Flight 161

A mission for Australia and Japan

For its third launch of the year, Arianespace will send two communications satellites into geostationary transfer orbit: Optus and Defence C1 for Australian operator Optus and the Australian Department of Defence, and BSAT-2c for Broadcasting Satellite System Corporation (B-SAT) of Japan, within the scope of a turnkey contract with Orbital Sciences Corporation of the United States.

Optus and Defence C1 is the second Australian satellite to be launched by Ariane. In September 1987, an Ariane 3 orbited the Aussat K3 satellite. The Optus parent company Singtel also has a satellite in orbit, ST-1, which was launched by an Ariane 44 P in 1998 (Flight 109).

Mitsubishi Electric Corporation of Japan is the prime contractor and is responsible for all communications systems for Optus and Defence C1. Space Systems/Loral (USA) designed, assembled and integrated the bus and satellite system.

Weighing about 4,725 kg at liftoff, it will be positioned at 156 degrees East. It will provide commercial communications services for Australia, New Zealand, East Asia and Hawaii, as well as dedicated links for the Australian Department of Defence.

BSAT-2c is the fifth satellite in this series to be launched by Arianespace, following BSAT-1a on Flight 95, BSAT-1b on Flight 108, BSAT-2a on Flight 140 and BSAT-2b on Flight 142.

Built by Orbital Sciences Corporation in Dulles, Virginia, using the Star–1 platform, BSAT–2c will weigh 1,275 kg at liftoff. It will be positioned at 110 degrees East, and provide direct digital TV broadcast links throughout Japan over its design life of 10 years.

BSAT-2c will be the 19th Japanese satellite launched by Ariane; Arianespace has signed 19 of the 27 commercial satellite launch contracts tendered in the Japanese market. In addition, Ariane launched the LDREX experimental satellite for Japanese space agency NASDA on Flight 138.

For Flight 161, Arianespace will use a standard Ariane 5G launch vehicle.

Follow the launch live on the Internet
at www.arianespace.com
(starting 20 minutes before lift-off)

1. Arianespace Flight 161 mission

The 160th Ariane launch (Flight 161/Ariane 515) will use an Ariane 5 to place 2 telecommunications satellites into geostationary transfer orbit: the Optus and Defence C1 satellite for Australian operator Optus and the Australian Department of Defence and BSAT-2c for B-SAT of Japan, within the scope of a turnkey contract with Orbital Sciences Corp. of the United States.
For Arianespace, this marks the thirteenth commercial mission of the Ariane 5 launcher.
The Ariane 515 launcher will carry a dual payload of 6,877 kg (15,130 lb), including 6,000 kg (13,200 lb) for the satellites.
The launch will be carried out from the ELA 3 launch complex in Kourou, French Guiana.

Injection orbit

Perigee altitude	***590 km***
Apogee altitude	***35,736 km at injection***
Inclination	***7° degrees***

The lift-off is scheduled on the night of June 11 to 12, 2003 as soon as possible within the following launch window :

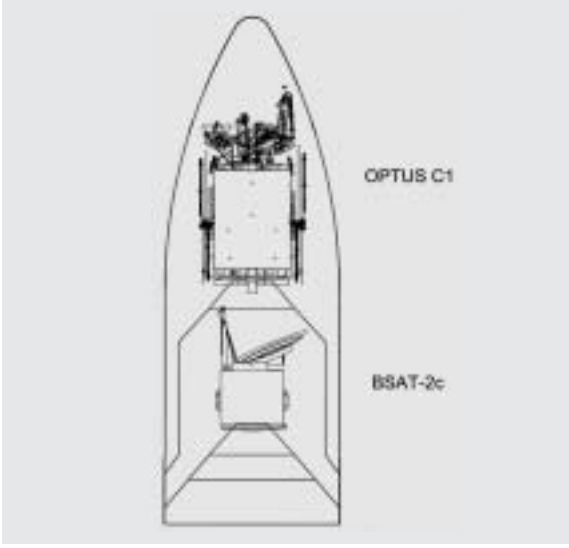
Launch opportunity

	Universal time (GMT)	*Paris time*	*Washington time*	*Kourou time*	*Tokyo time*	*Sydney time*
Between	*09:36 pm*	*11:36 pm*	*05:36 pm*	*06:36 pm*	*06:36 am*	*07:36 am*
and	*11:02 pm*	*01:02 am*	*07:02 pm*	*08:02 pm*	*08:02 am*	*09:02 am*
on	*June 11, 2003*	*June 11-12, 2003*	*June 11, 2003*	*June 11, 2003*	*June 12, 2003*	*June 12, 2003*

Ariane V161 payload configuration

The Optus and Defence C1 satellite was designed, assembled and integrated by Mitsubishi Electric Corporation of Japan as prime contractor and by Space Systems Loral (USA) and Raytheon Systems Company (USA) as major subcontractors.
Orbital position: 156° East, over Melanesia.

The BSAT-2c satellite was built by Orbital Sciences Corporation (Dulles, Virginia).
Orbital position: 110° East, over the Island of Borneo.



2. Range operations campaign : ARIANE 5 – Optus and Defence C1 - BSAT-2c

The actual work for satellite range operations lasts 19 working days for Optus and Defence C1 from its arrival in Kourou (before beginning combined operations).
The actual work for satellite range operations lasts 17 working days for BSAT-2c from its arrival in Kourou (before beginning combined operations).

Satellites and launch vehicle campaign calendar

Ariane activities	*Dates*	*Satellites activities*
	January 11, 2003	*Arrival in Kourou and beginning of Optus and Defence C1 preparation campaign in S1B building*
Campaign start review	*April 24, 2003*	
EPC Erection	*April 25, 2003*	
EAP transfer and positionning	*April 28, 2003*	
Integration EPC/EAP	*April 28, 2003*	
EPS Erection	*April 30, 2003*	
Integration equipment bay	*April 30, 2003*	
	May 13, 2003	*Arrival in Kourou and beginning of BSAT-2c preparation campaign in S5C-South building*
	May 20, 2003	*Transfer of Optus and Defence C1 into the S5A building*
	May 21, 2003	*Transfer of BSAT-2c into the S3A building*
	May 22-26, 2003	*Optus and Defence C1 filling operations in S5A building*
	May 23, 2003	*BSAT-2c filling operations in S3A building*
Roll-out from BIL to BAF	*May 23, 2003*	

Satellites and launch vehicle campaign final calendar

J-9	*Tuesday, May 27*	*Optus and Defence C1 integration on ACU*
J-8	*Wednesday, May 28*	*Optus and Defence C1 integration on Sylda*
J-7	*Saturday, May 31*	*BSAT-2c integration on ACU*
J-6	*Monday, June 2*	*BSAT-2c integration on launcher*
J-5	*Tuesday, June 3*	*Optus and Defence C1 integration on launcher*
J-4	*Wednesday, June 4*	*Filling of SCA with N_2H_4*
J-3	*Thursday, June 5*	*Filling of EPS with N_2O_4 - Launch rehearsal.*
J-2	*Friday, June 6*	*Launcher final preparation and arming of launch vehicle*
J-1	*Tuesday, June 10*	*Roll-out from BAF to Launch Area (ZL), launch vehicle connections and filling of the EPC Helium sphere. Launch readiness review (RAL)*
J-0	*Wednesday, June 11*	*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 satellites and the launch site. The nominal countdown leads to the ignition of the main stage engine, then the two solid boosters, for a liftoff at the targeted time, as early as possible in the satellites launch window.
The countdown culminates in a synchronized sequence (see appendix 3), which is managed by the control station and onboard computers starting at T-7 minutes.
If an interruption in the countdown results in T-0 falling outside the launch window, then the launch will be delayed by one, two or more days, depending on the problem involved, and the solution developed.

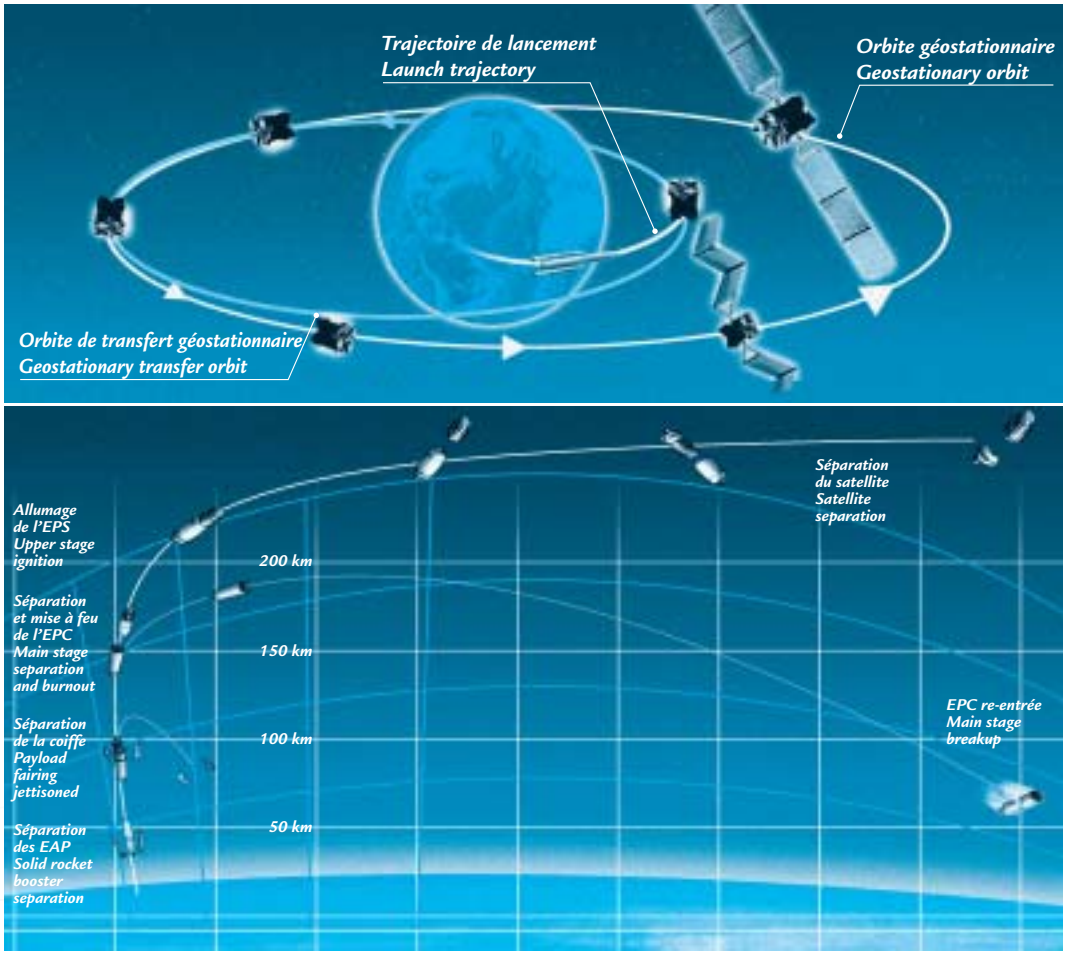
Time	Events
– 11h 30 mn	Start of final countdown
– 7 h 30 mn	Check of electrical systems
– 4 h 50 mn	Start of filling of main cryogenic stage with liquid oxygen and hydrogen
– 3 h 20 mn	Chilldown of Vulcain main stage engine
– 1 h 10 mn	Check of connections between launcher and telemetry, tracking and command systems
– 7 mn 00 s	"All systems go" report, allowing start of synchronized sequence
– 4 mn 00 s	Tanks pressurized for flight
– 1 mn 00 s	Switch to onboard power mode
– 04 s	Onboard systems take over
– 03 s	Unlocking of guidance systems to flight mode

HO	Ignition of the cryogenic main stage engine (EPC)	ALT (km)	V. rel. (m/s)
+ 7.0 s	Ignition of solid boosters	0	0
+ 7.3 s	Liftoff	0	0
+ 13 s	End of vertical climb and beginning of pitch rotation (10 seconds duration)	0.087	34.5
+ 17 s	Beginning of roll maneuver	0.293	65.7
+ 2 mn 22 s	Jettisoning of solid boosters	66.2	2070.8
+ 3 mn 20 s	Jettisoning of fairing	105.9	2330.5
+ 8 mn 09 s	Acquisition by Natal tracking station	133.1	5475.2
+ 9 mn 46 s	Extinction of main cryogenic stage	141.5	7775.9
+ 9 mn 52 s	Separation of main cryogenic stage	144.2	7794.8
+ 9 mn 59 s	Ignition of the storable propellant stage (EPS)	147.4	7791.4
+ 12 mn 17 s	Acquisition by Ascension tracking station	222.6	7921.5
+ 21 mn 35 s	Acquisition by Malindi tracking station	893.9	8339.3
+ 26 mn 52 s	Extinction of EPS	1680.5	8545.7
+ 28 mn 07 s	Separation of Optus and Defence C1 satellite	1916.9	8382.0
+ 31 mn 59 s	Separation of Sylda 5	2729.1	7860.6
+ 35 mn 02 s	Separation of BSAT-2c satellite	3430.5	7455.7
+ 51 mn 21 s	End of ARIANESPACE Flight 161 mission	7439.4	5702.6

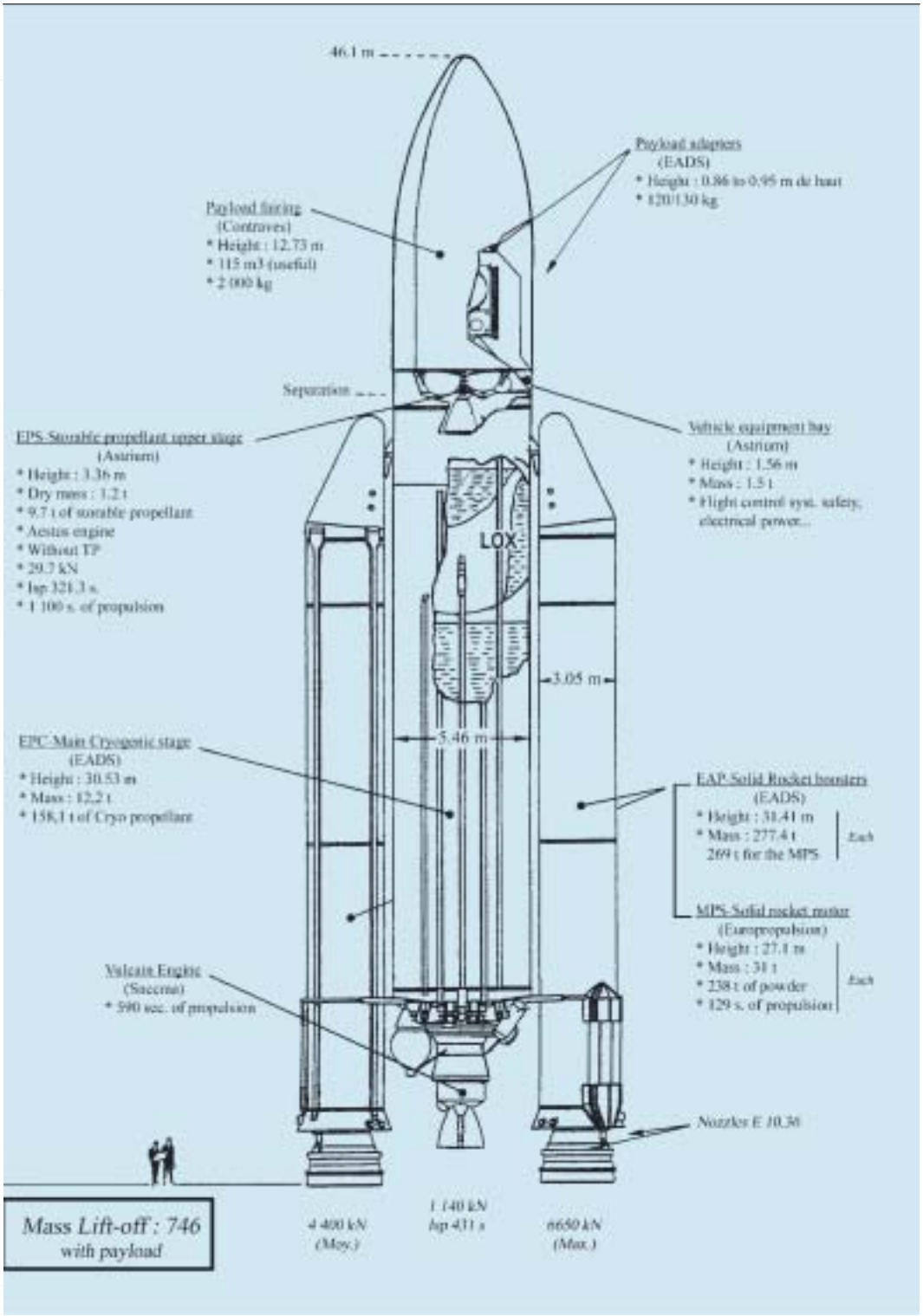
4 - Flight 161 trajectory

The launcher's attitude and trajectory are totally controlled by the two onboard computers, located in the Ariane 5 vehicle equipment bay (VEB).
7.0 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 6 seconds, then rotates towards the East. 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 stage.
The main stage falls back off the coast of South America in the middle of the Pacific Ocean.
On orbital injection, the launcher will have attained a relative velocity of approximately 8,547 meters/second, and will be at an altitude of about 1681 kilometers.
The fairing protecting the Optus and Defence C1/BSAT-2c spacecrafts is jettisoned shortly after the boosters are jettisoned at about T+200 seconds.

Standard Ariane 5 trajectory for geostationary transfer orbit



5 - ARIANE 5G LAUNCHER (Industrial architect: EADS Launch Vehicles)



6 - The Optus and Defence C1 satellite

Customer	***OPTUS and Australian Department of Defence***		
Prime contractor	*Mitsubishi Electric Corporation (Japan)*		
Major subcontractors	*Space Systems Loral (USA)* *Raytheon Systems Company (USA)*		
Mission	*Commercial and military communications*		
Mass	*Total mass at lift-off* *Dry mass*	*4,725 kg* *approx. 2,000 kg*	*(10,355 lb)* *(4,349 lb)*
Stabilization	*3 axis stabilized*		
Dimensions	*on orbit*	*8.2 x 7.8 x 24.9 m*	
Payload	*Commercial:* *Defence:*	*24 Ku band transponders* *4 X band transponders* *4 Ka band transponders* *6 UHF band channels*	
On-board power	*10,600 Watts*		
Life time	*15 years*		
Orbital position	*156° East (above Melanesia)*		
Coverage area	*Australia, New Zealand, Hawaii, Asia-Pacific Region*		

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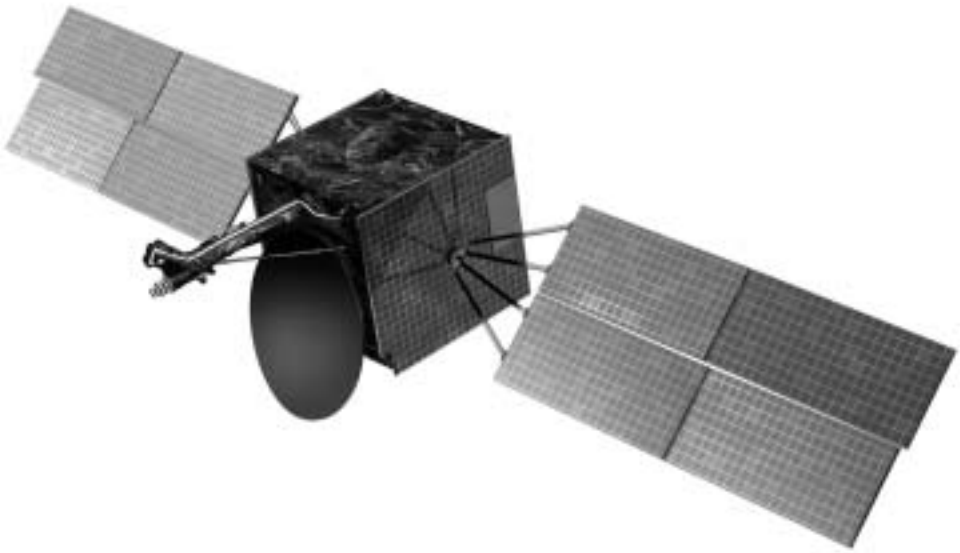
7 - The BSAT-2c satellite



Customer	***ORBITAL SCIENCES CORP. (USA) for B-SAT (Japan)***	
Prime contractor	*Orbital Sciences Corporation, Dulles, Virginia*	
Mission	*Digital Broadcasting*	
Mass	*Total mass at lift-off*	*1,275 kg (2,805 lb)*
	Dry mass	*535 kg (1,177 lb)*
Stabilization	*3 axis stabilized*	
Dimensions		*3.7 x 2.5 x 2.0 m*
	Span in orbit	*11.50 m*
Platform	*Orbital's Star-1*	
Payload	*4 Ku band transponders*	
	Uplink	*17.25 - 17.65 GHz*
	Downlink	*11.65 - 12.05 GHz*
On-board power	*2,6 kW (at begining of life)*	
Life time	*10 years*	
Orbital position	*110° East, above the Island of Borneo*	
Coverage area	*Japan*	

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Appendix 1 - Arianespace Flight 161 key personnel

In charge of the launch compaign			
Mission Director	*(CM)*	*Didier CASSE*	*ARIANESPACE*
In charge of the launch service contracts			
ARIANE Payload Manager	*(RCUA)*	*Steve HALL*	*ARIANESPACE*
ARIANE Deputy Mission Manager	*(RCUA/A)*	*Michael CALLARI*	*ARIANESPACE*
In charge of Optus and Defence C1 satellite			
Satellite Mission Director	*(DMS)*	*Gordon PIKE*	*OPTUS*
Satellite Launch Director	*(CPS)*	*Grant GOULD*	*SSL*
Satellite Preparation Manager	*(RPS)*	*Lawrence KENNEDY*	*SSL*
In charge of BSAT-2c satellite			
Satellite Mission Director	*(DMS)*	*Timothy HEMKE*	*OSC*
Satellite Project Director	*(CPS)*	*M. KRISHAMURTHY*	*OSC*
Satellite Project Manager	*(RPS)*	*Marcy TAYLOR*	*OSC*
In charge of the launch vehicle			
Launch Site Operations Manager	*(COEL)*	*Pierre-François BENAITEAU*	*ARIANESPACE*
ARIANE Production Project Manager	*(CPAP)*	*Bernard DONAT*	*ARIANESPACE*
In charge of the Guiana Space Center (CSG)			
Range Operations Manager	*(DDO)*	*Bruno GILLES*	*CNES/CSG*
Flight Safety Officer	*(RSV)*	*Hervé POUSSIN*	*CNES/CSG*

Appendix 2 - Launch environment conditions

Acceptable wind speed limits at liftoff range from between 7.5 m/s. to 9.5 m/s. according to the wind direction. The most critical is a northerly wind. For safety reasons, the wind's speed on the ground (Kourou) and at a high altitude (between 10,000 and 20,000 m) is also taken into account.

Appendix 3 - The synchronized sequence

The synchronized sequence starts 7 mn 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 two redundant computers at the ELA 3 launch complex until T-4 seconds.
The computers command the final electrical operations (startup of the flight program, servocontrols, switching from ground power supply to onboard batteries, etc.) and associated checks. They also place the propellant and fluid systems in flight configuration and perform 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 the Vulcain engine in the jet guite (T-18 sec);
- burnoff of hydrogen used for chilldown (T-5.5 sec);

At T-4 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+4.5 to T+7.3 sec);
- It commands ignition of the solid boosters for immediate liftoff at T+7.3 seconds.

Any shutdown of the synchronized sequence after T - 7 mn automatically places the launcher back in its T-7 min configuration.

Appendix 4 - ARIANESPACE, its relations with ESA and CNES

FROM A PRODUTION 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).

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 350. Share capital totals 317,362,320 €.

Arianespace is in charge of these main areas :

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

Personalized reliable service forms an integral part of Arianespace launch package. It includes the assignment of a permanent team of experts to each mission for the full launch campaign.

The world's commercial satellite operators have contracted to launch with Arianespace. This record is the result of our company's realistic cost-effective approach to getting satllites 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 launching of operational launchers to a private-law industrial structure, in the form of ARIANESPACE company, placing at its disposal the facilities, equipment and tooling needed of producing and launching the ARIANE launchers.

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 and its new launch facilities : ELA 3 (qualified on November, 1997). 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 5 Oct, 1998, 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.

THE GUIANA SPACE CENTER: EUROPE'S SPACEPORT

For over 30 years, the Guiana Space Center (CSG), Europe's Spaceport in French Guiana, has offered a complete array of facilities for rocket launches.

It mainly comprises the following:

- CNES/CSG technical center, including various resources and facilities that are critical to launch base operation, such as radars, telecom network, weather station, receiving sites for launcher telemetry, etc.
- Payload processing facilities (ECPU), in particular the new S5 facility.
- Ariane launch complexes (ELA), comprising the launch zone and launcher integration buildings.
- Various industrial facilities, including those operated by Regulus, Europropulsion, Air Liquide Spatial Guyane and EADS, which contribute to the production of Ariane 5 elements. A total of 40 European manufacturers and local companies are involved in operations.

Europe's commitment to independent access to space is based on actions by three key players: the European Space Agency (ESA), French space agency CNES and Arianespace.

ESA has helped change the role of the Guiana Space Center, in particular by funding the construction of the launch complexes, payload processing buildings and associated facilities. Initially used for the French space program, the Guiana Space Center has gradually become Europe's own spaceport, according to the terms of an agreement between ESA and the French government.

To ensure that the Spaceport is available for its programs, ESA takes charge of the lion's share of CNES/CSG fixed expenses, and also helps finance the fixed costs for the ELA launch complexes.

French space agency CNES plays several roles at the Space Center:

- It designs all infrastructures and, on behalf of the French government, is responsible for safety and security.
- It provides the resources needed to prepare the satellites and launcher for missions.

Whether during tests or actual launches, CNES is also responsible for overall coordination of operations. It collects and processes all data transmitted from the launcher via a network of receiving stations, to track Ariane rockets throughout their trajectory.

In French Guiana, Arianespace is in charge of launcher integration in the Launcher Integration Building (BIL), coordinates satellite preparation in the payload processing facility (EPCU), and integrates them on the launcher in the Final Assembly Building (BAF). It is also responsible for launch operations, from the CDL 3 Launch Center.

Arianespace has created a top-flight team and array of technical resources to get launchers and satellites ready for their missions. Building on this unrivalled expertise and outstanding local facilities, Arianespace is now the undisputed benchmark in the global launch services market.