

Inter-Agency Space Debris Coordination Committee

Report of the IADC Activities on Space Debris Mitigation Measures

Presented to:

41th Session of the
Scientific and Technical Subcommittee
United Nations Committee on the Peaceful Uses of Outer Space

Inter-Agency Space Debris Coordination Committee

- Members are
 - ASI, BNSC, CNES, CNSA, DLR, ESA, ISRO, JAXA, NASA,NSAU, Rosaviakosmos
- Consists of:
 - Steering Group
 - Working Group 1: Measurements
 - Working Group 2: Environment and Database
 - Working Group 3: Protection
 - Working Group 4: Mitigation

Background

- Man-made orbital debris poses a risk to spacecraft
- Probability of damaging collisions is increasing
- 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:
 - Limit objects released during normal operations
 - Prevent on-orbit break-ups
 - Remove non-operational objects from populated regions
 - Prevention of on-orbit collisions

IADC Space Debris Mitigation Guidelines: *Released in 2003*
(Summary presented at 40th session of UNCOPUOS S&TSC)

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**

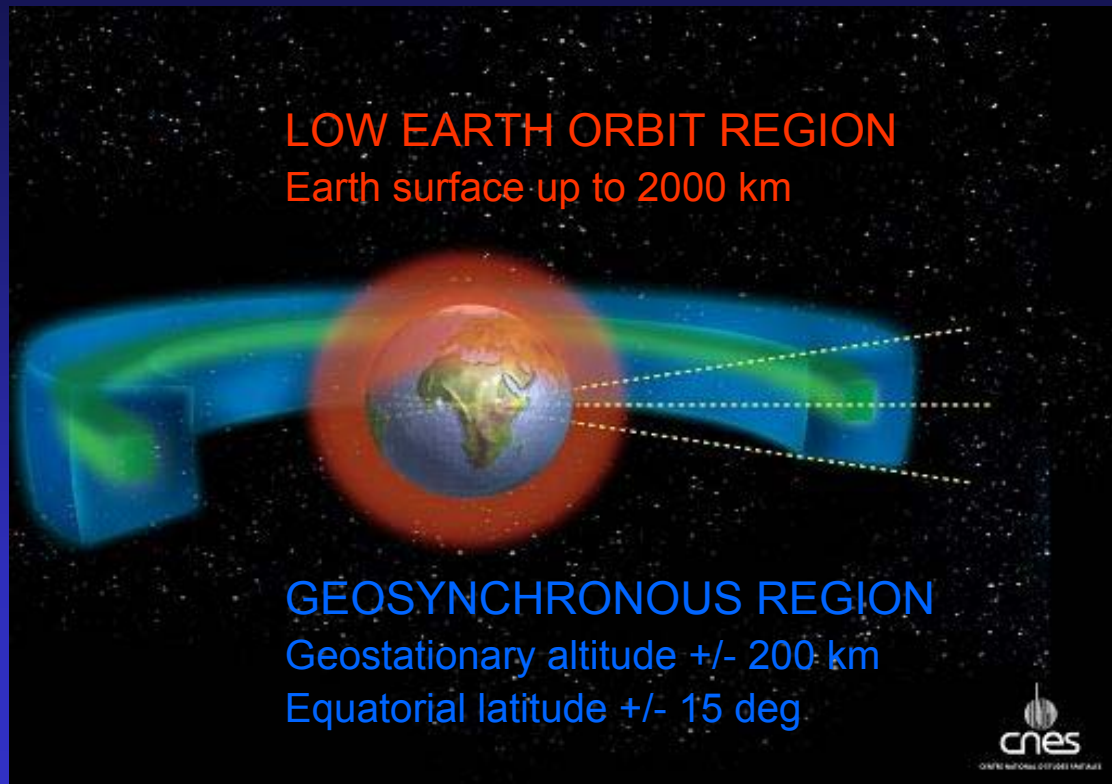
Application

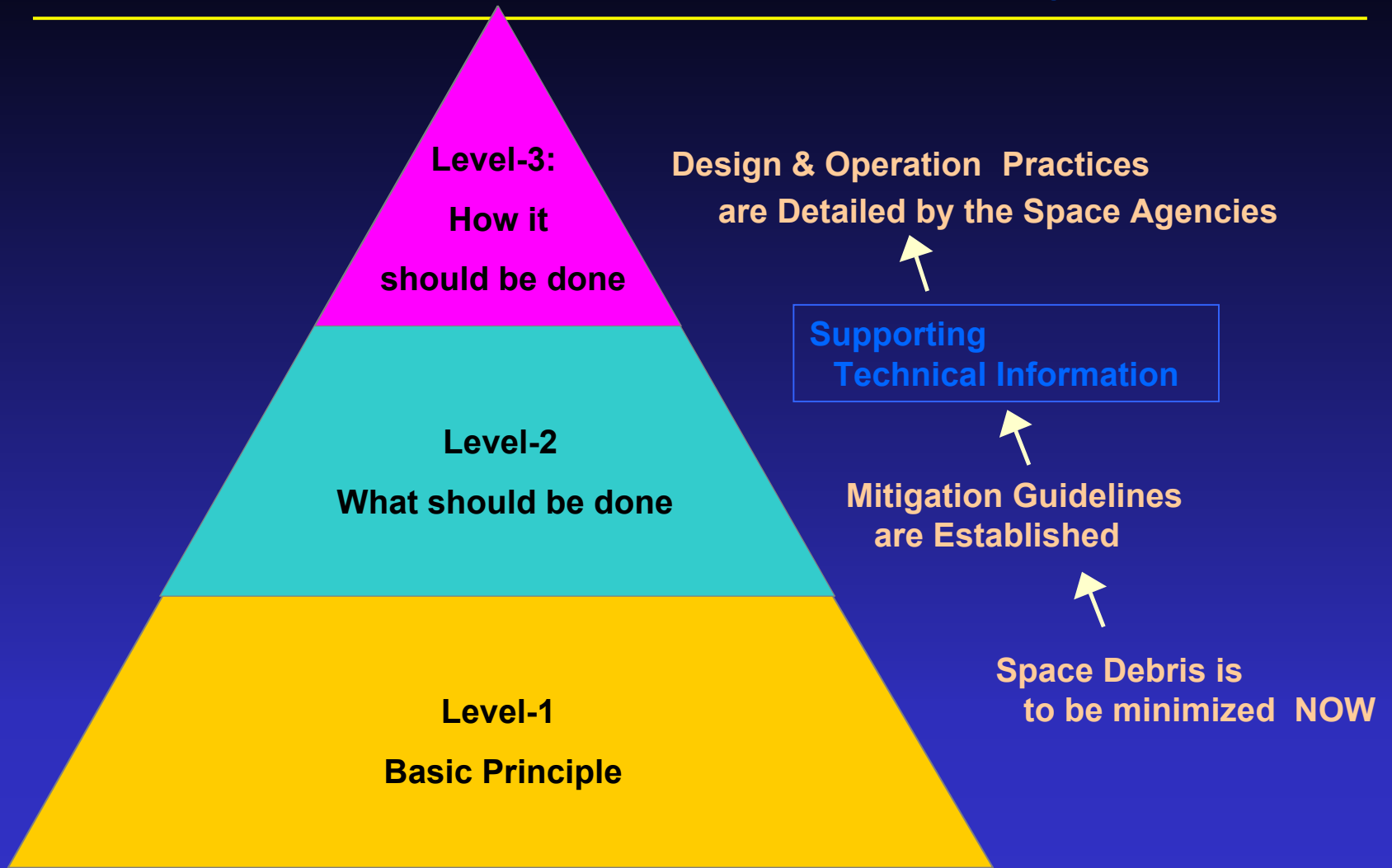
Applicable to planned Earth orbiting spacecraft, and existing systems where possible, addressing:

- Mission Planning
- Design
- Operation (launch, mission, disposal)

Protected Regions

- The Guidelines are based on the recognition of two unique regions in space that must be protected:

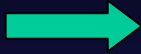




*Guideline 5.1***Limit debris released during normal operations**

- Space systems should be designed not to release debris during normal operations
- Where this is not feasible, any release of debris should be minimized in number, area, and orbital lifetime
- Any release of objects in orbit should not be planned unless adequate assessment can verify effect on orbital environment and operating space systems





Limit debris released during normal operations

- Approximately 12 % of the present catalogued objects are debris released during normal operations
- It is relatively easy, both technically and economically, to take mitigation measures against these objects
- Released objects should have limited orbital life time, e.g. less than 25 years

*Guideline 5.2.1***Minimise potential for post-mission break-ups**

All on-board sources of stored energy of a space system should be depleted or safed when they are no longer required for mission operations or post-mission disposal

Depletion should occur as soon as this operation does not pose an unacceptable risk to the payload

Mitigation measures should be designed so as not to create other risks





Minimise potential for post-mission break-ups

- Residual propellants and other fluids should be depleted
- Batteries should be designed to prevent break-ups and at end of operations charging lines should be de-activated
- High pressure vessels should be vented to ensure no break-ups can occur
- Self-destruct systems should be designed not to cause unintentional destruction
- Power to flywheels and momentum wheels should be terminated during disposal phase
- Other forms of stored energy should be assessed and adequate mitigation measures applied

*Guideline 5.2.2***Minimise potential for break-ups during operational phases**

- Using failure analyses, programs should demonstrate that there is no failure mode leading to accidental break-ups or, if cannot be excluded, probability should be minimised
- During operational phases, system should be periodically monitored to detect malfunctions which could lead to break-up or loss of control. If recovery measures cannot be conducted, disposal and passivation measures should be applied

*Guideline 5.2.3***Avoidance of intentional destruction & harmful activities**

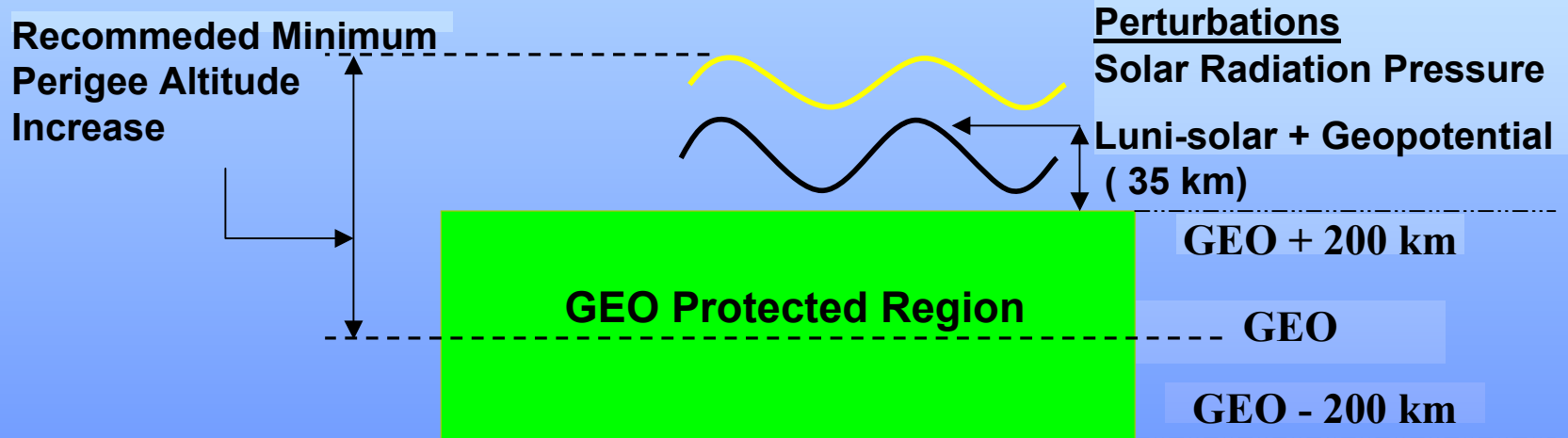
- Intentional destruction of a space system and other harmful activities that may significantly increase collision risks should be avoided
- Intentional break-ups should be conducted at sufficiently low altitudes so that orbital fragments are short-lived

*Guideline 5.3.1***Post mission disposal for geosynchronous region**

- Space systems that have terminated their mission should be manoeuvred far enough away from geostationary orbit to avoid interference with GEO systems
- Recommended minimum increase in perigee altitude is
 - $235 \text{ km} + (1000 \text{ Cr A/m})$
 - 235 km = 200 km (GEO protected region) + 35 km (gravitational perturbations)
 - Cr = solar radiation pressure coefficient
 - A/m = aspect area (m^2) to dry mass (kg) ratio



Post mission disposal for geosynchronous region



Re-orbit distance was determined as the sum of the upper side of GEO protected region (200 km), the maximum descent of a re-orbited space system due to luni-solar & geopotential perturbations (35 km) and solar radiation pressure.

*Guideline 5.3.2***Post mission disposal for objects through LEO region**

- Systems terminating operational phases in orbits passing through low Earth orbit region should be de-orbited or, where appropriate, manoeuvred to orbit with reduced lifetime
- Systems should be left in an orbit where drag and other perturbations will limit lifetime after completion of operations
- IADC has performed study of effect of post-mission orbital lifetime on collision rate in LEO. 25 years found to be reasonable and appropriate limit

*Guideline 5.4***Prevention of on-orbit collisions**

- Project should estimate and limit probability of accidental collision with known objects
- Avoidance of collisions and co-ordination of launch windows may be considered if collision risk is not negligible
- Spacecraft design should limit consequences of collision with small debris which could cause loss of control, preventing post-mission disposal

Summary

- IADC guidelines are based on common principles, derived from existing documents and agreed by consensus
- IADC is working on a Support Document on Mitigation Guidelines, which will provide rationale for the guidelines and technical information for their implementation
- Organisations are encouraged to use the information to help establish mission requirements for planned and existing space systems
- IADC Guidelines may be updated as new information becomes available