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Launch safety Part 3

**LESSONS LEARNED FROM THE APPLICATION OF THE REGULATIONS
ASSOCIATED TO FSOA DURING THE QUALIFICATION AND THE FIRST FLIGHTS OF
SOYOUZ AND VEGA**

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FSOA : FORMER LEGAL FRAMEWORK 1/2

A bit of history

- The Guiana Space Center is a French launch base set up in the mid 60's to follow up national program (' Diamant family')
- It was proposed to international cooperation in 1964, and used by ELDO for Europa 2 launcher
- 1973, July 31st creation of ESA and decision to develop Ariane

Agreement between French government and ESA (1976, May)

- ESA recognize that the French government has delegated to CNES, its responsibilities over the general safety, security and base management at the GSC.
- France and ESA set up sharing indemnification rules for damages caused by launchers operated from GSC

FSOA : FORMER LEGAL FRAMEWORK 2/2

European Intergovernmental treaty 1980, January 14th (“Ariane Production Declaration”)

ESA + French Gvt

- Specifies the liability regime of Ariane (operated by Arianespace)
- reaffirms the full and exclusive liability of the French government as a Launching State under the UN 1972 Liability Convention.
- Arianespace required to reimburse the French Gvt within a ceiling of 60 M€. ESA on its side is entrusted by the European State Participants to conclude a convention with Arianespace to implement this Declaration.

End of 90's, privatization of Arianespace and Eutelsat, who had their main office and center of activities in France and the perspectives to open GSC to other launchers than Ariane (namely Soyuz) will conduct on studies on the opportunity to propose legislation for space activities.

Soyuz in Guiana : First discussions started in 1999

Inter-gouvernemental (France + Russia) agreement in 2003

FRENCH SPACE OPERATIONS ACT LAW MAKING

- In parallel, of these evolutions of context for space activities, a report “on the evolution of Space Law in France” issued by the Ministry in charge of space affairs in 2003.
- Council of state is seized in order to conduct consultation and legal studies in this field.
- First official draft issued in 2007
- The French Space Operations Act (FSOA) enacted by French President on June 3rd 2008,
- Two implementing decrees, enacted by the Government on June 9th 2009, specifying
 - ◆ the authorization and control regime for Space activities
 - ◆ The specific regime for Guyana Space Center (safety of the Guiana Space Centre, coordination), and registration rules

EVOLUTION OF REGULATION FOR LAUNCHERS

CSG Range command rules

- Quality system
- Launcher reliability
- Stage fall-back
- Far field (quantitative requirement)
- definition and tuning and application of predictive intervention criteria
- Near field
- Staff protection on ground
- Launch field interfaces
- Real time safeguard operation

Code of conduct on debris

- space debris mitigation

Before the act

After the act

Technical Regulation

- Quality system
- Launcher reliability
- Stage fall-back
- Far field (quantitative requirement)
- definition and tuning of predictive intervention criteria
- space debris mitigation
- Collision avoidance
- Hazard analysis
- Environmental Impact analysis

Decree Regulating the Operation of CSG

- Application of predictive intervention criteria
- Near field requirements
- Staff protection on ground
- Launch field interfaces
- Real time safeguard operation

- A new approach required
- 2 new methodological requirements

SOYUZ IN GUIANA : LEGAL CONTEXT

- The Program is performed in the frame of inter-governmental agreement concerning the French-Russian cooperation in the field of space launchers (2003),

that defines :

- ◆ the repartition of responsibilities between France and Russia as regards the 1972 Liability Convention,
- ◆ France and Russia as co-states of launch.

that appoints

- ◆ Roskosmos, as the certification authority of the launcher Soyuz-ST adapted for CSG.

that mentions

- ◆ That launches are submitted to an authorization by French authority, and a continuous checking by the French party.

- Regulations applicable to the program Soyuz in Guiana, were CSG Range command rules at the beginning (2005), and became RT-REI, end of 2010.



*Soyuz first lift-off from CSG
2011, October 21th*

SOYUZ IN GUIANA : APPLICABLE REGULATIONS

Compliance with regulation

Soyuz basic configuration is qualified in Russia, with an autonomous on-board safety system which detects abnormal situations and triggers the automatic engine shutdown command.

In 2005, for conformity with RSG, adaptations of the launcher were made:

- Addition of a European Safety Kit (KSE) : possible neutralization of the rocket from the ground,
- Adaptation of the telemetry system to be compatible with the downrange stations tracking network used by CSG.
- Addition of devices on the strap-on boosters to assure quick sinking after their fallout at sea

Switch RSG -> RT-REI

The new regulations (RT and REI), made applicable on December, 2010 10th. They arrived at the end of development of the Soyuz program in CSG which started in 2005.

As previously shown, the new regulations introduced a limited number of additional requirements :



demonstration of conformity with the new regulations, made in a progressive way, without disturbances at the project level, and in a rather short time.

SOYUZ IN GUIANA : COMPLIANCE WITH THE REGULATIONS

Regime of authorizations of launch applied to Soyuz-ST in CSG

FSOA: authorizations to proceed to the launch operations granted after inspection by CNES of the conformity of the systems and the procedures with the regulations.

FSOA + inter-governmental agreement:

Roskosmos : certification authority of the launcher Soyuz-S. As such, the Russian Space Agency:

- Guarantees the compatibility of equipments supplied by the Russian entities concerning the Soyuz launch facilities and Soyuz-ST with the ground and flight protection standards of CSG
- Guarantees that supplied Soyuz-ST complies, on the ground and in-flight, with safety regulations and current protection in CSG, and in their own technical specifications,
- Assures the supply of documents concerning the certification of Soyuz-ST for its use in CSG, before, its transfer on the territory of the French Republic.

CNES :

- Check the equipments supplied by the European entities (KSE), check operation made by European teams

SOYUZ IN GUIANA : COMPLIANCE WITH THE REGULATIONS

Regime of authorizations of launch applied to Soyuz-ST in CSG

CNES and Roskosmos defined practical terms jointly within the framework of a workgroup (2011) to make sure of the conformity of the Soyuz launch system in CSG with the French regulations:

- Delivery of elements allowing to submit the authorization application, among others on the basis of the information supplied by Roskosmos (certificates and attestations of conformity),

The work of the group allowed to check:

- availability of technical data necessary (for the calculation of the risk in far field, calculation of the collision hazard with the ISS for specific missions, a.s.o.)
- perimeter covered by certification activities, in particular coverage of the Russian industrial activities by the Russian bodies of inspection,
- that the results of inspections were attested well in certificates, attestations of conformity and reports issued by the bodies of inspection,

SOYUZ IN GUIANA : GENERAL ORGANIZATION FOR TECHNICAL CHECK

The general organization for the technical conformity check, is a declination of the intergovernmental agreement.

- control « of level 1 » is within the competence of the Russian and European industrial entities
- conformity check « of level 2 » is performed by a mixed Franco-Russian inspection team :
 - ◆ The Russian entities of inspection check the activities realized in Russia or by the Russian part in Guiana,
 - ◆ CNES inspectors check the industrial activities realized in Europe and the operations in Guiana under the responsibility of the operator of launch Arianespace

To propose the authorization of launch, CNES inspectors take into account in their synthesis, the attestations and the reports delivered by the Russian entities of control.

- Cross-checks studies:
 - ◆ The Russian bodies of inspection and CNES inspectors perform independent studies to check dedicated performances or results.
 - ◆ Crosses-checks realized by CNES during the preparation of the Soyuz missions for the CSG essentially concern the quantitative evaluation of the launch risk and the analysis of the fragmentation of the launcher elements during their fall-back.

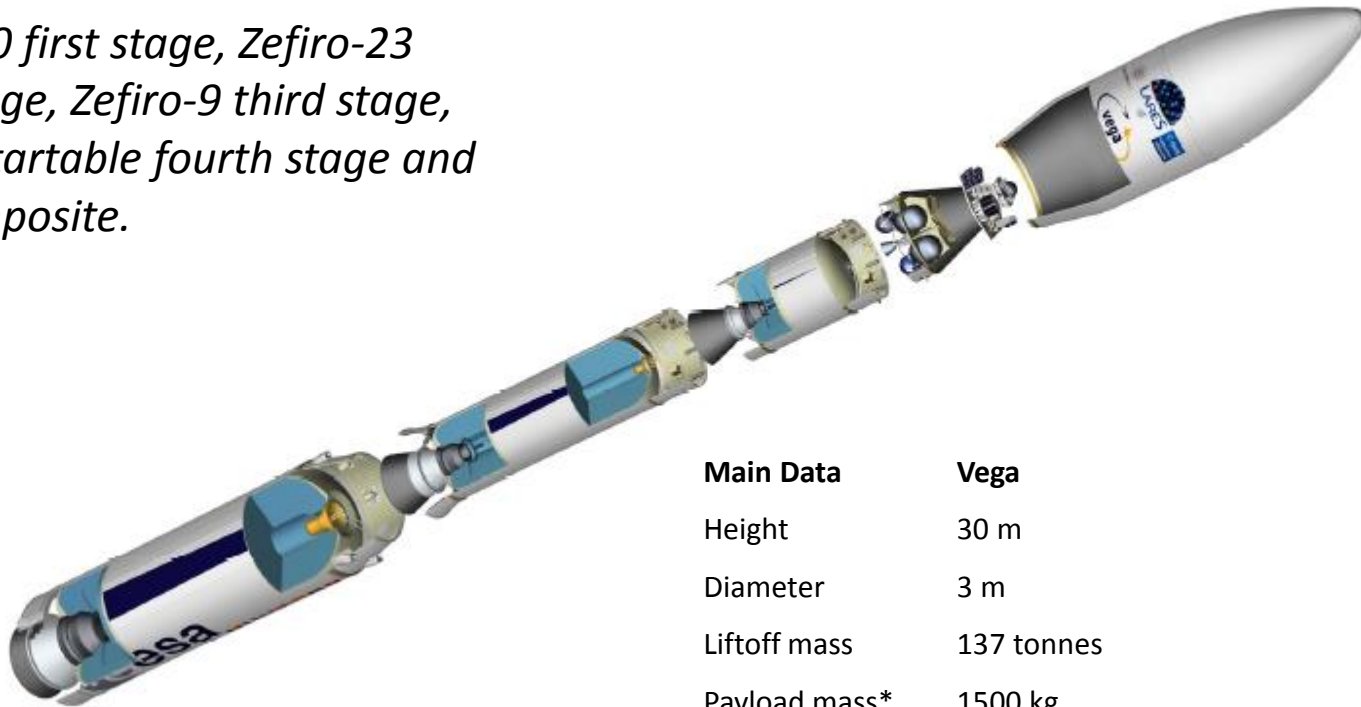
SOYUZ IN GUIANA : EXPERIENCE FEEDBACK FURTHER TO THE FIRST LAUNCHES

- The regime of authorization of the Soyuz launches, which leans on a French-Russian agreement, is assessed during an annual meeting of exchanges with the Russian partners.
- measures defined within the framework of the workgroup on the regime of the Soyuz authorizations were well applied for the first Soyuz launches.
- The application of the various components of the device set up within the framework of the regime of the authorizations of launch applied to Soyuz ST in CSG, effective from the first launch, widely contributed to the success of the first Soyuz launches in CSG.



VEGA : GENERAL DESIGN

VEGA : P80 first stage, Zefiro-23 second stage, Zefiro-9 third stage, AVUM restartable fourth stage and upper composite.



Main Data	Vega
Height	30 m
Diameter	3 m
Liftoff mass	137 tonnes
Payload mass*	1500 kg

Small European launcher to place 300–2000 kg satellites, economically, into the polar and low-Earth orbits used for many scientific and Earth observation missions

VEGA : a European launcher developed by ESA.

VEGA : LEGAL REGIME

- ESA, by virtue of the privileges and the immunities attached to its status of international organization is not submitted to national law, and so not submitted to FSOA.
- It is however planned in ESA status, that ESA cooperates any time with the appropriate authorities of member states to insure the observation of regulations concerning the public health or other national laws of similar nature.
- The agreement between the French Government and ESA concerning CSG and the services associated of December 18th, 2008 defines the skills of the CNES regarding protection, safety and security.
- In application of this agreement ESA has asked to be able to apply article 11, of the decree on authorization that allows any person responsible for designing or developing a system or a sub-system that is critical having regard for the safety of people and property and the protection of public health and the environment,

VEGA : LEGAL REGIME

Compliance with regulation

At the beginning of development of VEGA, the applicable regulation was the Guiana space Center Range command rules (RSG).

Switch RSG -> RT-REI

The new regulations associated with the FSOA (RT and REI), were made applicable on December, 2010 10th. They arrived at the end of development of the VEGA program which started end of 2000.

Attestation of conformity

After having shown the continuity of regulations, as previously presented, a coordination group was set up concerning the conformity of VEGA to the French regulation (RT/REI). Its objectives were to identify the requirements of the regulation covered by the qualification, the not covered one, the data to be exchanged, and thus establish the work allowing to demonstrate the conformity of VEGA launch system with the regulations.

The group worked between February and September of 2011.

A complete file of conformity was established by ESA , and analysed by CNES inspectors.

An inspection plan was established covering qualification aspects, realization of stages, and integration and operation activities.

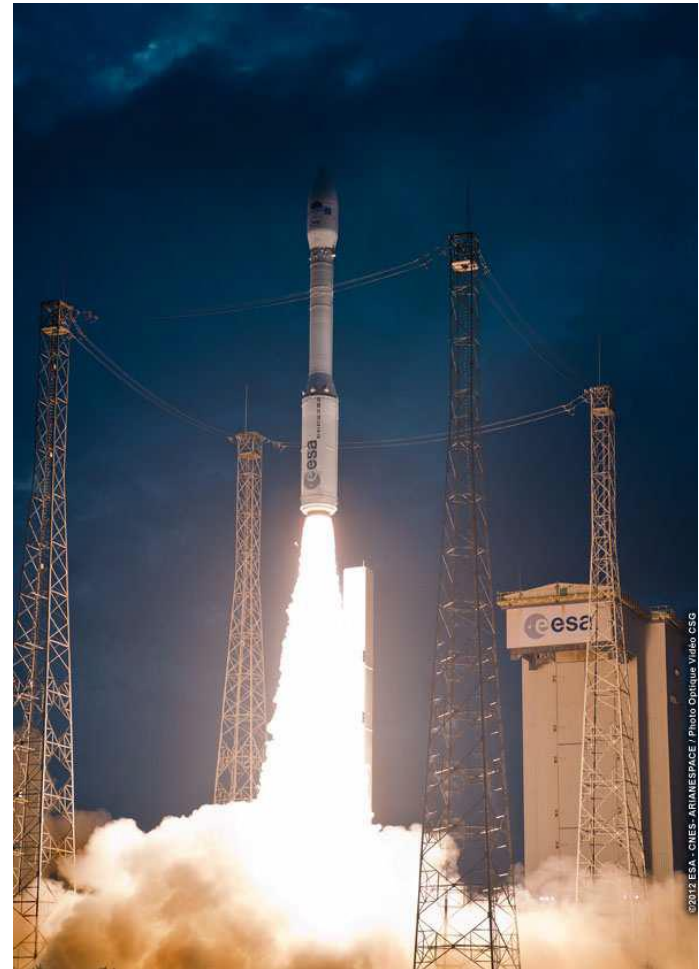
Methodology associated with RT requirement were implemented by VEGA project (ELECTRA,STELA, ...)

VEGA Flights

VEGA Flights

ESA operator

- of the first flight (qualification flight, February 13th 2012)
- of the second flight (2013 May, 13th) performed in the frame of an ESA program called VERTA. For VERTA, ESA has passed a contract of procurement to Arianespace.



ESA first launch: 2012, February 13th

LESSONS LEARNED

Soyuz and VEGA examples show that for launches from the French territory, the regulations applied, that defines the level of risks, are the same for any system. Thus, the procedures of application are adapted to the specificity of each system.

To achieve this goal, explanation and discussion between the operator and the inspectors will lead to the adapted and most efficient way of showing and monitoring the conformity, based on the existing documentation and practices of the project, while strictly respecting the rules of the regulations.

