

## ARIANE 5 launches one for environment

Arianespace's 11<sup>th</sup> Ariane 5 mission will orbit the European Space Agency's Envisat environmental satellite.

The largest satellite ever built in Europe, Envisat will be placed in a sun-synchronous quasi-polar orbit. Ariane 5 is the only operational launch system capable of carrying satellites this big and heavy into any type of orbit.

For the first time, Ariane 5 will be equipped with its long fairing, stretching some 17 meters high. This mission will set new records for a payload on an Ariane launcher at 8,111 kilograms and 10 meters long.

Envisat is the highest performance satellite ever built by ESA to monitor the state of our planet and the impact of human activities. Day after day, Envisat will transmit an unprecedented stream of environmental data. Combined with data from the ERS-1 and ERS-2 remote sensing satellites, this information will help us follow the evolution of environmental events over more than a decade.

Envisat was built by a European consortium of 50 companies led by Astrium. Weighing more than 8,100 kg. at launch, it will be positioned at an altitude of 800 kilometers, with each orbit taking 100 minutes. For most instruments, it will provide global coverage every three days, with exact revisit coverage every 35 days.

Envisat is the 50th Astrium-built satellite to be orbited by the European launcher.

All ground equipment for Envisat was built by a consortium of 20 companies led by Alcatel Space.

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## 1. Arianespace flight 145 mission

The 148<sup>th</sup> Ariane launch (Flight 145/Ariane 511) will use an Ariane 5 to place into sunsynchronous orbit the environmental satellite ENVISAT for the European Space Agency (ESA). The launch will be carried out from the ELA 3 launch complex in Kourou, French Guiana. For Arianespace, this marks the eighth commercial mission of the new Ariane 5 launcher. Arianespace has performed 2 other launches this year (2 ARIANE 4). The Ariane 511 launcher will carry a payload of 8,648 kg (19,025 lb), including 8,111 kg (17,844 lb) for the satellite.

### INJECTION ORBIT

Semi major axis	7159 km
Eccentricity	0,001165
Inclination	98,5° degrees
Argument of perigee	90° degrees

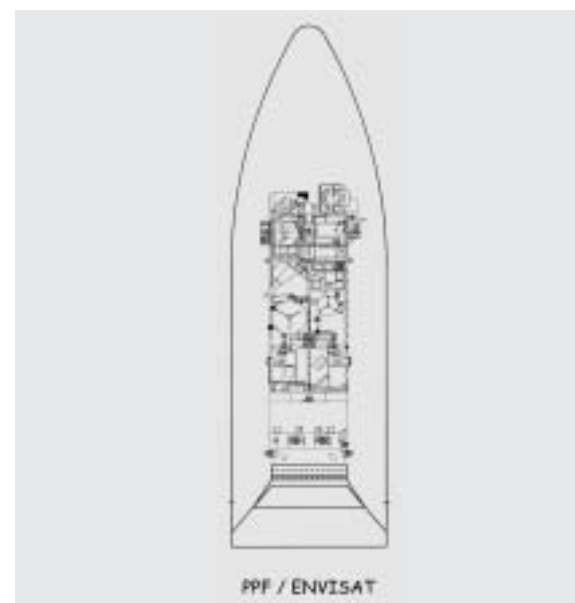
The lift-off is scheduled on the night of February 28 to March 1, 2002 at exactly:

### LAUNCH OPPORTUNITY

Universal time (GMT)	Paris time	Washington time	Kourou time
01:07.59 am	02:07.59 am	08:07.59 pm	10:07.59 pm
on March 1, 2002	March 1, 2002	February 28, 2002	February 28, 2002

## Ariane 511 payload configuration

The **ENVISAT satellite** was built by a consortium of 50 companies led by Astrium for ESA.  
Orbit: orbits Earth every 100 minutes at altitude 800 km.



## 2. Range operations campaign : ARIANE 5 – ENVISAT

The actual work for satellite range operations lasts 90 working days for ENVISAT from its arrival in Kourou (before beginning combined operations).  
The ARIANE 5 preparation campaign lasts 29 working days.

### Satellites and launch vehicle campaign calendar

<i>Ariane activities</i>	<i>Dates</i>	<i>Satellite activities</i>
	March 20, 2001 - May 16, 2001	Arrival in Kourou of modules and equipments at SSC
	May 17, 2001	Beginning of ENVISAT preparation campaign
	June 8, 2001	Integration of Payload and Service modules
	July 14, 2001 - January 4, 2002	Stand-by
Campaign start review	September 11, 2001	
EPC Erection	September 11, 2001	
EAP transfer and positioning	September 12, 2001	
Integration EPC/EAP	September 13, 2001	
Stand-by in operations	October 6, 2001 - January 7, 2002	
ROLL-OUT FROM BIL to BAF	January 7, 2002	
Stand-by in operations	January 7, 2002 - February 4, 2002	
	January 9, 2002	Integration of Solar Generator
EPS Erection	February 4, 2002	
Integration equipment bay	February 5, 2002	
	February 5, 2002	Transfer to the Filling Hall (SSA).
	February 7 and 8, 2002	Filling with hydrazine.
	February 16, 2002	Beginning of combined operations and integration on payload adaptor.

### Satellites and launch vehicle campaign final calendar

J-8	Monday, Feb. 18	ENVISAT transfer from SS to BAF.
J-7	Tuesday, Feb. 19	ENVISAT integration on launcher.
J-6	Wednesday, Feb. 20	Mating of fairings on launcher.
J-5	Thursday, Feb. 21	Preparation of SCA (attitude control system) before filling.
J-4	Friday, Feb. 22	Filling of SCA with N <sub>2</sub> H <sub>4</sub> .
J-4	Friday, Feb. 22	Filling of EPS stage with MMH.
J-3	Monday, Feb. 25	Filling of EPS stage with N <sub>2</sub> O <sub>4</sub> and LAUNCH REHEARSAL.
J-2	Tuesday, Feb. 26	LAUNCH READINESS REVIEW (RAL) and final mechanical preparation of launcher. Launcher arming
J-1	Wednesday, Feb. 27	ROLL-OUT FROM BAF to LAUNCH AREA and filling of the EPC Helium sphere.
J-0	Thursday, Feb. 28	LAUNCH COUNTDOWN including EPC filling with liquid oxygen and liquid hydrogen.

## 3 - Launch countdown and flight events :

The countdown comprises all final preparation steps for the launcher, the satellite and the launch site. If it proceeds as planned, the countdown leads to the ignition of the main stage engine, then the two solid boosters, for a liftoff at the targeted time. There is no “launch window” for V 145.

The countdown culminates in a synchronized sequence (see appendix 3), which is managed by the control station and onboard computers starting at T-6 minutes 30 s.

Any interruption in the countdown means the launch will be delayed by one or more days, depending on the problem involved, and the solution developed.

<b>Time</b>	<b>Events</b>
– 9 h 00 mn	Start of final countdown.
– 7 h 30 mn	Check of electrical systems.
– 5 h 20 mn	Start of filling of main cryogenic stage with liquid oxygen and helium.
– 3 h 20 mn	Chilldown of Vulcain main stage engine.
– 1 h 15 mn	Check of connections between launcher and telemetry, tracking and command systems.
– 6 mn 30 s	"All systems go" report, allowing START OF SYNCHRONIZED SEQUENCE.
– 35 s	Start of automated ignition sequence.
– 22 s	Authorization for control handover to onboard computer.
– 03 s	Onboard systems take over.
– 02 s	Unlocking of inertial guidance systems to flight mode.

<b>HO</b>	<b>Ignition of the cryogenic main stage engine (EPC)</b>
+7,0 s	Ignition of solid boosters.
+7,3 s	Liftoff.
+ 13 s	End of vertical climb and beginning of pitch rotation (10 seconds duration).
+ 17 s	Beginning of roll maneuver.
+ 2 mn 25 s	Jettisoning of solid boosters.
+ 3 mn 14 s	Jettisoning of fairing.
+ 9 mn 55 s	Extinction of main cryogenic stage.
+ 10 mn 01 s	Separation of main cryogenic stage.
+ 10 mn 08 s	Ignition of storable propellant stage.
+ 12 mn 06 s	Acquisition by Wallops (Virginia, USA) tracking station.
+ 24 mn 06 s	Acquisition by Svalbard (Norway) tracking station.
+ 25 mn 23 s	Extinction of storable propellant stage.
+ 26 mn 58 s	Separation of ENVISAT satellite.
+ 36 mn 15 s	End of ARIANESPACE Flight 145 mission.

## 4 - Flight 145 trajectory:

The launcher's attitude and trajectory are totally controlled by the two onboard computers, located in the Ariane 5 vehicle equipment bay (VEB).

7.05 seconds after ignition of the main stage cryogenic engine at T-0, the two solid-propellant boosters are ignited, enabling liftoff. The launcher first climbs vertically for 12 seconds, then rotates towards the North. It maintains an attitude that ensures the axis of the launcher remains parallel to its velocity vector, in order to minimize aerodynamic loads throughout the entire atmospheric phase, until the solid boosters are jettisoned.

Once this first part of the flight is completed, the onboard computer optimizes the trajectory in real time, minimizing propellant consumption to bring the launcher first to the intermediate orbit targeted at the end of the main stage propulsion phase, and then the final orbit at the end of the flight of the upper (storable propellant) stage.

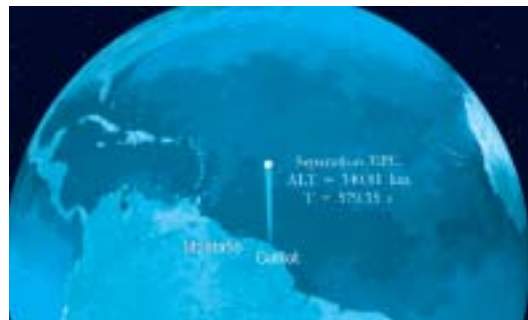
The main stage falls back in the Arctic Ocean. On orbital injection, the launcher will have attained a velocity of approximately 7,600 meters/second, and will be at an altitude of about 800 kilometers.

The fairing protecting the ENVISAT spacecraft is jettisoned shortly after the boosters are jettisoned at about T+200 seconds.

### TRAJECTORY



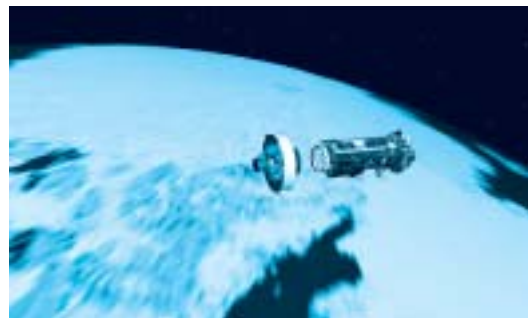
EAP jettison  
ALT = 74.55 km  
T = 143 s



EPC jettison  
ALT = 347 km  
T = 579 s

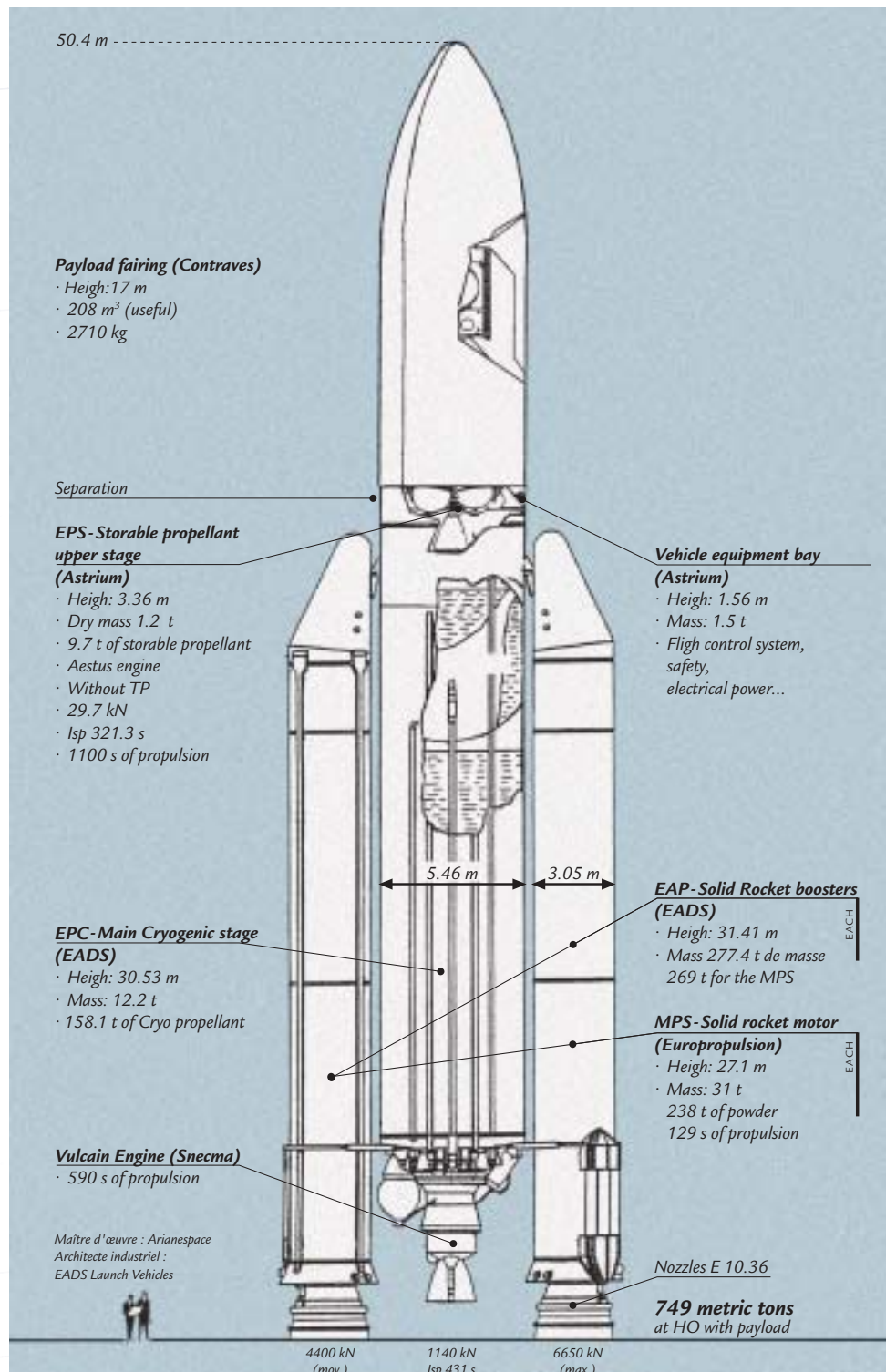


ENVISAT jettison  
ALT = 795.94 km  
T = 1595 s



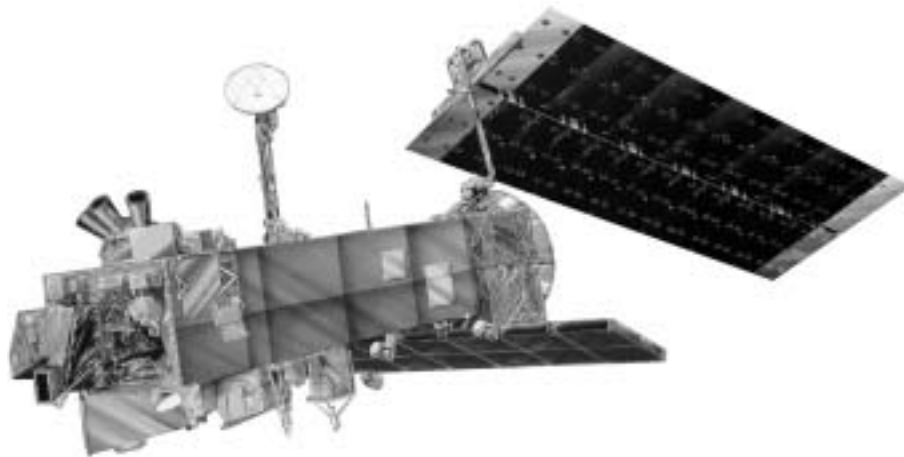
ENVISAT separation

## 5 - Ariane 5 launcher





## 6 - The ENVISAT Satellite:



**Customer** *European Space Agency (ESA)*

**Prime contractor** *Astrium*

**Mission** *Environmental survey*

**Mass** *Total mass at lift-off* 8,111 kg (17,844 lb)

**Dimensions** *10 x 4 x 4 m*  
*Span in orbit* 26 m

**Payload** *10 instruments for Earth observation and atmosphere monitoring*

**On-board power** *6.5 kW*

**Life time** *5 years design life*

**Orbital position** *Global*

**Coverage area** *Sunsynchronous orbit at 800 km*

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## Annex 1 - Arianespace flight 145 key personnel

### In charge of the launch campaign

Mission Director	(CM)	Bernard PUYGRENIER	ARIANESPACE
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### In charge of the launch service contracts

ENVISAT program director and ARIANE Payload Manager	(RCUA)	Patrick LOIRE	ARIANESPACE
ARIANE Deputy Mission Manager	(RCUA/A)	Christophe BARDOU	ARIANESPACE

### In charge of ENVISAT satellite

Satellite Mission Director	(DMS)	Jacques LOUET	ESA
Satellite Project Director	(CPS)	Derek TODMAN	ASTRIUM
Satellite Preparation Manager	(RPS)	Peter DUBOCK	ESA
Satellite Preparation Manager	(RPS)	David SPENCER	ASTRIUM

### In charge of the launch vehicle

Launch Site Operations Manager	(COEL)	Jean REBEU	ARIANESPACE
ARIANE Production Project Manager	(CPAP)	Franck VASSEUR	ARIANESPACE

### In charge of the Guiana Space Center (CSG)

Range Operations Manager	(DDO)	Philippe GILSON	CNES/CSG
Flight Safety Officer	(RSV)	Patrice BENARROCHE	CNES/CSG

## Annex 2 - Launch environment conditions

Acceptable wind speed limits at liftoff range from between 7.5 m/s. to 10 m/s. according to the wind direction. For safety reasons, the wind's speed on the ground (Kourou) and at a high altitude (between 10.000 and 2.000 m) is also into account.

## Annex 3 - The synchronized sequence

The synchronized sequence starts 7 minutes before ignition (T-0). It is primarily designed to perform the final operations on the launcher prior to launch, along with the ultimate checks needed following switchover to flight configuration. As its name indicates, it is fully automatic, and is performed concurrently by the onboard computer and by a redundant computer at the ELA 3 launch complex until T-5 seconds.

The computer commands the final electrical operations (startup of the flight program, servocontrols, switching from ground power supply to onboard batteries, etc.) and associated checks. It also places the propellant and fluid systems in flight configuration and performs associated checks. In addition, it handles the final ground system configurations, namely :

- startup of water injection in the flame trenches and jet guide (T-30 sec) ;
- hydrogen aspiration for chilldown of Vulcain engine in the jet guide (T-18 sec) ;
- burnoff of hydrogen used for chilldown (T-7 sec).

At T-3 seconds, the onboard computer takes over control of final engine startup and liftoff operations :

- It starts the ignition sequence for the Vulcain main stage engine (T-0) ;
- It checks engine operation (from T+4 to T+7 sec) ;
- It commands ignition of the solid boosters for immediate liftoff at T+7.05 seconds.



## Annex 4 - Arianespace order book

To date 195 satellites and 38 auxiliary payloads have been launched by Arianespace.  
Out of the 244 launch services contracted since 1981 by Arianespace and before Flight 145, 40 satellites and 9 ATV missions remain to be launched (2 confidential contracts at the request of customers).

### Europe 13 satellites

Astra 1K, X, 3A
e-Bird
<b>Envisat-1/PPF</b>
Hot Bird 6 & 7
MSG-1 & 2
Rosetta
Spot 5
Stentor
Syracuse III

+ 9 ATV launches

### International organizations 8 satellites

Ameristar (Worldspace)
Inmarsat 4
Intelsat 905, 906, 907
New Skies Satellites 6 & 7
Stellat

### Middle-East and Africa 1 satellite

Amos 2
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### Americas 8 satellites

Anik F2 (Canada)
Galaxy 12 (USA)
Galaxy VR & IRR (USA)
GE TBD (USA)
Loralsat 3 (USA)
Wild Blue 1 & 2 (USA)

### Asia 8 satellites

B Sat 2C (Japan)
Insat 3A & 3E (India)
JCSat 8 (Japan)
L-Star A & B
Thailand/Laos
N-Star C (Japan)
Optus C1 (Australia)

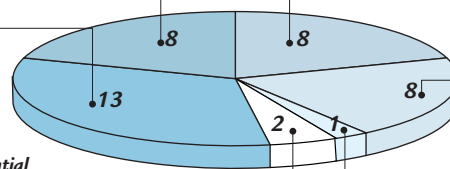
### International

- Inmarsat
- Intelsat
- New Skies
- Stellat
- Worldspace

### Europe

- ESA
- Eumetsat
- Eutelsat
- France
- Luxembourg

**Confidential**  
at the request of customers



### Asia

- Australia
- India
- Japan
- Thailand/Laos

### Americas

- Canada
- USA

### Middle East and Africa

- Israel

## 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 uprated 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 21<sup>st</sup> 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 uprated 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.