

Sixth IAASS-Session 2
Regulations and standards for safety

**FSOA AND ASSOCIATED REGULATIONS APPLIED TO FUTURE
EUROPEAN LAUNCHERS A5 ES GALILEO, A5ME, A6**

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- **ORIGIN OF REQUIREMENTS FOR LAUNCHERS**
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BASIS OF THE FRENCH SPACE OPERATIONS ACT 1/2

General purpose

the general purpose of FSOA is the declination in the French Law of:

- 1967 UN Treaties principles (Outer Space Treaty),
- 1972 Liability Convention
- 1976 Registration Convention

Made in accordance with European commitments with the ESA organization and its Members States

- ◆ Control and monitoring of Space operations (to ensure the safety of persons, property, public health and the environment, on the ground and during the flight)
- ◆ Responsibility of the operator

General regime

Authorizations are granted after completion of the following process:

- An administrative review to assess moral, financial and professional guarantees of the operator.
- A technical review of the Space system definition and procedures to be carried out by the applicant showing conformity to the Technical Regulation (RT)

Specific regime for operations from CSG (Guiana Space Port)

CNES general mission of “safeguard”

Coordination and control in flight.

A specific regulation applicable within the limits of the perimeter defined above is set out. (REI)

BASIS OF THE FRENCH SPACE OPERATIONS ACT 2/2

Consultation regime

Preliminary technical assessment (optional consultation) for systems under development (Authorization Decree: Article 11) :

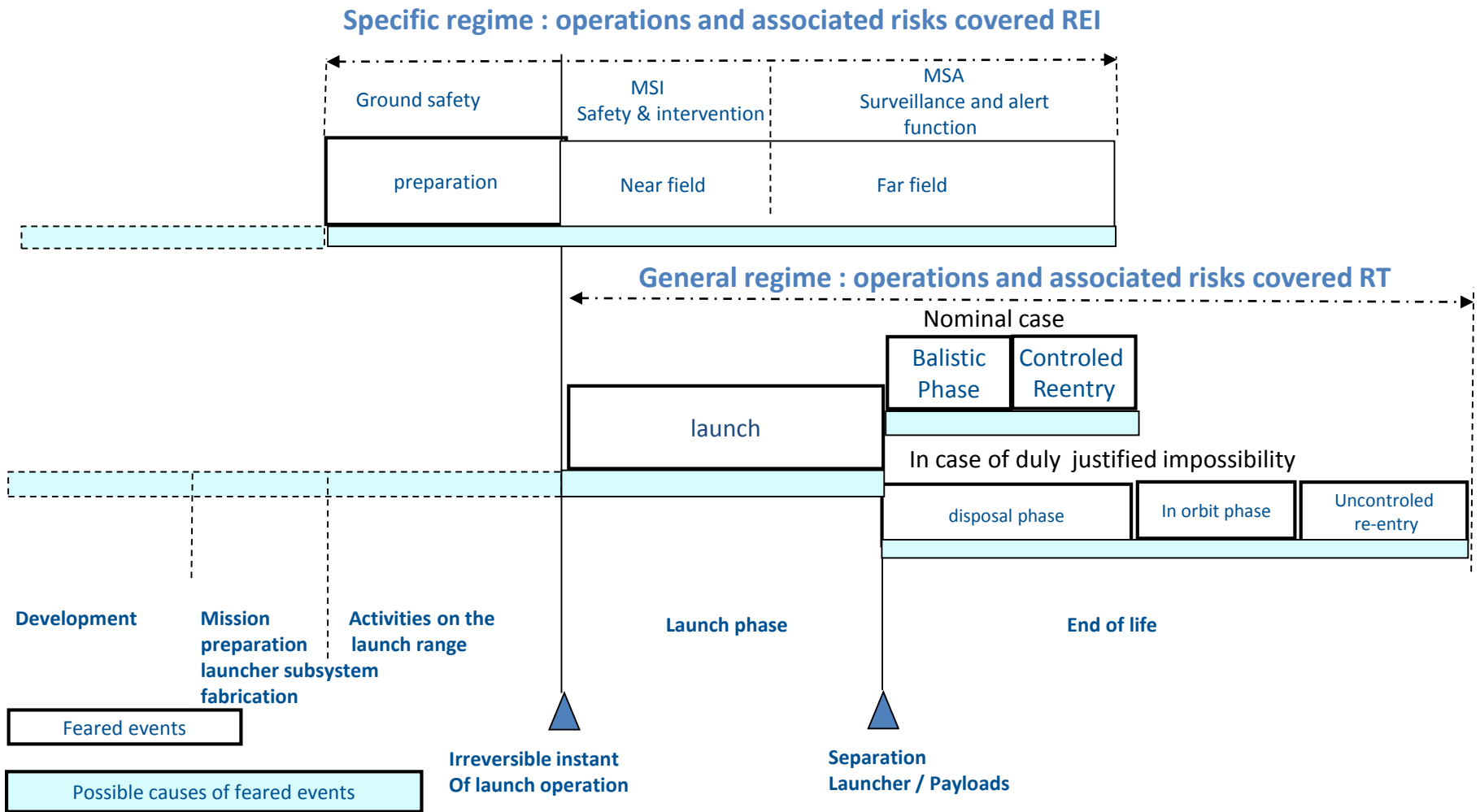
- This consultation enables CNES to certify systems or sub-systems under development at given milestones
- These certifications issued by CNES may be used by the operator in the authorization procedure to facilitate the granting of authorization

Regulations

In application of the above regimes, two regulations were set forth, in particular for the safety of persons and property, the protection of public health and the environment

- RT : The Technical Regulation (RT) associated with the general regime. It deals with risk starting at the moment when the launching operations become irreversible.
- REI : The decree regulating the operations of the Guiana Space center facilities (REI). It deals with risks on the ground and during the flight within the perimeter of CSG. It covers the preparation of the flight in CSG, and the flight in the vicinity of CSG.

CONTROL OF RISK / GLOBAL APPROACH : COVERING OF REGULATIONS ASSOCIATED TO FSOA



The generation of risks begins at the beginning of the development of the launch system and ends after re-entry. Control and monitoring of risks must therefore follow the same temporality.

ORIGIN OF REQUIREMENTS 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

DEVELOPMENT MAIN STEPS

- feasibility phase
- preliminary definition phase
- detailed definition phase
- pre-flight qualification tests
- qualification phase
- qualification flights phase
- exploitation phase

Certification of conformity possible for:

- launch system
- propulsion subsystem of a launcher
- launch installations

A5ES GALILEO 1/2

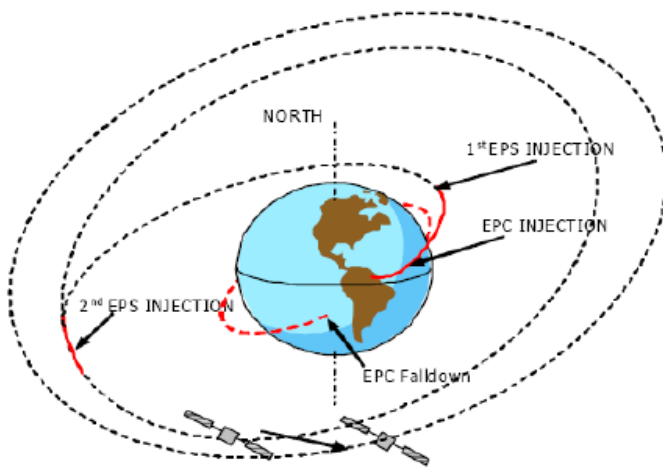
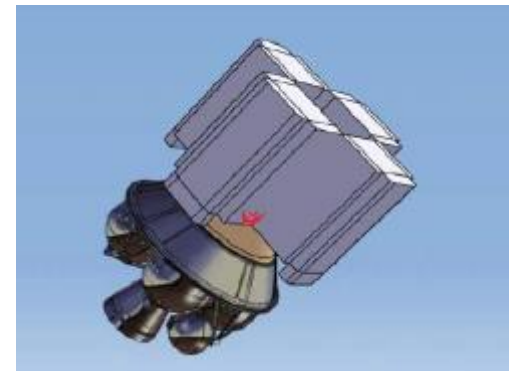
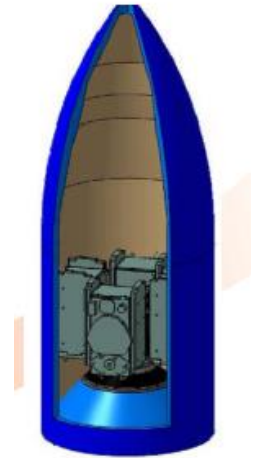
A5 ES Galileo (European positioning system)

Mission

- satellites injected at an altitude of 23 222 km
- orbit inclination 56° to the Equator
- in three orbital planes.
- Ten satellites will be spread evenly around each plane
- First flight scheduled 2014

Launcher

- Ariane 5 same configuration as ATV + adapted upper composite



A5ES GALILEO 2/2

Conformity file submitted to CNES after PDR

- general notice of conformity
- internal standards and quality management provisions
- hazard study and impact assessment

project team objectives

- to mitigate the risks of non-conformities identified late in the development

certification entity objective

- the safety risk has to be identified and to be mitigated

the common goal

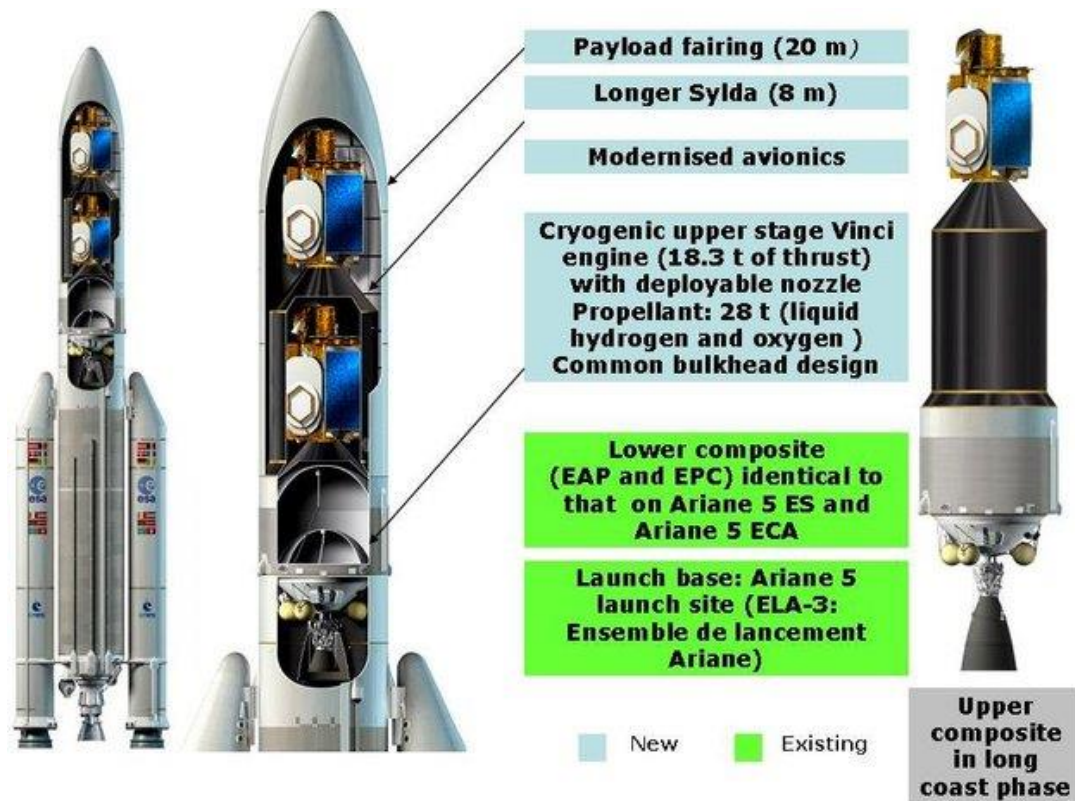
- to identify the most early all the sources of future dangers in flight. Moreover, for both entities, the goal is to make the formal certification loop efficient.

Organization

- One leader in the project to establish the conformity
- One leader in the inspector team to check the conformity
- Strong and regular dialogue between the two teams
- Access to information and reviews for inspectors and their technical support

For example, concerning effects of failure during upper stage ignition or passivation flight phases, several meetings were organized between CNES inspection team and ESA project team to define the final solution.

ARIANE 5 ME 1/3



November 2012 ESA Council meeting at ministerial level in Naples, Italy, Ministers secured investments for development of Ariane 5 ME.

Main data	Ariane 5 ME
Height	Up to 53 m
Diameter	Up to 5.4 m
Lift-off mass*	~ 800 t
Payload mass **	Up to 11.5 t

•* Dual satellite launch
** into GTO

ARIANE 5 ME 2/3

Conformity file submitted to CNES after PDR

- Submission of the conformity file in 2012
- coordination process between the certification entity CNES and the project team ESA has been implemented.
- in March 2013, a Certificate of preliminary technical conformity to the Technical Regulation was granted to ESA by CNES for the A5ME launch system at the PDR stage.
- After this event, a continuous process of implication is set-up. The certification entity is informed of each step of the implementation of the working plan aiming to prove before the first flight, that the launch system is in complete compliance. During the phase of detail design, the inspectors of CNES will be associated to the development and especially to the subsystems reviews.
- Next step for the submission of a certificate of conformity will be the Critical Design Review.

ARIANE 5 ME 3/3 : LESSONS LEARNED

For the same reasons than for A5 ES Galileo a dialogue has been established continuously between the different entities.

Before delivery of the certificate, this dialogue allows

- the project team to well understand the objectives of the regulation
- the inspectors to understand the technical issues raised by this new development, using some new technologies, as the deployable nozzle of the Vinci engine.

Before delivery of the certificate, the development goes on and thus the system evolves in parallel to the certification analysis. Exchanges of information have been necessary, so that the certifier could consider as far as possible the updates of files in the final certificate.

After delivery of the certificate, the results of the development can confirm or infirm the foreseen working plans. For this reason, it is necessary to inform the inspectors of these hazards, in order to adapt continuously the working plan.

ARIANE 6

Main characteristics

Single-payload launch system that can cover a wide range of missions:

- GEO, either directly or through intermediate orbits, in particular GTO and LEO,
- Polar/SSO,
- MEO or MTO,
- other.

Targeted payload performance of Ariane 6 is

- 4 t for polar/SSO missions at 800 km altitude
- 3–6.5 t in GTO equivalent

Exploitation cost is a key driver

First flight is targeted for 2021

November 2012 ESA Council meeting at ministerial level in Naples, Italy, Ministers secured investments for detailed definition studies of the new Ariane 6 launcher.

Ariane 6 will be the first European launcher developed, taking in account RT and REI as reference regulations since the first steps of its development.



Some of the Ariane 6 concepts under investigation

EXPERIENCE FEEDBACK

- Positive consideration of the regulation (RT, REI) for future launcher, which is now the reference.
- Preliminary technical assessment are requested by project teams.
- Requirement are taken in account by the project, in the early steps of the projects.
- Requirements (RT, REI) are expressed in a more explicit way, and so is easier to check.
- Inspectors having generally participated to development are able to discuss with the project people.