Cooperation on International Standards for Safety and Emergency Assistance

By
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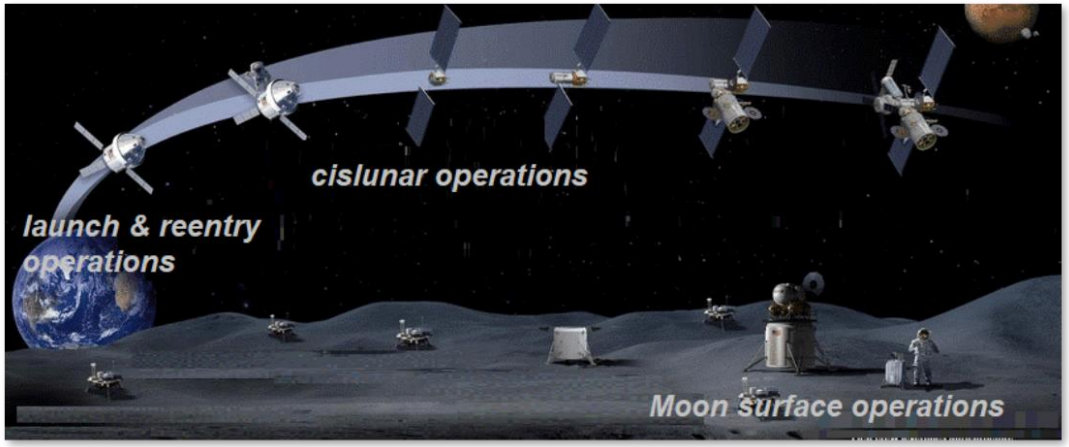
Introduction

Except for “Space Resources” and “Deconfliction of Activities”, the Artemis Accords principles are a reiteration of existing principles well established by UN treaties on outer space, and by the guidelines on space debris mitigation.

In all cases, it is not so much the AAs principles that are potentially contentious as their possible implementation. In this presentation I will try to highlight possible weak points based on current US Space Policy and Presidential Directives, for the AAs principles on:

a) Space Debris and Spacecraft Disposal
b) Interoperability/Emergency Assistance



Space Debris and Spacecraft Disposal

Orbital Debris and Spacecraft Disposal

Committment to effective compliance with UN Space Debris Mitigation Guidelines through policies, and national laws/regulations that implement best practices.

United Nations Space Debris Mitigation Guidelines

There is a total of seven guidelines:

a) limit debris released during nominal operations;

b) minimize the potential for break-ups during operational phases;

c) limit the probability of accidental collision in orbit;

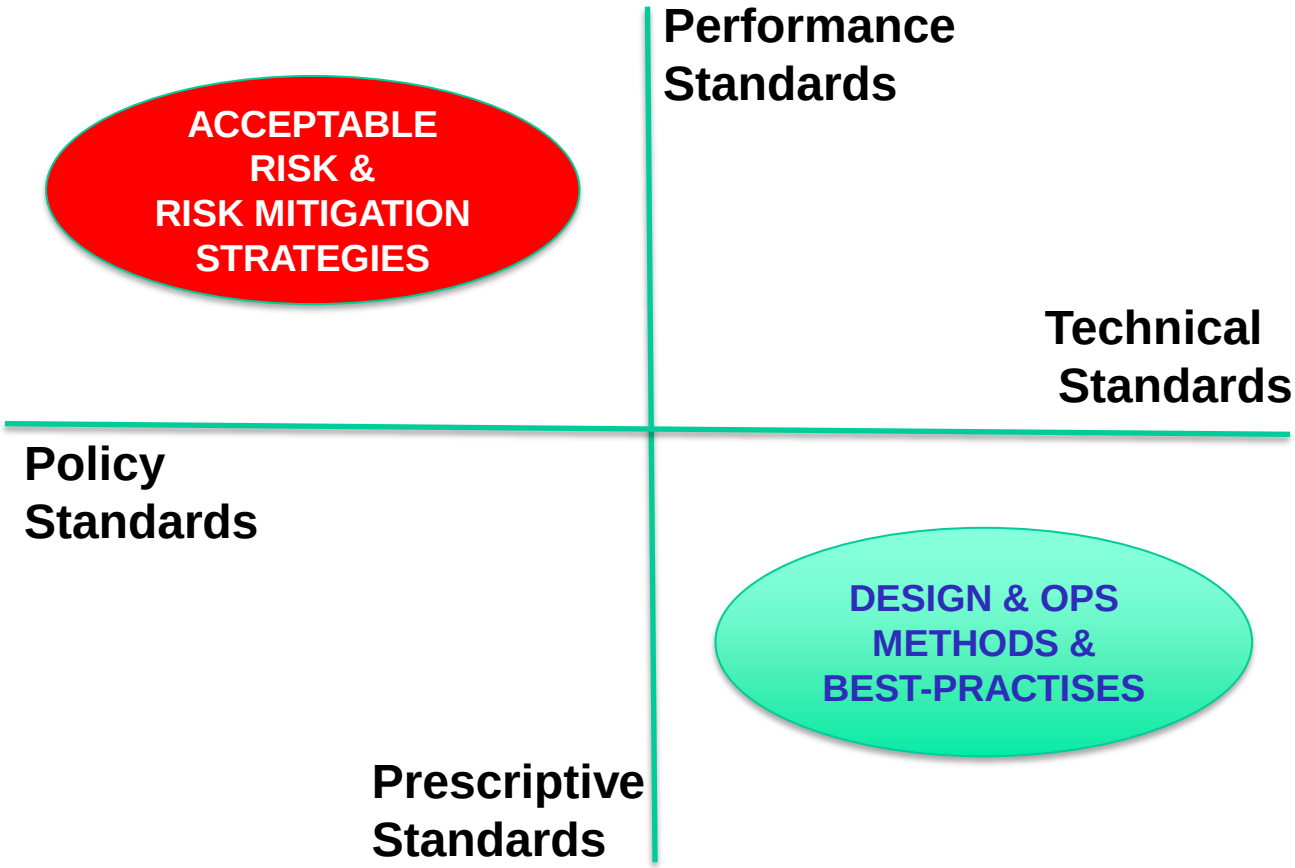
d) avoid intentional destruction and other harmful activities;

e) minimize the potential for post-mission break-ups resulting from stored energy;

f)/g) limit the long-term presence of spacecraft and launch vehicle orbital stages in the low-Earth orbit (LEO) region/geosynchronous Earth orbit (GEO) region after the end of their mission.

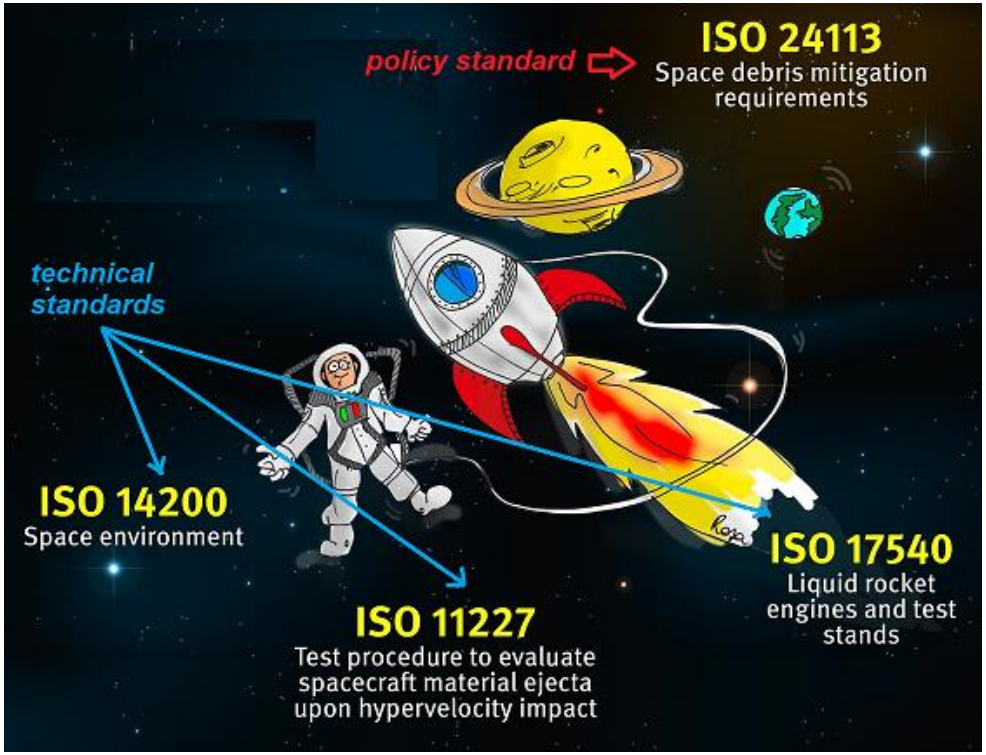
Policy Standards vs Industrial Standards

The implementation of UN guidelines on space debris requires the development of standards and compliance enforcement.



Policy Standards vs Industrial Standards

The ISO (International Standardization Organization) institutional mission is to develop industrial standards to facilitate international commerce, and not to set up safety policies (e.g. ISO 24113 for Space Debris), which are a government responsibility.



Policy Standards vs Industrial Standards

Safety standards can be divided in **policy standards** (sometimes referred to as policy requirements, doctrine, or rules) and industrial or **technical standards**.

Policy standards define the acceptable level of risk and risk mitigation strategies on the basis of technical as well as non-technical considerations of various kinds (including economic effectiveness). **Safety policies are for government to define**. Instead industrial standards define the state-of-art and best-practices (design solutions, engineering methods, etc.) to achieve those policies.

Although specialized commercial companies and private entities can provide efficient and competitive space safety services and technical support, it is not advisable to delegate the definition of space safety policies to consensus standards development organizations (SDO). SDOs should concentrate on industrial consensus standards development. On the other hand, the IADC and UN COPUOS are not suitable (mandate/organization) to operate as space safety policies coordination organization.

Interoperability / Emergency Assistance

Interoperability

Interoperability

Interoperability of systems is critical to ensure safe and robust space exploration.

Therefore, the Artemis Accords call for partner nations to utilize open international standards, develop new standards when necessary, and strive to support interoperability to the greatest extent practical.

ARTEMIS

In the context of Moon surface operations, the systems that could interoperate are vehicles, space suits, habitat/modules, robots, and associated data and power systems.

Aspects of Interoperability

Technical interoperability: *A characteristic of a product or system, whose interfaces are completely understood, to work with other products or systems, present or future, in either implementation or access, without any restrictions*.

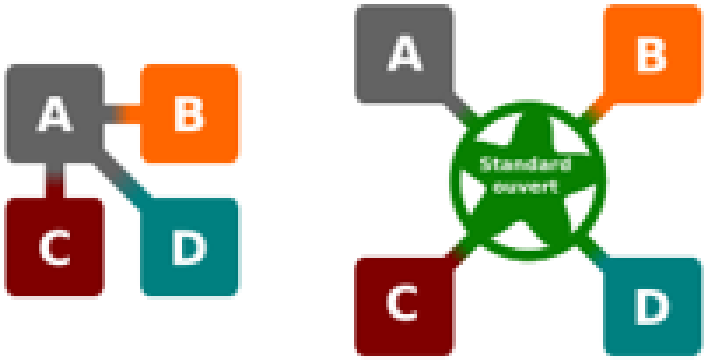
Legal interoperability: *The broader environment of laws, policies, procedures and cooperation agreements needed to allow the seamless exchange of information between different organizations.*

Semantic interoperability: *The ability to ensure that the precise meaning of exchanged information is unambiguously interpretable by any other system, service or user.*

For example issues of security/privacy related to the exchange of medical data.

Achieving Technical Interoperability

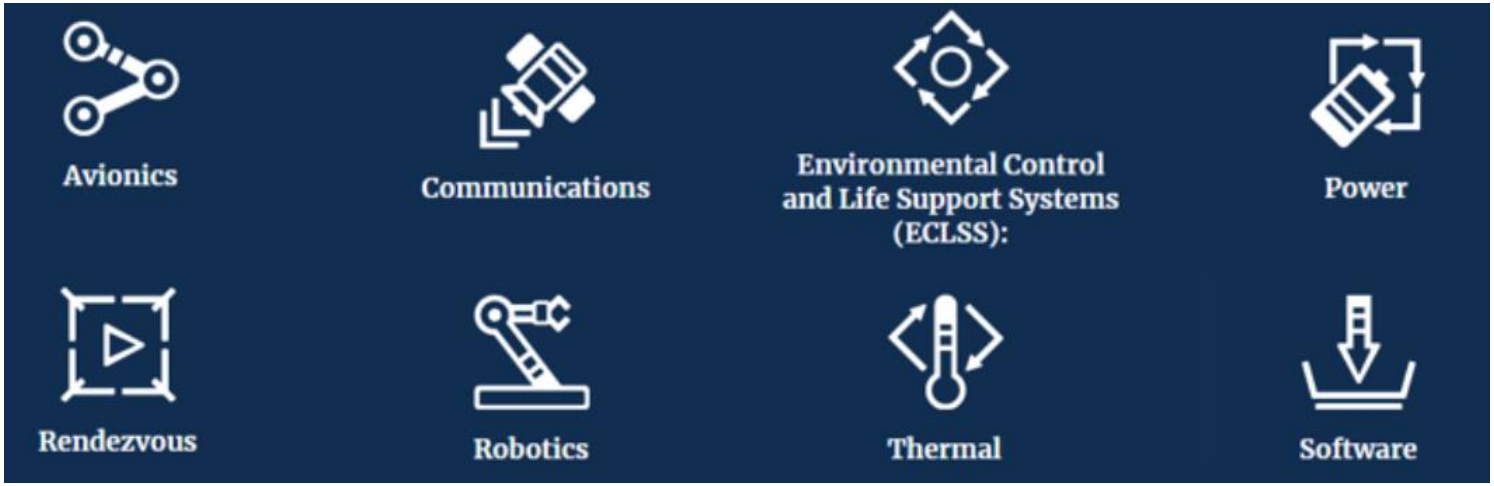
Interoperability can be achieved through:
- ***de facto standards*** or
- ***open standards***



- *De facto standards* usually reflect a “monopolistic” situation
- *Open standards* presuppose the free involvement of all stakeholders

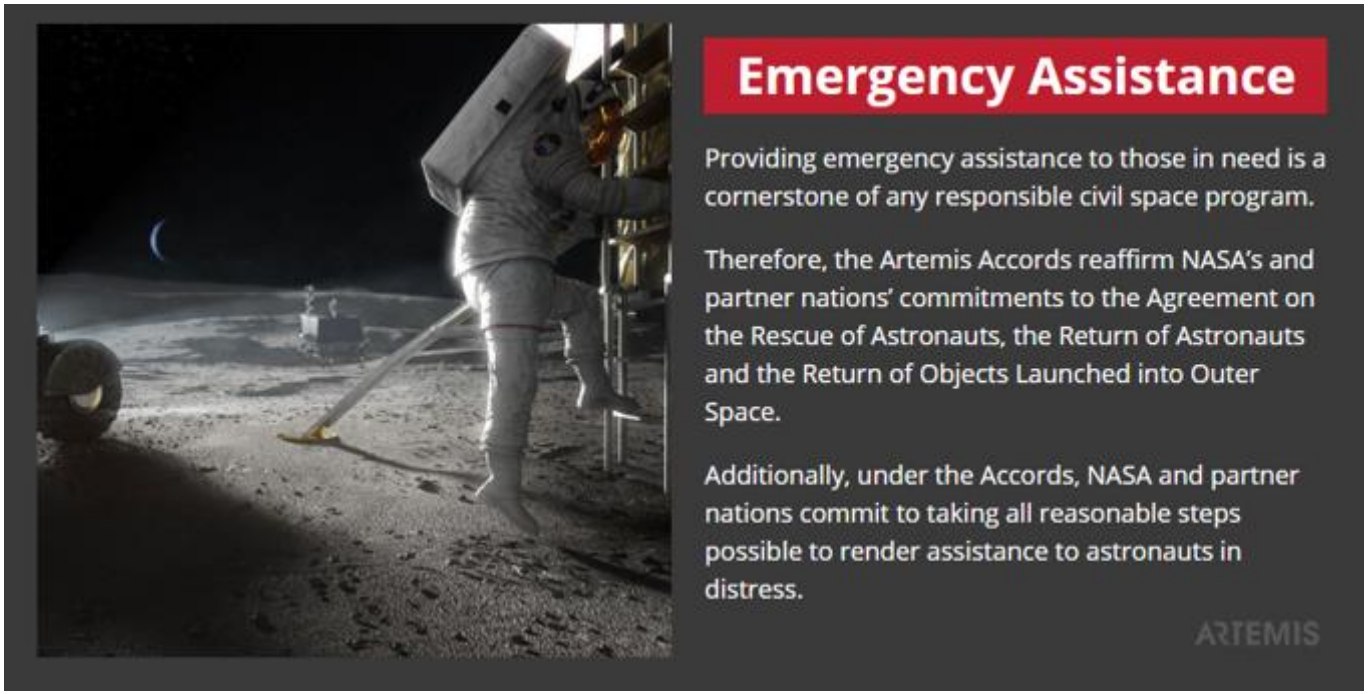
International Deep Space Interoperability Standards

In the period 2018-2019, the International Space Station (ISS) partners agencies derived from the ISS specifications eight ***International Deep Space Interoperability Standards*** *with the goal of defining interfaces and environments to facilitate cooperative deep space exploration endeavors…to engage the wide-ranging global spaceflight industry, and encourage feedback on the standards from all potential stakeholder audiences.* *(https://www.internationaldeepspacestandards.com/)*



Eight de-facto interoperability standards

Emergency Assistance



Rendering assistance to astronauts in distress on a Moon mission requires development of emergency capabilities and resources, systems interoperability, emergency procedures, preplanning, training, and integrated safety analyses.

Emergency Assistance – Outer Space Treaty*

Article XII
All stations, installations, equipment and space vehicles on the Moon and other celestial bodies **shall be open** to representatives of other States Parties to the Treaty on a basis of reciprocity…

Article IX
In the exploration and use of outer space, including the Moon and other celestial bodies, States Parties to the Treaty shall be guided by the principle of **cooperation and mutual assistance**…

**Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*

Emergency Assistance – Astronauts Rescue Agreement*

Article 10 (2)
States Parties **shall offer shelter** in their stations, installations, vehicles and other facilities to persons in distress on the Moon.

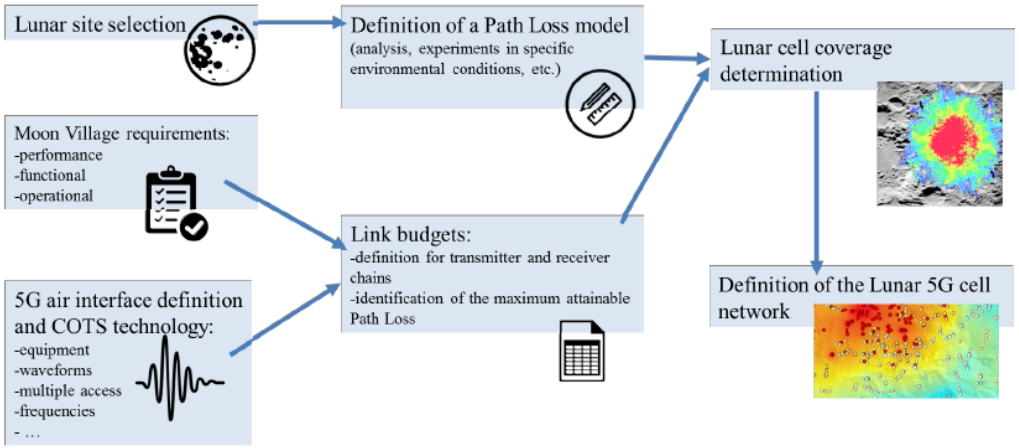
Article 12 (3)
In the event of an emergency involving a threat to human life, States Parties may **use the equipment, vehicles, installations, facilities or supplies of other States Parties** on the Moon.

**Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space*

Emergency Assistance should be an International Program

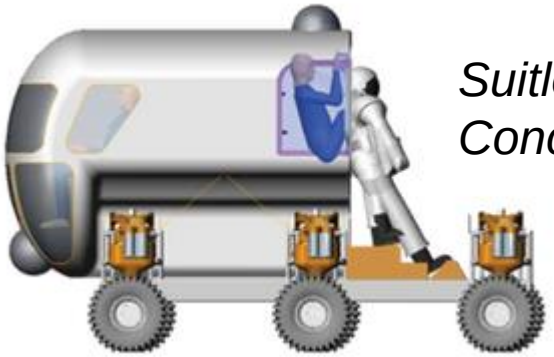
- The Moon surface area is about 38 million square miles, more than twice the size of Russia. Emergency assistance on the surface would be possible only if Moon bases will be in close proximity.

- Emergency assistance requires surface-to-surface communication. Line of sight limitation can be solved using orbiting relay satellites and wireless ground infrastructure. Moon outposts of different countries would need integrated communication and navigation services.



Emergency Assistance should be an International Program (cont'd)

- Emergency assistance requires compatible hardware/software and procedures between EVA suits and habitats for astronauts ingress/egress, including the case of incapacitated astronaut.
- Sheltering of astronauts in distress requires overdesigned life support systems, prepositioning of extra consumables, and emergency accommodation.
- Emergency equipment and procedures require testing and periodic end-to-end training by simulation.



Suitlock Concept

Artemis Suits

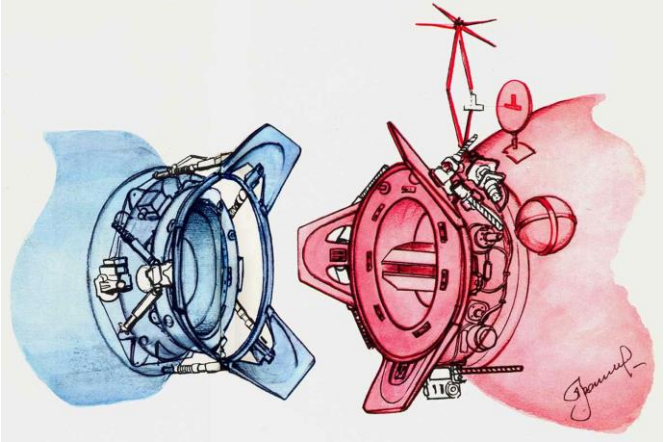
Emergency Assistance as Program: Previous Experience

1975 Apollo-Soyuz Test Project (ASTP): *USA and USSR agreed in 1972 to develop compatible rendezvous and docking systems to provide a basis for docking and rescue on future spacecraft of both nations.*

Emergency Assistance: Liabilities?

On the last day of the [ASTP] mission, the NASA Docking Module Pilot (DMP) took over control of the Apollo spacecraft to perform the second docking with Soyuz...right after docking he inadvertently made a small movement of left Rotational Hand Controller, firing a roll thruster which caused both vehicles to oscillate for a short time, folding them toward one another.

There was a real threat of damaging the joint docking mechanism and the possibility of a catastrophic depressurization of the Soyuz. (Space Safety and Human Performance, Elsevier 2018)

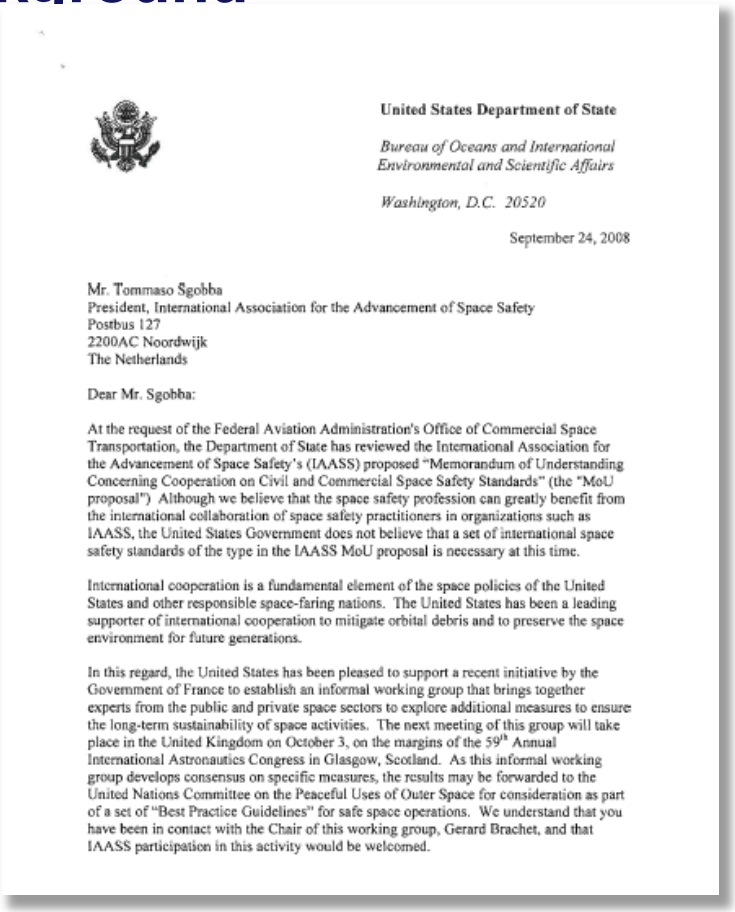


Artemis Accords: Opportunity for International Space Governance

IAASS Safety Standardization Cooperation Proposal: Background

At the 2nd IAASS Conference in Chicago (IL) in 2007, Bryan O'Connor NASA Associated Administrator Safety & MA suggested that international space governance could be better achieved through cooperation on space safety standards. The IAASS followed up with a draft MoU that NASA presented first to FAA/AST and then jointly to the DoS.

In 2008, IAASS received a letter from DoS stating that «*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*».



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.

In this regard, the United States has been pleased to support a recent initiative by the Government of France to establish an informal working group that brings together experts from the public and private space sectors to explore additional measures to ensure the long-term sustainability of space activities. The next meeting of this group will take place in the United Kingdom on October 3, on the margins of the 59th Annual International Astronautics Congress in Glasgow, Scotland. As this informal working group develops consensus on specific measures, the results may be forwarded to the United Nations Committee on the Peaceful Uses of Outer Space for consideration as part of a set of "Best Practice Guidelines" for safe space operations. We understand that you have been in contact with the Chair of this working group, Gerard Brachet, and that IAASS participation in this activity would be welcomed.

IAASS Safety Standardization Cooperation Proposal: MoU Goal

The IAASS has proposed a standardization cooperation open to all spacefaring countries based on the subscription of a dedicated MoU.

The MoU provides the mechanism for the international coordination of national space safety policies pertaining to those **space safety risk management issues that are international in nature and that can be effectively mitigated only through international cooperation**.

The parties subscribing the proposed MOU would voluntarily adopt the resulting rules as main/preferred reference for their own national regulations. Furthermore they would jointly review the adequacy of industrial standards, issued by specialized standardization bodies such as ISO, ASTM, SAE, etc. in view of recommending their use (recommended practices)

IAASS Safety Standardization Cooperation Proposal: Standards Groupings

Five coordinated groupings of policy standards proposed:

I) **Public Safety**. Standards on public safety risk management, including launch and re-entry operations, safe use of NPS (Nuclear Power Sources), health hazard in proximity of launch sites, and interfaces between air traffic and outer space bound traffic.

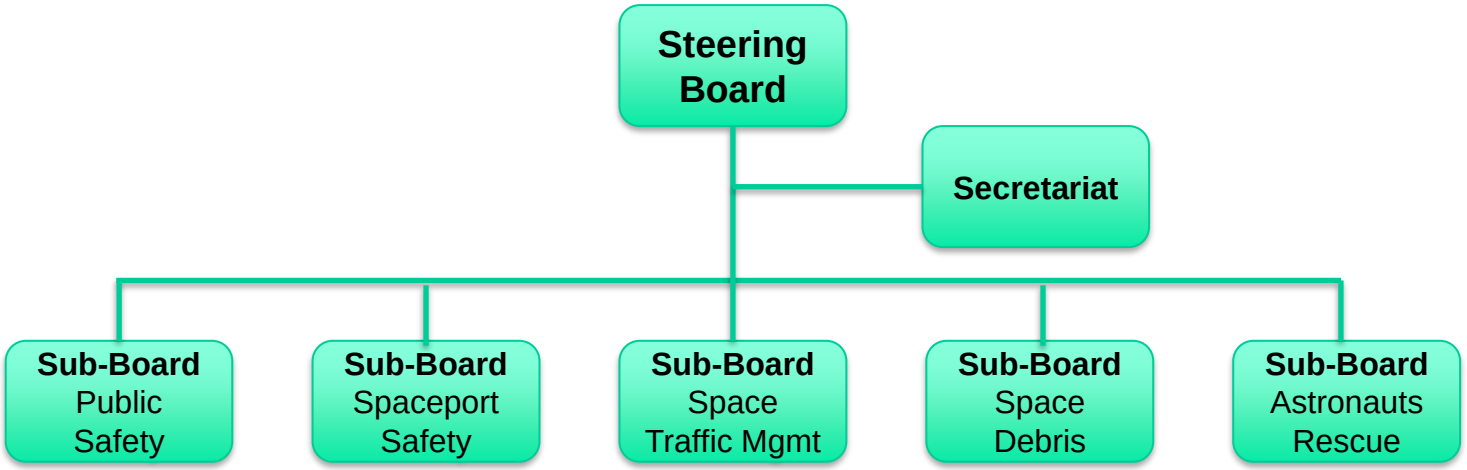
II) **Spaceport Safety**.
Standards establishing general design and operations safety requirements for ground processing of Commercial Space Vehicles and Payloads at international spaceports (i.e. on-site foreign integration teams).

III) Space Traffic Management. Standards establishing exchange of space situational awareness data, and operational traffic management rules to prevent physical and functional interferences between operational space systems, and to prevent collision with orbital debris.

IAASS Safety Standardization Cooperation Proposal: Standards Groupings (cont'd)

IV) **Space Debris**. Standards for mitigation and remediation of space debris. [Note: On going standardization activities within ISO would be duly taken into consideration].

V) **Astronauts Rescue**. Standards establishing minimum interoperability and safety requirements for astronauts rescue, and emergency assistance.

IAASS Safety Standardization Cooperation Proposal: Organization

- The top body for guiding and coordinating all aspects of the space safety standardization activity is the **Steering Board**. Each Subscribing Party would have one representative as member of the Steering Board.
- The Steering Board would be supported by Sub-Boards dealing with specific areas of standardization and by a Secretariat.
- The Steering Board decisions would be taken by unanimity.