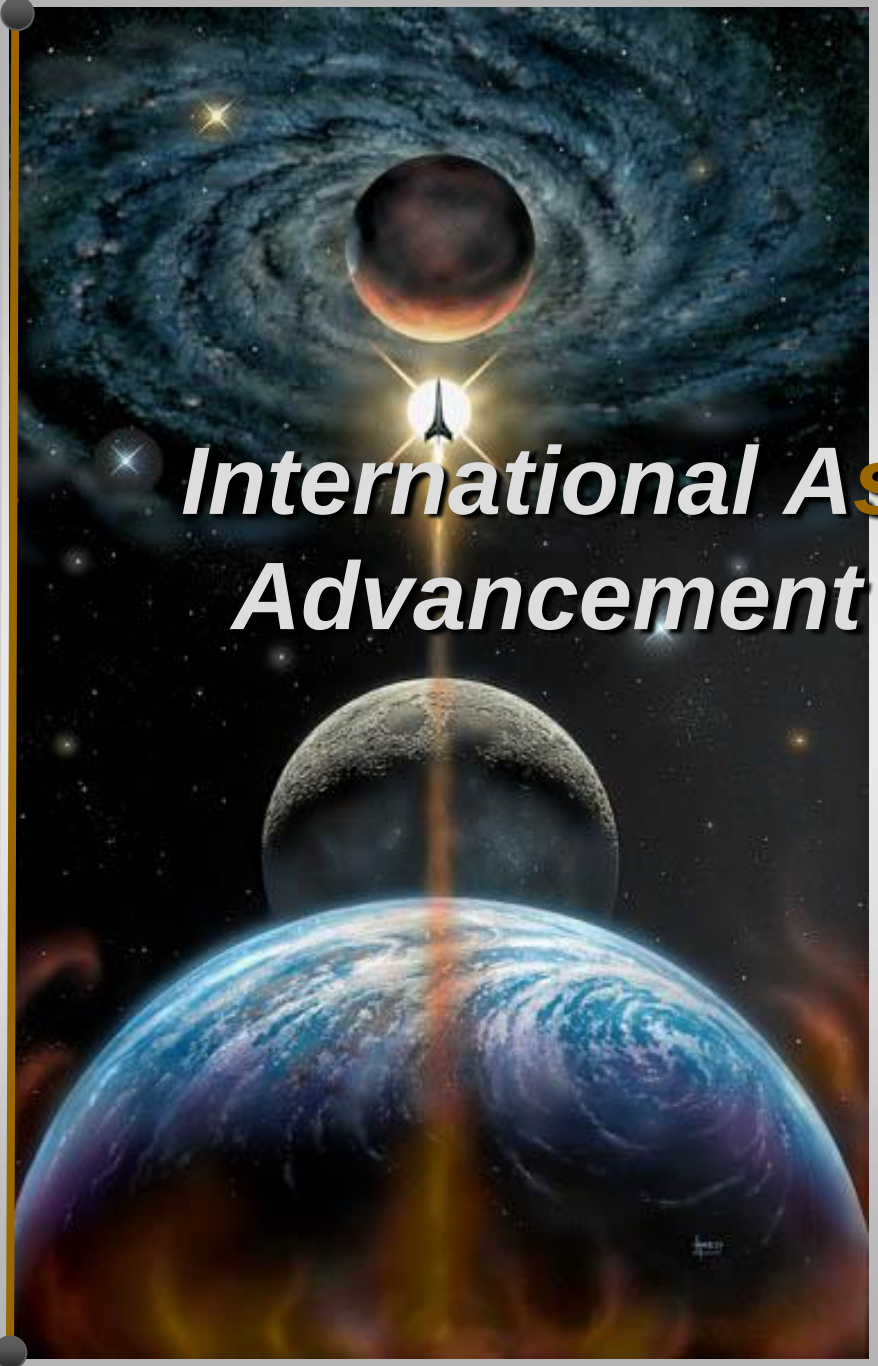


IAASS

International Association for the Advancement of Space Safety

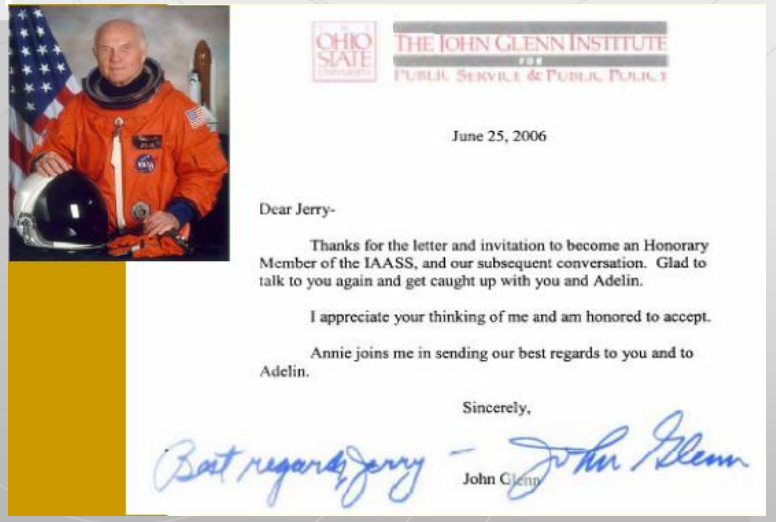
"Over the long run the safety of all human beings in the global commons of space is a responsibility that must be shared by all space-faring powers"

(G.Rodney, NASA Associated Administrator S&MA,40th IAF Congress, October 1989, Beijing – China)

International Interdisciplinary Congress on Space Debris
7-9 May 2009

Introducing IAASS

- A non-profit organisation dedicated to furthering international cooperation and scientific advancement in the field of space systems safety
- Legally established 16 April 2004, The Netherlands
- Since October 2004 member of IAF (International Astronautical Federation)
- June 2006, former US Senator John Glenn and first American to orbit becomes Honorary Member



OHIO STATE — THE JOHN GLENN INSTITUTE FOR PUBLIC SERVICE & PUBLIC POLICY

June 25, 2006

Dear Jerry-

Thanks for the letter and invitation to become an Honorary Member of the IAASS, and our subsequent conversation. Glad to talk to you again and get caught up with you and Adelin.

I appreciate your thinking of me and am honored to accept.

Annie joins me in sending our best regards to you and to Adelin.

Sincerely,

Best regards, Jerry — John Glenn

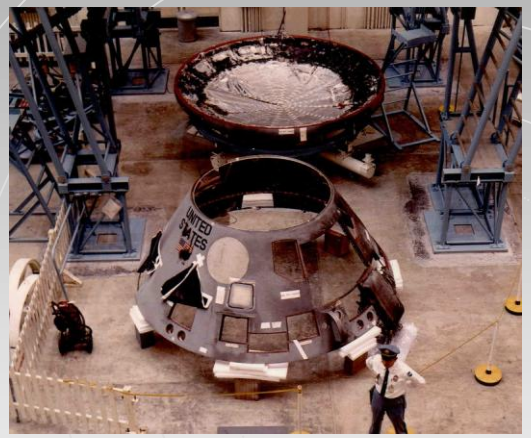
John Glenn

What is Space Safety?

Safety risk of space missions

- As of today (at least) 200 people have been killed on ground by rocket explosions during processing, launch preparations and launch. Since the year 2000, 35 casualties were counted (last accident, July 2007)
- In the last 10 years at least 6 launches were terminated by launch range safety officer to prevent risk for the public. Several more cases of launchers which did not make to orbit and crushed back on Earth
- A total of 22 astronauts and cosmonauts have lost their lives since the beginning of human spaceflight. Four of which on ground during training, (one Russian, plus the Apollo 1 crew).
- The Shuttle Columbia accident posed a serious risk to civil aviation due to falling debris (in the order of 1/1000 for commercial airlines and 1/100 for general aviation)
- A Proton launcher failure in September 2007 contaminated a vast swath of agricultural land of Kazakhstan with 200 tons of toxic fuel

Crew accidents



Apollo 1 -January 1967

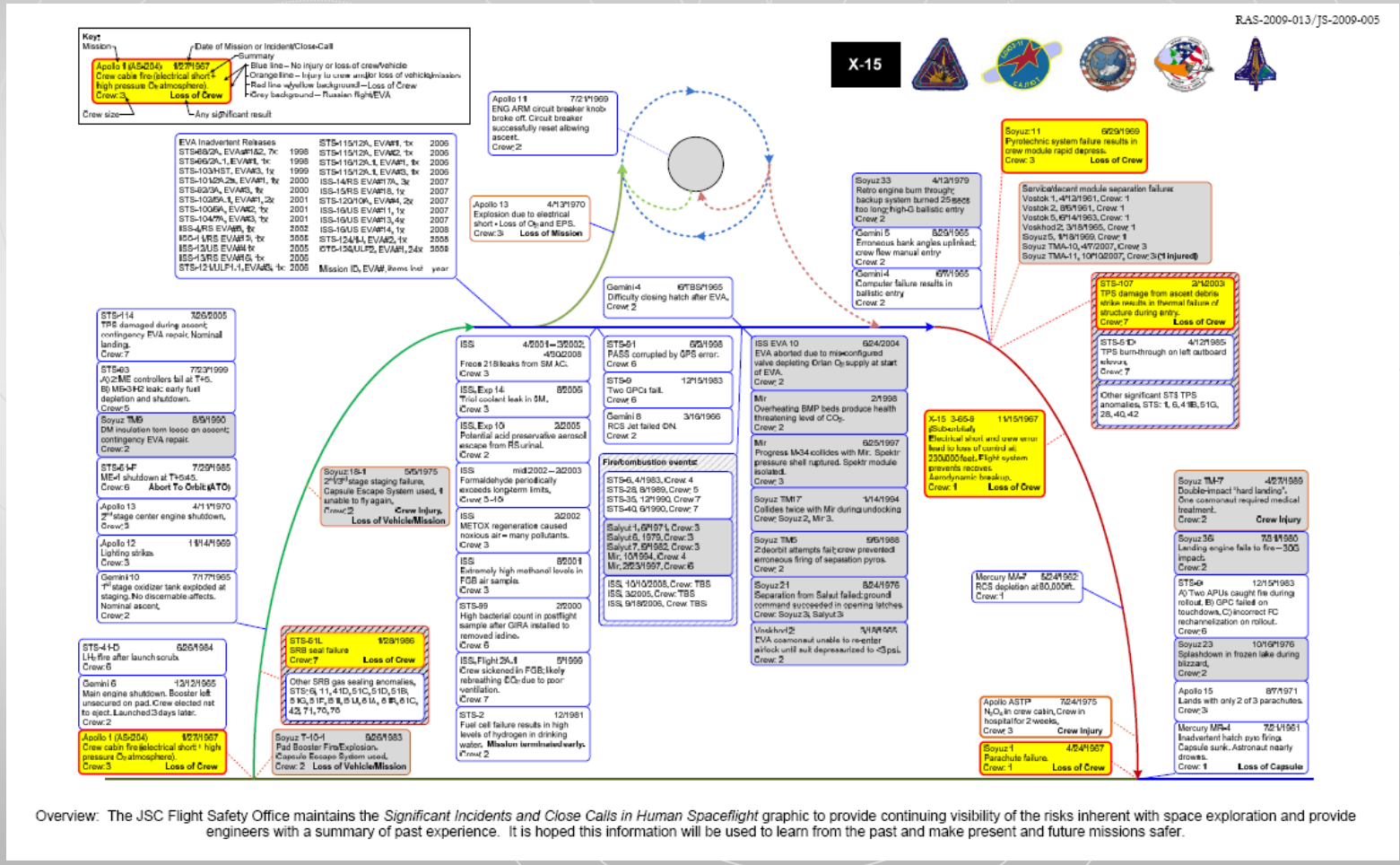
STS Challenger

Soyuz 11

Soyuz 1 -April 1967

STS Columbia - February 2003

Crew incidents & close calls

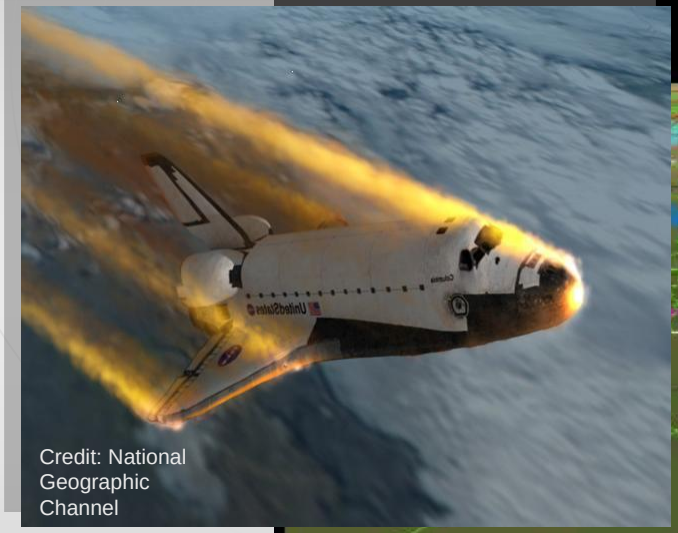


Overview: The JSC Flight Safety Office maintains the *Significant Incidents and Close Calls in Human Spaceflight* graphic to provide continuing visibility of the risks inherent with space exploration and provide engineers with a summary of past experience. It is hoped this information will be used to learn from the past and make present and future missions safer.

Public safety: risk at international spaceports (e.g. Foton M-1 failure, Oct. 2002)

During the Foton M-1/Soyuz accident at Plesetsk in October 2002, a young Russian soldier was killed not far from the location where a large team of European engineers, scientists and students was watching the launch.

Public safety:
STS Columbia debris aviation risk (Febr. 2003)



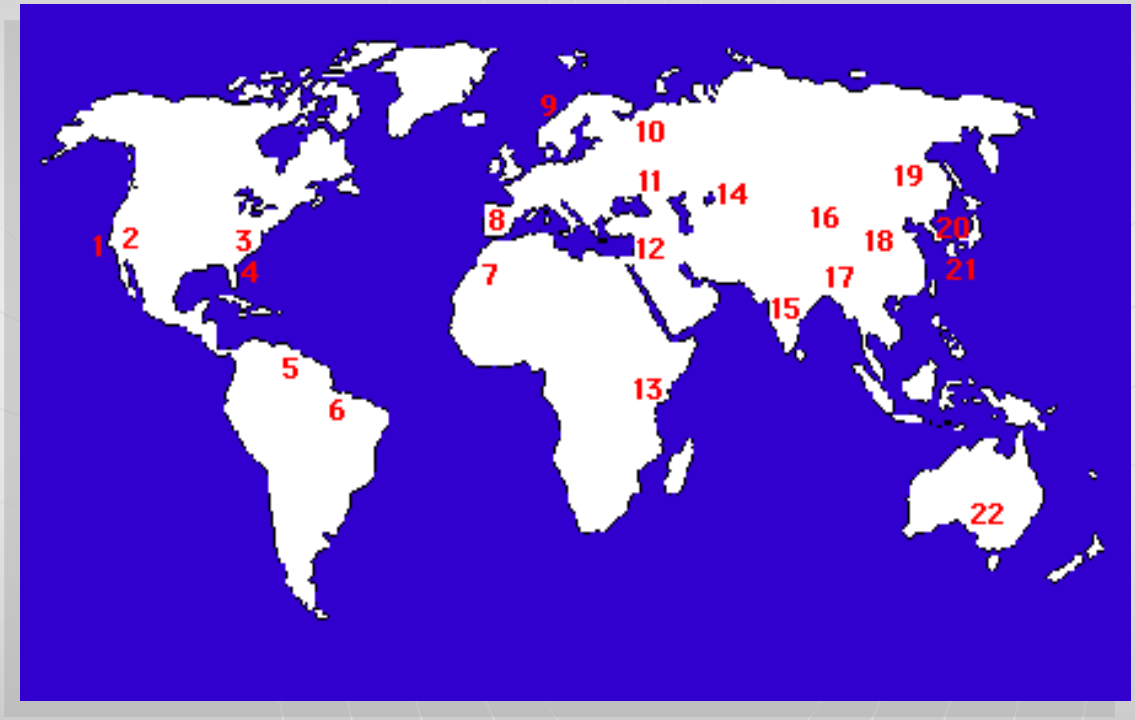
Environmental risk: Launcher failure contamination

Source Jonas Bendiksen's book: *Satellites -2006*

International dimension of launch & re-entry risk

- Rising number of countries with independent access to space
- Non uniform launch safety record worldwide
- Lack of uniform international risk acceptance criteria
- International nature of spaceports operations (foreign teams on-site)
- Cumulative risk from different launch sites not accounted for
- Case-by-case & country-by-country management of airspace interfaces
- Environmental issues of air/ground/water contamination
- Re-location of some launchers from their original launch sites
- Overall issue of uncontrolled spacecraft re-entries

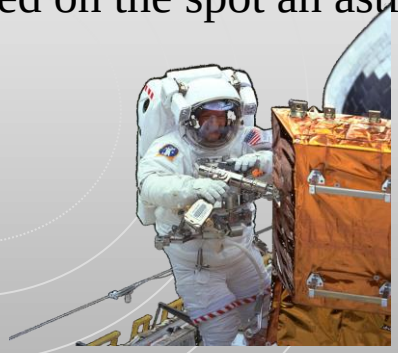
International dimension of launch & re-entry risk



Launch Sites Worldwide – Most of the space-bound traffic takes place through the international airspace (ICAO jurisdiction)

Safety Risk of Space Missions (orbital debris)

- Risk represented by orbital debris, including hundredths of "dead" spacecraft abandoned in orbit, and the risk of uncontrolled spacecraft re-entry.
- Currently about 9,000 orbiting objects are being tracked, while more than 100,000 bits of debris are too small to follow. Some debris will remain in orbit for hundreds or thousands of years and constitute a potential catastrophic hazard for operational spacecraft because the high relative velocities at impact.
- Debris impacts on the Shuttle are counted on every mission. The second largest hit was the perforation of a thermal radiator during the STS-115 mission in September 2006. It could have killed on the spot an astronaut performing extra-vehicular activities (EVA)
- Collision with orbital debris is the primary safety risk for the International Space Station



Safety Risk of Space Missions (orbital debris - cont'd)

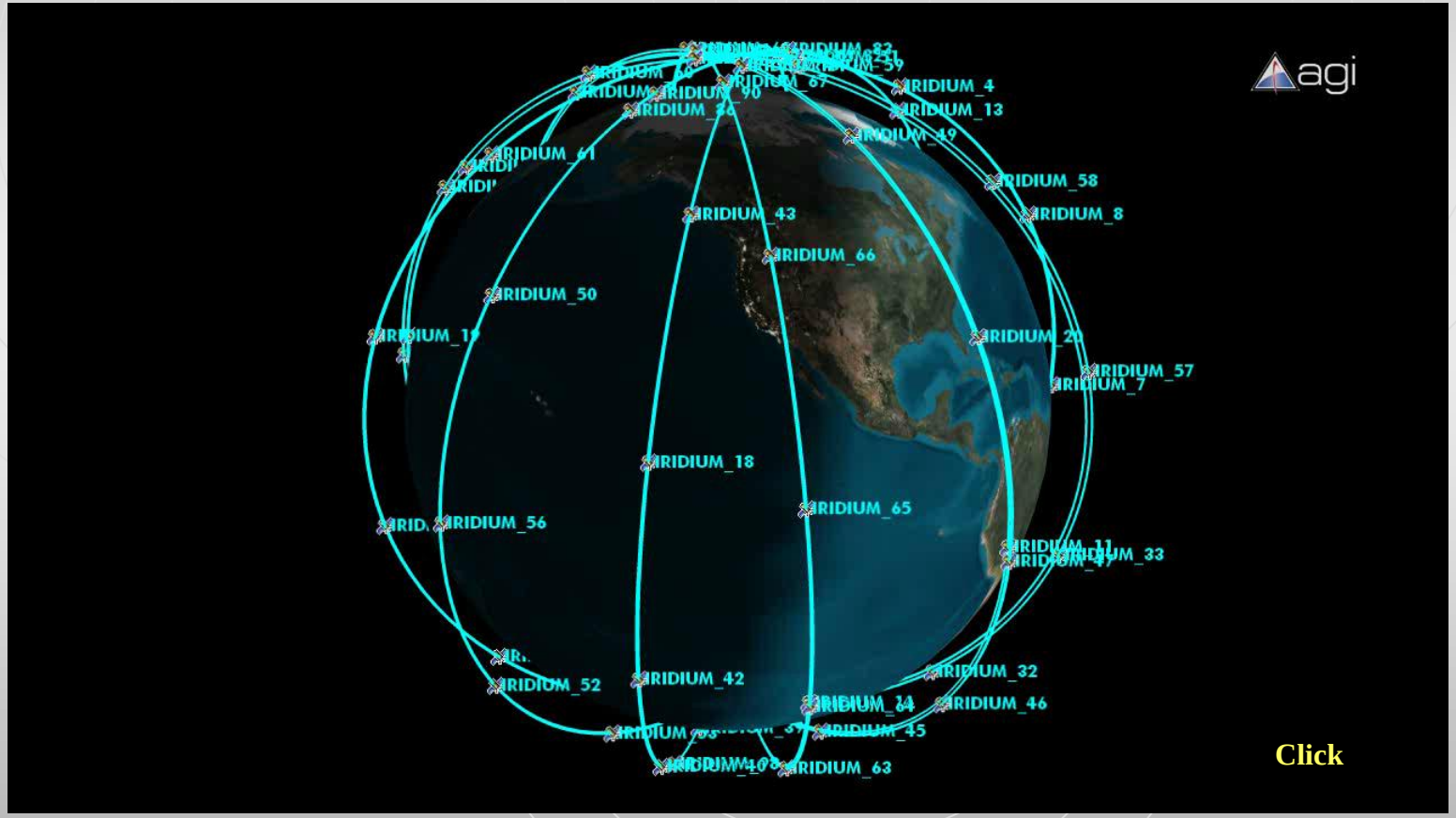
- **January 2007-** a Chinese ASAT (anti-satellite test) caused an increase of collision risk for many satellites. For the International Space Station (ISS) the risk increased of nearly 60% for fragments > 1cm.

- **February 2008 -** the US Navy shot down with a missile a malfunctioning intelligence satellite, allegedly because of the risk for ground population of ½ ton of toxic fuel on board.

- **February 2009 -** a non-operational 16-years-old Russian satellite, Cosmos 2251, collided with US Iridium 33 telecommunication satellite over Siberia at an altitude of 790 km and closing speed well over 24,000 km/h.

- Satellites should be disposed, in accordance with UN guidelines, at the end of their operational life by either de-orbiting (those in LEO) or moving to "graveyard" orbits (those in GEO). It can be expected that such guidelines will not be uniformly followed world wide as long as there is no legal obligation.

Cosmos 2251-US Iridium 33 collision
February 10, 2009



Safety Risk of Space Missions (cont'd) (radioactive risk)

- As of today there have been 10 cases of failures leading to dispersal of radioactive material, including:
  - plutonium payload on board Apollo 13 lunar module which ended up in the Pacific Ocean close to the coast of New Zealand, or
  - 68 pounds of uranium-235 from the Russian Cosmos 954 which were spread over Canada's Northwest Territories in 1978;
  - most recent accident of this kind in 1996, when the Russian MARS96 disintegrated over Chile releasing its plutonium payload which has never been found.
- Currently there are 32 defunct nuclear reactors, 13 reactor fuel cores and at least eight radio-thermal generators (RTGs) circling Earth. The total mass of RTG nuclear fuel is about 150kg, while there are 1,000kg of radioactive fuel from nuclear reactors.

Operation *Morning Lights* -Canada 1978

Which way ahead?

A turning point ?

The post WWII enthusiasm for international governance of global matters did gradually erode over the years. (It took just 3 years to establish the International Civil Aviation Organization-ICAO).

There has been for a while a growing awareness that space has become as international sea waters and airspace another realm where it is in the interest of the global community to operate in accordance with common rules, but countries became “culturally” accustomed to the idea that something as an ICAO for space was not just not feasible. The response: *Code of Conducts !*

November 2008 with the explosion of the global financial crisis may have signed a cultural turning point. It brought back the full awareness of our global interdependence. Words as *global rules* and *international governance* are respected ones again!

The minimum needed?

- International harmonization of (policy) space safety standards and recommended practices, and a (light) organization to support their establishment and maintenance.

- Continuation of industrial active involvement and leadership in developing support/implementation industrial space safety standards.

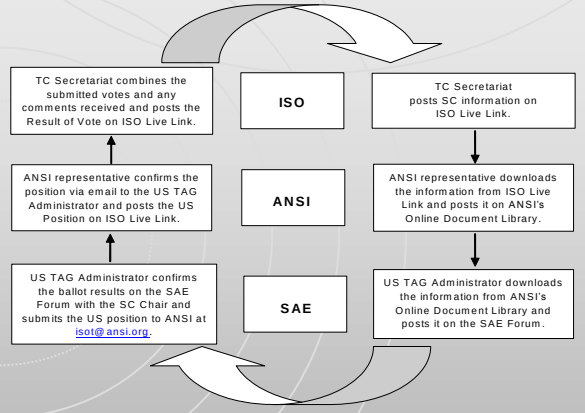
- Substantial growth of government, academic and industrial research on space safety engineering methods, models and techniques.

The limits of ISO standards

- ISO - International Standardisation Organization, was established on 27 February 1947 with the purpose of facilitating the international exchange of goods and services through the coordination and unification of industrial standards.

- ISO membership is constituted by representatives of National Standards bodies (e.g. ANSI, DIN, etc.) on the basis of 1 member for each country body. Currently 158 members.

- Proposed standards are reviewed at national level through industrial national advisory groups supporting their national standard body.



Example (US vehicles manufacturers)

The limits of ISO standards (cont'd)

- Generally the application of safety standards is mandated by law. Safety standards are developed under the legal authority of specialised national or international agencies (e.g. FAA, FDA, ICAO, IAEA, for aviation, nuclear, pharmaceuticals) and not by national industrial standardization bodies.

- It is not the role of ISO standards to define acceptable risk levels, but to lower the cost and barriers to international commerce. The ISO standards are voluntary because they follow a logic industrial interest (toward lower costs)! ISO standards which functionally compete with national regulations are doomed to be neglected (see the example of toys safety).

- ISO standards are not suitable as *policy standards* but only as *industrial standards* (i.e best technical practices, methods, etc.). ISO standards are reviewed periodically (every 4 years). Safety standards are changed whenever necessary!

The limits of ISO standards (cont'd)

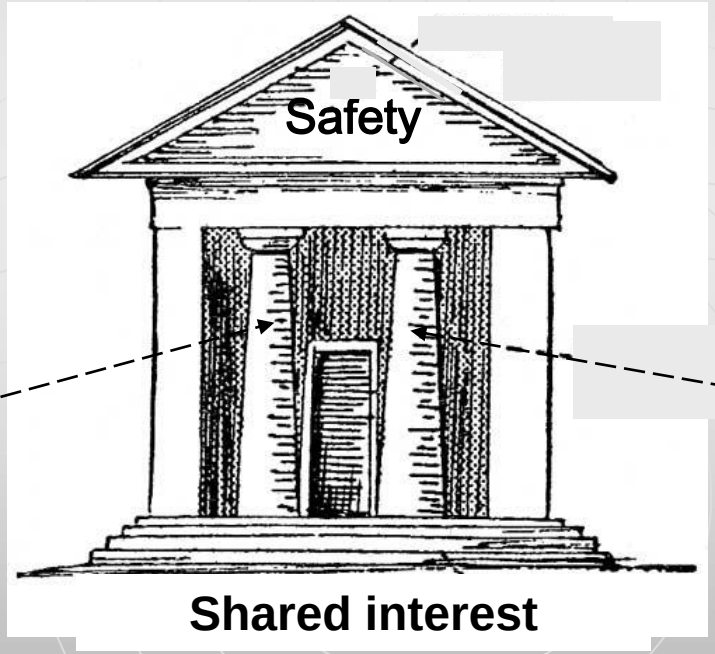
Example: ISO and the toys safety

✓"***Over the last three years, the membership has been actively involved in the development of an international toy safety standard through the International Standardization Organization. While the ICTI and ISO standards are supported by the membership, they cannot actually supersede the safety standards, regulations and testing procedures of local or national governments or agencies which are applicable to any product to which these standards apply***". (Website of the International Council of Toy Industries)

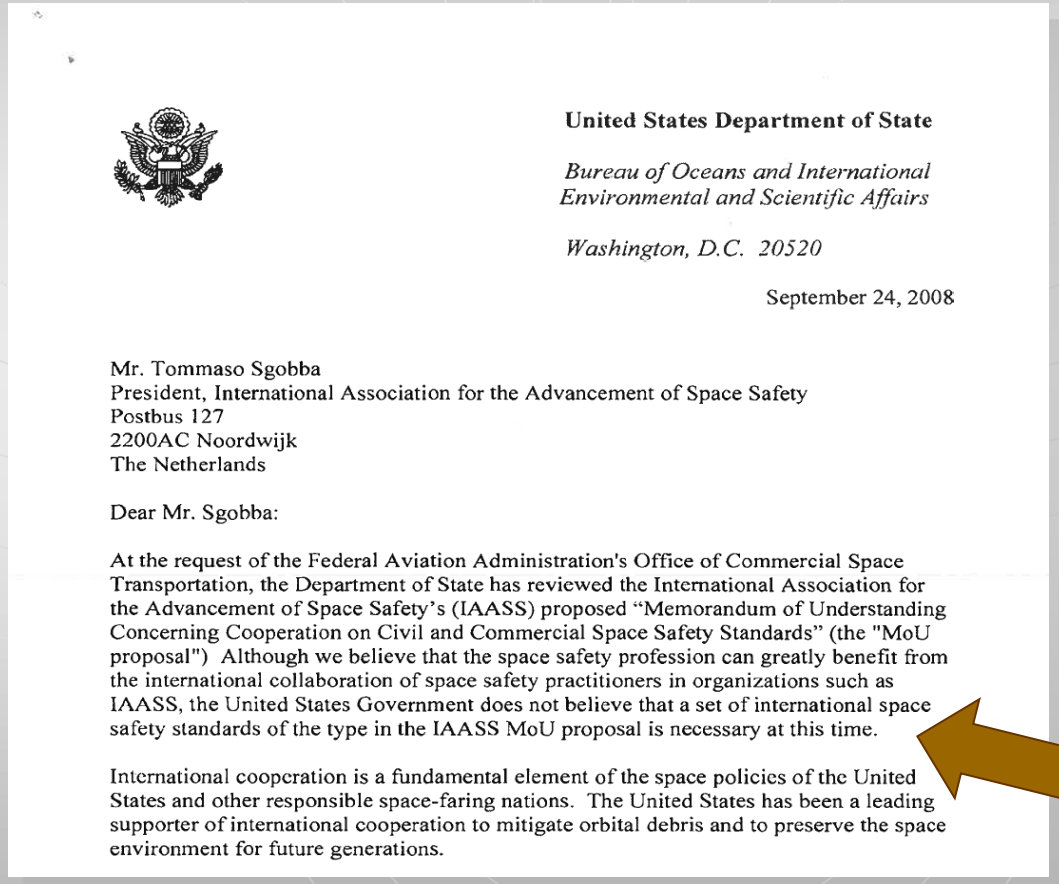
✓ BRUSSELS (Reuters) (Thu Nov 8, 2007) - The European Union and the United States want new global toy safety rules. "***If the EU and the U.S. can agree a regulatory framework, then this in essence becomes the global standard and forces other countries like China to follow suit…..***"

The IAASS initiative

The International Association for the Advancement of Space Safety (IAASS) is calling (again) for institutional stakeholders of space-faring countries to jointly establish safety policy consensus standards to become recommended references for national regulations.



…not necessary at this time (Sept. 2008)



United States Department of State

Bureau of Oceans and International Environmental and Scientific Affairs

Washington, D.C. 20520

September 24, 2008

Mr. Tommaso Sgobba
President, International Association for the Advancement of Space Safety
Postbus 127
2200AC Noordwijk
The Netherlands

Dear Mr. Sgobba:

At the request of the Federal Aviation Administration's Office of Commercial Space Transportation, the Department of State has reviewed the International Association for the Advancement of Space Safety's (IAASS) proposed "Memorandum of Understanding Concerning Cooperation on Civil and Commercial Space Safety Standards" (the "MoU proposal") Although we believe that the space safety profession can greatly benefit from the international collaboration of space safety practitioners in organizations such as IAASS, the United States Government does not believe that a set of international space safety standards of the type in the IAASS MoU proposal is necessary at this time.

International cooperation is a fundamental element of the space policies of the United States and other responsible space-faring nations. The United States has been a leading supporter of international cooperation to mitigate orbital debris and to preserve the space environment for future generations.

NASA Authorization Act 2008

- NASA Authorization Act – 2008 (H.R. 6063), signed into law on October 15, 2008, in the sections related to space traffic management and crew rescue. In Sec.1102, **SPACE TRAFFIC MANAGEMENT**, NASA is instructed to initiate an international coordination in that field. In fact it is stated that: "*(a) In General- As more nations acquire the capabilities for launching payloads into outer space, there is an increasing need for a framework under which information intended to promote safe access into outer space, operations in outer space, and return from outer space to Earth free from physical or radio-frequency interference can be shared among those nations.(b) Discussions- The Administrator, in consultation with other appropriate agencies of the Federal Government, shall initiate discussions with the appropriate representatives of other spacefaring nations with the goal of determining an appropriate framework under which information intended to promote safe access into outer space, operations in outer space, and return from outer space to Earth free from physical or radio-frequency interference can be shared among those nations*."

NASA Authorization Act 2008 (cont'd)

- In Sect. 406, **EXPLORATION CREW RESCUE**, it is further stated that: "*In order to maximize the ability to rescue astronauts whose space vehicles have become disabled, the Administrator shall enter into discussions with the appropriate representatives of spacefaring nations who have or plan to have crew transportation systems capable of orbital flight or flight beyond low Earth orbit for the purpose of agreeing on a common docking system standard*".

Code of Conduct for Outer Space Activities

(EU proposed draft 2009)

"*The Subscribing States resolve to promote the development of guidelines for space operations within the appropriate fora for the purpose of protecting the safety of space operations and long term sustainability of outer space activities*".

Policy Standards Groupings

Five groups of space safety standards are proposed by IAASS for initial development because of general interest and mutual benefits:

I) Public Safety Risk of Space Missions

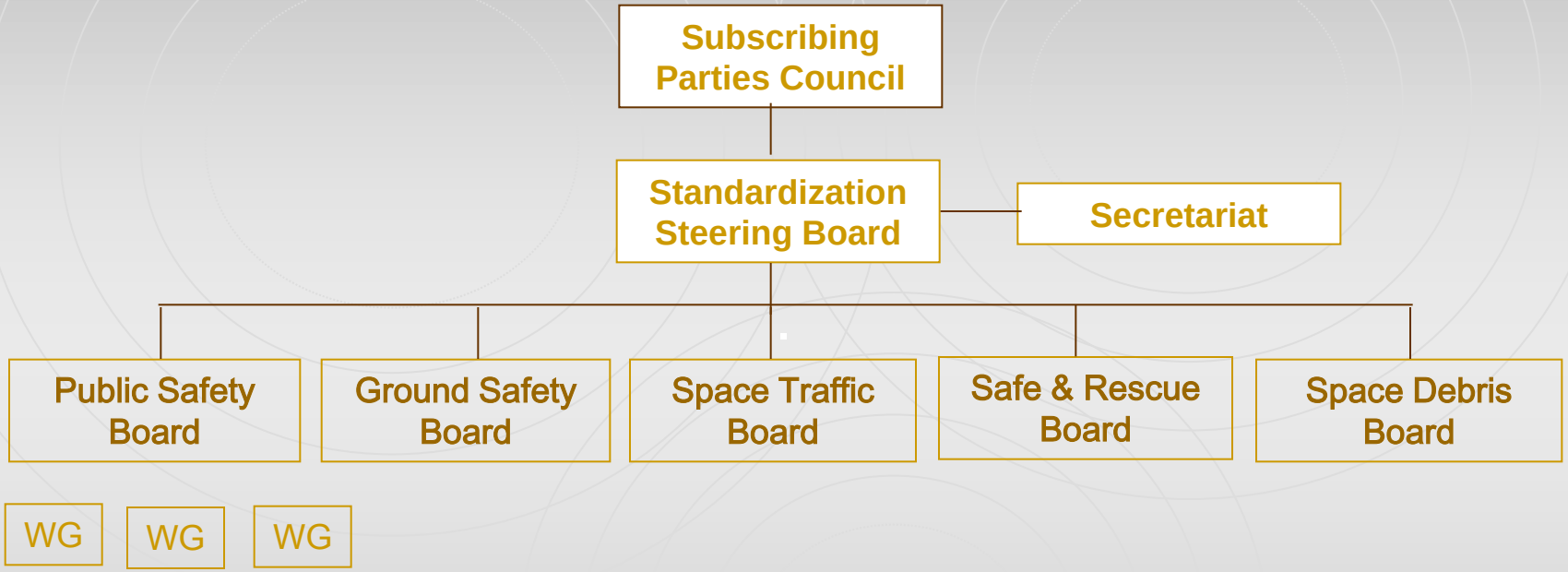
II) Ground Processing Safety

III) On-orbit Space Traffic Management

IV) Safe and Rescue

V) Space Debris

Proposed organization



Proposed organization (cont'd)

- Each Subscribing Party nominates one representative as member of the Steering Board

- The Steering Board is responsible for the overall coordination of the standardization efforts. The Steering Board nominates members and chairs of the Sub-Boards. The Steering Board decisions are taken on the basis of unanimity

- Each Sub-Board is responsible for the coordination of the standardization activities for their assigned policy standards grouping. The Sub-Boards nominate experts to be members and chairs of each Working Group

- The decisions of the Sub-Boards and Working Groups can be either by unanimity or by qualified 2/3 majority. In the latter case the decisions will need to be ratified by a decision of the Steering Board

Transitional Rules
(Initial baseline establishment)

- Each Subscribing Party proposes a list of candidate international policy standards among those already existing (as national/regional standards)

- The Sub-Boards will determine if overlaps exists and initiate working groups with the participation only of members and chairs sponsored by Subscribing Parties of the overlapping standards

- If only a single national standard of a Subscribing Party exists, that standard will be automatically adopted as international standard, save for text adaptation or reformulation necessary for the international use.

More international R&D needed in support of industrial standards development (Example)

- In the early morning hours of September 29, 2008 the ESA ATV "Jules Verne." Completed its six month logistics mission to the International Space Station and re-entered Earth's atmosphere.

  To improve safety risk assessment methods, an international team of scientists took off from Tahiti, French Polynesia, onboard two aircraft: NASA's DC-8 airborne laboratory and a Gulfstream V jet. Both aircraft flew southwest to the re-entry site above the Pacific Ocean.

  The aircraft were loaded with a variety of cameras and sensors capable of imaging the event in the visible, infrared and ultraviolet wavelengths of light, as well as gathering spectroscopic data.

  At the same time the Russians used their ISS on-board sensors (Fialka) to record the event from top in a combined unique effort.

Advanced R&D activities example: ATV re-entry Observation Campaign

click

The Fourth IAASS Conference

The Fourth IAASS Conference ***"Making Safety Matter"*** will take place at the *Von Braun Center* in Huntsville (AL) USA, in the period 19-21 May 2010