A/AC.105/2005/CRP.8
10 June 2005

Original: English only

COMMITTEE ON THE PEACEFUL USES OF
OUTER SPACE
Forty-eighth session
Vienna, 8-17 June 2005
Item 7
Report of the Scientific and Technical Subcommittee
on its forty-second session

INTERSESSIONAL MEETING OF THE WORKING GROUP ON SPACE DEBRIS OF THE SCIENTIFIC AND TECHNICAL SUBCOMMITTEE (13-16 JUNE, CONFERENCE ROOM VII)

PROPOSALS FOR A DOCUMENT ON SPACE DEBRIS MITIGATION

1. At its forty-second session, held in Vienna from 21 February to 4 March 2005, the Scientific and Technical Subcommittee endorsed the agreement of its Working Group on Space Debris to develop a document on space debris mitigation.

2. In accordance with the new multi-year work plan endorsed by the Subcommittee, the Working Group on Space Debris agreed to hold an intersessional meeting during the forty-eighth session of the Committee, from 13 to 16 June, to prepare for the work to be conducted in 2006. The intersessional work would include, among other tasks, consideration of proposals from member States of the Committee on the Peaceful Uses of Outer Space for the document to be developed covering space debris mitigation (A/AC.105/848, Annex II, para. 6).

3. The present document compiles the proposals received from the member States for the document to be developed on space debris mitigation.

V.05-85261 (E)

Proposal for a United Nations Space Debris Mitigation Document Considered by the International Relations Committee of the European Space Agency (ESA) at its 54th session held in Frascati, Italy on 30 and 31 May 2005

Background

Since the United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS) published its Technical Report on Space Debris in 1999, it has been a common understanding that the current man-made space debris poses a moderate risk to ordinary unmanned spacecraft in Earth orbit. It is now, however, common practice to consider the collision risk with orbital debris in planning manned missions. As the population of debris continues to grow, the probability of collisions that could lead to potential damage will consequently increase. The prompt implementation of appropriate debris mitigation measures is therefore considered a prudent and necessary step towards preserving access to space for future generations.

Rationale

A set of Mitigation Guidelines has been developed by the Inter-Agency Debris Committee (IADC) which reflects the fundamental mitigation principles of a series of existing Standards, Codes and Handbooks developed by a number of national and international organisations. UN COPUOS acknowledges the need for a higher level set of objectives, having wider acceptance amongst the global space community. A Working Group on Space Debris was therefore established [at the Scientific and Technical Subcommittee of COPUOS] to develop a set of recommended practices, based upon these IADC Mitigation Guidelines (and adopting their basic definitions), which could be endorsed by the UN. These recommended practices, for application on a voluntary basis by Member States, are based on the following axioms for minimising the space debris hazard:

- Limiting the objects released during normal operations
- Preventing on-orbit break-ups
- Removing spacecraft and orbital stages from the useful, densely populated regions at the end of normal operations.

Application

During an organisation's planning for, and operation of, a space system, it should take systematic actions to reduce adverse effects on the orbital environment. This reduction can be achieved by considering space debris mitigation throughout the lifecycle, from mission requirement and definition phases through to final disposal at end of life.

Recommended Mitigation Practices

The design and operation of a space system, including orbital stages and mission related objects, should comply with the following recommended practices.

Recommended Practice 1: Limit debris released during normal operations
Space systems should be designed not to release debris during normal operations. If this is not feasible, any release of debris should be minimised in number, area and orbital lifetime. Any program, project or experiment that will release objects into orbit should not be planned unless an adequate assessment can verify that the effect on the orbital environment, and the hazard to other operating space systems, is acceptably low.

Recommended Practice 2: Limit the probability of accidental collision on orbit
In developing the design and mission profile of a space system, a program or project should estimate and limit the probability of accidental collision with known objects during the system's launch phase and orbital

lifetime. If reliable orbital data are available, adjustment of the launch time and on-orbit avoidance manoeuvres should be considered if the collision risk is unacceptable.

Recommended Practice 3: Minimise potential for break-ups during operational phase
During the design of a space system, each program or project should demonstrate that there is no probable failure mode leading to accidental break-ups. If such failures cannot be excluded, the design or operational procedures should minimise the probability of their occurrence. During the operational phase, a space system should be monitored to detect malfunctions that could lead to a break-up or loss of control function. In the case that a critical malfunction is detected, disposal and passivation measures should be planned and executed.

Recommended Practice 4: Avoid intentional destruction
The intentional destruction on orbit of a space system, that may increase collision risks to other systems, should be avoided.

Recommended Practice 5: Disposal of geostationary (GEO) systems
Spacecraft that have terminated their mission should be re-orbited above GEO in accordance with the relevant IADC Guideline. Upper stages, boost motors and/or mission related objects which cannot comply with this IADC Guideline should not be placed or released in or near GEO.

Recommended Practice 6: Disposal of Low Earth Orbit (LEO) systems
Space systems that are terminating their operational phases in orbits that pass through the LEO region, should be de-orbited directly. If this is not possible, they should be manoeuvred into an orbit with a reduced lifetime in accordance with the relevant IADC Guideline, or re-orbited above LEO.

Recommended Practice 7: Minimise potential for post-mission break-ups resulting from stored energy
In order to limit the risk to other space systems from accidental break-ups, all on-board sources of stored energy of a space system should be depleted or made safe when they are no longer required for mission operations or post-mission disposal. After separation, orbital stage depletion should occur as soon as this operation does not pose an unacceptable risk to the payload.

Recommended Practice 8: Reduction of risk on the ground
If a space system is disposed of by re-entry into the atmosphere, debris that survives to reach the surface of the Earth should not pose an unacceptable risk to people or property. This may be accomplished by limiting the amount of surviving debris, or by confining the debris impacts to uninhabited areas. Pollution, of the atmosphere or on the surface, caused by the release of radioactive or toxic substances, should be prevented or minimised.

Draft Proposal of Japan
for Contents of Space Debris Mitigation Document

I. General

Document on space debris mitigation has been developed on the following consideration:

a. It would use the technical content of the Inter-Agency Space Debris Coordination Committee Space Debris Mitigation Guidelines (as contained in A/AC.105/C.1/L.260) as the basis;
b. It would not be more technically stringent than the Inter-Agency Space Debris Coordination Committee Space Debris Mitigation Guidelines;
c. It would not be legally binding under international law;
d. The implementation of space debris mitigation remains voluntary and should be carried out through national mechanisms;
e. It would recognize that exceptions may be justified;
f. It would be a living document that could be updated on a regular basis in accordance with evolving national and international practices on space debris mitigation and related research and technology developments;
g. It would be applicable for mission planning and operation of newly designed spacecraft and orbital stages and, if possible, for existing ones;
h. It would take into consideration the United Nations treaties and principles on outer space;
i. The space debris mitigation document is planned to be a concise document containing high-level qualitative guidelines and making reference to the Inter-Agency Space Debris Coordination Committee mitigation guidelines. The document will have annexes.

II. Guideline for Mitigation

1. Mission Planning :

(Com.) *Restriction on Planning is possible?*

2. System Design of Space Systems

a. No generation of Space Debris
- Deployment : (Ref.) IADC SD MG ××.××
- Explosion :

b. Orbit Design :
c. End-of-Mission Procedure
- Re-entry within some reasonable years for the system in LEO, with acceptable hazard probability :
- Orbit change to the orbit without any interference with others, for the systems in LEO/GEO :
- No explosion by some measures (discharge of battery, consumption of fuel etc.) :

d. - - - - - :
e. - - - - - :

3. Manufacturing
   a. High Reliability :
   b. - - - - - :
   c. - - - - - :

4. Launching
   a. Some measures to the upper stages :
   b. No interference with the manned space systems :
   c. - - - - - :
   d. - - - - - :

5. Operation in Orbit
   a. Monitoring of the orbit :
   b. No collision with other space systems :
   c. - - - - - :
   d. - - - - - :

6. End-of-Mission Phase
   a. Orbit change
      - Re-entry into the atmosphere within some reasonable years :
      - Shift to the higher orbit (NPS) (TBD) :
      - Shift to the orbit for less interference with other systems (GEO) :
   b. Some procedure for no explosion :
   c. - - - - - :
   d. - - - - - :

Note :

Com. : Comment
Ref. : Corresponding to the section No. of IADC Space Debris Mitigation Guidelines

Draft Proposal of the United States on the STSC Space Debris Mitigation Guidelines

1. Description of Space Debris

Space debris are all man made objects including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional.

This definition is similar to others currently in use in the international aerospace community and is accepted as being adequately descriptive to meet the purposes of this document and should not be considered to apply more generally.

2. Fundamental Space Debris Mitigation Measures

The STSC recommends that Member States and international organizations voluntarily take measures, through national or other appropriate mechanisms, to ensure that all designers, manufacturers, and operators of launch vehicles and spacecraft adopt, to the greatest extent feasible, comprehensive and effective space debris mitigation practices and procedures to preserve the near-Earth environment for future generations.

Space debris mitigation measures can be divided into two broad categories: those that directly prevent the generation of potentially harmful space debris in the near-term, and those that indirectly limit the generation of potentially harmful space debris over the longer term. The former involves the curtailment of the production of mission-related space debris and the avoidance of break-ups. The latter concerns end-of-life procedures that remove decommissioned spacecraft and launch vehicle orbital stages from regions populated by operational spacecraft.

Historically, the primary sources of space debris in near-Earth orbits have been (1) debris released intentionally during launch vehicle and spacecraft operations, including disposal activities, and (2) accidental and intentional break-ups which produce long-lived debris.

The space debris mitigation guidelines cited in this document are applicable through all phases of space flight, including deployment, operations, and post-mission disposal.

Space Debris Mitigation Guideline 1: The release of long-lived debris during the deployment and operations of spacecraft and launch vehicle orbital stages should be avoided.

During the early decades of the space age, launch vehicle and spacecraft designers permitted the intentional release of numerous objects into Earth orbit, including sensor covers, separation mechanisms, and deployment articles. During the past ten years the rate of production of this type of space debris has dramatically diminished due to dedicated redesign efforts, prompted by the recognition of the threats posed by such objects.

Space Debris Mitigation Guideline 2: Breakups of Earth-orbiting spacecraft and launch vehicle stages that produce long-lived debris should be avoided.

By far the largest percentage of the space debris population has originated from the fragmentation of spacecraft and launch vehicle orbital stages. The majority of these breakups were unintentional, many arising from the abandonment of space systems with significant amounts of stored energy. In some cases, breakups resulted during space system malfunctions, *e.g.*, catastrophic failures of propulsion systems, or deliberate fragmentations in long-lived orbits. The awareness of the risks posed by space debris to operational space systems has led to specific measures to curtail such events. The most effective means have been the adoption of thorough passivation measures following the completion of spacecraft and launch vehicle orbital stage missions. Space system passivation requires the removal of all forms of stored

energy, including residual propellants and compressed fluids, and the discharge of electrical storage devices.

Spacecraft designers and operators should consider, and where practicable limit, the probability of collisions with space debris. Numerous studies indicate that, if the number and mass of space debris in Earth orbit continue to grow, the future primary source of new space debris will be from accidental collisions. The most effective means of curtailing the rate of future collisions in space between uncontrolled space objects is to remove the objects entirely from Earth orbit or to transfer them to less congested orbital regimes.

Space Debris Mitigation Guideline 3: After their useful operations have been completed, spacecraft and launch vehicle orbital stages should not be left in orbits that will result in their long-term presence within 2000 km of the surface of the Earth.

For space objects in widely used low Earth orbits (LEO), *i.e*., in the region below 2000 km altitude above the surface of the Earth, the most practical means of removing space objects after the completion of their missions normally is to transfer the objects to lower altitudes, thereby accelerating their natural fall back into the atmosphere. For space objects in the region between 1500 km and 2000 km, the most energy efficient solution might be to maneuver the object into an orbit above 2000 km.

When making determinations regarding potential solutions for removing objects from LEO, due consideration should be given to ensure that debris which survives to reach the surface of the Earth does not pose an undue risk to people or property, including through environmental pollution caused by hazardous substances.

Space Debris Mitigation Guideline 4: Spacecraft and launch vehicle orbital stages in geosynchronous orbits, following the completion of their missions, should be transferred to higher altitude disposal orbits to prevent their future interference with operational GEO spacecraft.

For space objects in or near the geosynchronous regime (GEO), *i.e*., in nearly circular orbits with a mean altitude of approximately 35,785 km above the surface of the Earth, the potential for future collisions can be reduced by maneuvering objects at their end of mission to a region above GEO such that they will not return to within 200 km of GEO within 100 years. Objects that cannot be later transferred, including mission-related debris, should not be placed or released in or near GEO.

3. Other Issues and Updates

Research by Member States is continuing in other areas related to space debris, including risks of human casualty associated with the uncontrolled reentry of space debris. In addition, future advances in technology might lead to more effective means of limiting or even reducing the space debris population. Consequently, this document will be reviewed and revised as warranted.

Annex

For more in-depth descriptions and recommendations pertaining to space debris mitigation measures that Member States are encouraged to observe, Member States and international organizations should review the current version of the Inter-Agency Space Debris Coordination Committee (IADC) *Space Debris Mitigation Guidelines*, which can be located at the following world-wide web address: www.iadc-online.org. The current version of these guidelines at the time of the publication of this document is annexed.

[Include as annex Sections 1-6 of IADC *Space Debris Mitigation Guidelines*, October 2002 or later approved revision.]