REACTION ENGINES

SATURN

Evolutionary Commercial Spaceflight

Doing it Safely

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ICAO SPACE2015 The ICAO/UNOOSA AeroSPACE Symposium ICAO Headquarters, Montréal, 18–20 March 2015 UNOOSA

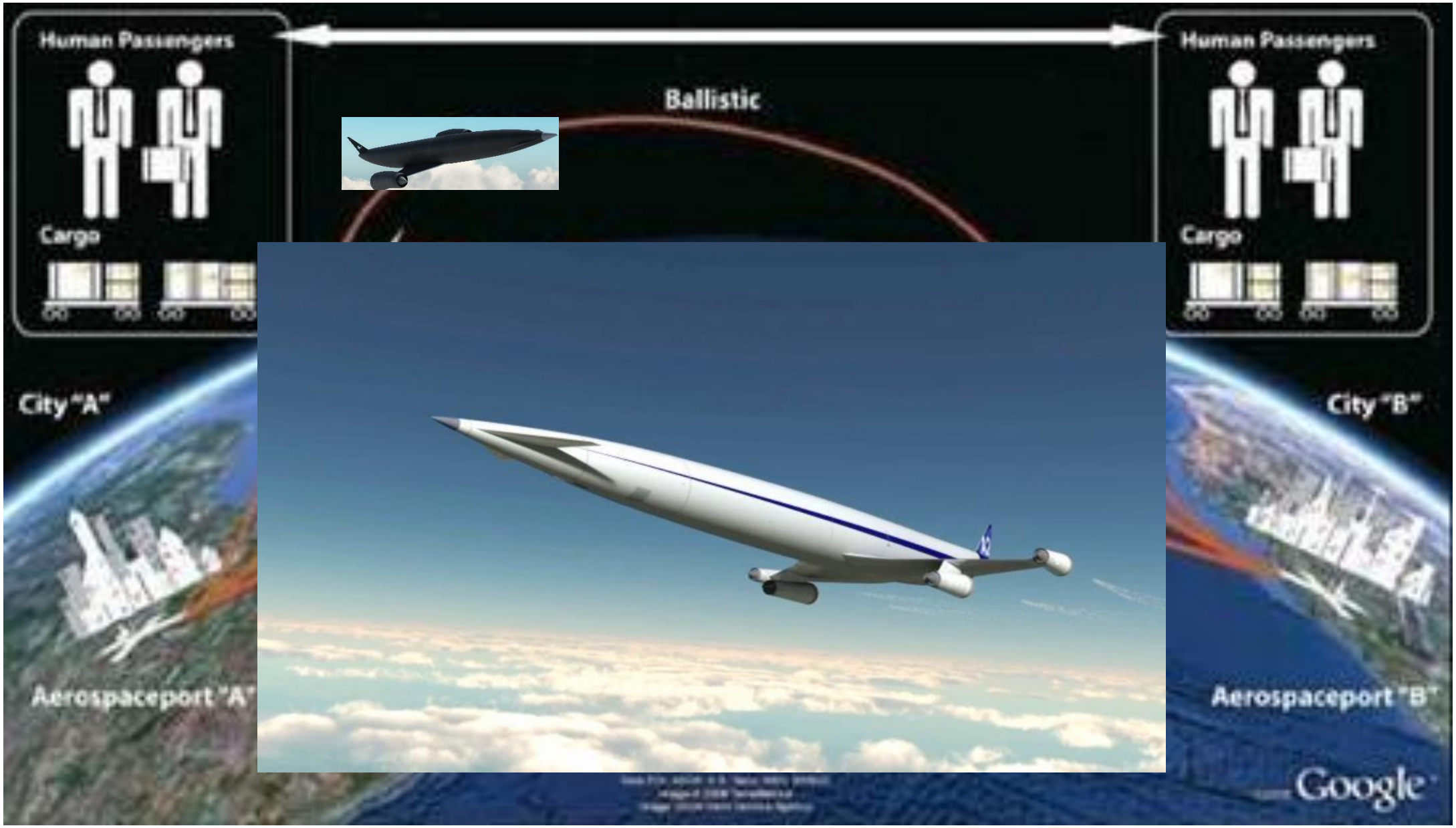
TOPICS

- Suborbital Players, Spaceports & Future P2P
- Acceptable Level of Safety (ALOS)
- Regulatory Frameworks & Standards & Guidelines

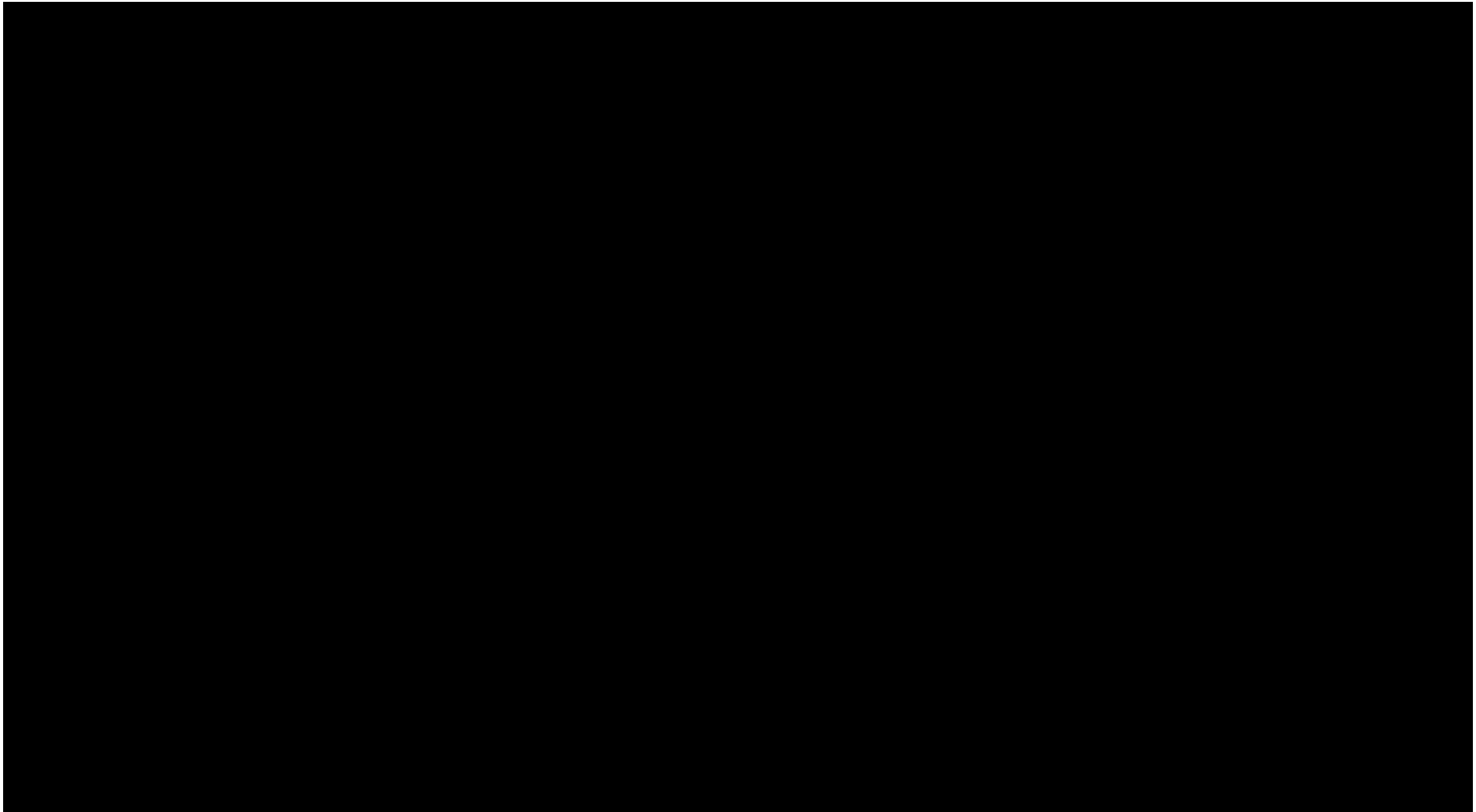
THE PLAYERS

SPACEPORTS

POINT-2-POINT GAME-CHANGERS

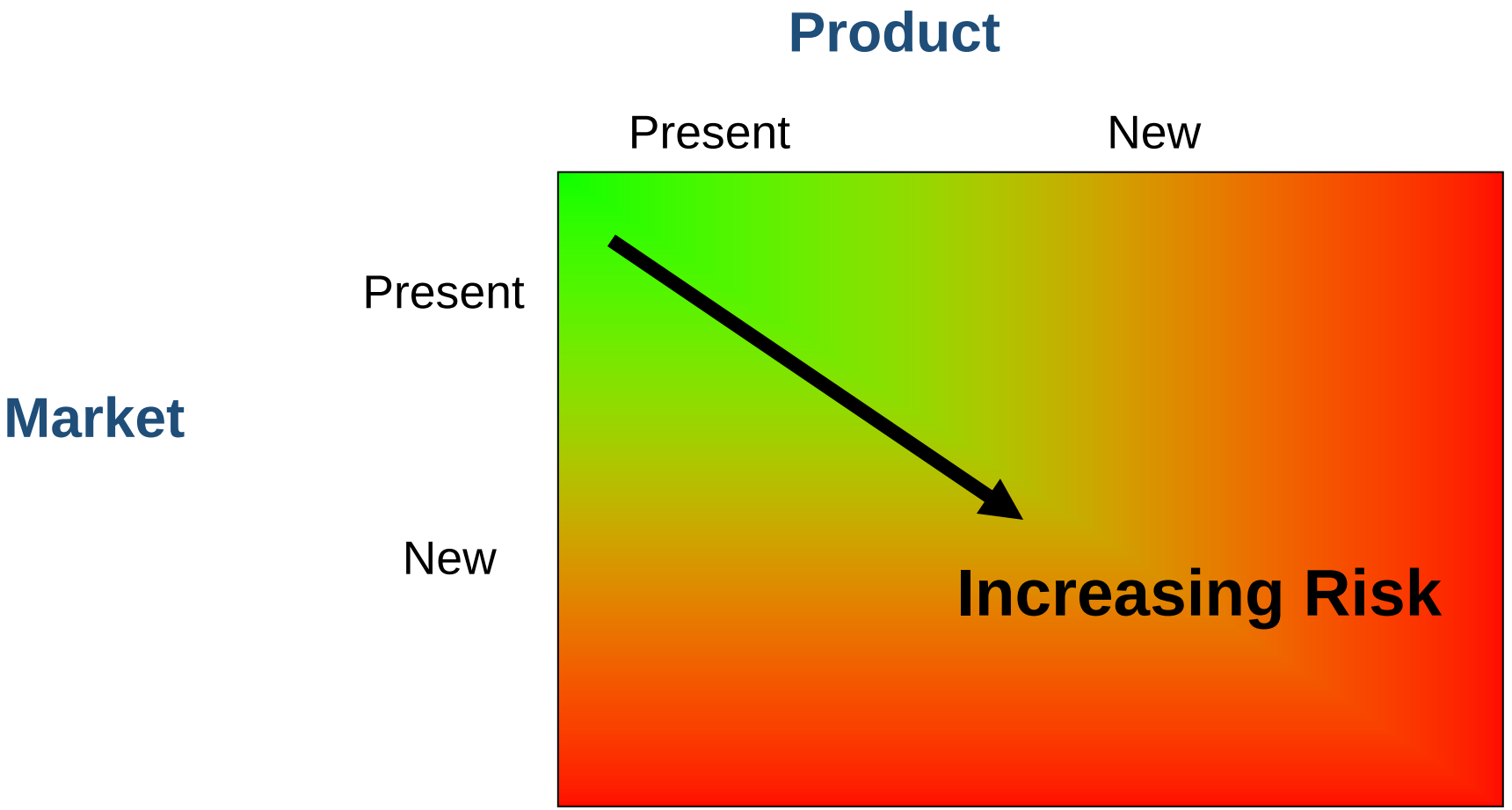


P2P LAPCAT SPACEPLANE



RISK

- A new product, a new market ……



RISK

ACCEPTABLE LEVELS OF RISK

ACCEPTABLE LEVELS OF RISK

- **Acceptable Levels of Safety (public perception of acceptable risk)**
  - Aircraft: Hull Loss Rate – 1 in 10 million per flight (equivalent of 0.01 accidents per 100,000 flights)
  - North Sea Helicopter Ops (transportation of workers) – 1.35 accidents per 100,000 flights
  - Military Fast Jet Target – 2 per 100,000 flights; (was much higher until 2010 and reliability and less low level ops and combat missions)
  - UAVs (Reaper/Predator) – 3 to 5 accidents per 100,000 flights (was 30 per 100,000 initially and reliability now better)
  - **P2P (like SKYLON derivative /JAXA HST Spaceplane) – initially somewhere here?**
    - Equivalence for 1 in 20,000 would be 5 accidents per 100,000 missions (is this acceptable?)
  - **Current Suborbital Vehicles – somewhere here?**
    - Equivalence for 1 in 10,000 would be 10 accidents per 100,000 missions (is this acceptable
  - Orbital SKYLON Spaceplane – somewhere here?
    - Equivalence for 1 in 2,000 would be 50 accidents per 100,000 missions (is this acceptable?)
  - NASA CCP – targets
    - 1 in 1000 (ascent/re-entry), equivalence 100 accidents per 100,000 missions during ascent/re-entry
    - 1 in 270 overall for 210 day mission 370 accidents per 100,000 missions
  - Space Shuttle – 1 in 90 per mission (1000 accidents per 100,000)

STANDARDS, GUIDELINES, FRAMEWORKS

- **These must be:**
  - International; relevant for those presenting at this conference (US, EU & JAXA based vehicles)
  - Inclusive; so point A-to-A and also Point A-to-B
  - Practicable and rationalized; hence achievable
  - Providing Safety Targets/Objectives and Safety Requirements
- **The Industry needs proper oversight:**
  - ICAO/UNOOSA -
    - Symposium great start to listen, to learn, to debate in order to move forward together, safely
  - A separate Space Safety Institute?
- **The SKYLON (& SABRE) approach:**
  - Engaging with the UK CAA for the engine
  - Already engaged with ESA
  - Safety Management & Safety Engineering able to influence design from beginning (based on understanding of aviation + space requirements/targets to rationalize what is appropriate to reach an acceptable level of safety); so an example derived safety requirement could be that for failure modes leading to Inadvertent operation of safety critical systems resulting in Catastrophic Loss shall have 3 inhibits

STANDARDS, GUIDELINES, FRAMEWORKS

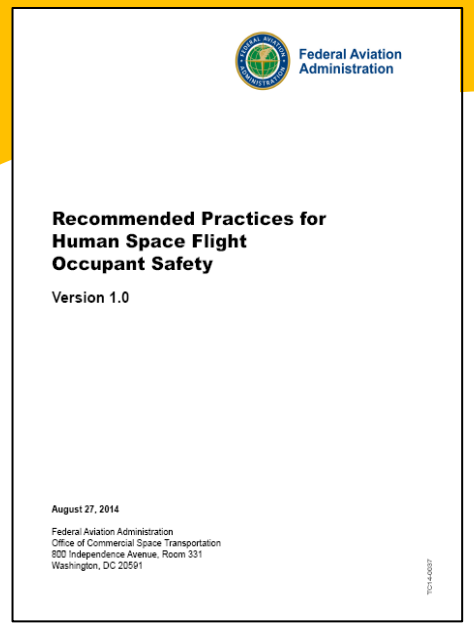
ACCEPTABLE MEANS OF COMPLIANCE

OVERSIGHT

ICAO ---------- **Space Safety Institute??**

SARPs ----------Role??

FAA-AST



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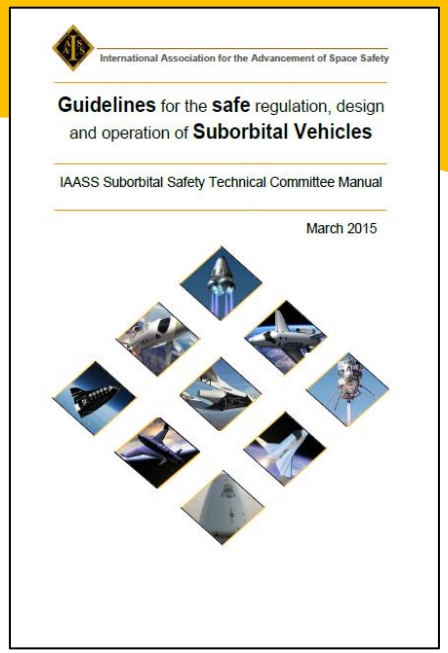

GUIDANCE MATERIAL

HOW SAFE IS SAFE ENOUGH?

To achieve an Acceptable Level of Safety we need regulators providing appropriate safety targets & safety requirements and we need designers/ operators doing this the RIGHT WAY and not just relying on the RIGHT STUFF

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THANK YOU

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