Standards and Processes for Enabling COPUOS and Other Guidelines

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COPUOS

• The Committee on the Peaceful Uses of Outer Space was set up by the General Assembly in 1959 (resolution 1472 (XIV)) to:
  – **review** the scope of international cooperation in peaceful uses of outer space
  – **devise** programmes in this field to be undertaken under United Nations auspices
  – **encourage** continued research and the dissemination of information on outer space matters, and
  – **study** legal problems arising from the exploration of outer space.
IADC

The Inter-Agency Space Debris Coordination Committee (IADC) is an international governmental forum for the worldwide coordination of activities related to the issues of man-made and natural debris in space.

The primary purposes of the IADC are to exchange information on space debris research activities between member space agencies, to facilitate opportunities for cooperation in space debris research, to review the progress of ongoing cooperative activities, and to identify debris mitigation options.
INFERENCE

• Neither of these bodies has authority or the charter to implement any program or process.

• They:
  – Review, devise, encourage, and study
  – Coordinate, exchange, facilitate, review, and identify

KEY ELEMENTS THAT ARE MISSING:

IMPLEMENTATION
OPERATIONAL FEASIBILITY
OBJECTIVE VALUE PROPOSITION
Questions

• How will debris mitigation and management practices be established, demonstrated, and verified?

• What technical and administrative authorities will be responsible for implementation and validation?

• What criteria will be used to judge debris minimization and mitigation sufficiency?

All of these must be addressed before codes of conduct, conventions, treaties, or national laws can be developed.
How will debris mitigation and management practices be established, demonstrated, and verified?

- **Agency guidelines and practices**
  - NASA Technical Standard 8719.14
    - August 2007, Process for Limiting Orbital Debris

- **Individual program provisions**
  - End of life disposal plans

- **National laws and regulations**
  - FCC debris mitigation plan required for licensing

- **International standards**
Establishment, Demonstration, and Verification Issues

- Agency rules apply only to the agency and its programs.
- Individual programs and contracts may consider only measures that are convenient or inexpensive.
- National laws and regulations must be founded on demonstrated practice and sound technology.
  - Some environmental regulations disregard technology and science
- International Standards development and application are voluntary.
What technical and administrative authorities will be responsible for implementation and validation?

• Program authorities or commercial customers are ultimately responsible for assuring that products they accept meet requirements.

• Providers and vendors are responsible for demonstrating to their customers that requirements have been satisfied.
Issues with Implementation and Validation

• Few customers have the skills and experience to guide implementation or validate the outcome.

• Providers suffer a conflict of interest between offering the most efficient mission solution and debris mitigation.

• Independent validating organizations eventually suffer institutional cancer, growing and expanding for their own sake.
What criteria will be used to judge debris minimization and mitigation sufficiency?

- **Microscopic Criteria**
  - Material and coating selection
  - Shielding and survivability measures

- **Macroscopic Criteria**
  - Structural sufficiency
  - System hazard and consequence analyses
  - Orbit and constellation design
### International Diversity

<table>
<thead>
<tr>
<th>Mission Related Objects</th>
<th>Action</th>
<th>IADC Guidelines</th>
<th>UN Guidelines</th>
<th>ISO (DIS24113)</th>
<th>JAXA (JMR-003A)</th>
<th>European CoC</th>
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<tr>
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<td>Operational Debris</td>
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<td>○ (Rec-1)</td>
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<td>Slag from solid motor</td>
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<td>slag &lt; 0.01mm (revised to 1mm ?)</td>
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<td>Pyrotechnics</td>
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<td>secondary ejecta</td>
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# International Diversity

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<th>Mission Terminated Systems</th>
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<tr>
<td>GEO</td>
<td>Reorbit of GEO S/C</td>
<td>235 km+ (1,000 ・ Cr ・ A/m) e&lt;0.003</td>
<td>○ (Rec-7)</td>
<td>235 km+ (1,000 ・ Cr ・ A/m) e&lt;0.003, success rate&gt;0.9 non-interference: 100 years</td>
<td>○ (SD-DE-04)</td>
<td>235 km+ (1,000 ・ Cr ・ A/m) (e&lt;0.003 will be added in 2009)</td>
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<td>Probability &lt; 10^-3 (SD-DE-05)</td>
<td>Probability &lt; 10^-3 (SD-DE-05)</td>
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<td>○</td>
<td>○ (Rec-2)</td>
<td>Probability &lt; 10^-3</td>
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<td>○</td>
<td>○ Required generally Also; ① Pressure vessels: pressure &lt; 50% of Cr Pres. ② To be passivated within one year after EOM, Success probability&gt;0.9</td>
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<td>Residual Propellants</td>
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CREATING THE ENVIRONMENT FOR FEASIBLE DEBRIS MITIGATION REGIMES

• Voluntary national and international standards stipulate essential elements of process implementation, verification, and documentation.

• Voluntary standards are driven by user needs.
  – They are self-prioritizing

• Voluntary standards are developed ecumenically, working groups chosen by virtue of technical expertise not national origin.

You cannot bring a horse to water – unless there is water.
Whether he drinks is still his choice, but he has no choice without water.
What ISO is trying to accomplish

- Institutionalize consensus based on feasible technology and engineering
- Establish a hierarchy and framework for implementing and verifying debris mitigation measures.
- Develop detailed standards for critical debris issues.
  - Standards that can be adopted wholly or in parts and that can be tailored to need.
Space Systems: Space Debris Mitigation

• Acquiring organizations shall … explicitly include requirements for managing a space debris mitigation programme within the development.

• Measures to manage and mitigate space debris shall be tracked, documented, and validated.

• A Space Debris Management Plan shall define approach, methods, procedure, resources, and organization to coordinate and manage debris mitigation activities.
Disposal of Satellites in Geostationary Orbit

• This International Standard specifies requirements for
  – planning for disposal of satellites operating at geosynchronous altitude to ensure that final disposal is sufficiently characterized and that adequate propellant will be reserved for the maneuver,
  – selecting final disposal orbits where the satellite will not re-enter the operational region within the next 100 years,
  – executing the disposal maneuver successfully, and
  – depleting all energy sources on-board the vehicle before the end of its life to minimize the possibility of an event that can produce debris.
Estimating mass of remaining usable propellant

• Mass of remaining usable propellant shall be monitored through life

• Approaches to propellant gauging shall be described in detail, including measurement uncertainties.

• Allowance shall be made for sufficient propellant to execute end of life maneuver

• When usable propellant is within margin for end of life, the mission shall be terminated.
Standards development and implementation issues

• Competing standards bodies and conflicting desires
  – National and industrial pressures
• Insufficient technical expertise
  – Many member bodies are affected by outcomes but only a few have required expertise to influence outcomes
• Resistance from industry and government
  – Debris standards increase manufacturing and operations costs.
  – Debris standards impose additional constraints
• Resource demands for developing standards
Conclusion

• Debris mitigation codes of conduct, guidelines, and similar instruments are ineffective.
• Guidelines should not be static
  – Guidelines may be based on desire rather than feasibility
• Industrial standards are the environment for space debris mitigation.
  – Debris mitigation requirements throughout space system life cycle are the most effective and verifiable approach
  – Industry must be involved from inception, not just in final review.
• Many issues must be overcome to develop a sufficient set of standards.
Iridium 13 Conjunctions with 10 Feb 09 Debris

5-10 May 2009
A close approach does not itself imply a collision. Few collisions have catastrophic consequences.
Iridium 13 Vulnerability
This Week

Cumulative Probability of Iridium 13 Conjunction

Event Epoch

Probability of Conjunction

5/5/09 0:00  5/6/09 0:00  5/7/09 0:00  5/8/09 0:00  5/9/09 0:00  5/10/09 0:00  5/11/09 0:00