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Soyuz at the Guiana Space Centre

European Space Agency
Agence spatiale européenne

In 2008 a Russian-built Soyuz launcher will take off from Europe's spaceport in French Guiana. This historic event will be the first time that a Soyuz launcher has lifted off from anywhere other than Baikonur or Plesetsk, and represents a milestone in the strategic cooperation in the launch sector between Europe and Russia.

The introduction of Russia's Soyuz 2 launcher to French Guiana is an exciting new opportunity for ESA and it means that however diverse future launch requirements are, Europe will be able to offer a solution in the form of either Ariane-5, Soyuz or Vega.

The agreement between Europe and Russia on commercial launches of the updated Soyuz 2 carrier rockets from Europe's Spaceport in French Guiana was signed in the summer of 2003 and will benefit both sides.

Russia's space programme will receive additional income through the launch of satellites and spacecraft from one of the world's most attractive and best-placed space centres.

ESA, meanwhile, will benefit from the availability of a dependable and well-proven medium-class launch vehicle, known and respected throughout the world.

Later, it also introduces the possibility of launching crewed missions from Europe's spaceport, a move which could have tremendous significance further raising the profile of Europe in this field.

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ESA Director of Launchers

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A dynamic new phase

A dynamic new phase of development has begun at the European spaceport in French Guiana that will lead to the launch of Soyuz rockets from the equatorial launch base in South America.

The European Space Agency (ESA), Arianespace and the Russian Federal Space Agency (Roskosmos), have embarked on a bold new project to construct and develop new launch facilities for Soyuz.

Known as the Soyuz at CSG (Soyuz at the Guiana Space Centre) programme, strongly supported by the French Space Agency (CNES), it will bring a new perspective to the European launcher sector and consolidate European access to space for medium-sized spacecraft.

The Russian Soyuz will fit neatly between the ESA-developed launchers – Ariane-5 and Vega – and Europe's international commercial launch company Arianespace will have exclusive rights for the commercial exploitation of Soyuz from French Guiana.

As well as strengthening Europe's long-term cooperation in the launch sector with Russia, Soyuz will bring the exciting future potential for upgrading the new launch facility to allow crewed launches to the International Space Station.

Europe benefits from the best-placed and most efficient launch base in the world, near Kourou, in French Guiana, South America. The launch sites extend along a 15 km stretch of coast – launch towers, assembly buildings and telemetry dishes bordered on one side by the Atlantic and on the other by the northern reaches of tropical rain forest.

The first launch facilities at Kourou were developed by ESA and CNES in the 1970s. The launch site for Ariane-5 was inaugurated in 1996 and is operated by Arianespace for launching spacecraft into geostationary, synchronous and medium and low-Earth orbits.

Strategy

ESA's launcher strategy is founded on the principle of offering the nations of Europe guaranteed access to space – by implication meaning that Europe should endeavour to launch by its own means any category of mission.

It is now more than two decades since ESA first sent an Ariane launcher – designed, developed and manufactured by ESA and its prime partners in CNES and European industry – into space from French Guiana.

Ariane-5 is currently meeting the requirement for larger satellites, and Vega will complement this from the end of 2007 onwards for smaller spacecraft requiring launch performances at the lower end of the mass spectrum. The middle ground between Ariane-5 and Vega will be filled neatly and economically by Soyuz.

Arianespace will be the commercial operator and although Soyuz cannot be considered a genuine European launcher, the exclusivity agreements between Arianespace/Starsem and Roskosmos, and the Launcher Agreement between ESA and Roskosmos provide adequate guarantees for it to be considered within the efficient implementation of the European Guaranteed Access to Space (EGAS) programme.

From a European perspective, closer cooperation with Russia will bring significant other benefits too, such as cheaper access to new technologies, a reduction in the development and production costs of new launcher systems, as well as opening the door to other possible commercial partnerships in the future.

Soyuz at the Guiana Space Centre represents a shrewd and prudent strategy for Europe – for a limited cost, it will add a new and very significant dimension to Europe's launch capabilities.

Arianespace
Arianespace is a global commercial launch services leader, holding more than 50 percent of the world market for satellites to geostationary transfer orbit (GTO). It was created as the first commercial space transportation company in 1980 and has signed contracts for over 250 satellite payloads. Arianespace is responsible for the production, operation and marketing of the Ariane-5 launchers, and is a partner in the commercial operations of Starsem's Soyuz launch vehicle.

Starsem
Starsem is the Soyuz company dedicated to providing commercial launch services with the reliable and proven Soyuz family of launch vehicles from Baikonur. Created in 1996, the Russian-European company brings together all key players involved in the production and operation of Soyuz and is responsible for international sales of the world's most versatile launch vehicle.

Human spaceflight

The Soyuz launcher is currently one of the few systems in the world capable of transporting humans into space so, in designing the Soyuz launch facilities in French Guiana, it makes sense to take into account this potential for the future.

The new launch infrastructure has therefore been designed to ensure that it can be adapted for human spaceflight, should this be decided upon at some point in the future.

Transportation

Before blasting its payload into orbit, the Soyuz launcher will have to complete the journey from Russia to French Guiana by both rail and sea.

The first part will carry various launcher elements from Samara on the banks of the Volga river in Russia, where the launcher is built, on a three-day rail journey to St Petersburg, where they will be transferred to ship for a 15 day ocean voyage to the port of Kourou on the South American continent.

Launch site

The Kourou Space Centre offers numerous advantages in the context of projected Soyuz launches. Its proximity to the equator means it takes more or less the same thrust-to-weight ratio (i.e. the same sized rocket) to put a 3.0-3.2 tonne payload into orbit from Kourou as a 1.5-2.0 tonne payload from Baikonur in Russia. The advantages are obvious.

A major construction project for a new launch pad and support facilities started in early 2004 following geotectonic surveys the previous year. European industry is responsible for the ground infrastructure and Russian industry is providing the launch table, the mobile gantry, fixed and mobile filling systems, test benches and other equipment.

The Soyuz launch site is being constructed some 13 km north west of the Ariane-5 launch complex. It comprises two main areas – the forward zone, containing the launch pad, and the rear zone that will include the spacecraft preparation building.

launch construction 1

The entrenched reinforced concrete construction incorporates an approximately 15 metre diameter opening over the two upper levels to accommodate the launch table. It includes both the Russian and European facilities necessary for launch operations.

mobile gantry 2

The metallic mobile gantry protects the launcher against external climatic conditions and gives access to all stages of the launcher, including the upper composite, for all operations relating to integration and control. Prior to the final launch sequence the mobile gantry will be moved on rails to a stand-by position.

flame trench 3

Cut out of the granite below, this enables the evacuation of the launcher's jet stream on lift-off and the collection/removal of any water sprayed onto the launch pad.

launcher preparation zone (ZP) 4

This comprises a main building (MIK) for the horizontal integration of a Soyuz launcher, its control facilities, off-loading of the stage containers, handling, control, and storage of the launcher stages and Fregat upper stage.

launch control centre (CDL) 5

It houses the ground service equipment and control/command facilities, enabling remote operation and monitoring of the system during launch. For safety reasons this is located away from the launch pad.

The two zones are separated by a distance of approximately 700 metres and a rail track between the two will enable the Soyuz three stage launcher to be transferred in a horizontal position to the launch pad, where it will be erected into its vertical launch position. The upper composite will then be transferred to the pad and hoisted onto the top of the launcher.

The launch pad is based on an existing Russian design already used at Baikonur and adapted to conform with European safety regulations.

A 45 metre high launch tower, including platforms for access at different levels, is being constructed for placing the upper payload unit on the launcher and this would be extendable to 53 metres for manned spacecraft. The pad itself will be protected by 80 metre-high lightning rods.

A new launch control centre will house the equipment and personnel necessary for launch operations. The building will be large enough for the expected workforce of 80 to 100 people required to launch the Soyuz with Fregat stage and, with safety in mind, will be designed to withstand the impact of a three tonne object falling from a height of 40 metres.

Launch systems integration and testing will be carried out by combined European and Russian teams.

ancillary areas 6

The launcher propellant storage and decanting zones are spread out over the launch site area at a safe distance from the pad. Special zones are reserved for kerosene, hydrogen peroxide, liquid oxygen and nitrogen, and compressed gases.

In addition, there are a number of buildings for ground service equipment located in the preparation zone about 200 metres from the launch pad. These provide shelter for the ground service equipment and associated facilities, including nitrogen and helium compressors, launcher battery chargers, air conditioning and power production.

Payload preparation complex (EPCU)

Complementing original facilities of CNES and later ones from the Ariane development programmes, ESA has constructed a complex for preparing satellites, located halfway between the Technical Centre and launch sites.

These buildings provide for satellite and control equipment packing, mechanical assembly work, electrical and mechanical inspections, and check-out of the various platform and payload sub-systems.

The S3 building will be used to fill the Fregat upper stage and complete upper composite assembly under the fairing.

Launch vehicles

Vega

Although there is a growing tendency for satellites to become larger, there is still a need for an economical small launcher to place the 300 to 2000 kg satellites used for many scientific and Earth-observation missions into polar and low-Earth orbits.

Europe's answer to these needs is Vega – named after the second brightest star in the northern hemisphere – which, unlike most small launchers, will be able to place multiple payloads into orbit.

Development costs have been minimised using advanced low-cost technologies and by optimising the synergy with existing production facilities used for Ariane launchers.

Vega has been designed as a single body launcher. Its development started in 1998 and the first launch is planned for the end of 2007 from French Guiana, where the original Ariane-1 launch facilities have been adapted for its use.

The reference mission for Vega is the launch of a 1500 kg spacecraft into a 700 km polar orbit. But Vega will also be able to lift heavier spacecraft into lower orbits or orbits closer to the equator.

The Vega launcher configuration comprises three solid-propellant stages – the P80 first stage, the Zefiro 23 second stage, the Zefiro 9 third stage, plus an upper liquid propulsion module, called AVUM, for attitude and orbit control and satellite release. The Vega upper composite includes the payload adapter and the fairing.

Ariane-5

Ariane-5 – conceived by ESA to ensure Europe maintained its competitive edge in the global launch market – made its first successful launch on 30 October 1997.

Its first operational flight took place two years later in December 1999 when it launched ESA's X-ray Multi-Mirror (XMM) satellite. Since then it has been used to launch satellites for commercial communications, Earth observation and scientific research.

Ariane-5 is used for launches into geostationary orbit, medium and low-Earth orbits, and Sun-synchronous orbits. The launch site also includes facilities to integrate the solid boosters and produce the solid propellant they use.

The workhorse Ariane-5 is currently available in three configurations for service to low-Earth, geostationary-transfer and Earth-escape orbits. ESA is also considering a more powerful upper stage and has evaluated alternative configurations to create a super-heavy-launch version of Ariane-5 version.

Soyuz 2 and Soyuz ST

The Soyuz launcher in various configurations has been the workhorse of Russia's manned and unmanned programme since the 1960s and more than 1700 Soyuz rockets have been launched in its various guises.

Soyuz 2 is the latest evolution of the renowned family of Russian launchers that started the space race almost 50 years ago with the launch of Sputnik in 1957 and later put the first man – Yuri Gagarin – into space.

Soyuz is a medium-class launcher and its performance will perfectly complement that of the ESA launchers, Ariane and Vega. It will enhance the competitiveness and flexibility of the exploitation of the Ariane launcher on the commercial market. At the same time Russia will have access to what experts consider to be the best location from which to launch telecommunication satellites – close to the equator.

It will have improved performance due to the geographic location and be able to place up to 3.2 tonnes into geostationary transfer orbit, as opposed to the 2.0 tonnes that can be launched from Baikonur in Kazakhstan.

The Soyuz 2 features two major upgrades. The Soyuz 2-1a with a modern digital control system increases atmospheric flight control capability and allows large fairing utilisation, providing additional volume to the payload and greater mission flexibility. The Soyuz 2-1b will add an upgraded third stage engine to the digital control system, increasing the launcher's load carrying capability by 15 percent.

The Soyuz 2-1a successfully lifted off from the Plesetsk cosmodrome in Russia on 8 November 2004. It was a major step forward prior to the launcher's entry into commercial operation and its arrival in Kourou.

The next step will be the introduction of the ST fairing into flight with Soyuz 2-1a in early 2006 from Baikonur. This will define the Soyuz-ST configuration also applicable for French Guiana.

The market entry of the Soyuz 2-1b will be with the launch from Baikonur in 2006 of the COROT science satellite developed by CNES to seek out exo-planets and probe the inner workings of stars.

This second commercial launch will complete the Russian demonstration of improved capabilities for the Soyuz ST launch vehicle, anticipating a first launch from French Guiana in 2008.

Launch market

ESA's Ariane launcher has become one of the biggest commercial success stories in the history of space. It began in 1973 after the nations of Europe realised that independent access to orbit and the development of a pioneering space programme go hand-in-hand.

Soon the Arianespace-operated launcher family – based on Ariane-5, Soyuz and Vega – will be able to launch any size of spacecraft at competitive prices and cover the entire range of potential spacecraft sizes, from 500 kg to 20 tonnes and more in low Earth orbits, up to 10 tonnes in geostationary orbit.

The capacities of the three launchers will be fully complementary for low-Earth-orbit applications as their market sectors will not cross.

It is anticipated that the demand for non-commercial missions – such as a Galileo demonstration spacecraft or Venus Express – should give a yearly launch rate of one or two missions for Soyuz from either Baikonur or French Guiana.

Commercially, Arianespace forecasts that the addition of Soyuz in French Guiana could help it capture at least two thirds of the market for spacecraft of less than three tonnes, compared to an expected maximum 50 percent market share with Ariane 5 alone.

Ariane-5 G

Ariane-5 ECA

Ariane-5 ES

Soyuz

VEGA

Construction costs

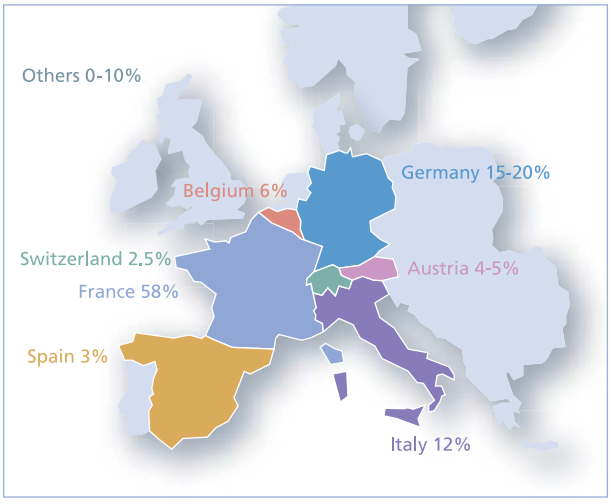
The total cost to Europe for the Soyuz launch system installation in French Guiana is estimated to be € 344 million (2003 economic conditions). This cost is split between the ESA Participating States, providing € 223 million, and Arianespace, contributing € 121 million.

The cost covers:

- Ground segment infrastructure development in French Guiana by European companies
- Soyuz launcher adaptation to CNES/CSG regulations
- Development, manufacture and transport of Russian equipment
- Industrial management and ESA internal costs.

Initial finance will be provided by a pool of investors managed by ESA as a third-party activity. Once the facility has been built and operationally qualified, Arianespace will commence exploitation within the framework of a ten-year rental contract.

ESA Member State contributions



Acronyms

CDL	Launch centre Centre De Lancement
CNES	French National Space Agency Centre National d'Etudes Spatiales
ELS	Soyuz launch site Ensemble de Lancement Soyuz
EPCU	Payload preparation complex Ensemble de Préparation des Charges Utiles
MIK	Main building for horizontal integration Bâtiment d'intégration lanceur
ZL	Launch zone Zone de Lancement
ZP	Preparation zone Zone de Préparation
ZTO	Orchidée technical zone Zone Technique Orchidée

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