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Space Debris Mitigation Policy for Agency Projects

1. INTRODUCTION

As a consequence of spaceflight activities, the number of functional and non-functional (i.e.: space debris) human-made objects in Earth orbit continues to grow. To minimise the impact of space operations on the orbital environment, to reduce the risk of collision on orbit and to ensure the safety of the public on ground during re-entry, mitigation and safety measures must be anticipated as from the conception of a space system.

In May 2011, the 2nd edition of ISO 24113 "Space Systems – Space Debris Mitigation Requirements" was issued as the international standard which establishes the design and operations requirements to minimise the impact of space operations on the orbital environment. On 10th February, 2012, this standard was adopted by the European Coordination on Space Standardisation (ECSS) as the ECSS-U-AS-10C standard (Adoption Notice of ISO 24113: Space Systems – Space debris mitigation requirements).

The present Instruction establishes the ESA standard for the technical requirements on space debris mitigation for Agency projects, it sets out the principles governing its implementation and the definition of responsibilities.

2. POLICY

In order to ensure a corporate approach on space debris mitigation, it is the Agency's policy that the ECSS-U-AS-10C is established as the ESA standard ("the standard") for the technical requirements on space debris mitigation for Agency projects.

As the standard foresees that in cases of re-entry the maximum acceptable casualty risk shall be determined by the approving agents, it is the Agency's policy to define that the maximum acceptable casualty risk for ESA space systems shall be as follows:

- a) For ESA Space Systems for which the System Requirements Review has already been kicked off at the time of entry into force of this Instruction, casualty risk minimisation shall be implemented on a best effort basis and documented in the Space Debris Mitigation Report.
- b) For ESA Space Systems for which the System Requirements Review has not yet been kicked off at the time of entry into force of this Instruction, the casualty risk shall not exceed 1 in 10,000 for any re-entry event (controlled or uncontrolled). If the predicted casualty risk for an uncontrolled re-entry exceeds this value, an uncontrolled re-entry is not allowed and a targeted controlled re-entry shall be performed in order not to exceed a risk level of 1 in 10,000.

3. SCOPE OF APPLICATION

This policy shall apply to:

- the procurement of ESA space systems (e.g.: launchers, satellites, inhabited or robotic vehicles);
- operations, under the responsibility of ESA, of any given space system.

For the procurement of launch services for ESA space systems, all reasonable efforts shall be made to ensure the use of launchers which are compliant with the space debris mitigation technical requirements in the standard.

4. ASSESSMENT OF COMPLIANCE

During the development phase, compliance of ESA Space Systems with the space debris mitigation requirements shall be assessed in the frame of the Technical Project Reviews .

In case of major deviations from space debris mitigation requirements during the orbital lifetime of space systems operated under ESA responsibility and prior to the start of the disposal phase, the space systems compliance with the space debris mitigation requirements shall be assessed by the Space Debris Mitigation Review Panel chaired by the Head of the Independent Safety Office and composed of experts in the relevant technical disciplines. In case of non-compliance, the Space Debris Mitigation Review Panel shall make recommendations for the approval of an associated Request for Waiver.

5. RESPONSIBILITIES

- Directors, within their respective areas of responsibilities, are responsible for the implementation of this policy.
- Study Managers, Project Managers and Mission Managers are responsible for the preparation and maintenance of the Space Debris Mitigation Plan and Space Debris Mitigation Report in accordance with the Implementation Requirements described in Annex 1.
- The Director in charge of technical and quality management and the relevant Programme Director are delegated by the Director General the responsibility and authority to approve waivers to requirements in the standard.
- The Head of the Department in charge of product assurance and safety is delegated by the Director in charge of technical and quality management, the responsibility for the management of the implementation of this policy and the approval of the Space Debris Mitigation Plan at the time of System Requirements Review and the Space Debris Mitigation Report at the time of Acceptance Review.
- The ESA Inspector General is responsible for ensuring that the implementation of the applicable requirements and the Space Debris Mitigation Plan and Report, are reviewed in the frame of the Technical Project Reviews.

- The Head of the Independent Safety Office is the Technical Authority delegated by the Head of the Department in charge of product assurance and safety for:
 - the maintenance of the Space Debris Mitigation Policy with the related requirements;
 - the independent supervision of their verification of compliance and
 - the processing of waivers with the technical assistance and expertise of the Directorate in charge of technical and quality management and the Space Debris Office of the Directorate in charge of operations.

- The Head of the Independent Safety Office is responsible for the periodic compilation of a report on the status of implementation of the Space Debris Mitigation Policy for all ESA projects.

6. EVALUATION OF THE POLICY

The effectiveness of this policy will be evaluated by the Head of the Department in charge of product assurance and safety on a periodic basis, or at the request of the Director General.

7. VALIDITY

This Instruction is effective for a period of four years subject to prior revocation or revision as determined by the Director General. Not later than 6 months before the end of its period of validity, the present instruction shall be the subject of a review to establish whether it requires being extended, modified or revoked. Such review shall be carried out in compliance with the procedure applicable to the review of DG Instructions.

8. PUBLICITY

This instruction shall be made publicly available through appropriate means.

9. SUPERSEDED INSTRUCTION

This Instruction supersedes ESA/ADMIN/IPOL(2008)2.

10. ENTRY INTO FORCE

This Instruction enters into force on the day of its publication.



Jean-Jacques Dordain
Director General

Annex 1

IMPLEMENTATION REQUIREMENTS

1. RESPONSIBILITIES

To implement the space debris mitigation policy for Agency projects, the Study Managers for the mission analysis and feasibility phase, the Project Managers for the development phases and the Mission Managers for the mission operations/utilisation phase shall ensure the execution of the following activities in order to implement the applicable space debris mitigation requirements :

- definition of derived design requirements specifications at system and sub-system level;
- verification of compliance with the design requirements;
- definition and verification of necessary operational procedures prior to launch;
- preparation of documentation and submittal for review to the ESA Technical Reviews;
- release the Requests for Waiver for any case of non-compliance with the applicable requirements and provide supporting justification (as relevant) to the Independent Safety Office for assessment and processing.

2. DOCUMENTATION

Starting with the Preliminary Requirements Review, the project shall provide a Space Debris Mitigation Plan (SDMP) documenting how the compliance with the requirements is intended to be achieved and containing as a minimum:

1. Statement of planned compliance of the proposed design with all the space debris mitigation requirements, including justification for all non-compliances;
2. Description of design and operational measures planned for achieving compliance with the space debris mitigation requirements;
3. Identification of the verification and validation methods and plans to demonstrate compliance with the applicable space debris mitigation requirements;
4. For space systems that will re-enter:
 - Preliminary re-entry casualty risk analysis with rationale for the planned re-entry approach and identification of the tools and methodologies used for the assessment ;
 - Identification of the space system functions that contribute to the planned controlled re-entry, if applicable;
 - Identification of the re-entry scenario, including nominal and degraded de-orbit cases;
 - Verification and validation plan to demonstrate compliance with the re-entry casualty risk requirement.

Starting with the Preliminary Design Review, the project shall provide a Space Debris Mitigation Report (SDMR) documenting the implementation and verification of the space debris mitigation requirements to be updated at each major project review and submitted for approval at the time of the Acceptance Review.

The Space Debris Mitigation Report shall report the analysis performed and the mitigation measures adopted by the project to comply with the space debris mitigation requirements; the SDMR shall contain as a minimum:

1. Description of the design and operational measures implementation for achieving compliance with the Space Debris Mitigation requirements;
2. Analysis and test reports in support of the implementation of the space debris mitigation requirements;
3. List of objects (mission-related objects or space debris) planned to be released as part of the nominal mission, including physical characteristics, orbital characteristics and predicted orbital lifetime;
4. List of events which can cause violation of the requirements and relevant consequences (e.g., description and characteristics of debris generated, etc.);
5. Verification Control Document covering all space debris mitigation requirements with related justification;
6. Assessment of the compliance of the selected launch services with the space debris mitigation technical requirements in the standard;
7. For space systems that will re-enter:
 - Re-entry casualty risk analysis, including methodology, assumptions, model uncertainties, identification of simulation tools, and results of the assessment for both nominal and degraded cases;
 - Description of the space system functions that contribute to the controlled re-entry, if applicable;
 - Description of the re-entry scenario, including nominal and degraded de-orbit cases;
 - Definition of the flight rules;
 - Definition of the notification Plan to the Authorities.

The Space Debris Mitigation Plan shall be provided at:

- Preliminary Requirements Review in preliminary form for review;
- System Requirements Review for review/approval.

The Space Debris Mitigation Report shall be provided at:

- Preliminary Design Review for review;
- Critical Design Review for review;
- Acceptance Review for review /approval.

Guidelines for the verification of the compliance to the requirements in the policy will be provided in the “ESA Space Debris Mitigation Compliance Verification Guidelines “.

Annex 2

TERMS AND DEFINITIONS

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| Approving agent: | entity from whom approval is sought for the implementation of the space debris mitigation requirements with respect to the procurement of a spacecraft, or its launch, or its operations in space, or combination of those activities. |
| Casualty Risk: | the probability of serious injury or death. |
| Disposal : | actions performed by a spacecraft or launch vehicle orbital stage to permanently reduce its chance of accidental break-up and to achieve its required long-term clearance of the protected regions. |
| Disposal Phase: | begins at the end of the operational phase of the Space System, and ends when either the Space System has performed a direct re-entry or completed its disposal activities (having reached its disposal orbit and having completed its passivation). |
| ESA Space Systems | all Space Systems procured under ESA Programmes including launchers, satellites , inhabited or robotic vehicles. |
| End of Life: | end of disposal phase. |
| Operational Phase: | period of time during which a space system performs planned tasks and functions prior to its disposal. |
| Orbital lifetime: | period of time from when the spacecraft or launch vehicle orbital stage achieves Earth orbit to when it commences re-entry. |
| Space Debris: | any man-made space object, including fragments and elements thereof, in Earth orbit or re-entering the Earth's atmosphere, that is non-functional (IADC definition). |
| Re-entry: | process in which atmospheric drag cascades deceleration of a spacecraft or launch vehicle orbital stage (or any part thereof), leading to its destruction or return to earth. |