

A launch to observe the Earth

With its latest launch, Arianespace is supporting the observation and understanding of our planet and its environment. Flight 151 will place the French space agency CNES's SPOT 5 satellite into a Sun-synchronous orbit.

The SPOT remote sensing system has been in operation for 15 years, with four earlier SPOT satellites already launched by Arianespace: SPOT 1 in February 1986, SPOT 2 in January 1990, SPOT 3 in September 1993 (until an in-orbit failure in March 1996) and SPOT 4, launched on Flight 104 in March 1998.

SPOT 5 incorporates major upgrades, with several new instruments improving the quality of images and services offered to customers.

Like SPOT 4, SPOT 5 also carries two payloads: Vegetation 2 and Doris, an orbital position-determination and location system.

Approved in 1978, the SPOT program was designed by CNES and produced by France in collaboration with Belgium and Sweden. It comprises a family of satellites, ground control and programming facilities, receiving stations and image processing centers.

Flight 151 will also launch an auxiliary passenger, called Idefix, for the French amateur satellite association, AMSAT. It will be placed into orbit without separating from the third stage. IDEFIX is an educational payload, involving the transmission of telemetry and prerecorded vocal messages. Designed for an orbital life of 25 to 60 days, it will be activated about 15 days after the launch.

For its sixth mission this year, Arianespace will use an Ariane 42P, the version equipped with two solid-propellant strap-on boosters.

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1 - Arianespace Flight 151 mission

The 151st Ariane launch (Flight 151) is scheduled to place the CNES' SPOT 5 Earth observation satellite into sun-synchronous orbit, along with the IDEFIX auxiliary passenger using an ARIANE 42P launch vehicle equipped with two solid strap-on boosters (PAP). This will be the 112th Ariane 4 launch and the 15th in the ARIANE 42P configuration. It will be launched from the Ariane launch complex n°2 (ELA2), in Kourou, French Guiana. The launch vehicle performance requirement is 3 360 kg (7 392 lb) of which 3 030 kg (6 666 lb) represent the mass of the spacecraft to be separated on the injection orbit.

Injection orbit

Perigee	794 km
Altitude Apogee	812.7 km at injection
Inclination	98.74° degrees

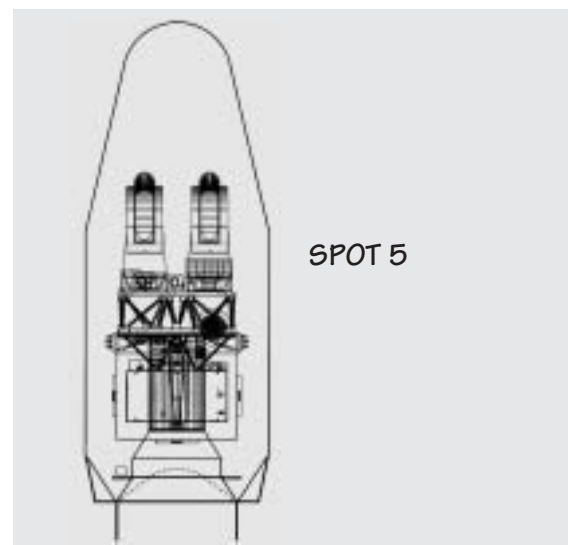
The ARIANE 42P launcher liftoff for Flight 151 is scheduled on the night of May 3 to 4, 2002 as early as possible on the 3 precise moments:

Launch opportunity

	GMT	Paris time	Washington time	Kourou time
at	01:31.46 am	03:31.46 am	09:31.46 pm	10:31.46 pm
or	01:43.46 am	03:43.46 am	09:43.46 pm	10:43.46 pm
or	01:49.46 am	03:49.46 am	09:49.46 pm	10:49.46 pm
on	May 4, 2002	May 4, 2002	May 3, 2002	May 3, 2002

Ariane payload configuration

The SPOT 5 satellite : Astrium is the prime contractor, also in charge of integration and of major equipments (platform, HRG and HRS instruments). Alcatel Space is prime contractor for the Végétation instrument and other equipments (equipment bay, main HRG camera, TMCU...)
Orbit: sun-synchronous orbit at an altitude of 812.7 km.



2. Range operations campaign: ARIANE 42P – SPOT 5

The actual work for satellite range operations lasts 40 working days for SPOT 5 from its arrival in Kourou (before start of combined operations).

The actual work for IDEFIX range operations lasts 2 working days.

The ARIANE 42P preparation campaign lasts 23 working days.

Satellite and launch vehicle campaign calendar

<i>Ariane activities</i>	<i>Dates</i>	<i>Satellite activities</i>
	February 21, 2002	SPOT 5 arrival in Kourou and beginning of its preparation in S1 buildings.
Campaign start review	April 8, 2002	
First stage erection	April 8, 2002	
Second stage erection	April 9, 2002	
Third stage erection	April 13, 2002	
Flight 150	April 16, 2002	Launch of NSS-7
	April 17, 2002	Beginning of SPOT 5 filling operations in S3B.
Roll-out to launch pad	April 22, 2002	
Solid strap-on boosters erection	April 24, 2002	
D-7	Wednesday, April 24	Start of combined operations with SPOT 5.
D-6	Thursday, April 25	Satellite encapsulation operations and fairing enclosure.
D-5	Friday, April 26	Satellite composite transfer to the launch pad.
D-4	Saturday, April 27	Satellite composite mating onto launcher and overall checks.
D-3	Monday, April 29	Launch Rehearsal.
D-2	Tuesday, April 30	Launch Readiness Review (RAL) and launcher arming.
D-1	Thursday, May 2	Filling of 1st stage and 2nd stage with UH 25 and N2O4.
D-1	Friday, April 3	Launch Countdown including 3rd stage filling with liquid oxygen and liquid hydrogen.

3. Launch countdown and flight events

The final launch countdown runs through all the final launcher and satellites related operations. It configures the vehicle and its payload for ignition of the first stage engines at the selected launch time, as soon as possible on the 3 precise moments authorized by the spacecraft.

A synchronized sequence (see Appendix 3), controlled by the Ariane ground check-out computers, starts at H0 - 6mn and concludes the countdown.

Should a hold in the countdown delay the H0 time beyond the launch window, the launch is postponed to (in days) : D + 1 or D + 2 (or later) depending on the source of the problem and the time to resolve it.

Time	Events
- 12h 30 mn 00 s	Start of final countdown.
- 5 h 35 mn 00 s	Start of gantry withdrawal.
- 3 h 35 mn 00 s	Start of the 3rd stage filling operations with liquid hydrogen and liquid oxygen.
- 1 h 5 mn 00 s	Activation of launcher telemetry, radar transponders, telecommand.
- 6 mn 00 s	"Green status for all systems" to authorize : start of synchronized launch sequence
- 3 mn 40 s	Spacecraft switched to on-board power (latest time).
- 1 mn 00 s	Launcher equipment switched to on-board batteries.
- 09 s	Inertial platform released.
- 05 s	Release command to cryogenic arms retraction system.
H0	Ignition of first stage engines
+4,2 s	Ignition of solid strap on boosters.
+4,4 s	Lift-off.
+ 30 s	End of vertical ascent phase of pitch motion (10 s duration).
+ 1 mn 31 s	Solid strap-on booster jettison.
+ 3 mn 20 s	First stage separation.
+ 3 mn 23 s	Second stage ignition.
+ 3 mn 53 s	Fairing jettison.
+ 5 mn 31 s	Second stage separation.
+ 5 mn 36 s	Third stage ignition.
+ 13 mn 00 s	Launcher acquired by St Hubert station.
+ 16 mn 33 s	Lost of acquisition by Galliot station.
+ 18 mn 32 s	Third stage shutdown sequence.
+ 19 mn 15 s	SPOT 5 separation.
+ 19 mn 13 s	Start of the third stage avoidance maneuver.
+ 25 mn 36 s	End of Arianespace Flight 151 mission.

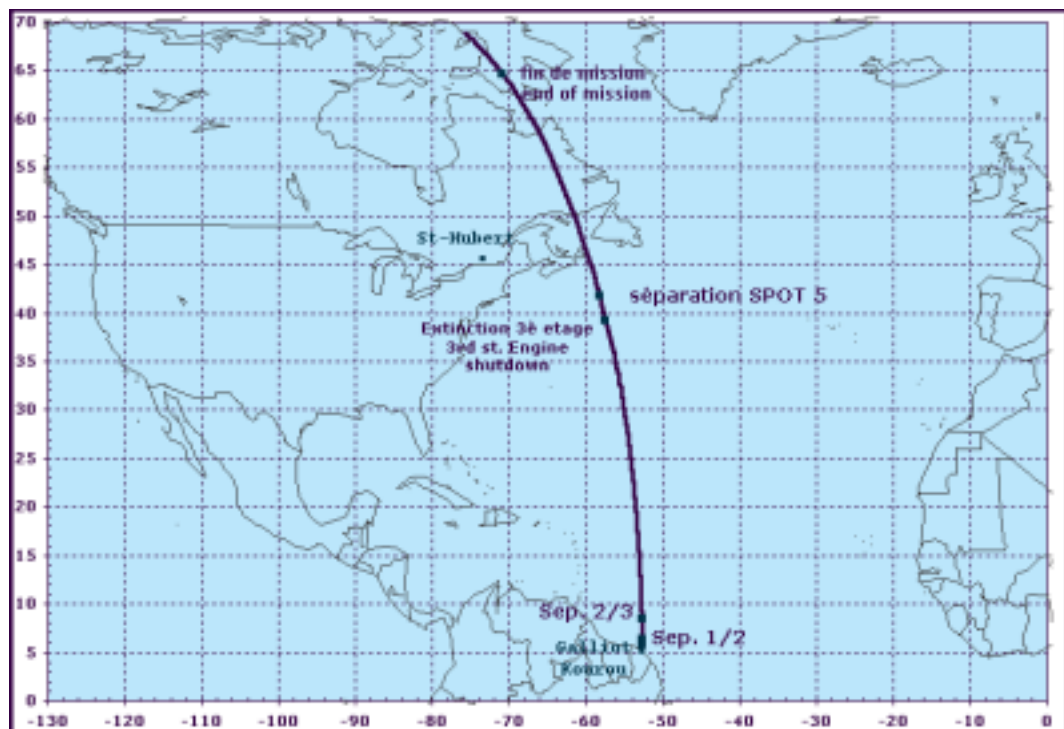
4. Flight 151 Trajectory

The launcher ascends vertically from lift-off to H0+30 sec. During a period of 10 sec. after this vertical ascent, the launch vehicle tilts in the pitch plane defined by the trajectory and pre-calculated by the on-board computer.

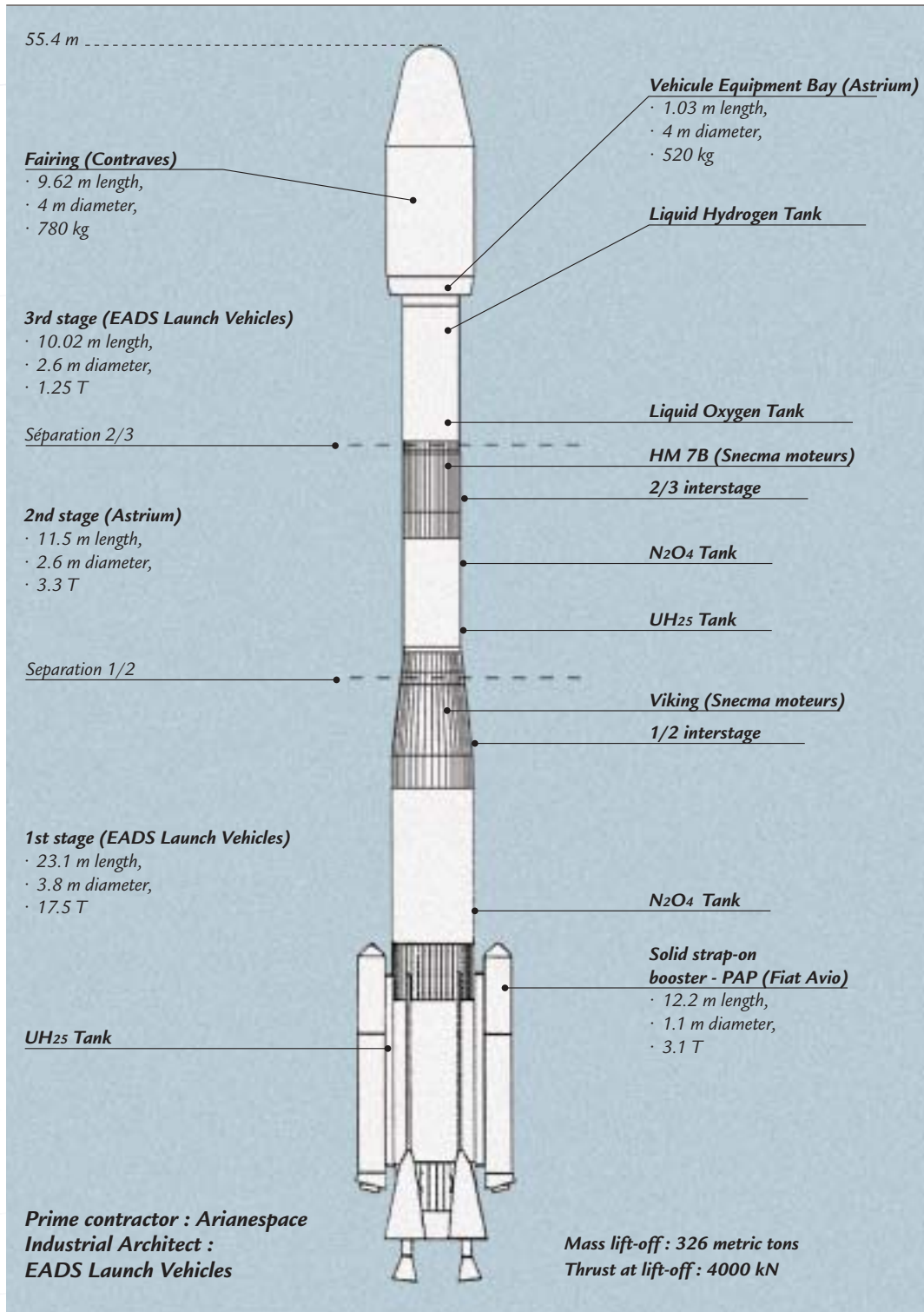
The vehicle's attitude is commanded by a predetermined law. The guidance phase is initiated 10 sec. after ignition of the 2nd stage. The attitude law in the pitch-and-yaw plane is optimized in order to minimize the 3rd stage propulsion time necessary to reach the target orbit with a performance margin of about 180 kg (396 lb). This ensures reaching this orbit with a probability of about 99% before the exhaustion of third stage propellant.

The roll law is applied so as to improve the launcher/ground station radio link budget.

Trajectory for sun-synchronous orbit



5. The launch vehicle



6. The SPOT 5 satellite



Customer	<i>Centre National d'Etudes Spatiales (France)</i>	
Prime contractor	<i>Astrium</i>	
Mission	<i>Earth observation</i>	
Mass	<i>Total mass (at lift-off)</i>	<i>3 030 kg (6 666 lb)</i>
Stabilization	<i>3 axis</i>	
Dimensions	<i>3.1 m x 3.1 m x 5.7 m</i>	
Payload	<i>The HRG instruments (High Resolution Geometry: 2.5 m/60 km) The HRS instruments (High Resolution Stereoscapy: 120 km/15 m) Végétation 2250 km swath, 1 km spatial resolution</i>	
On-board power	<i>2 350 W (beginning of life)</i>	
Life time	<i>5 years</i>	
Orbital location	<i>Sun-synchronous at an altitude of 812.7 km</i>	

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Annex 1 - Arianespace flight 151 key personnel

In charge of the launch campaign

Mission Director	(CM)	Philippe ROLLAND	ARIANESPACE
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In charge of the launch service contracts

SPOT 5 Mission Manager and ARIANE Payload Manager	(RCUA)	Christophe BARDOU	ARIANESPACE
Deputy Mission Manager	(RCUA/A)	Patrick LOIRE	ARIANESPACE

In charge of SPOT 5 satellite

Satellite Mission Director	(DMS)	Bernard LAMAISON	CNES
Satellite Project Manager	(CPS)	Gilles LAFFAYE	ASTRIUM
Satellite Preparation Manager	(RPS)	Jean-Paul RIEU	ASTRIUM

In charge of IDEFIX

Satellite Mission Director	(DMS)	Ghislain RUY	AMSAT FRANCE
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In charge of the launch vehicle

Launch Site Operations Manager	(COEL)	Daniel GROULT	ARIANESPACE
Ariane Production Project Manager	(CPAP)	Rudiger ALBAT	ARIANESPACE

In charge of the Guiana Space Center (CSG)

Range Operations Manager	(DDO)	Philippe MAUBERT	CNES/CSG
Flight Safety Officer	(RSV)	Isabelo DENIS	CNES/CSG

Annex 2 - Launch environment conditions

The allowable weather conditions for gantry withdrawal depend on the Ariane stage pressurization values.

Wind speed has to be below 17 m/s.

Acceptable wind speed limit at liftoff is 9,5 m/s for any wind direction. For safety reasons, the wind speed on the ground (at Kourou) and at a high altitude (between 10,000 and 20,000 m) also is taken into account.

Annex 3 - Synchronized sequence

The synchronized sequence starts at H0 -6 min. This sequence is used for final preparation of the launcher, and for checkout operations related to switchover to flight configuration. The sequence is fully automatic, and is controlled in parallel, up to H0-5 sec., by two computers in the Ariane Launch Center (CDL). All resources used for launch are synchronized on a common countdown sequence.

One computer configures fluids and propellants for flight and performs associated checks. The other computer executes final preparation of the electrical systems (initiation of flight program, start-up of servomotors, switchover from ground power to flight batteries, etc.) and corresponding checkout operations.

After H0 - 5 s. and retraction of the cryogenic arms retraction from the launcher, a majority logic sequencer delivers the main timing pulses for :

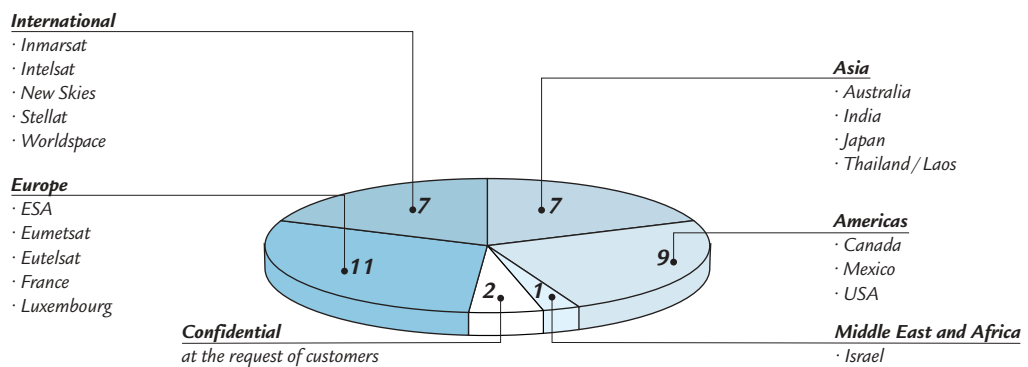
- first stage engines ignition (H0) ;
- engine parameter checkout (conducted in parallel by the two computers, starting at H0 + 2.8 s.) ;
- opening of the launch table clamps (releasing the launch vehicle between H0 + 4. 1s. and H0 + 4.6 s.) as soon as engine parameters are judged as nominal by one of the computers.

Any hold in the synchronized sequence before H0 - 5 s. automatically resets the launcher to the H0 - 6 min. configuration

Annex 4 - Arianespace order book

To date 199 satellites and 38 auxiliary payloads have been launched by Arianespace. Out of the 245 launch services contracted since 1981 by Arianespace and before Flight 151, 37 satellites and 9 ATV missions remain to be launched.

Europe 11 satellites	International organizations 7 satellites	Americas 9 satellites	Asia 7 satellites
Astra Y, X	Ameristar (Worldspace)	Anik F2 (Canada)	B Sat 2C (Japan)
e-Bird	Inmarsat 4	Galaxy 12 (USA)	Insat 3A & 3E (India)
Hot Bird 6 & 7	Intelsat 905, 906, 907	Galaxy VR & IRR (USA)	L-Star A & B (Thailand/Laos)
MSG-1 & 2	New Skies Satellites 6	GE TBD (USA)	N-Star C (Japan)
Rosetta	Stellat	Loralsat 3 (USA)	Optus C1 (Australia)
Spot 5		Satmex 6 (Mexico)	
Stentor		Wild Blue 1 & 2 (USA)	
Syracuse III			
	Middle-East and Africa 1 satellite	Confidential contract at the request of customers 2 satellites	
+ 9 ATV launches	Amos 2		



Appendix 5 - Arianespace, its relations with ESA et CNES

FROM A PRODUCTION BASE IN EUROPE, ARIANESPACE, A PRIVATE COMPANY, SERVES CUSTOMERS ALL OVER THE WORLD. Arianespace is the world's first commercial space transportation company, created in 1980 by 36 leading European aerospace and electronics corporations, 13 major banks and the French space agency CNES (Centre National d'Etudes Spatiales).

Arianespace is a European venture--, the direct result of the participating nation's commitment to bringing the Ariane family of launch vehicles from the drawing board to the launch pad. To do so, they turned to the European Space Agency (ESA) and mobilized the scientific and technological expertise of CNES.

The shareholder partners in Arianespace represent the scientific, technical, financial and political capabilities of 12 countries : Belgium, Denmark, Germany, France, Great Britain, Ireland, Italy, Netherlands, Norway, Spain, Switzerland and Sweden.

In order to meet the market needs, Arianespace is present throughout the world: in Europe, with its head office located near Paris, France at Evry, in North America with its subsidiary in Washington D.C. and in the Pacific Region, with its representative offices in Tokyo, Japan, and in Singapore.

Arianespace employs a staff of 380. Share capital totals 317 M€.

As a space transportation company, Arianespace:

- markets launch services to customers throughout the world;
- finances and supervises the construction of Ariane expendable launch vehicles;
- conducts launches from Europe's Spaceport in Kourou in French Guiana;
- insures customers for launch risks.

Personalized reliable service forms an integral part of Arianespace's launch package. It includes the assignment of a permanent team of experts to each mission for the full launch campaign. Our customers appreciate the time and cost savings made possible by our efficiency and flexibility.

Most of the world's commercial satellite operators have contracted to launch at least one payload with Arianespace. This record is the result of our company's realistic cost-effective approach to getting satellites into orbit.

Relations between ESA, CNES and Arianespace

Development of the Ariane launcher was undertaken by the European Space Agency in 1973. ESA assumed overall direction of the ARIANE 1 development program, delegating the technical direction and financial management to CNES. The ARIANE 1 launcher was declared qualified and operational in January 1982. At the end of the development phase which included four launchers, ESA started the production of five further ARIANE 1 launchers. This program, known as the "promotion series", was carried out with a management arrangement similar to that for the ARIANE 1 development program

In January 1980 ESA decided to entrust the commercialization, production and launch of operational launchers to a private-law industrial structure, in the form of ARIANESPACE, placing at its disposal the facilities, equipment and tooling needed to build and launch the ARIANE vehicles.

Ariane follow-on development programs have been undertaken by ESA since 1980. They include a program for developing updated versions of the launcher : Ariane 2 and Ariane 3 (qualified in August 1984); the program for building a second ARIANE launch site (ELA 2) (validated in August 1985); the Ariane 4 launcher development program (qualified on June 15th, 1988); and the preparatory and development program of the Ariane 5 launcher (qualified in October 21st 1998) and its new ELA 3 launch facility. All these programs are run under the overall direction of ESA, which has appointed CNES as prime contractor.

In general, as soon as an updated version of the launcher has been qualified, ESA makes the results of the development program together with the corresponding production and launch facilities available to ARIANESPACE.

ESA is responsible (as design authority) for development work on the Ariane launchers. The Agency owns all the assets produced under these development programs. It entrusts technical direction and financial management of the development work to CNES, which writes the program specifications and places the industrial contracts on its behalf. The Agency retains the role of monitoring the work and reporting to the participating States.

Since Flight 9 Arianespace has been responsible for building and launching the operational Ariane launchers (as production authority), and for industrial production management, for placing the launcher manufacturing contracts, initiating procurements, marketing and providing Ariane launch services, and directing launch operations.

Use of the Guiana Space Center

The "Centre Spatial Guyanais" (CSG), CNES's launch base near Kourou, has all the equipment needed for launching spacecraft: radar tracking stations, telemetry receiving stations, a meteorology station, a telecommand station, safety facilities, etc.

It became operational in 1968 for the purpose of the French National Space Program.

ESA built its own launch facilities, the ELA 1 and ELA 2 complexes (for Ariane 4) and ELA 3 (for Ariane 5) and the EPCU payload preparation complex. These facilities comprise Europe's Spaceport. The use of these facilities requires CSG's technical and operational resources, especially during launch operations. The French Government has granted ESA the right to use the CSG for its space programs. In return, ESA shares in the costs of operating the CSG.

Arianespace directly covers the costs of use, maintenance and upgrading of the Ariane launch sites and the payload preparation complex.