United Nations A/AC.105/770

General Assembly

Distr.: General
30 November 2001

Original: English

Committee on the Peaceful Uses of Outer Space

National research on space debris, safety of space objects with nuclear power sources on board and problems relating to their collision with space debris

Note by the Secretariat

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V.01-89171 (E) 040102 070102

I. Introduction

1. At its forty-fourth session, the Committee on the Peaceful Uses of Outer Space agreed that Member States should continue to be invited to report to the Secretary-General annually with regard to national and international research concerning the safety of space objects with nuclear power sources, that further studies should be conducted on the issue of collision between space debris and orbiting space objects with nuclear power sources on board and that the Committee's Scientific and Technical Subcommittee should be kept informed of the results of such studies.[1] The Committee also took note of the agreement of the Subcommittee that national research on space debris should continue and that Member States and international organizations should make available to all interested parties the results of that research, including information on practices adopted that had proved effective in minimizing the creation of space debris (A/AC.105/761, para. 127).

2. In a note verbale dated 8 August 2001, the Secretary-General requested Governments to submit any information on the above questions by 31 October 2001 so that it could be submitted to the Scientific and Technical Subcommittee at its thirty-ninth session. The present note has been prepared by the Secretariat on the basis of information received from Member States by 3 December 2001. Information received subsequent to that date will be included in addenda to the present document.

II. Replies received from Member States

Australia

1. Australia's report discusses debris mitigation procedures in the context of the operation of domestic space launch facilities. While there are no space launch facilities currently operational, there are several firm proposals to establish such facilities in the near future. Australia's report also discusses activities undertaken by the private sector with regard to debris management.

Licensing arrangements

2. Australia does not manufacture satellites at the present stage, with the exception of the small experimental FedSat 1 satellite. However, as a potential launching country, Australia is concerned about the impact of nuclear-driven activities in space.

3. Under Australia's space licensing regime, applicants must satisfy strict safety and environmental requirements. In addition, space objects cannot contain nuclear weapons or fissionable materials unless the approval of the Minister has been gained. Under these three sets of legal requirements, the regime is strict about nuclear sources in space debris.

Asia Pacific Space Centre

4. The Asia Pacific Space Centre is establishing a commercial space launch facility on Christmas Island. The Centre will use the Russian Aurora launch vehicle, which will consist of three stages plus an upper optional stage, and will target geostationary launches. It is planned to commence launches in 2004.

5. The Government of Australia has completed a full assessment of the impact of the proposed launch facility on the environment and made a number of recommendations to the company. Among the issues addressed by those recommendations were the potential for orbital debris generation in both normal operation and malfunction conditions, the potential for orbital debris generation due to on-orbit impact with existing space debris or other orbiting space systems and the potential for items to pose a safety or environmental threat upon re-entry.

6. The Centre has developed an Environmental Management Plan, which sets out strategies to address those recommendations. In line with the *ESA Space Debris Mitigation Handbook* published by the European Space Agency (ESA) in 1999, the plan advises that no objects be released by either the stage 3 separation or the kick-stage (Corvet) separation. This means that no small debris is to be generated and, hence, that there is no contribution to space debris from mission-related objects.

[1] *Official Records of the General Assembly, Fifty-sixth Session, Supplement No. 20* and corrigendum (A/56/20 and Corr.1), para. 108.

7. Passivation is used in stage 3 and Corvet, which removes the danger of a later explosion. This will result in one object being tracked rather than the potential for numerous objects resulting from an uncontrolled explosion. When the Corvet is used and the mission permits, stage 3 can be de-orbited using sub-orbital separation. The kick stage (Corvet) is also capable of active de-orbiting when the mission permits.

Other space launch proposals

8. The remaining proposals to establish space launch facilities have not advanced to a point where they are in a position to provide advice about debris mitigation procedures.

Electro-optic systems

9. Research specific to debris avoidance is undertaken by Electro Optic Systems, an Australian company specializing in electro-optic space tracking systems. Over the past several years, Electro Optic Systems has developed a new generation of laser and optical tracking devices for tracking and cataloguing space debris. The research and development of the new technologies was supported directly by the Government of Australia through funding and facility-sharing.

10. In full-scale trials, the new tracking systems have demonstrated the ability to accurately track debris of 1 centimetre (cm) in size up to altitudes of 800 kilometres. The technology includes the ability to acquire previously unknown debris objects of that size, in large numbers, and the potential catalogue will expand from 20,000 objects to 100,000 objects using the technology. The present global infrastructure can track debris down to 10 cm in size and has a capacity of about 15,000 debris objects. Deployment of tracking infrastructure to allow expansion and maintenance of the debris catalogue by Electro Optic Systems is now under way in several countries. The company plans to make the new debris catalogue available on a commercial basis from 2003.

Australian commitment

11. Australia is concerned about the risks posed by space debris, in particular about geostationary orbit (GEO) satellites, and is aware that there have been a number of near collisions in recent years. The loss of bandwidth for lengthy periods in the event of such a collision is one consequence with far-reaching implications for the global industry.

12. Australia endorses the need to ensure that space continues to be accessible and safe. To that end, Australia remains committed to supporting measures to minimize the harmful effects of debris in space, through avoidance, regulatory and mitigation measures. Integrated coordinated tracking and technologies to facilitate de- and re-orbiting of potentially dangerous satellites and debris have an important role to play in that regard.

Finland

Finland has several ongoing space debris research activities and applications:

(a) DEBIE space debris sensors and data-processing units were launched on board the PROBA satellite in October 2001;

(b) DEBIE will later fly on the International Space Station in a more operational role;

(c) A low-Earth orbit (LEO) space debris survey was carried out using European incoherent scatter (EISCAT) radars (demonstrated capability: 1-cm and larger objects) in Lapland;

(d) The University of Oulu/Sodankylä Geophysics Observatory carried out a contract study for the ESA European Space Operations Centre to measure small-sized space debris;

(e) The University of Turku carried out a geostationary orbit space debris survey using the European Space Agency's telescope in the Canary Islands.

Iran (Islamic Republic of)

Owing to the effects of humankind's aerospace activities on the environmental health of the Earth, space debris has emerged in recent decades as a problem seriously threatening the survival of orbiting spacecraft, space platforms and astronauts carrying out space walks in near-Earth orbit. Space debris research in the Islamic Republic of Iran is carried out through the orbital debris team of the Aerospace Research Institute as a part of the Space Standards and Law Research Group. The orbital debris team is working on a variety of subjects, such as categorization, characteristics, tracking and laws relating to orbital debris. Mathematical simulation, collision probability functions and hazard analysis are prospective topics for the Group's studies.

Republic of Korea

1. On the issue of the safety of space objects with nuclear power sources, the Republic of Korea has never used nuclear power sources and does not plan to use them in the near future. Therefore, the Republic of Korea has fully implemented the safety of space objects without nuclear power sources.

2. On the issue of space debris, the Republic of Korea does not yet have its own space launch vehicle. Therefore, the issue does not yet concern space activities in the Republic of Korea. However, a Republic of Korea launcher will be launched in 2005. In that case, the Republic of Korea will do its best to minimize the creation of space debris.

United Kingdom of Great Britain and Northern Ireland

I. Introduction

1. The continued commitment of the British National Space Centre (BNSC) to addressing the space debris issue is outlined in its *UK Space Strategy Report (1999-2002)*. A key objective is to coordinate with other agencies that are also working on the threat posed by space debris. In that regard, BNSC coordinates national activities through the United Kingdom Space Debris Coordination Group and ensures that those activities are harmonized with those of ESA and its member States via the ESA Coordinating Group on Space Debris. Through its membership of the Inter-Agency Space Debris Coordination Committee (IADC), BNSC is actively pursuing international agreement on a variety of space debris issues. It also supports the related programme of work in the Committee on the Peaceful Uses of Outer Space.

2. National meetings provide a forum for the co-ordination of all debris research activities in the United Kingdom. The group enables researchers to exchange information and ideas and, where possible, fosters collaborative opportunities. The group last met in November 2001, and most of the major debris research groups in industry and academia in the United Kingdom participated. These included QinetiQ (formerly DERA), the Ministry of Defence, Astrium, Century Dynamics, Observatory Sciences, Advanced System Architectures, the Rutherford Appleton Laboratory, the Open University and the Universities of Cranfield, Oxford and Southampton.

3. ESA coordination of space debris is now managed by a network of centres for space debris involving the Italian Space Agency (ASI), BNSC, the Centre national d'études spatiales of France and the German Aerospace Centre (DLR), with participation open to all ESA members active in the area of space debris.

4. IADC is an international forum for cooperation on all aspects of the debris problem. In particular, efforts within the group are focused on achieving agreement on recommended mitigation practices based on sound technical analysis of the problem. Within the last year, the United Kingdom participated in the 19th IADC meeting, which was hosted by DLR in March 2001. The 20th IADC meeting will be hosted by BNSC at the University of Surrey in April 2002.

5. The United Kingdom has particularly strong debris research capabilities, which BNSC regularly calls upon for impartial technical support and advice. During the past year, organizations in the United Kingdom have conducted the research and development activities outlined below.

II. Observation and measurement of the debris population

A. Debris camera system

6. Sira Electro-Optics Ltd has been involved in the supply of an electronic debris camera system in collaboration with Carl Zeiss Jena for ESA. This has been installed on a 1-metre (m) diameter Zeiss telescope at the Teide Observatory in Tenerife. Extensive test observations with the telescope and Sira's camera were carried out from December 2000 until July 2001. The optical observations were focused on GEO and its vicinity, the so-called geostationary ring. This is one of the most heavily used regions in space, with about 300 operational spacecraft. Unfortunately, break-ups of a rocket upper stage and a satellite are known to have occurred, but the locations

of the fragments were largely unknown, since routine activities of the US Space Surveillance Network ignore objects in GEO smaller than about 1 m in size. With the Zeiss 1-m telescope a large number of debris objects were detected and their orbits determined in a preliminary manner. The limiting magnitude is slightly beyond 20 for 2 seconds' exposure time, which corresponds to a minimum object size of 10-20 cm. The test observations have thus led to the discovery and partial characterization of a large population of small-size debris objects in GEO. Currently the charge-coupled device (CCD) camera, including dewar, are at Carl Zeiss Jena for final work. It is expected that the final test observations on Tenerife will be resumed by November 2001.

B. Debris radar

7. A collaborative arrangement between the Rutherford Appleton Laboratory and QinetiQ has been established to develop the 3-gigahertz (GHz) radar system at the Chilbolton Observatory in Hampshire for space debris detection. Although this uses a fully steerable 25-m antenna, the existing magnetron transmitter, used principally for radar meteorology, has insufficient power to detect all but the largest debris objects. During the past year, a travelling wave tube transmitter has been installed and this will provide a much higher mean power capability (2.7 kilowatt (kW) as opposed to 600 W). The new system will be fully coherent and allow the detection of objects as small as 5 cm in diameter up to a range of 1,000 km (i.e. in the LEO region). Testing of the new system is expected to be completed in early 2002.

III. Debris environment modelling

8. Modelling of the debris environment, its long-term evolution and the potential risks it causes to possible future space systems continues to be a major activity amongst debris researchers in the United Kingdom. The effect of continually introducing new assets into near-Earth space and therefore the consequences for the debris environment is also a key research area.

A. Modelling the debris environment in low-Earth orbits

9. During the past year, QinetiQ has focused on the study of space debris mitigation measures in terms of their long-term benefits in reducing future debris growth, the costs involved in implementing those measures and the risk implications to important space assets. The study has been achieved by significant improvements to the long-term space debris environment models, IDES (for the Ministry of Defence of the United Kingdom) and DELTA (for ESA) and the development of a stand-alone tool called DEORBITER for post-mission manoeuvre planning and propellant estimation. A special presentation on cost-effectiveness of space debris mitigation measures was made at the meeting in Vienna in February 2001 of the Committee on the Peaceful Uses of Outer Space. An extensive analysis of long-term debris environment evolution, debris mitigation measures and spacecraft protection has been performed for the *Update of the ESA Space Debris Mitigation Handbook*. Technical leadership and input has been provided to a key international study on LEO end-of-life disposal for the development of IADC space debris mitigation guidelines.

10. In 2001 the University of Southampton began a new work project concerned with space "tethers". A space tether is a long, high-strength cable, which is generally used to connect spacecraft to each other. The tether provides a mechanical connection that enables the transfer of energy and momentum from one object to another and as a result can be used as a form of space propulsion. It can also interact with the Earth's magnetosphere to generate power or propulsion. Tethers are increasingly being considered for use in Earth orbit. The work at Southampton focuses on tether dynamics, the vulnerability of tethers in the space debris environment and the converse effect that tethers have on the environment.

B. Modelling the debris environment in high-Earth orbits

11. The IDES and DELTA models (developed by QinetiQ) have both been extended to predict the long-term evolution of the orbital debris environment in low-Earth orbit, medium-Earth orbit and geosynchronous Earth orbit regions simultaneously. Similarly, the long-term prediction of collision risk in any Earth orbit (including highly eccentric orbits) is also possible, based upon full population dynamics simulation.

12. The main thrust of research at the University of Southampton during the period has been in the area of GEO debris. A software analysis tool is being developed, under a contract sponsored by the United Kingdom Engineering and Physical Sciences Research Council (“The long-term evolution of space debris in high-Earth orbit”). The software, called Debris Analysis and Monitoring Architecture for the Geosynchronous Environment (DAMAGE), will include novel features and techniques to assess the long-term evolution of the high-Earth orbit debris environment and the risk to orbiting systems in that region. The model now incorporates a reference population of objects intersecting the geosynchronous environment, two control volumes and an orbital propagator featuring perturbations arising from the major zonal spherical harmonics, low-order tesseral harmonics, luni-solar gravitation and solar radiation pressure. Much effort has been expended in developing and validating the propagator in close collaboration with QinetiQ. The model’s development is now continuing with the addition of several collision risk assessment algorithms and an explosion model. The applications of the tool include investigation of the stability of the environment and of end-of-life spacecraft disposal strategies.

13. During the past year, an international consortium comprising the University of Kent, QinetiQ, Onera (Toulouse, France), the Max Planck Institute (Heidelberg, Germany) and the University of Maryland (United States of America) has completed an ESA contract to extend modelling of space debris and other environmental factors from LEO to GEO. In particular, quantitative assessments of the interactions and modelling of population dynamics have been undertaken. As part of that activity, a model for predicting GEO populations has been developed and tested (DIADEM). This is linked to Master 99 (the comprehensive ESA tool for characterizing the debris and meteoroid flux environment).

IV. Spacecraft debris protection and risk assessment

14. The assessment of risk to and protection of spacecraft from hypervelocity debris impacts is another research area in which the United Kingdom is very active.

A. Satellite survivability modelling

15. QinetiQ has completed development of version 1.0 of an innovative and unique software model called SHIELD, whose purpose is to evaluate the survivability of unmanned spacecraft designs in the debris environment and to recommend appropriate cost-effective debris protection strategies. An initial set of validation simulations has recently been performed and demonstrated that a high degree of confidence can be placed in the results from SHIELD. An invited paper illustrating some of the capabilities and results from the model was presented at the International Astronautical Federation Congress in Brazil in 2000.

B. Hypervelocity impact simulation

16. Century Dynamics continues to sell and provide support for the AUTODYN hydrocode software to the worldwide space community. The model is used to simulate the response of a material under hypervelocity impact. The company has numerous customers directly involved in space debris studies relating to hypervelocity impact protection. ESA, the European Aeronautic Defence and Space Company, the National Aeronautics and Space Administration (NASA) of the United States and the National Space Development Agency of Japan and many of their contractors continue to use AUTODYN. There is a wider usage of AUTODYN for non-metallic materials such as glass and composites. Within the last year, Century Dynamics has launched the AutoShield software, which is specifically designed for the numerical analysis of hypervelocity impact shielding studies.

17. The company continues to be involved in contract work for ESA/Alenia relating to the validation of the International Space Station’s Columbus shielding design. It has also participated in several other contracts related to hypervelocity impacts on satellite structures and components.

C. Engineering spacecraft for debris risk reduction

18. The Earth Observation and Science Directorate of Astrium Ltd continues to work in the field of debris engineering, looking at spacecraft systems engineering and mission analysis. NASA tools and ESA research, as well as in-house tools, are used for analysis of satellite collision risk and end-of-life de-orbit. Research continues into unmanned spacecraft shields and associated structures. During the past year, this has

included the development of a filament-wound carbon fibre structure, which is combined with Kevlar shielding layers.

United States of America

1. Space debris research and operations in the United States of America remained very active in 2001 and important advances in both measurements and modelling were achieved. The Space Shuttle and the International Space Station continued their space debris countermeasure procedures and reported no significant damage. NASA was a major participant in the Third European Conference on Space Debris in Darmstadt, Germany, in March 2001, with 19 technical papers. Six additional papers were presented by NASA at the 52nd International Astronautical Congress in Toulouse, France, in October.

2. Two United States long-duration spacecraft were retired in 2001 and placed in disposal orbits to mitigate risks to other satellites. The 24-year-old GOES 2 satellite was moved to a storage orbit above the geosynchronous regime (35,785 km +/- 200 km). The 19-year-old Landsat 4 satellite was taken out of its Sun-synchronous orbit near 700 km and manoeuvred into a lower orbit to ensure that it did not remain in LEO for more than 25 years after completion of the mission.

3. The United States Government continued its activities to ensure a full understanding of United States policies and practices with regard to debris mitigation, both internally and with industry. For example, representatives from each of the NASA centres and various contractors attended a colloquium on orbital debris at NASA headquarters in April. The prime objective of the meeting was to review NASA policy and guidelines for the mitigation of space debris in Earth orbit. A special NASA-wide meeting on risks associated with re-entering satellites was held at the NASA Johnson Space Center in June. Also, in April, the annual meeting of the NASA/Department of Defense Orbital Debris Working Group was held in Colorado Springs, Colorado.

4. The United States provided tracking information to the Russian Federation in support of the highly successful operations to de-orbit the Mir space station in March and participated in the Mir re-entry workshop at the European Space Operations Centre in May. In addition, the United States was pleased to participate in the March and October meetings of IADC.

Space debris impact hazards and shielding research

5. The potential hazards of space debris, specifically meteoroids, was an important issue during the first decade of the space age, when little was known about the space environment. Simple spacecraft designs were found to offer adequate protection against this natural threat for relatively short missions. Today’s longer-duration spacecraft face the challenges of not only the natural particle environment but also an increasing one of man’s own creation.

6. Since the return and examination of components of the Solar Maximum Mission satellite by the Space Shuttle in 1984, the United States has renewed its investigations of space debris impact hazards and shielding. That same Space Shuttle mission also deployed NASA’s Long-Duration Exposure Facility (LDEF), which provided extensive space debris impact data upon its retrieval six years later. More than 30,000 LDEF impact sites—an average impact rate of 15 per day or nearly one per revolution about the Earth—were identified. Similar impact features are routinely observed on the Hubble Space Telescope and the Space Shuttle itself.

7. Particles of up to 1 millimetre (mm) in diameter do not normally cause significant damage to spacecraft systems. However, spacecraft engineers must compensate for the long-term effects of such high-speed impacts in their designs, especially for power-generation and thermal control systems. Prolonged exposure to space debris particles can reduce power output as a result of the loss of individual solar cells or their connections and can lead to lower efficiencies of heat rejection surfaces.

8. Following 12 Space Shuttle missions during the period from October 1998 to April 2001, a total of 30 outer window panes were replaced because of small meteoroid and orbital debris impacts. This represents a nearly 25 per cent replacement rate per flight for the 11 principal windows on the Space Shuttle. As indicated in this Subcommittee’s *Technical Report on Space Debris*,[2] the origins of particles of this size are now almost equally divided between natural and man-made sources.

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[2] United Nations publication, Sales No. E.99.I.17.

9. Owing to the hypervelocity of most space debris impacts, even very small particles can achieve high relative kinetic energies that can lead to damage features much larger than the particles themselves. For example, a 0.1-mm aluminium impactor caused a 2-mm crater in a Space Shuttle window during a flight in the year 2000. In 1998, a 0.3-mm paint particle created a 1-mm diameter hole in a Space Shuttle radiator. During the past few years, the Space Shuttle radiators have been modified to reduce the probability of penetration and the potential subsequent breach of a thermal control system coolant tube.

10. In 2001, space debris holes were found on the International Space Station, one discovered during a space walk and others during the inspection of the Leonardo multi-purpose logistics module after its inaugural flight of less than two weeks. One of the more serious impacts by space debris of less than 1 mm in diameter was caused by a 0.4-mm particle that penetrated a cloth covering and struck a Space Shuttle manifold line. The force of the impact resulted in a crater with a depth of half the line thickness and causing part of the wall on the coolant side to detach. A slightly larger or faster-moving particle might have caused a coolant leak, prematurely terminating the mission.

11. Occasionally, particles larger than 1 mm will also strike spacecraft, although the flux of 1-mm particles at the International Space Station altitudes is 1,000 times less than that of 0.1-mm particles. On several flights, the Space Shuttle has been struck by space debris 1-2 mm in diameter. Two pieces of stainless steel debris of this size struck the Space Shuttle Columbia in 1996 and a 2-mm piece of aluminium hit the Space Shuttle Atlantis in 1997. Fortunately, those impacts occurred on relatively rugged, non-critical surfaces.

12. The largest known impact on a United States spacecraft was found on one of the high-gain antennas of the Hubble Space Telescope during the first servicing mission in 1993. A hole with a diameter of 1.9 cm was discovered by the crew of the Space Shuttle Endeavour. A particle large enough to cause that level of damage could have resulted in a serious malfunction for many satellites, including those used for human space flight.

13. To determine the vulnerability of specific spacecraft components and structures, hypervelocity impact tests in terrestrial laboratories have proved very valuable. Using conventional two-stage, light-gas guns, projectile velocities of up to 7 kilometres per second (km/s) can be obtained. Velocities as high as 11 km/s are possible with inhibited shaped-charges. Such facilities enable researchers to evaluate the effects of particle size, composition, shape, impact velocity and impact angle. Major hypervelocity impact testing facilities are located in the United States at the NASA White Sands Test Facility and the Air Force Arnold Engineering Development Center.

14. To reduce testing requirements and to predict the effects of impacts at velocities higher than 11 km/s, physics-based computer simulations, called hydrocodes, are employed. Together, the test and hydrocode results permit the development of ballistic limit equations, in other words, mathematical relationships that indicate under what conditions a surface will be penetrated by debris. Penetration is the principal measure of merit in evaluating protection capabilities.

15. Overall space vehicle risk assessments are determined by combining the space debris environment model with a detailed description of the space vehicle, including its numerous ballistic limit equations for each type of surface. The NASA bumper model is used for such evaluations for the Space Shuttle, the International Space Station and robotic satellites, by calculating the probabilities of impact and penetration over a specified time interval.

16. Debris shields may be necessary to meet spacecraft requirements for the probability of no penetration. Vehicles are inherently shielded to some degree against small space debris by the spacecraft structure and insulation materials. The simplest type of shielding is called a Whipple shield and consists of a thin (typically aluminium) sheet of material called a bumper, which is attached a short distance in front of the surface to be protected. When a space debris particle strikes the bumper, a pressure shock propagates through the particle and the bumper, creating a debris cloud of smaller, less hazardous fragments. By the time the debris cloud reaches the spacecraft surface, the fragments are spread over a larger area, reducing the energy per unit area imparted to the spacecraft structure.

17. The stuffed Whipple shield, pioneered by NASA and also known as a multi-shock shield, employs the basic Whipple shield design but incorporates

additional, light-weight material between the bumper and the spacecraft surface. Typical materials placed behind the bumper are Kevlar and Nextel. By varying the bumper material, thickness and stand-off distance, as well as the number and type of intermediate layers, stuffed Whipple shields can be efficiently tailored to protect a given spacecraft surface from a defined space debris threat with a total shield mass significantly less than a simple Whipple shield.

18. On the International Space Station, more than 300 types of Whipple and stuffed Whipple shields will be used to guard against particles as large as 1-2 cm in diameter. For example, one stuffed Whipple shield for the Destiny Laboratory Module is 10.7 cm in depth and consists of a 0.2-cm aluminium bumper, multi-layer insulation, six layers of Nextel and six layers of Kevlar in front of the 0.48 cm-thick module wall. This shield can prevent penetration of a 1.35-cm aluminium particle impacting head-on at a velocity of 7 km/s.

19. A mesh double bumper debris shield is a variation of the stuffed Whipple shield with a thin metal mesh placed in front of the solid bumper. The mesh helps disrupt the debris particle before reaching the second, conventional bumper.

20. NASA has also developed a new debris shield design that is particularly attractive for large, inflatable space vehicles. A sample configuration uses a "sandwich" of four layers of Nextel (two sheets each) and one layer of Kevlar, all separated by low-density foam. During launch, the shield can be stowed in a small volume and then extended on-orbit to a height of 75 cm to provide the necessary separation between the Nextel and Kevlar sheets to make the shield effective. Such a configuration can stop aluminium particles of up to 1.8 cm in diameter travelling at 7 km/s.

III. Replies received from international organizations

A. United Nations

International Telecommunication Union

There is no information relevant to this topic arising from the work of technical study groups within the Radiocommunication Sector of the International Telecommunication Union.

B. Other international organizations

International Astronomical Union

The International Astronomical Union regards the space debris problem as an important item among the environmental issues affecting the science of astronomy—in particular but not exclusively the part carried out from satellites. The International Astronomical Union will follow the work on practical debris mitigation measures initiated by the Committee on the Peaceful Uses of Outer Space as a follow-up to the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) with great interest and expects to make some contributions to that work. Otherwise, given the nature of the International Astronomical Union, members of the Union contribute to the subject as part of their professional activity in national and international space agencies, but the Union does not conduct an independent programme in the area.