

October 5-11, 1991/Montreal, Canada

# 42nd CONGRESS OF THE INTERNATIONAL ASTRONAUTICAL FEDERATION

*Space Debris Group*

*the IAA Ad Hoc*

*by*

*Formulation of an  
International Position  
Paper on Orbital Debris*



# Formulation of an International Position

## Paper on Orbital Debris

by

Dr. Darren S. McKnight  
Kaman Sciences Corporation  
2560 Huntington Ave., Suite 200  
Alexandria, VA 22303 USA

and

Dr. Walter Flury  
European Space Operations Centre  
Robert-Bosch-Str. 5  
6100 Darmstadt GERMANY

## Abstract

The Committee on Safety and Rescue Studies of the International Academy of Astronautics (IAA) is sponsoring the writing of a position paper on space debris. An IAA ad hoc group of space debris experts has been formed to complete this task. The goal for the project is explained in the group's Terms of Reference. The space debris position paper will be presented at the World Space Congress to be held in Washington, D.C., in August/September 1992.

## Introduction

In 1981, the American Institute of Aeronautics and Astronautics (AIAA) released a position paper on orbital debris. This paper commented on the well-established orbital debris program run by the National Aeronautics and Space Administration (NASA) and concern for the future state of the space environment [1]. Since that time numerous publications by national and international governmental, scientific, and industrial organizations have summarized much of the work done in this area over the last ten or so years [2-10].

The foregoing studies and analyses have led to the following main conclusions:

- space debris is a long-term threat to space activities
- unabated growth of the number and mass of space debris continues in many regions in space
- there is still a significant lack of knowledge of the debris population and factors affecting its growth
- there is a clear need for identification and application of minimization/mitigation strategies.

The IAA is sponsoring the writing of a position paper on space debris. An IAA ad hoc group of space debris experts has been formed to complete this task (list of members is given in Annex).

The report will be written in consultation with the International Institute of Space Law as well as with other concerned IAA Committees, such as the Committee on International Space Plans and Policies and the Committee on Space Sciences.

The improved level of understanding, awareness, and interest in this growing environmental problem has now led us into a new era. The authors of this international position paper on orbital debris will attempt to consolidate concerns, analyses, and techniques on debris control in order to recommend the best ways to prevent the continued growth of orbital debris. Previous publications in this area have focused on describing what the problem is. This report, however, will address the identification of debris minimization/mitigation techniques and measures to curb the growth of man-made objects in space.

The effort of the group is to elaborate upon the work in progress and the major status reports issued by ESA and the US Interagency Group but to also focus on why the issue is of immediate significance.

The objective is to exploit the Academy's status and expertise to establish that there is current urgency to initiate intervention even though the most significant adverse effects may not occur for a long time. The primary goal is therefore to explain and elaborate why action now is necessary to preclude serious ramifications later. The group shall furthermore give some indication of what classes of action are to be undertaken in order to make progress.

The report of the group should focus on the technical urgency for action and provide some framework for addressing debris control options in the future. It may address particular solutions or measures to be effected if a consensus is reached in this area.

The group shall, in preparing its report, establish and maintain consultation with the international Institute of Space Law as well as with other concerned IAA Committees such as the Committees on International Space Plans and Policies and on Space Sciences. The report shall be based on consensus within the group and reflect the comments made by other members of the Academy and the aerospace community.

The members of the IAA Committee on Safety and Rescue Studies will be given opportunity to comment on the draft report then, upon approval by the Committee Co-chairmen, the report will be submitted to the President of the Academy for adoption as a position paper of the Academy according to the rules and procedures of the Academy.

## Terms of Reference

The terms of reference for the paper follow:

## Outline

The draft outline for the international position paper is shown below:

Introduction

State present hazard concisely (LEO & GEO)

Purpose of paper

List of definitions and measures of merit

Review Debris Documents

OTA Report

IG Space Report

ESA Report

Japanese Review

AIJA Position Paper - 1981

700 papers (mention complete bibliography)

Review Key Research Findings

SSN Resolution (10 cm to 50 cm)

LDEF/STS Window Data

Debris Growth by Source and Altitude

Cascading Phenomenon - Soon? (Best, Worst Scenarios)

Others?

Needed Technology Efforts

RCS Modeling

Characterize 1 mm to 10 cm in LEO and 1 cm to 1 m in GEO

Lifetime of nontrackable debris

Determination of Breakup Cause

LEO vs GEO

Debris Minimization and removal techniques (what is presently being

done/what is effective)

Cost benefit Tradeoff Analysis for debris control options

Spacecraft Breakup Modeling

Others?

Needed Policy Efforts

International - research and procedures

Track Two Approach

Others?

Conclusion

Recommendations for follow-on actions

Discuss new large LEO constellations

Conclusion

The IAA position paper on space debris is slated for presentation at the World Space Congress (Washington, D.C.) in August/September 1992. A draft of the paper is scheduled for completion by October 1991. The committee would like any comments or suggestions that anyone has on this topic for inclusion in the paper. It is important to the success of this effort that all concerned parties are involved in the

compilation of data and ideas for this paper. Please contact any member of the group, preferably by mail, with your input. A list of members is attached at the end of this paper.

We look forward to the completion of this paper and hope that it will be a step toward more international cooperation in the area of orbital debris control.

#### References

1. "Space Debris," AIAA Position Paper prepared by the AIAA Technical Committee on Space Systems, July, 1981.

2. "Report on Orbital Debris," Prepared for the National Security Council by the Interagency Group - Space, Washington, D.C., February 1989.

3. "Space Debris," Prepared by the ESA Space Debris Working Group, ESA SP-1109, November 1988.

4. "Orbiting Debris: A Space Environmental Problem," Published by the US Congress Office of Technology Assessment, OTA-8P-ISC-72, U.S. Government Printing Office, September 1990.

5. "Space Debris: A Potential Threat to Space Station and Shuttle," Prepared by the U.S. General Accounting Office, GAO/IMTEC-90-18, April 1990.

6. Congressional testimony to the Committee on Science, Space, and Technology, U.S. House of Representatives, Washington, D.C., July 13, 1988.

7. McKnight, D.S., et al., "The Orbital Debris Issue: A Status Report," Space Technology, Vol. 10, No. 3, August 1990.

8. Reynolds, R.C. and Potter, A.E., Jr., "Orbital Debris Research at NASA Johnson Space Center, 1986-1988, NASA TM-102 155, September 1989.

9. Johnson, N.L. and McKnight, D.S., "Artificial Space Debris, 2nd edition, Krieger Publishing, Malabar, FL, July 1991.

10. "Orbital Debris Monitor," International newsletter published quarterly, 12624 Varny Place, Fairfax, VA 22033, USA.

#### Ad Hoc Committee on Space Debris

Dr. Darren McKnight (Co-chair)

Kaman Sciences Corporation

2560 Huntington, Ave., Suite 200

Alexandria, VA 22303

Dr. Walter Flury (Co-chair)

ESOC European Space Operations Centre

Robert-Bosch-Str. 5

6100 Darmstadt / Germany

Dr. Lubos Perek  
Czechoslovak Academy of Sciences  
Astronomical Institute CSAV  
Budeccka 6  
12023 Praha 2  
CSFR

Dr. Malcolm G. Wolfe  
The Aerospace Corporation  
MS/557  
P.O. Box 92957  
Los Angeles, CA 90009

Tetsuo Yasaka  
NTT Radio Comm. Sys. Lab.  
1-2356 Take  
Yokosuka-shi, Kanagawa-ken, Japan

Prof. Hartmut Sax  
Deutsche Forschungsanstalt für Luftund Raumfahrt (DLR)  
Hauptabteilung Systemanalyse Raumfahrt  
Linder Hoehe  
5000 Koeln 90 / Germany

Prof. Dr.-Ing. Dietrich Rex  
TU Braunschweig  
Institut für Raumflugtechnik and Reaktortechnik  
Postfach 33 29  
3300 Braunschweig / Germany

Pamela Meredith  
Space Conform  
Watergate South # 1211  
700 New Hampshire Ave., NW  
Washington, D.C. 20037

Dr. J. P. Loftus, Jr.  
NASA Johnson Space Center  
Houston, TX 77058  
Nicholas L. Johnson  
Teledyne Brown Engineering  
1250 Academy Park Loop, Suite 240  
Colorado Springs, CO 80910

Dr. Val Chobotov  
The Aerospace Corporation  
MS M4/948  
P.O. Box 92957  
Los Angeles, CA 90009-2957