Inter-Agency Space Debris Coordination Committee

Report of the Inter-Agency Space Debris Coordination Committee Activities on IADC Space Debris Mitigation Guidelines & Supporting Document

Presented to:

42th Session of the
Scientific and Technical Subcommittee
United Nations Committee on the Peaceful Uses of Outer Space

Inter-Agency Space Debris Coordination Committee

- Comprises 11 space agencies:
  - ASI, BNSC, CNES, CNSA, DLR, ESA, ISRO, JAXA, NASA, NSAU, ROSCOSMOS.
- Consists of:
  - Steering group
  - Working group 1: measurements
  - Working group 2: environment and database
  - Working group 3: protection
  - Working group 4: mitigation

Recall of the background

- Man-made orbital debris poses a small but increasing risk to space vehicles.
- Mitigation measures are needed to preserve the near-Earth space environment for future generations.
- Fundamental principles followed by many space-faring organisations for debris mitigation are essentially the same.
- The IADC Space Debris Mitigation Guidelines cover the following:
  - Limitation of debris released during normal operations.
  - Minimisation of the potential for on-orbit break-ups & collisions.
  - Removal of non-operational objects from populated regions.

IADC SDMG

- Upon request the **IADC Space Debris Mitigation Guidelines** (IADC SDMG) were submitted to STSC on 18 November 2002 as IADC proposal for SD mitigation.

  Ref. Doc. # is A/AC.105/c.1/l.260.

- The IADC SDMG is a document of a technical nature and is proposed to be applicable to Earth orbiting vehicles addressing:

  Mission Planning

  Design

  Operation (launch, mission, disposal)

IADC Space Debris Mitigation Guidelines (Summary presented at 40th session of UNCOPUOS S&TSC)

IADC SDMG

1. Scope, 2. Application, 3.Terms and Definitions

4 General Guidance

5. Mitigation Measures

- 5.1 Limit Debris Released During Normal Operations
- 5.2 Minimize Potential for On-Orbit Break-Ups
- 5.3 Post Mission Disposal
- 5.4 Prevention of On-Orbit Collisions

Member States' comments

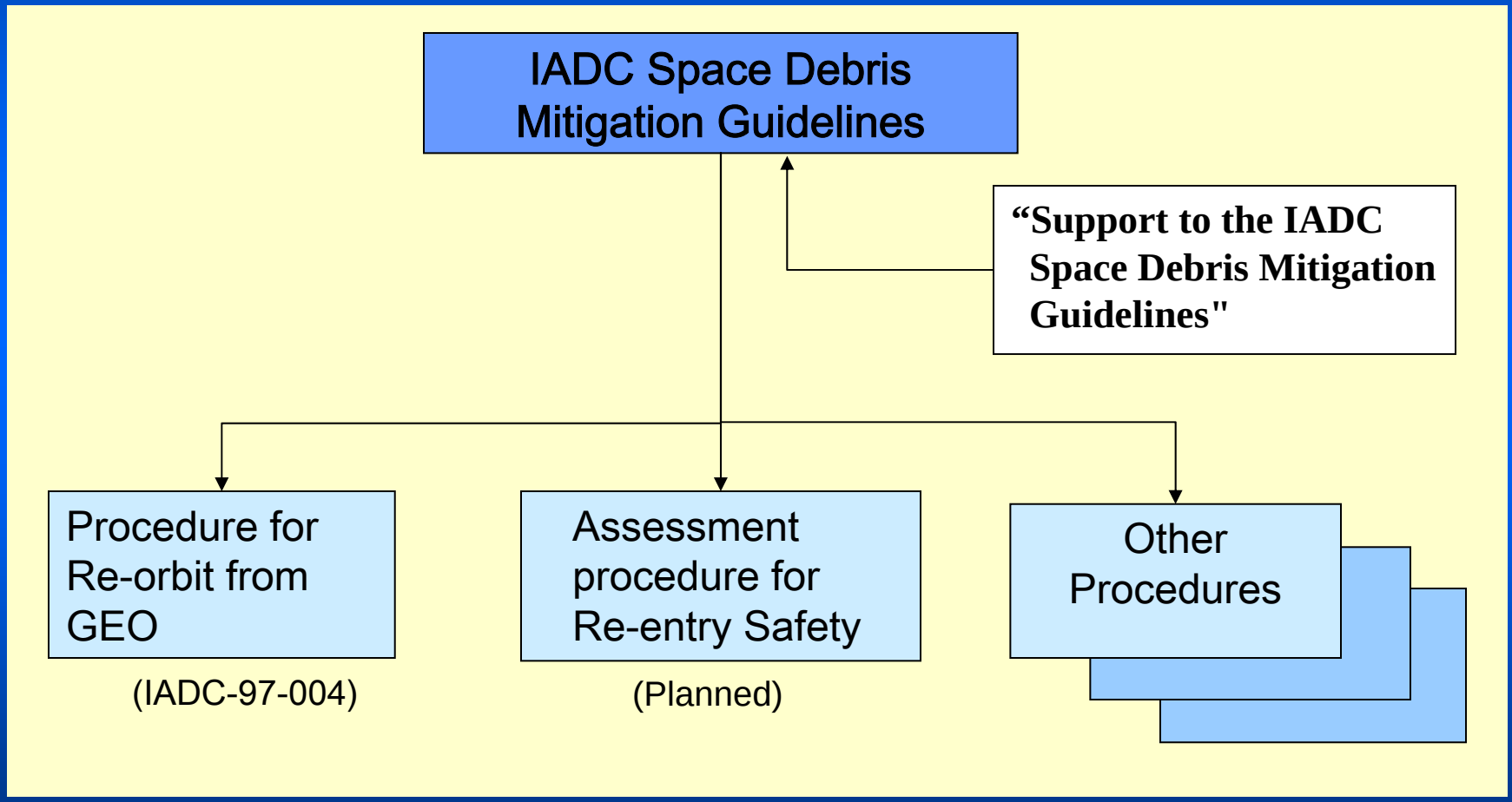
- About 25 comments from member States were received on IADC proposal on space debris mitigation in February 2004 plus some general statements.

  Ref. Doc. # is : A/AC.105/c.1/2004/CRP.29 + Add.1.
- The IADC, in accordance with its Terms of Reference, considered all technical comments and is reviewing the IADC SDMG for possible changes.
- Some comments require specific technical investigations and some others require consultations on NPS.
- Some comments are of other nature (political, economical) and beyond of IADC ToR mandate.

Additional IADC achievements

- New documents were put on the website (www.iadc-online.org):
  - New version of the Protection Manual.
  - Report on Space Debris Measurement Campaigns in GEO.
- New supporting document to IADC SDMG has been developed within IADC as its own initiative:
  - **Support to the IADC Space Debris Mitigation Guidelines.** ➡

Planned IADC Document System for Debris Mitigation Guidelines



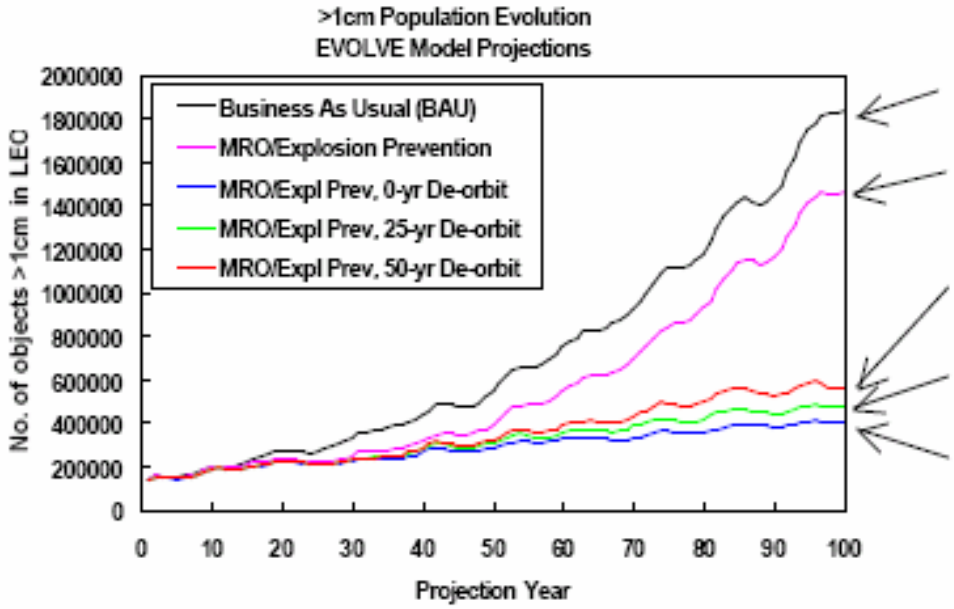
Why the supporting document to SDMG?

To provide additional technical information to the reader of the IADC SDMG, the IADC developed a supporting document with the following systematic content:

- Origin of the guideline;
- Rationale for the guideline;
- Justification of the numerical values, when applicable;
- Recommendations on how to cope with the guideline, applicable methods;
- Tailoring guide for each guideline;
- Applicable references and examples.

Example of Supporting document content

The IADC recommendation is to ensure that the lifetime after disposal will not exceed 25 years.
IADC Working Group 2 studied the effect of de-orbiting in LEO and the result is shown below.



Case-1: Business as Usual (No mitigation measures are taken.)

Case-2: Mission Related Objects are refrained to be released, and explosions are prevented.

Case-3: In addition to case-2, systems are removed within 50 years after mission termination.

Case-4: In addition to case-2, systems are removed within 25 years after mission termination.

Case-5: In addition to case-2, systems are removed immediately after mission termination.

Figure 5.3.2-1 Debris (> 1cm) Average Population Evolution from Evolve

Example of supporting document content

Practice of re-orbiting at end-of-life.
Estimation of penalty: Required propellant for lifetime reduction within 25 years.

Initial Altitude	Perigee Altitude Decrease	Final perigee Altitude	Delta Velocity	Mass Fraction (Propellant / Dry Mass)
800 km	70 km	730 km	18 m/s	0.8%
1,000 km	370 km	630 km	88 m/s	4.3 %
1,500 km	965 km	535 km	236 m/s	11 %
2,000 km	1505 km	495 km	349 m/s	17 %

[Ref: Space Debris Handbook NASDA-CRT-98006, 1998]

~~(Isp = 200 sec, A/m = 0.05)~~

For orbits above 1400 km, less energy is required to re-orbit above 2000 km than to manoeuvre into a disposal orbit with a lifetime of 25 years or less.

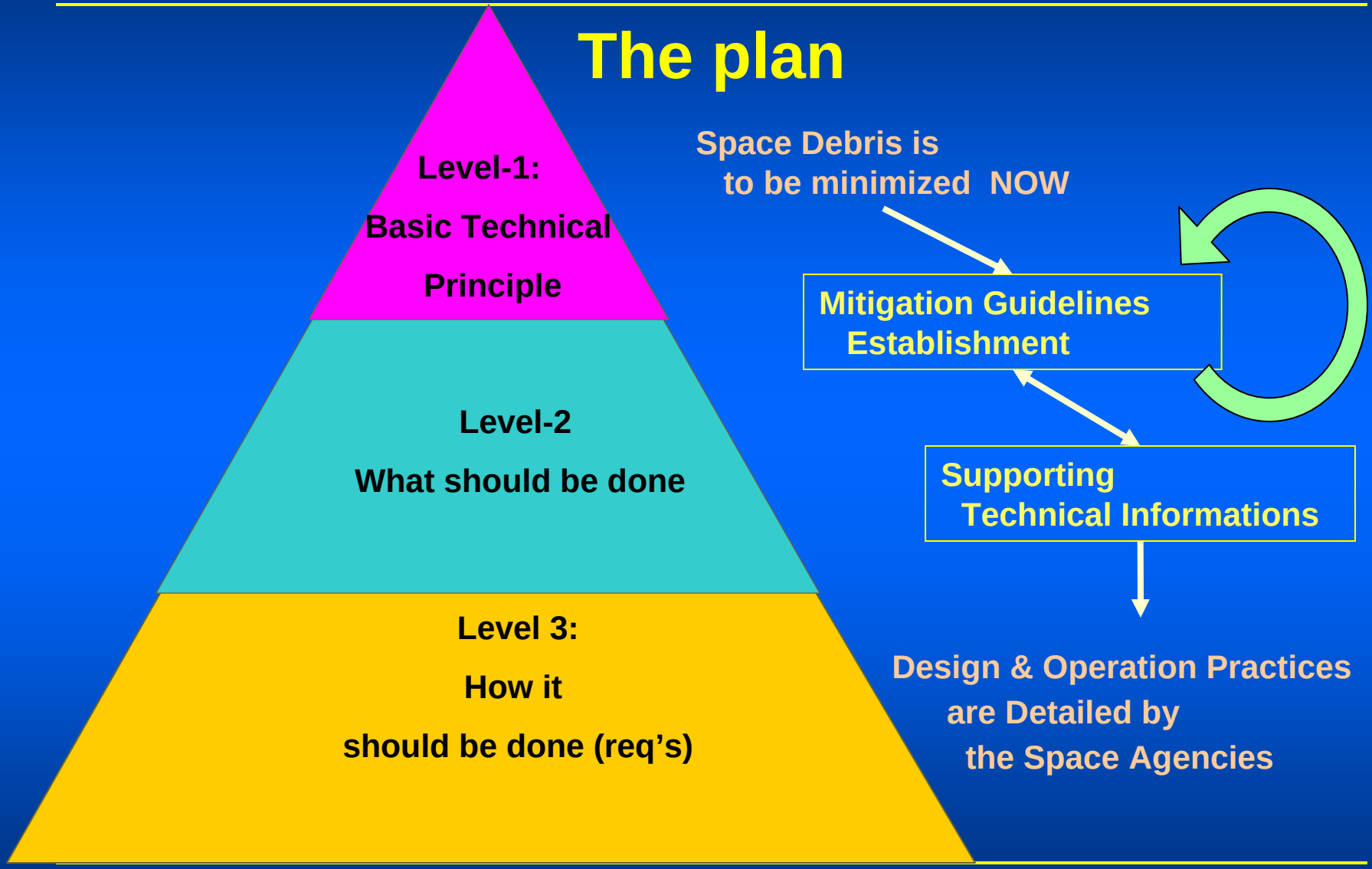
Example of supporting document content

The IADC recommends that the risk of large object re-entries be evaluated and limited where possible. **Example: Table of large objects re-entered after 1980.**

Name	Nationality	Mass [kg]	Date of Decay	Mode
Salyut 6/Cosmos 1267	Russia	35,000	29-Jul-82	Controlled Re-entry
Cosmos 1443	Russia	15,000	19-Sep-83	Controlled Re-entry
Apollo 9 CSM BP-16	USA	16,700	10-Jul-85	Natural Re-entry
Apollo 8 CSM BP-26	USA	16,700	8-Jul-89	Natural Re-entry
Salyut 7/Cosmos 1686	Russia	40,000	7-Feb-91	Natural Re-entry
Compton GRO	USA	14,910	4-Jun-00	Controlled Re-entry
Mir	Russia	120,000	23-Mar-01	Controlled Re-entry

http://www.aerc.org/cords/faq3.html

The plan



Space Debris is
to be minimized NOW

Mitigation Guidelines
Establishment

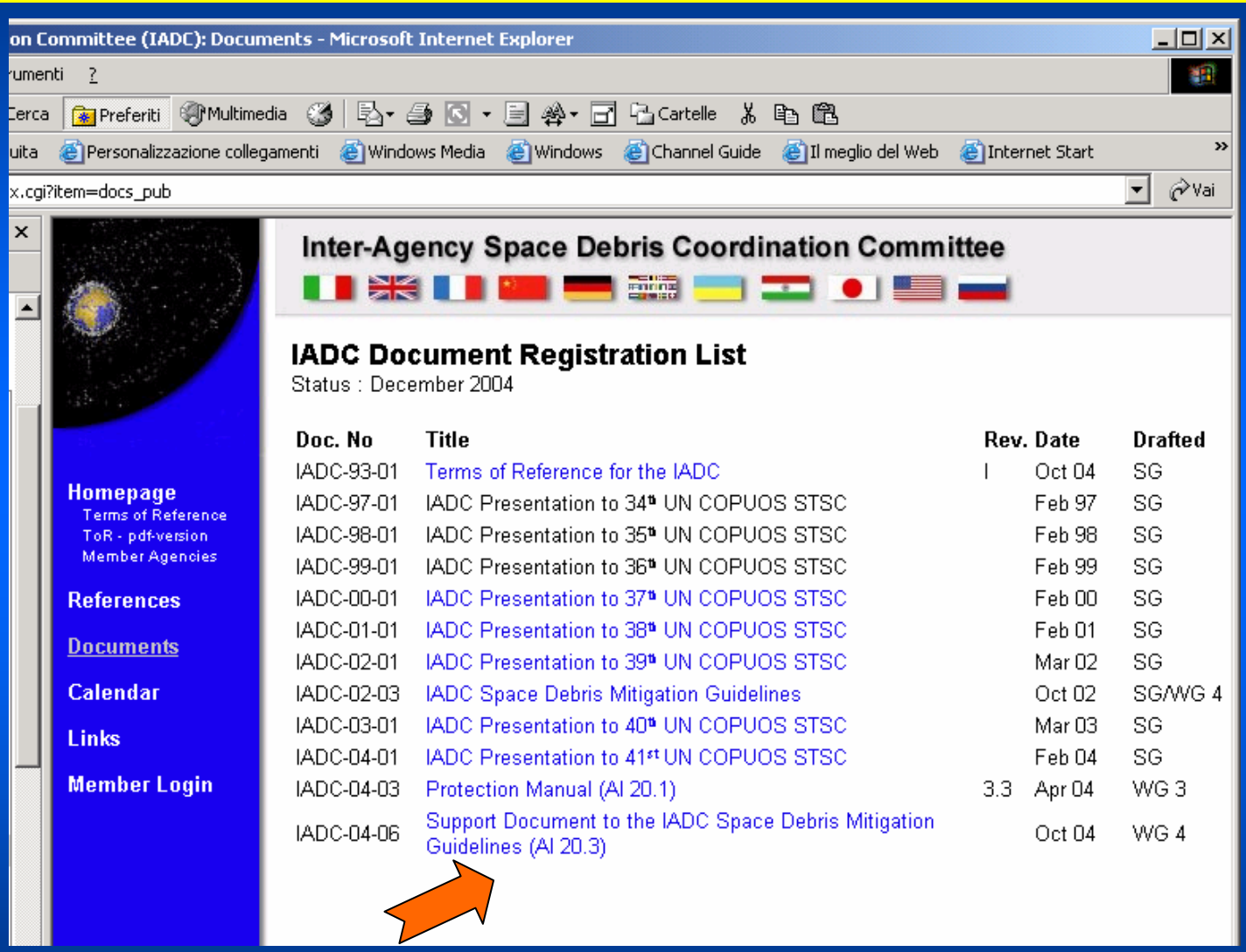
Supporting
Technical Informations

Design & Operation Practices
are Detailed by
the Space Agencies

Summary

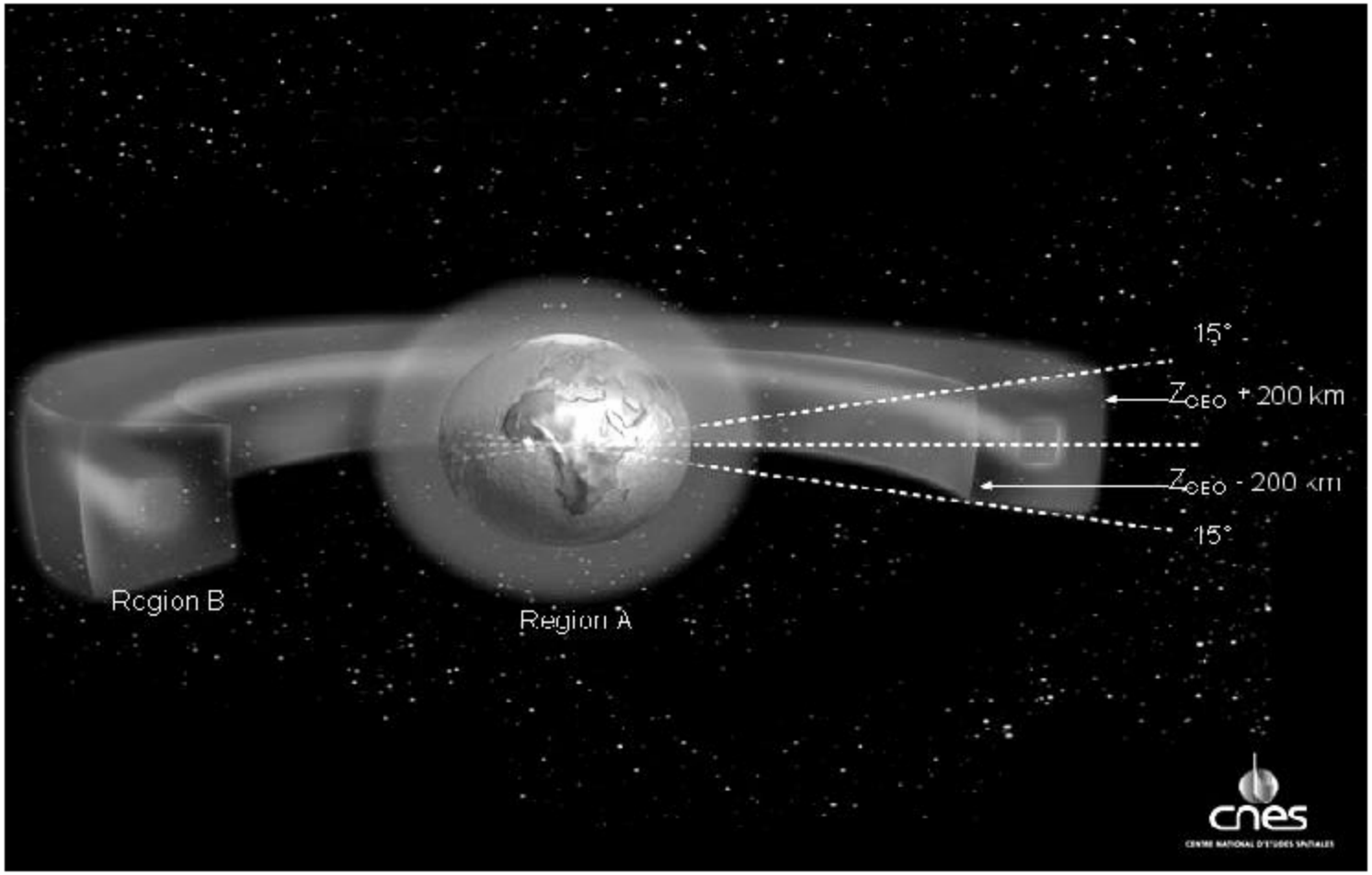
- The IADC has completed its preliminary review of S&T Sub Committee technical comments to the IADC SDMG and has forwarded its first response to OOSA.
- IADC WG4 has been requested to evaluate proposed changes to the IADC SDMG, based upon IADC consensus by 2005.
- IADC Supporting Document on Mitigation Practices provide rationale for the Guidelines and technical information for implementation of the Guidelines.
- Organisations are encouraged to use the technical information, provided by the IADC SDMG (and its future updates) to help establish mission requirements for planned and existing space systems.

Space Debris Mitigation Guidelines



Space Debris Mitigation Guidelines

For clarification, the protected regions are indicated by the 3D figure below.



Space Debris Mitigation Guidelines

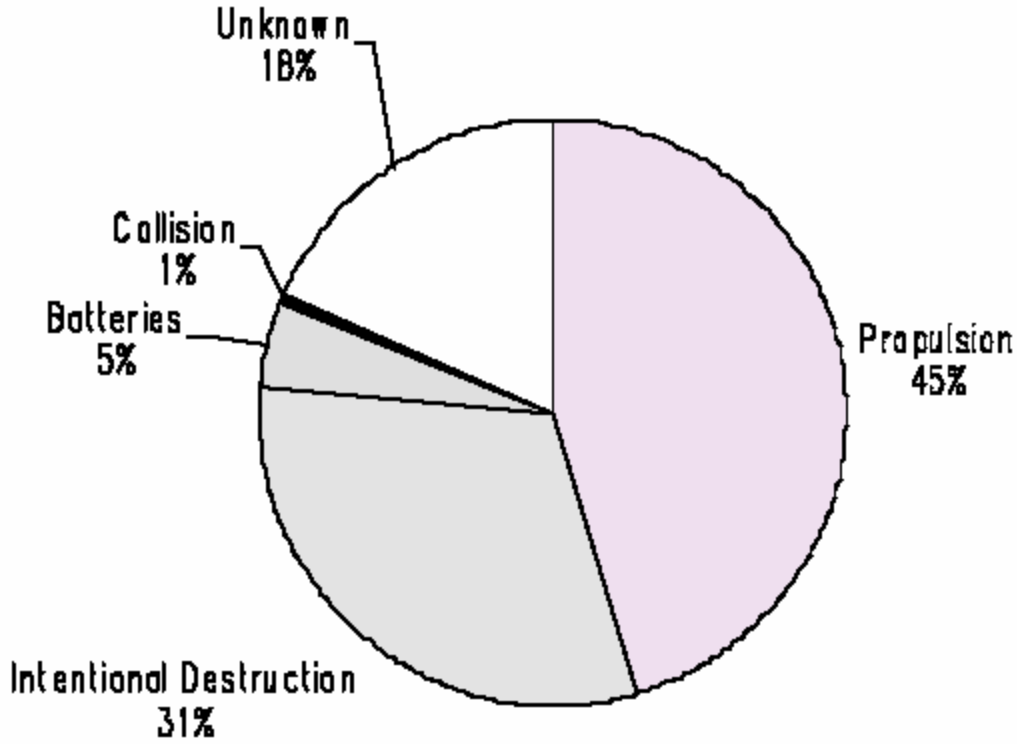


Fig. 5.2-1 Causes of Breakup