INTER-AGENCY SPACE DEBRIS COORDINATION COMMITTEE

Report on the IADC Activities

in particular with regard to the

IADC Mitigation Guidelines

Presented to :

39th Session of the
Scientific and Technical Subcommittee
United Nations' Committee on the Peaceful Uses of Outer Space

IADC Organisational Aspects

Steering Group and

4 Working Groups:

- **WG1 Measurements**
- **WG2 Environment and Data Base**
- **WG3 Protection**
- **WG4 Mitigation**

Current members include space agencies of

China ***ESA*** ***France*** ***Germany*** ***India*** ***Italy*** ***Japan***

Russia ***Ukraine*** ***United Kingdom*** ***United States***

(no new member since last report in 2001)

IADC Website: http://www.iadc-online.org

Report on the 19th IADC Meeting

- **19th IADC**

  Held at DLR (German Aerospace Center) in Cologne, Germany, 22-23 March 2001

  (after the 3rd European Conference on Space Debris, March 19-21, 2001, Darmstadt, Germany)

- **Controlled Mir De-orbit**

  ROSAVIAKOSMOS kept the plenary informed about precise implementation of the planned de-orbit scenario with

  - **successful stabilisation procedure and manoeuvre to lower the orbit of the station for the final de-orbit manoeuvre**
    (status of 22 March 2001)
  - **successful controlled de-orbit and reentry manoeuvres on March 23, 2001**
    (splash down 05:58 GMT in previously determined Pacific Ocean area)

Report on the 19th IADC Meeting (cont'd)

- **Re-entry of Risk Objects**

  - **IADC carries out at least 1 training re-entry exercise per year**
  - **Purpose: maintain proficiency within IADC**
  - **Between the 18 and 19th IADC no further test object observation campaign has taken place** (but the Mir controlled de-orbiting was a very good exercise even if not a risk object. IADC re-entry information network was used as a back up source of information for MCC-Moscow)
  - **During Jan 9, 2002 until Jan 19, 2002 a re-entry campaign for Cosmos 1043 rocket body (78-094 B) has been performed**

- **Recommendations for re-orbiting of GEO satellites**

The IADC recommendation for GEO satellites (~36000 km above Earth)

The disposal orbit associated with a space vehicle in the geosynchronous orbit shall have a minimum perigee altitude ΔH above the geostationary altitude according to the following formula:

$$\Delta H = \Delta H_{min} + 1000 \times Cr \times S/m$$

with ΔH in km

$\Delta H_{min} = 235$ km

Cr = radiation pressure (or momentum exchange) coefficient of the space vehicle at the beginning of its life (beginning of orbital phase),

S/m = ratio of cross-section area (in m^2) to dry mass (in kg) of the space vehicle.

Recommendation: An additional margin in ΔH should be considered to take into account uncertainties in fuel estimate, effective ΔV and orbit determination.

Note: In above formula, S is the aspect cross section area.

Note: Cr can vary between 0 and 2, but typical values range from 1 to 2.

Report on the 19th IADC Meeting (cont'd)

(Recommendations for re-orbiting of GEO satellites cont'd)

General conclusions

- **IADC has drafted a recommendation on GEO re-orbiting, which has been communicated to appropriate ITU national delegates.**

- **ITU-R Working Party 4 A already has an action to further study the definition of the proper graveyard orbit.**

- **At IADC Steering Group meeting members were made aware of the opportunity to pass information on to National Representatives to the ITU meeting on 23 April 2001 in Seattle.**

- **Strategy of STSC of UNCOPUOS**
  (based on UN Report A/AC.105/761)

  STSC agreed that member States of UNCOPUOS shared a common interest in limiting the production of space debris.

  STSC strongly endorsed the action undertaken by IADC to reach an experts consensus on debris mitigation measures and encouraged IADC to treat the topic with due priority.

  STSC agreed that a work plan should be established with the goal of expediting international adoption of voluntary debris mitigation measures.

Space Debris Mitigation (cont'd)

- **STSC Multi-year Work Plan** (UN Report A/AC.105/761)

2002 **The Subcommittee invites IADC to present its proposals on debris mitigation at the 40th session of the Subcommittee, in 2003. The STSC discusses space debris impact hazards and shielding.**

2003 **IADC presents its proposals on debris mitigation, based on consensus among the IADC members.**

Member States review the IADC proposals on debris mitigation and discuss the means of endorsing their utilization.

2004 **IADC continues its presentation on its proposals on debris mitigation (as required), based on consensus among its members.**

Member States continue to review the IADC proposals on debris mitigation.

The subcommittee may wish to endorse the utilization of the IADC proposals on debris mitigation as guidelines to be implemented on a voluntary basis through national mechanisms.

2005 **Member States begin annual reporting on a voluntary basis of national activities to implement the guidelines.**

IADC Status of Space Debris Mitigation Guidelines

- **IADC Activity**
  - **IADC started 1999 activities on mitigation guidelines**
  - **Based on the invitation of the STSC to the IADC** (UN Report A/AC.105/761) **and to start activities to achieve the STSC work plan, WG4 ‚Mitigation' has compiled a draft version of**

IADC Space Debris Mitigation Guidelines

  - **Main point under discussion is the post mission residual lifetime for de-orbiting in LEO**
  - **Draft Guidelines reviewed by IADC Steering Group**
  - **IADC members may discuss the draft IADC Mitigation Guidelines with industry and/or multi-national satellite operators as part of their internal review**
  - **Unanimous acceptance by IADC is necessary**

- **Protection Manual (PM)**

  The PM is focussed on the most critical topics related to spacecraft protection against meteoroid and orbital debris impacts.

  The objective is to provide a synthesis of related knowledge and experience.

  The Protection Manual provides:

  - **A standard methodology for meteoroid/debris risk assessments**
  - **Reliable ballistic limit equations**
  - **Procedures and results used to calibrate hypervelocity impact test facilities**
  - **Benchmark cases for validation of numerical simulation codes**
  - **Reports on activities for validation of hypervelocity impact simulation codes**
  - **Design guidelines for protection of spacecraft against the meteoroid and obital debris impacts**

IADC Current IADC Action Items (Status: 01 October 2001)

NUMBER	TITLE	ASSIGNMENT	STATUS
12,1	International Geostationary Observation Campaign	WG1	Closed
14,7	Catalogue of Debris Mitigation Practices	WG4	Open [1]
15,1	LEO Constellation Model Comparison	WG2	Closed
15.3	Development of Protection Manual	WG3	Closed
15,4	HVI Test Facilities Calibration	WG 3	Open [2]
16,1	LEO End of Life Disposition	WG2 / WG4	Open WG2 effort complete
17,1	IADC Beam Park Experiment 2000	WG1	Open
17,2	IADC Space Debris Mitigation Guidelines	WG4	Open
18,1	International Space Debris Measurement Campaigns in GEO	WG1	Open
18,2	GTO-MEO-Molniya Upper Stage Disposal	WG4	Open
18,3	Entry Criteria and Procedures	WG4	Open
18,4	Small Satellites	WG4	Open
19,1	Analyse the Potential Benefits and Risks of Using Tethers	WG2	Open
19,2	Comparison of Engineering Models	WG2	Open
19,3	IADC Beam Park Experiment 2002	WG1	Open

[1] Closed on SG Meeting Oct 2001
[2] To be closed formally when test report is available

Planned Short-term Activities

- **New Action Items**

  - **Analysis of the potential benefits and risks of using tethers**

    Tethers are currently discussed for orbit lowering and raising. An impact risk analysis for space tether systems has been performed, confirming that there is a survivability problem. This AI proposes the collection of information on tethers and existing software tools to analyse tether dynamics taking into account their benefits and risks.

  - **Comparison of orbital debris engineering models (NASA 90, NASA ORDEM 96, NASA ORDEM 2000, ESA MASTER 99 & ROSAVIAKOSMOS SDPA-E)**

    This AI shall provide a comprehensive comparison of recently updated debris models to get an estimate of agreements and differences

  - **IADC Beam Park Experiments 2002**

    LEO space debris environment changes over time → regularly revisits and re-measurements of this environment are necessary. Proposed planning of measurements every 2 years.

Planned Short-term Activities (cont'd)

- **Other planned activities**
  - **Collection of data on retrieved materials and interpretation of the observed damages**
  - **Continuation of correlation of HVI** (hypervelocity impact) **test results with numerical simulations**
  - **Risk analysis cross calibration to the orbital debris environment Model ORDEM 2000**
  - **Co-operation between participants to acquire test data on targets**
  - **Leonids observation and measurement campaign**

- **Next IADC Meeting**

  20th IADC, organized by BNSC (British National Space Centre)

  9-12 April 2002 at the University of Surrey, UK