



arianeGROUP

ARIANE 6 AND SPACE DEBRIS LIMITATION

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- 01 FRENCH SPACE OPERATIONS ACT**
- 02 ARIANE 6 CHARACTERISTICS AND MISSIONS**
- 03 SPACE DEBRIS MITIGATIONS ON ARIANE 6 LAUNCHER**
- 04 CONCLUSION**

01 FRENCH SPACE OPERATION ACT (FSOA)

Act n° 2008-518 relating to Space Operations of 3rd of June 2008



Decree no. 2009-643 of 9th June 2009 Technical Regulation [RT]



PART TWO - LAUNCH OF A SPACE OBJECT



Article 21 – **Space debris limitation**

01 ARTICLE 21 OF RT – SPACE DEBRIS LIMITATION

Minimization of space debris production

- Single mission → 1 launcher element in orbit
- Multiple missions → max 2 launcher elements in orbit

Protection of LEO region

- **De-orbitation** when orbit in or passing through protected region A
- *If not possible, uncontrolled atmospheric re-entry **within 25 years***

Protection of GEO region

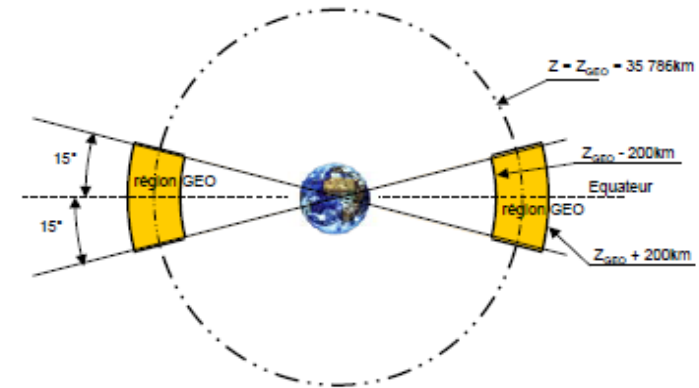
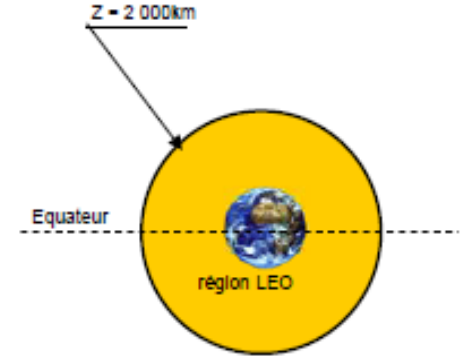
- Launcher components **not interfere 1 year <>100 years**

Passivation

- On-board energy reserves depleted and all means of energy production deactivated

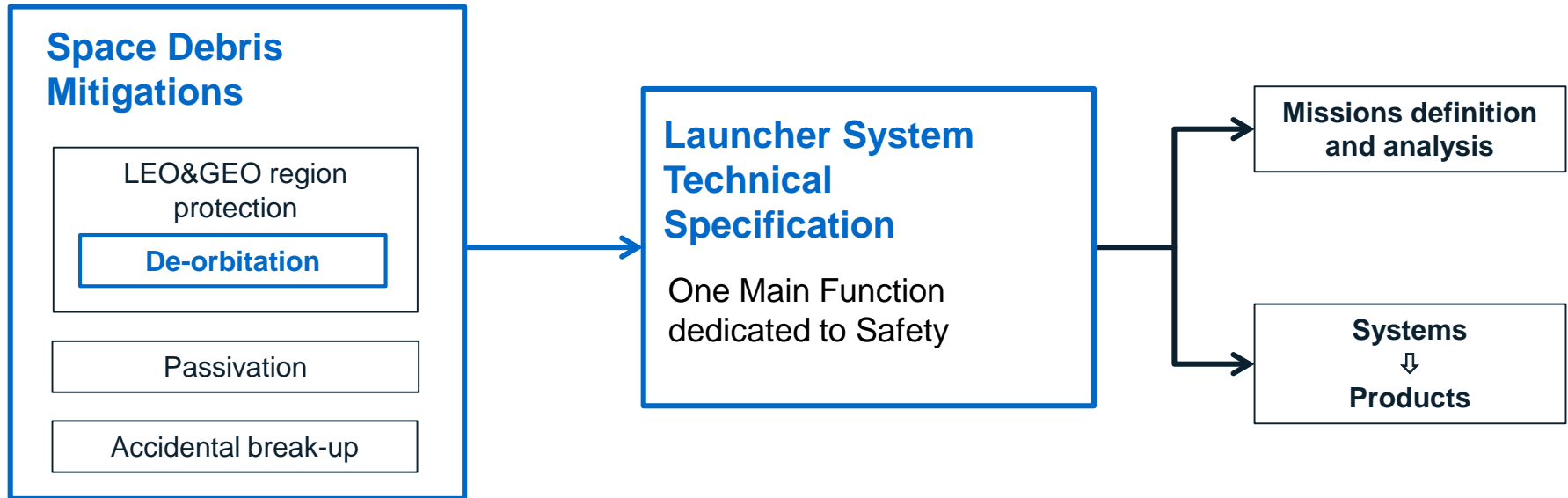
Success probability of disposal maneuvers > 0.9

Accidental break-up probability < 10^{-3}

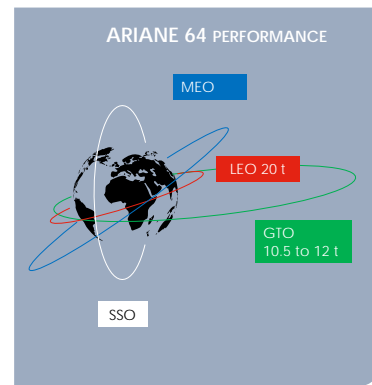
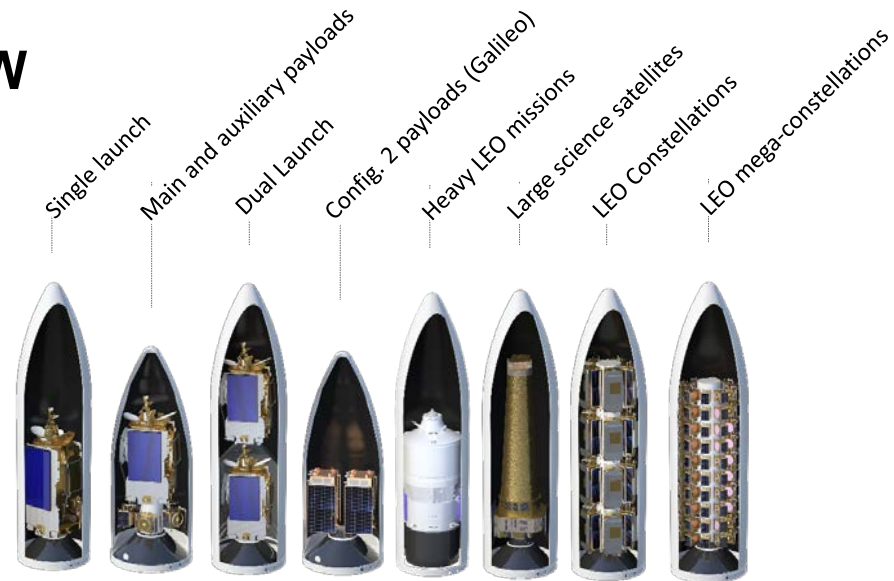
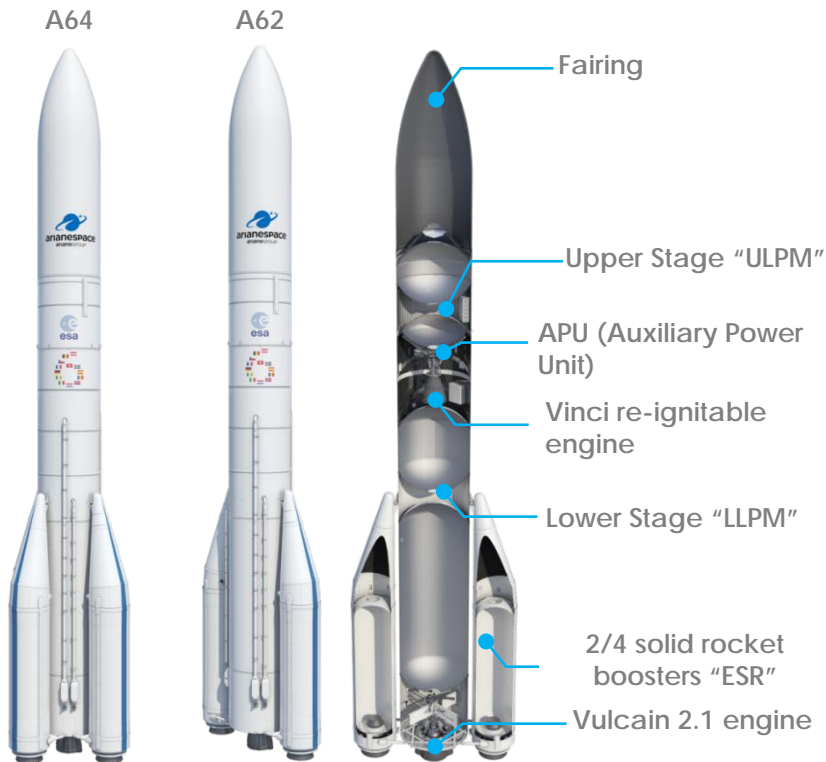


01 SPACE DEBRIS MITIGATION ALLOCATION

⇒ Ariane 6 : 1st application of the Space Law from the beginning of European launcher development



02 ARIANE 6 LAUNCHER OVERVIEW



02 EXEMPLE OF ARIANE 6 MISSIONS

A62/A64 GTO mission



A62 SSO mission



A62 MEO Galileo mission



A64 GTO/GTO+ mission



03 ARIANE 6 SPACE DEBRIS MITIGATION - MISSION DEFINITION

Launcher elements placed in orbit

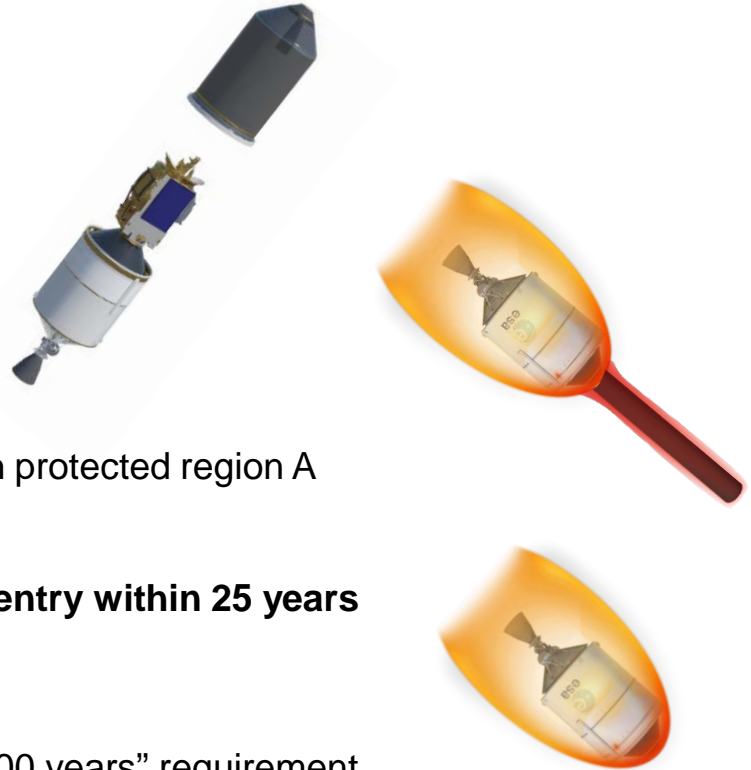
- Single launch : ULPM in orbit at the end of the mission
- Multiple payloads
 - At most : ULPM + Dual Launch Structure (DLS)
 - Dispenser attached to ULPM

Protection of LEO region

- **ULPM de-orbitated** when injection orbit passing through protected region A
 - Vinci or APU de-orbitation boost
- DLS (no propulsion) injection orbit defined → natural **re-entry within 25 years**

Protection of GEO region

- **ULPM injection orbit** defined to comply with “1 year / 100 years” requirement



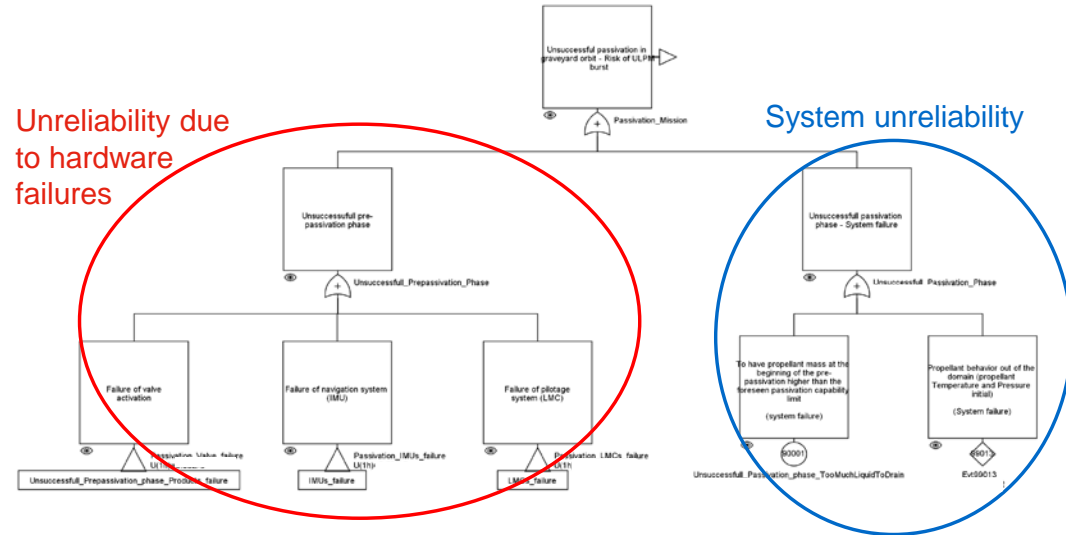
03 PROBABILITY OF ACCIDENTAL BREAK-UP IN ORBIT

Accidental break-up in orbit <math>< 10^{-3}</math>

- to identify all contributors leading to ULPM explosion in orbit including degraded cases

Main contributors:

- Vinci engine and APU failures
- “System failure” : propellant exhaustion
- Passivation failure including degraded situations



- Requirement not easy to meet for missions with several re-ignitions → need to have disposal performance (de-orbitation or passivation) above 90%

04 CONCLUSION - ARIANE 6 SPACE DEBRIS MITIGATION

Space debris mitigations embedded in Ariane 6 program since the beginning

Safety aspects fully integrated in Launcher System Development and in coherence with Launcher System Development milestones

Safety requirements considered at the same level as other requirements

Ariane 6 paves the way for space debris elimination at source

THANK YOU FOR YOUR ATTENTION

