United Nations A/AC.105/770/Add.1

General Assembly

Distr.: General
18 February 2002

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*

Addendum

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II. Replies received from Member States

Canada

1. Canada is supporting various efforts related to the issue of space debris, mainly concentrated on orbital debris protection and end-of-life removal. Canada's RADARSAT-2 will include additional protection against orbital debris design elements in its construction, for example for solar panel protection. The satellite will also include approximately 50 kg of fuel for de-orbiting at the end of its useful life (estimated to be seven years). The Canadian Space Agency's prime contractor MDA even includes consideration of protection against orbital debris in its specifications to subcontractors.

* The present document contains replies received from Member States between 4 December 2001 and 20 February 2002.

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2. Canadian scientists are also conducting studies of Leonids, with particular interest being attributed to the meteor storm in late 2001. Canadian scientists are currently updating study models and are hoping to have the opportunity to validate their studies and theories in the course of the coming year. Until very recently, portable radars were being used to complete these studies. However, a radar based in London (Ontario) is now accessible. Canada expects to use such equipment in the near future to monitor orbital debris.

3. Canadian scientists also participated in infrasonic monitoring of re-entry at Los Alamos, United States of America, in the course of 2001. Using an array of ground-based instruments, scientists are evaluating the low-frequency noise made upon re-entry. Such equipment successfully detected the re-entry of a Proton upper stage over the Midwest of the United States in December 2001.

Japan

I. Introduction

1. Space-related organizations in Japan have taken a coordinated approach towards space debris issues and set up the Space Debris Committee in 2000 to support the Government of Japan in this field. The Committee consists of experts from space agencies, research institutes, universities and related organizations. They include, but are not limited to, the following: the Communications Research Laboratory, the Institute of Space and Astronautical Science, the Japan Space Forum, Kyoto University, Kyushu University, the National Aerospace Laboratory (NAL), the National Astronomical Observatory and the National Space Development Agency (NASDA).

2. The Committee acts as the instrument to coordinate Japan’s input to the Committee on the Peaceful Uses of Outer Space, its Scientific and Technical Subcommittee and the Inter-Agency Space Debris Coordination Committee (IADC).

3. Prepared by the Space Debris Committee in response to a note verbale dated 8 August 2001 from the Secretary-General, the present note describes the status of national research on space debris in Japan as at 2001, including information on practices adopted that have proved effective in minimizing the creation of space debris, and space debris impact hazards and shielding.

II. Practices to minimize the creation of space debris

4. Recognizing that the generation of space debris pollutes the space environment, member organizations of the Space Debris Committee seek to minimize space debris. NASDA, for example, established the Space Debris Mitigation Standard (NASDA STD-18) in 1996 and the Standard has been applied to NASDA space systems in both the design and operational phases.

5. Among the measures set forth in NASDA STD-18, those currently most important and effective in mitigating space debris are:

(a) Passivating residual energy sources;

(b) Moving geostationary satellites into a higher orbit at the end of operation to preserve the geostationary orbit region, which lacks natural forces to remove space debris;

(c) Designing space systems to prevent their parts from becoming separated or released during operation.

NASDA practices to incorporate the above measures into its missions are as follows:

(a) *Passivating residual energy sources*. For the H-IIA launch vehicle, whose maiden flight was successfully completed in August 2001, a number of measures were taken to passivate residual energy sources, as was the case with H-IIA's predecessor, H-II. Examples of measures for the H-IIA orbital stage include (i) burning residual propellants to depletion; (ii) equipping batteries with venting ports to avoid excessive pressure increases; (iii) covering the command destruct charges with insulation to prevent the devices from exploding from solar heating; and (iv) cutting off power supply to the command destruct receivers immediately after they become unnecessary. For satellites, residual propellants are vented after the disposal manoeuvres, the battery charging lines are shut off and batteries are discharged completely;

(b) *Moving geostationary satellites into higher orbits*. Geostationary satellites have been reorbited into an orbit higher than the geostationary orbit at the end of operation. For Engineering Test Satellite 8 (ETS-8), a NASDA satellite to be launched into geostationary orbit in a few years, NASDA plans to ensure a reorbit distance of about 300 km, in compliance with an IADC recommendation;

(c) *Avoiding parts separation and release*. Fasteners, including bolt cutters and clamp bands, are designed not to be separated or released during operation.

6. At the thirty-sixth session of the Scientific and Technical Subcommittee, in 1999, Japan proposed to study establishing an international baseline document to control space debris generation. Though the proposal was subsequently withdrawn, IADC is now drafting its space debris mitigation guidelines along similar lines. Japan made a significant contribution to the study group drafting the guidelines, on which consensus has almost been reached. The guidelines will be authorized by IADC members in 2002 and will be presented to the Scientific and Technical Subcommittee in 2003.

III. Observation and modelling

7. Other important issues related to space debris are observation and modelling. Developments in Japan in those areas are described below.

A. Observation

8. During the past 10 years, Kyoto University's Middle and Upper atmosphere (MU) radar system has contributed to an experiment to establish an altitude distribution model for debris and to estimate shapes of debris.

9. In addition to the MU radar, optical and radar observation facilities are being constructed in Japan. The optical facility, the Bisei Spaceguard Center, will be used to measure high-altitude debris and will be capable of observing debris 50 cm in

diameter in geostationary orbit. The facility, which is now conducting pre-operational experiments, has succeeded in observing the excessive proximity of geostationary satellites and confirming the final orbit of the H-IIA orbital stage.

10. The radar system, Kamisaibara Spaceguard Center, which is to become operational in 2004, will be capable of measuring a piece of debris 1 metre in diameter at a range of 600 km, day and night, and to track 10 objects simultaneously.

11. The completion of these systems will enable Japan to contribute to international cooperation for a better understanding of the space debris environment.

B. Modelling

12. A model for debris in the near-geostationary orbit has been studied at Kyushu University. Such space debris will increase steadily because the area lacks natural forces to remove such objects. The study shows that future space debris increases can be suppressed to a significant extent by preventing the break-up of upper stages and satellites.

IV. Space debris impact hazards and shielding

13. Measures against impacting space debris are already being taken in Japanese manned space missions. The Japanese Experiment Module, a part of the International Space Station system, includes protectors, such as shielding bumpers and layers of textile materials between the inner pressurized and outer walls.

14. NAL has been researching the nature of debris in low-Earth orbit impacting spacecraft at speeds of 10 km per second. For that purpose, NAL developed the hypervelocity launching system based on conical shaped charges, an impact database and a high-accuracy computer simulation program. The Institute of Space and Astronautical Science conducts similar research jointly with NAL using a rail gun system.

15. NAL conducted a post-flight analysis of the surface of the Space Flyer Unit reusable platform that was retrieved in 1996 from space after 10 months in low-Earth orbit. NAL developed a photo-documented database of collision evidence and judged origins (man-made or natural) of the impacting particles from chemical characteristics of their residuals. It also produced a calibration database to estimate physical characteristics of the impacting particles. All data acquired to date have been made available to researchers all over the world through the Internet.