.

Studies will be carried out in the first phase of FLTP to prepare for the in-flight experimentation in FLTP Phase-2 with one or more demonstrators to support and validate the newly developed technologies. A flight-testing strategy, complementary to and coherent with the ground-testing strategy, will be established. Programmatic data will be prepared for a decision on in-flight demonstration to be taken at the next ESA Ministerial Council Meeting.