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Procedural
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COMPLIANCE IS MANDATORY

NASA Procedural Requirements for Limiting Orbital Debris and Evaluating the Meteoroid and Orbital Debris Environments

Responsible Office: Office of Safety and Mission Assurance

Table of Contents

Preface

- P.1 Purpose
- P.2 Applicability
- P.3 Authority
- P.4 Applicable Documents and Forms
- P.5 Measurement/Verification
- P
- .6 Cancellation

Chapter 1. Introduction

- 1.1 Technical Objectives
- 1.2 Guiding Policies
- 1.3 Relief from Requirements

Chapter 2. Roles and Responsibilities

- 2.1 Chief, Safety and Mission Assurance (Chief, SMA)
- 2.2 Center-Level SMA Technical Authority
- 2.3 Mission Directorate Associate Administrator
- 2.4 NASA Project Manager
- 2.5 NASA Launch Services Program Manager (LSPM)
- 2.6 Office of International and Interagency Relations (OIIR)
- 2.7 NASA Robotic Conjunction Assessment Risk Analysis (CARA) Team
- 2.8 NASA Johnson Space Center Human Space Flight Operations Directorate

Chapter 3. Requirements

- 3.1 Mission Formulation
- 3.2 Mission Design and Assessment
- 3.3 Mission Operations and Termination
- 3.4 Reentries

Appendix A. Acronyms

Appendix B. References

Preface

P.1 Purpose

- a. The purpose of this NASA Procedural Requirements (NPR) document is to define responsibilities and requirements to ensure that NASA and its partners, providers, and contractors take steps to preserve the near-Earth space environment, in accordance with the National Space Policy and the U. S. Government Orbital Debris Mitigation Standard Practices and to mitigate the risk to human life and space missions due to orbital debris and meteoroids.
- b. In this NPR, orbital debris is defined as any object placed in space (see P.2.b) by humans that remains in orbit and no longer serves any useful function. Objects range from spacecraft to spent launch vehicle stages to components and also includes materials, fragments, or other objects which are intentionally or inadvertently cast off or generated.
- c. Meteoroids are defined as naturally occurring free-flying space objects and are typically generated as a result of collisions between asteroidal objects or released from comets.
- d. This NPR specifies NASA requirements and guidelines for limiting the generation of orbital debris and for implementing the U.S. Government Orbital Debris Mitigation Standard Practices provided in NASA Standard (NASA-STD) 8719.14, Process for Limiting Orbital Debris, (which superseded NASA Safety Standard (NSS) 1740.14), and NASA-Handbook (NHBK) 8719.14, Handbook for Limiting Orbital Debris.

P.2 Applicability

- a. This NPR is applicable to NASA Headquarters and NASA Centers, including Component Facilities and Technical and Service Support Centers. This language applies to the Jet Propulsion Laboratory (a Federally-Funded Research and Development Center), other contractors, recipients of grants and cooperative agreements, and parties to other agreements only to the extent specified or referenced in the applicable contracts, grants, or agreements.
- b. This NPR is applicable to programs and projects responsible for NASA or NASA-sponsored objects launched into space to the extent that Federal authority to oversee the mitigation of orbital debris for those missions or portions thereof does not reside with another Federal department or agency. This NPR only applies to objects which exceed 130km (~70mi) in altitude and achieve or exceed Earth orbital velocity.

Note 1: Sponsored by NASA are those objects developed or operated by NASA, under contract from NASA, or under agreement with NASA.

Note 2: Per the National Space Transportation Policy of 2013, it is recognized that the Department of Transportation (DOT) has authority to oversee orbital debris mitigation practices for Federal Aviation Administration (FAA)-licensed launches. Furthermore, for the purpose of this NPR, NASA does not consider itself a sponsor of launch vehicles furnished by the Department of Defense or foreign partners. Consequently, this NPR does not apply to such launch vehicles. NASA or NASA-sponsored payloads of such launch vehicles, and operation of such payloads and vehicles that are not otherwise covered under

licensure by any other Federal Agency that has authority to oversee the mitigation of orbital debris, are subject to the requirements of this NPR and standards invoked by it.

c. In addition to limiting generation of debris in all Earth orbits, NASA also desires to limit the generation of debris in other orbits where debris might pose a hazard to future spacecraft. Section 3 applies to Earth, Moon, or Mars or in the vicinity of Sun-Earth or Earth-Moon Lagrange Points. All missions traveling beyond Earth orbit must comply with NASA's Planetary Protection policy and requirements as described in NPD 8020.7 and NPR 8020.12. In the event of conflicts between this document and Planetary Protection requirements, the Planetary Protection requirements will take precedence.

d. NASA International Space Station (ISS) payloads that remain encapsulated by or permanently mounted on the ISS or other spacecraft are exempted from this NPR. The NPR also does not apply to payloads that are temporarily installed outside the ISS and later returned as cargo in a vehicle destined for destruction in a controlled de-orbit. The NPR does apply to NASA payloads and components that are expected to be released (jettisoned or deployed) from the ISS.

e. NASA exploration vehicle payloads that remain encapsulated by or permanently mounted on the vehicle are exempted from this NPR. This NPR also does not apply to payloads that are temporarily installed outside the vehicle and later returned as cargo in a vehicle destined for destruction in a controlled de-orbit. The NPR does apply to NASA payloads and components that are expected to be released (jettisoned or deployed) from the exploration vehicles.

f. In this directive, all mandatory actions (i.e., requirements) are denoted by statements containing the term "shall." The terms: "may" or "can" denote discretionary privilege or permission, "should" denotes a good practice and is recommended, but not required, "will" denotes expected outcome, and "are/is" denotes descriptive material.

g. In this directive, the term "Project Manager" is meant to apply to both Project Managers and Program Managers.

h. In this directive, document citations are assumed to be the latest version, unless otherwise noted.

P.3 Authority

- a. National Aeronautics and Space Act, 51 U.S.C. § 20113 (a).
- b. National Space Policy of the United States of America, 2010.
- c. U.S. Government Orbital Debris Mitigation Standard Practices, 2001.
- d. NPD 1000.3, The NASA Organization.
- e. NPD 8700.1, NASA Policy for Safety and Mission Success.

P.4 Applicable Documents and Forms

- a. NPD 8010.3, Notification of Intent to Decommission or Terminate Operating Space Systems and Terminate Missions.
- b. NASA-STD-8709.20, Management of Safety and Mission Assurance Technical Authority (SMA TA) Requirements.

c. NASA-STD-8719.14, Process for Limiting Orbital Debris.

P.5 Measurement/Verification

Compliance by programs and projects with the requirements contained within this NPR is verified as part of selected life-cycle reviews and by assessments, reviews, and audits. This NPR specifies development of milestone products and control plans that are reviewed at each of the selected life-cycle reviews conducted in accordance with the requirements of NPR 7120.5, NASA Space Flight Program and Project Management Requirements and NPR 7123.1, NASA Systems Engineering Processes and Requirements. Compliance with the requirements contained within this NPR is also monitored by Centers, Mission Directorates, and by the Safety and Mission Assurance (SMA) Technical Authority.

P.6 Cancellation

NPR 8715.6A, NASA Procedural Requirements for Limiting Orbital Debris, dated May 14, 2009.

Chapter 1. Introduction

1.1 Technical Objectives

1.1.1 This NPR defines responsibilities and requirements to ensure that NASA and its partners, providers, and contractors consider the preservation of the near-Earth space environment and the space environment beyond Earth's orbit and mitigation of the risk to human life and space missions due to orbital debris and meteoroids, by pursuing the following objectives.

1.1.2 A first objective is to control the generation of orbital debris and mitigate its growth. In particular:

- a. Orbital debris released as part of normal operations is minimized.
- b. The potential for orbital debris generated by accidental explosions is limited.
- c. The potential for breakup or loss of passivation and disposal capabilities due to on-orbit collisions is limited.
- d. The number of expended or decommissioned space objects remaining in orbit, and their durations in orbit, are limited.
- e. The likelihood of collisions with other space objects is minimized.

1.1.3 A second objective is to ensure that the meteoroid and orbital debris environments are characterized and risk to human life (public and crew) and space missions from the environment is minimized or limited. In particular:

- a. Sufficient knowledge of the meteoroid and orbital debris environments exists to inform design and operation decisions.
- b. Risks to spacecraft and crew from meteoroids and orbital debris are mitigated.
- c. The risk of human casualty due to reentry of orbital debris is limited to accepted levels.

1.1.4 This NPR documents organizational responsibilities related to these objectives. NASA-STD-8719.14 contains technical requirements and requirements for the documentation of related assessments. NASA-HDBK 8719.14 provides relevant background information.

1.2 Guiding Policies

1.2.1 This NPR serves in part to implement the U.S. National Space Policy of 2010, which states:

1.2.1.1 Preserve the Space Environment. For the purposes of minimizing debris and preserving the space environment for the responsible, peaceful, and safe use of all users, the United States shall:

- a. Lead the continued development and adoption of international and industry standards and policies to minimize debris, such as the United Nations Space Debris Mitigation Guidelines;
- b. Develop, maintain, and use space situational awareness (SSA) information from commercial, civil, and national security sources to detect, identify, and attribute actions in space that are contrary to responsible use and the long-term sustainability of the space environment;

- c. Continue to follow the United States Government Orbital Debris Mitigation Standard Practices, consistent with mission requirements and cost effectiveness, in the procurement and operation of spacecraft, launch services, and the conduct of tests and experiments in space;
- d. Pursue research and development of technologies and techniques, through the Administrator of the National Aeronautics and Space Administration (NASA) and the Secretary of Defense, to mitigate and remove on-orbit debris, reduce hazards, and increase understanding of the current and future debris environment; and
- e. Require the head of the sponsoring department or agency to approve exceptions to the United States Government Orbital Debris Mitigation Standard Practices and notify the Secretary of State.

1.2.1.2 Foster the Development of Space Collision Warning Measures. The Secretary of Defense, in consultation with the Director of National Intelligence, the Administrator of NASA, and other departments and agencies, may collaborate with industry and foreign nations to: maintain and improve space object databases; pursue common international data standards and data integrity measures; and provide services and disseminate orbital tracking information to commercial and international entities, including predictions of space object conjunction."

1.2.2 Compliance with this NPR and NASA-STD-8719.14 is intended to meet the guidelines and intent of the U.S. Government Orbital Debris Mitigation Standard Practices.

1.3 Relief from Requirements

1.3.1 In this NPR it is recognized that the current state of spacecraft and launch vehicles might preclude total compliance with orbital debris mitigation requirements. Project managers and launch service providers may, therefore, seek relief from those requirements.

1.3.2 The process for requesting and granting of waivers and exceptions is defined in NPR 8715.3. Requests for relief to the requirements in this NPR and NASA-STD-8719.14 are elevated to the Headquarters level.

1.3.3 Relief from requirements may be requested from the Chief, Safety and Mission Assurance (SMA) by the MDAA sponsoring the mission.

1.3.4 In evaluating requests for relief, the Chief, SMA considers whether any additional risk to the public and space environment is acceptable given the importance of the mission, whether design and operational measures have been applied to the extent reasonably practicable, and whether a violation of the U.S. Government Orbital Debris Mitigation Standard Practices would exist if relief were granted. If the latter is true, the Chief, SMA may obtain the Administrator's consent to adjudicate the request at his or her level or, otherwise, will elevate the request to the Administrator. The Administrator and Chief, SMA, would make such determinations in consideration of applicable National Space Policy and the responsibilities defined in NPD 8700.1 with regards to consent to residual human safety or property risk on behalf of the general public.

1.3.5 The MDAA may appeal decisions by the Chief, SMA to the Associate Administrator and Administrator in accordance with the dissenting opinion process defined in NPD 1000.0.

1.3.6 Waiver requests pertaining to collision avoidance (paragraphs 3.3.2, 3.3.3, and 3.3.5) will be sent to the Chief Engineer for review and concurrence prior to submittal to the Chief, SMA.

1.3.7 On behalf of the Administrator, the Associate Administrator for International and Interagency Relations (AA/OIIR), following coordination with the Chief, SMA, notifies the Secretary of State of any non-compliance with the U.S. Government Orbital Debris Mitigation Standard Practices, as

required by the June 2010 National Space Policy.

Chapter 2. Roles and Responsibilities

2.1 Chief, Safety and Mission Assurance (Chief, SMA)

2.1.1 The Chief, SMA, as stated in NPD 1000.3, is responsible for advising the Administrator and other senior officials on matters related to risk, safety, and mission success. As part of this responsibility, the Chief, SMA:

- a. Establishes Agency policy, requirements, and guidelines to limit the generation of orbital debris from and safely dispose of NASA's spacecraft, payloads, and launch vehicle components consistent with national policy and international guidelines.
- b. Collects, develops, promulgates, and advises on procedures, tools, models, methods, and data bases, including characterizations and forecasts of the orbital debris and meteoroid environments, to assess and mitigate the risk of orbital debris generation, disposal operations, and orbital debris and meteoroid impacts.
- c. Reviews, monitors, and periodically reports to the Agency on compliance with requirements to limit the generation of orbital debris and safely dispose of spacecraft, payloads, and launch vehicle components by NASA programs and projects.
- d. Adjudicates requests for relief to requirements in this NPR and NASA-STD-8719.14 on behalf of the Administrator or elevates such decisions to the Administrator.
- e. Initiates, in coordination with the relevant offices, notifications of external Agencies concerning significant events and non-compliances.
- f. Assists the Department of Defense and other U.S. Government departments and organizations on matters related to the characterization of the orbital debris environment and the application of orbital debris mitigation measures and policies for NASA space missions.
- g. In coordination with OIIR, promotes the determination, adoption, and use of international orbital debris mitigation guidelines through international forums, such as the Inter-Agency Space Debris Coordination Committee (IADC) and the International Organization for Standardization (ISO).

2.1.2 The Chief, SMA established and maintains the NASA Orbital Debris Program Office and the NASA Meteoroid Environment Office to support the implementation of these responsibilities.

2.1.3 The NASA Orbital Debris Program Office (NASA ODPO):

- a. Develops, maintains, and updates the orbital debris environment models and associated uncertainties to support the Chief, SMA, and programs and projects with the mitigation of orbital debris risk, and compliance with this NPR.
- b. Conducts measurements of the orbital debris environment and conducts other research as needed to support the development of the orbital debris environment models.
- c. Assists NASA mission project managers in technical orbital debris assessments by providing information and completing evaluations of the Orbital Debris Assessment Reports (ODARs) and End of Mission Plans (EOMPs) on behalf of the SMA Technical Authority.
- d. Assists the Department of Defense and other U.S. Government departments and organizations on matters related to the characterization of the orbital debris environment and the application of orbital

debris mitigation measures and policies.

e. Contributes to the determination, adoption, and use of international orbital debris mitigation guidelines through international forums such as the United Nations Committee on the Peaceful Uses of Outer Space, the IADC, and ISO.

2.1.4 The NASA Meteoroid Environment Office (NASA MEO):

a. Provides technical expertise and assistance to NASA mission project managers on behalf of the SMA Technical Authority.

b. Performs and supports research into improved techniques for determination of the meteoroid environment.

c. Develops, validates, and updates meteoroid models and databases (such as the Meteoroid Environment Model, MEM) and makes those software tools available to NASA programs and partners.

d. Collects meteoroid data and information internal and external to NASA for use in environment model improvement and validation and risk and anomaly investigations. The MEO facilitates the collection of this data through the appropriate agreements and distribute subsets upon request.

e. Forecasts meteor shower activity and disseminates these forecasts to U.S. Government spacecraft missions and operators via the MEO Web site or by direct email to interested parties. The MEO also provides, when feasible, custom meteor shower forecasts to programs upon request and provides assistance in assessing the risks posed by meteor showers.

f. Tracks meteor events and updates the U.S. Government and public on the circumstances surrounding these events.

2.2 Center-Level SMA Technical Authority

2.2.1 The Center-Level SMA Technical Authority, as defined in NPR 7120.5, oversees the implementation of requirements in this NPR and applicable standards and ensures the Chief, SMA is informed regarding potential concerns about non-compliances with these documents.

2.3 Mission Directorate Associate Administrator

2.3.1 The MDAA sponsoring the mission is responsible for limiting the risks to the public and space environment associated with NASA missions and NASA-provided hardware to accepted levels.

Note: Responsibilities for the Program Office are those that are delegated from the respective MDAA's.

2.3.2 Accordingly, the MDAA sponsoring the mission:

a. Ensures compliance with this NPR and NASA-STD-8719.14 as part of mission and project formulation and acquisition decisions.

b. Ensures requirements to limit the generation of orbital debris from and safely dispose of spacecraft, payloads, and launch vehicle components are included in relevant program or project documentation.

- c. In coordination with the MDAA responsible for the launch service, requests relief from requirements for launch vehicle non-compliance(s) with orbital debris mitigation requirements.
- d. Requests relief from requirements for spacecraft, payload, or hardware non-compliance(s) with orbital debris mitigation requirements.

2.4 NASA Project Manager

2.4.1 The Project Manager responsible for the mission, spacecraft, payloads, or hardware contributions to other spacecraft:

- a. Ensures that the launch vehicle, spacecraft, payloads, or hardware contributions to other spacecraft comply with this NPR and NASA-STD-8719.14.

Note: Compliance for all secondary payloads (including small payloads such as CubeSats) is the responsibility of the secondary payload's Project Manager. The sponsoring MDAA is responsible for ensuring that the secondary payload's Project Manager is identified.

- b. Provides documented evidence of compliance with orbital debris mitigation requirements and coordinates review and concurrence with the SMA Technical Authority for the Project.
- c. Provides documented commands and passivation procedures to the spacecraft integration organization, (domestic or foreign partner responsible for spacecraft integration and operations), if applicable.
- d. Evaluates the risk of orbital debris and meteoroid impacts to the project's mission objectives using appropriate environment models and failure criteria.

Note: Consult with the MEO and ODPO on the environment models.

- e. Implements operational measures to limit the generation of orbital debris from and safely dispose of the spacecraft.
- f. If the launch vehicle, spacecraft, payloads, or hardware contributions to other spacecraft are not, or not anticipated to be, in compliance with applicable orbital debris mitigation requirements, supports the MDAA responsible for the element in submittal of a waiver (relief from requirement), in coordination with the MDAA sponsoring the mission, if different.
- g. Informs the Conjunction Assessment Risk Analysis (CARA) Team or NASA Human Space Flight Operations Directorate prior to execution of spacecraft maneuvers that will result in a change to their nominal mission orbit, allowing completion of analysis to prevent potential co-location or systematic conjunctions with debris or other on-orbit assets.

2.5 NASA Launch Services Program Manager (LSPM)

2.5.1 The LSPM is responsible for compliance with orbital debris mitigation requirements by the launch vehicles and components provided by LSP. Accordingly, for launch services provided by LSP, the LSPM:

- a. Supports the Project Manager and MDAA to ensure that the launch vehicle, its components, and associated payload adapters comply with this NPR and NASA-STD-8719.14.
- b. Provides documented evidence of compliance with orbital debris mitigation requirements to the Project Manager and MDAA.
- c. If the launch vehicle or launch service is not, or is not anticipated to be, in compliance with applicable orbital debris requirements, supports the submittal of requests for relief from requirements by the Human Exploration and Operations Mission Directorate (HEOMD) AA and the MDAA sponsoring the mission.

2.6 Office of International and Interagency Relations (OIIR)

2.6.1 In the case where there is foreign participation, OIIR, in coordination with the MDAA and OSMA, negotiates with the foreign partner, to establish which party is to be the lead organization for end of mission planning.

2.6.2 The AA/OIIR, following coordination with the Chief, SMA, notifies the Secretary of State of any non-compliance with the USG Orbital Debris Mitigation Standard Practices, as required by the June 2010 National Space Policy.

2.7 NASA Robotic Conjunction Assessment Risk Analysis (CARA) Team

2.7.1 The NASA Robotic CARA Team at the Goddard Space Flight Center (GSFC) maintains liaison with the Department of Defense (DoD) Joint Space Operations Center (JSpOC), the 18th Space Control Squadron (SCS), and the U.S. Air Force Space Command for ensuring the data needed for CARA assessments is provided to NASA and that information regarding upcoming maneuvers is delivered to JSpOC in a timely manner. CARA is the single point of contact to Joint Space Operations Center (JSpOC) and the 18th SCS for all robotic mission Space Situational Awareness (SSA) and conjunction assessment activities, including the submission of Orbital Data Requests for related services.

2.7.2 The CARA team implements conjunction assessment-related requirements on behalf of the Agency for uncrewed missions and ensures the NASA Chief SMA and Chief Engineer are informed regarding concerns about non-compliance with these requirements.

2.7.3 The NASA CARA Team is a mission-funded Agency institutional resource. The NASA CARA Team assists NASA robotic spaceflight project managers in monitoring and identifying potential conjunctions and in developing possible maneuvers to avoid conjunctions.

2.7.4 The CARA Team maintains a process to receive and disposition data and communication requests in a timely manner.

2.7.5 The CARA Team evaluates the relevance, utility, and validity of commercial conjunction assessment tools to the Agency mission and coordinates with the funding Mission Directorate, OCE, and OSMA, to implement them as part of the Agency conjunction assessment process as appropriate.

2.8 NASA Johnson Space Center Human Space Flight Operations Directorate

2.8.1 The NASA Johnson Space Center Human Space Flight Operations Directorate, through the console positions Trajectory Operations Officer (TOPO) and Flight Dynamics Officer (FDO) at the Johnson Space Center, maintains liaison with the DoD JSpOC, the 18th SCS, and the U.S. Space Command to maintain data regarding the International Space Station, Commercial Crew and Exploration vehicle orbital position. TOPO and FDO plan all orbital maneuvers.

2.8.2 TOPO and FDO are maintained by the Human Exploration and Operations Mission Directorate and assists NASA human spaceflight project managers in monitoring and identifying potential conjunctions and developing possible maneuvers to avoid conjunctions. This includes risk assessments of ISS, its associated visiting vehicles with or without crew, and human exploration vehicles with or without crew.

Chapter 3. Requirements

3.1 Mission Formulation

3.1.1 The MDAA shall ensure that program and project documentation, to include proposals and Announcements of Opportunity for future missions, and project agreements incorporate requirements consistent with this NPR.

3.1.2 The MDAA, in coordination with OIIR, and in consultation with the applicable organizations as needed, shall ensure that negotiated agreements for space activities and launch services with governmental, non-governmental, and international organizations specify the lead organization for end of mission planning, conjunction assessment, and standards for the mitigation of orbital debris consistent with the requirements in this NPR or a partner's requirements.

3.1.3 This NPR defines NASA-STD-8719.14 as the applicable standard for the mitigation of orbital debris. Agreements for the delivery of hardware by NASA to another U.S. Government Agency, a U.S. non-governmental organization, or international partner, may include orbital debris standards other than NASA-STD-8719.14 with formal concurrence from the Chief, SMA that such an alternate standard meets the intent of NASA-STD-8719.14.

3.1.4 The MDAA shall define and assign responsibilities for the management of risks of non-compliance with applicable requirements to limit the generation of orbital debris from and safely dispose of objects by the integrated launch vehicle and spacecraft.

3.2 Mission Design and Assessment

3.2.1 The MDAA, in coordination with the Project Manager, shall procure, design, operate, and dispose of spacecraft, payloads, launch vehicles, and adapters and their components in accordance with NASA-STD-8719.14.

3.2.2 The Project Manager shall ensure that the mission and trajectory design minimizes, to the extent practical, the risk of collision with other operational spacecraft during the time period between the end of the launch phase and the point at which the spacecraft is incorporated into the JSpOC satellite catalog specific to its orbital regime.

3.2.3 The Project Manager responsible for the delivery of hardware to a non-NASA spacecraft integrator, including another U.S. Government Agency, a U.S. non-governmental organization, or an international partner, may design such hardware in accordance with an alternate standard if that standard is part of a formal agreement between NASA and the spacecraft integrator and is verified by the Chief, SMA as meeting the intent of NASA-STD-8719.14.

3.2.4 The Project Manager responsible for the integration of a spacecraft shall:

- a. In coordination with the Mission Directorate, distribute and obtain concurrence on an ODAAR covering the integrated spacecraft and launch vehicle in accordance with the schedule in Table A.
- b. In coordination with the Mission Directorate, distribute and obtain concurrence on an EOMP covering the anticipated spacecraft configuration at the end of the spacecraft's mission in accordance with the schedule in Table A.
- c. Establish and implement a plan to evaluate the risks posed by the meteoroid and orbital debris

environment to spacecraft functionality and adopt mitigation approaches where warranted.

3.2.5 For launch services provided by the Launch Services Program or other NASA organizations, the NASA manager responsible for the launch service shall:

- a. Ensure the launch vehicle, its components, and associated payload adapters are procured, designed, operated, and disposed of in accordance with NASA-STD-8719.14.
- b. When launch services are provided to a NASA mission, provide debris assessment information for launch vehicles and associated payload adapters to the NASA Project Manager responsible for the integration of a spacecraft for incorporation into the ODAR.

Note: When launch vehicle data is not available in time to support the Table A delivery schedule, with the concurrence of the Chief, SMA, the launch vehicle portion of the ODAR may be separately submitted at a defined later date.

- c. When launch services are provided to a non-NASA mission, provide debris assessment information for the launch vehicle and associated payload adapter to the Chief, SMA prior to the payload Mission Design Review (or equivalent similar review) obtain concurrence from the Chief, SMA on an ODAR covering the launch vehicle prior to no later than 30-days prior to launch.
- d. Prior to decisions to commit funds to acquire a launch vehicle or launch services, provide notification of potential non-compliances with orbital debris mitigation requirements to the Chief, OSMA and the MDAA sponsoring the mission.

3.2.6 For launch services that are not under NASA's control, per P.2.b, the launch vehicle portion of the mission ODAR should be replaced with a memorandum from the MDAA identifying the governmental or international organization responsible for limiting the generation of orbital debris from and safe disposal of the launch vehicle and its components.

3.2.7 For missions disposing of spacecraft beyond GEO disposal orbits that are not (or will not be) in orbit about another solar system body, the EOMP may be replaced with a memorandum from the MDAA stating the disposal location and conditions, subject to NPR 8020.12.

3.2.8 Project managers, responsible for the delivery of hardware to a non-NASA spacecraft integrator shall:

- a. In coordination with the Mission Directorate, distribute and obtain concurrence on an abbreviated ODAR covering such hardware in accordance with NASA-STD-8719.14 and the schedule in Table A.
- b. In coordination with the Mission Directorate, negotiate the lead organization for end of mission planning. If the lead organization for end of mission planning is a foreign partner, the End of Mission Plan may use the requirements of the foreign partner.
- c. Provide, as part of the hardware delivery to the integrating organization, a version of the abbreviated ODAR that is modified as needed to remove proprietary or otherwise restricted information that cannot be shared with the integrating organization.
- d. Provide documented commands and passivation procedures to the spacecraft integration organization, (domestic or foreign partner responsible for spacecraft integration and operations).
- e. Coordinate with the MDAA, OIIR, and OCE to determine whether that mission will require conjunction assessment screening.

3.2.9 Project managers, responsible for spacecraft that are deployed from the ISS, may limit the ODAR required per paragraph P.2.d and 3.2.4.4 to the spacecraft portion.

3.2.10 Project managers, responsible for spacecraft planned to remain operational during their return to Earth and land essentially intact, whether carrying humans or cargo, including planetary sample return capsules, shall prepare an EOMP for portions of the spacecraft (e.g., a service module) that will be separated prior to reentry. If the separated item(s) will reenter not far from the crew or cargo module (i.e., all surviving debris expected to fall within the protected range), the EOMP may be replaced with a memorandum stating the disposal location and conditions.

3.2.11 Contents and formats for ODARs, abbreviated ODARs, and EOMPs are defined in NASA-STD-8719.14. The Project Manager may use the abbreviated ODAR format to share orbital debris assessment information between projects.

Milestone	Mission Concept Review	Preliminary Design Review (Spacecraft Portion Only)	Mission Critical Design Review	Safety and Mission Success Review⁸	Hardware Delivery	EOMP updates once on orbit and final EOMP
ODAR	OSMA ⁴ MDAA ³	OSMA ⁴ , HEOMD ⁶ , EMD ² , PPO ¹ MDAA ³	OSMA ⁴ , HEOMD ⁶ , EMD ² , PPO ¹ MDAA ³	OSMA ⁴ , HEOMD ⁶ , EMD ² , PPO ¹ MDAA ⁵		
Abbreviated ODAR		OSMA ⁴ , EMD ² , PPO ¹ MDAA ⁵			OSMA ⁴ , EMD ² , PPO ¹ MDAA ⁵	
EOMP ⁷				OSMA ⁴ , HEOMD ⁶ , EMD ² , PPO ¹ MDAA ⁵		OSMA ⁴ , HEOMD ⁶ , EMD ² , PPO ¹ MDAA ⁵

1. NASA Planetary Protection Officer. Distributed for spacecraft traveling to the Moon or another solar system body only. Notification only.
2. Environmental Management Division, Office of Strategic Infrastructure. Distributed for spacecraft reentering into Earth's atmosphere. Notification only.
3. Notification only.
4. OSMA with technical support from ODPO. Concurrence is required. Concurrence indicates that the ODAR or EOMP is considered to be adequate given the project life-cycle phase and that the project is expected to meet requirements or that acceptable mitigations are planned or implemented to address potential non-compliances. Allow 14 days for review and concurrence.
5. Approval is required. For EOMP, MDAA approval is only required for initial, mission extensions, and final submittals.

6. For missions that could pose a risk to humans in space. Notification only.
7. For CubeSat missions that will passively reenter Earth within 25 years with no command from the ground, the ODAR may also serve as the EOMP.
8. The final ODAR and initial/pre-launch EOMP may be combined and submitted as one document for the SMSR.

Table A. Distribution and review schedule for ODARs and EOMPs.

3.3 Mission Operations and Termination

3.3.1 The project manager of spacecraft in orbit around the Earth, Moon, or Mars or in the vicinity of Sun-Earth or Earth-Moon Lagrange Points shall:

- a. Implement operational measures identified in the EOMP to limit the generation of orbital debris from and safely dispose of the spacecraft.
- b. In coordination with the Mission Directorate, establish and implement a plan to monitor spacecraft and launch vehicle stage items defined as critical in the ODAR or EOMP for conditions or events that may affect the planned passivation or disposal maneuvers at EOM.
- c. Update or annotate the EOMP when a spacecraft condition or event occurs that significantly reduces the likelihood of success of planned passivation or disposal maneuvers.
- d. In coordination with the MDAA, revalidate the EOMP as part of a periodic mission review process by the Mission Directorate (e.g., Senior Review process), but no less than once every two years.
- e. In conjunction with any decision to extend the spacecraft mission or change planned procedures for the termination of the mission or decommissioning of space systems, update the EOMP.
- f. In coordination with the Mission Directorate, distribute and obtain concurrence on any update to the EOMP within 60 days of the decision or event necessitating the EOMP update.

Note: If the update is triggered by a mission extension, it must be submitted to the OSMA for review at least 30 days prior to the decision on the mission extension.

3.3.2 The Project Manager responsible for operational Earth-orbiting spacecraft shall ensure that:

- a. CARA services, including Orbital Safety Analysts at JSpOC, are used for robotic missions and NASA Johnson Space Center Human Space Flight Operations Directorate services are used for human spaceflight missions with or without crew.
- b. All maneuvers are planned, screened, and have risk analysis performed prior to execution.
- c. An ephemeris and covariance that models planned maneuvers for Earth-orbiting satellites are provided to CARA or NASA Johnson Space Center Human Space Flight Operations Directorate Team for screening by the JSpOC, as necessary, based on mission orbit and defined in mission documentation.

Note: Ephemeris is a file containing a time-ordered set of position and velocity measurements describing an object's predicted trajectory, including modelling of planned maneuvers.

d. Earth-orbiting missions planning a post-launch change to their mission orbit requirements inform the CARA or NASA Johnson Space Center Human Space Flight Operations Directorate group with sufficient time prior to spacecraft maneuvers for analysis of potential co-location or systematic conjunctions with other on-orbit assets.

Note: Operational missions are defined as those that are being actively operated and have not been determined to be past their mission lifetime through the senior review process.

3.3.3 The Project Manager responsible for a mission that will fly around the Moon or Mars or in the vicinity of Sun-Earth or Earth-Moon Lagrange Points shall ensure that:

a. Ephemeris data is provided to NASA for performing conjunction assessments by uploading ephemeris data to the Deep Space Network (DSN) Service Preparation Subsystem (SPS) Portal.

Note: Ephemeris is a file containing a time-ordered set of position and velocity measurements describing an object's predicted trajectory, including modelling of planned maneuvers.

b. Updated ephemeris is provided to the DSN SPS as soon as practical, after a planned maneuver is or is not executed, to allow other spacecraft operators to evaluate conjunction assessments based on the most accurate data possible.

c. Missions requiring trajectory plan changes provide updated trajectories to the DSN SPS Portal with sufficient time prior to spacecraft maneuvers for analysis of potential co-location or systematic conjunctions with other on-orbit assets.

Note: Trajectory plan changes are any adjustments to orbit parameters or the trajectory occurring between launch and end of mission.

d. Conjunction assessments are performed based on the database of trajectory data supplied to the Deep Space Network (DSN) Service Preparation Subsystem (SPS) Portal.

e. A plan for addressing identified conjunctions is submitted to CARA or the Human Space Flight Operation Directorate (CARA or the Human Space Flight Operation Directorate will communicate to all appropriate HQ organizations).

3.3.4 The Project Manager of spacecraft in orbit, in coordination with the sponsoring MDAA, shall promptly notify the Chief, SMA:

a. Upon discovering the spacecraft may have generated orbital debris;

b. At least 48 hours before jettisoning an object or otherwise undertaking an activity that may generate orbital debris;

c. When the spacecraft is within six months of planned EOM;

d. When the propellant remaining onboard the spacecraft stage falls below the quantity required to sustain operations for six months and then perform the planned disposal maneuvers (with sufficient margin to ensure a high probability of successfully performing the disposal maneuver).

- e. When a spacecraft loses a redundancy or other key functionality resulting in an inability or significant reduction of the likelihood of a successful disposal maneuver as defined in the EOMP.
- f. When the Mission Directorate intends to change plans for mission termination or space system decommissioning.

3.3.5 The project manager of spacecraft in orbit around the Earth, in coordination with the sponsoring MDAA, shall promptly inform the Department of Defense's JSpOC prior to planned spacecraft and launch vehicle disposal or evasive maneuvers that result in a change of Earth orbit altitude of greater than 1 km. Notifications are made through the CARA team for unmanned missions or NASA Johnson Space Center Human Space Flight Operations Directorate for manned missions.

3.3.6 The Project Manager, in coordination with the sponsoring MDAA, shall provide the final EOMP to the Chief, SMA with the notification of intent to terminate the mission required by NPD 8010.3.

3.3.7 For operational missions already on-orbit, relief from requirements in NASA-STD-8719.14 is not required for non-compliances caused by design issues that existed prior to launch, changes in the estimated orbital debris environment, or spacecraft anomalies or failures. In contrast, relief from the requirements is required for non-compliances that would be the result of planned operational changes or planned mission life extensions.

3.3.8 NASA payloads and components, jettisoned from the ISS, will comply with ISS Partner Program Directive (PPD) 1011, Multilateral Jettison Policy, in addition to this NPR.

3.4 Reentries

3.4.1 For controlled, commanded, or targeted reentries, the Project Manager shall notify the MDAA, the Chief SMA, and the ODPO about the reentry at least three months prior to reentry.

3.4.2 To augment existing national procedures where the U.S. Department of Defense alerts Government agencies to the impending reentry of NASA-related space objects, the AA/OIIR may, in consultation with the program's MDAA, Chief, SMA, Office of Communications, and the Office of the General Counsel, coordinate amplifying information with other U.S. Government agencies.

3.4.3 AA/OIIR coordinates any NASA press releases for reentries with the Office of Communications, Office of the General Counsel, OSMA, the National Security Council, and the Office of Science and Technology Policy, United States Strategic Command (USSTRATCOM) (via Department of Defense Public Affairs), and the U.S. Department of Homeland Security, as needed.

Appendix A. Acronyms

AA/HEOMD	Associate Administrator, Human Exploration and Operations Mission Directorate
AA/OIIR	Associate Administrator, Office of International and Interagency Relations
ASM	Acquisition Strategy Meeting
CARA	Conjunction Assessment Risk Analysis
CDR	Critical Design Review
DoD	Department of Defense
DOT	Department of Transportation
DSN	Deep Space Network
EMD	Environmental Management Division
EOM	End-of-Mission
EOMP	EOM Plan
FAA	Federal Aviation Administration
FDO	Flight Dynamics Officer
GEO	Geosynchronous Earth Orbit
GSFC	Goddard Space Flight Center
HEOMD	Human Exploration and Operations Mission Directorate
IADC	Inter-Agency Space Debris Coordination Committee
ISO	International Organization for Standardization
ISS	International Space Station
ITAR	International Traffic in Arms Regulations
JSpOC	Joint Space Operations Center
KSC	Kennedy Space Center
LSPM	Launch Services Program Manager
MADCAP	Multi-mission Automated Deepspace Conjunction Assessment Process
MDAA	Mission Directorate Associate Administrator
MEM	Meteoroid Environment Model
MEO	Meteoroid Environment Office

NASA-STD	NASA Standard
NHBK	NASA Handbook
NPD	NASA Policy Directive
NPR	NASA Procedural Requirements
NSS	NASA Safety Standard
ODA	Orbital Debris Assessment
ODAR	ODA Report
ODPO	NASA Orbital Debris Program Office
OIIR	Office of International and Interagency Relations
OSMA	Office of Safety and Mission Assurance
PDR	Preliminary Design Review
PPD	Partner Program Directive
PPO	Planetary Protection Officer
SCS	Space Control Squadron
SMA	Safety and Mission Assurance
SMSR	Safety and Mission Success Review
SPS	Service Preparation Subsystem
SSA	Space Situational Awareness
TOPO	Trajectory Operations Officer
USG	United States Government
USSTRATCOM	United States Strategic Command

Appendix B. References

- B.1 National Environmental Protection Act, 42 U.S.C. § 4321 et seq. as amended.
- B.2 NPD 1000.0, NASA Governance and Strategic Management Handbook.
- B.3 NPD 8010.3, Notification of Intent to Decommission or Terminate Operating Space Systems and Terminate Missions.
- B.4 NPD 8020.7, Biological Contamination Control for Outbound and Inbound Planetary Spacecraft.
- B.5 NPR 7120.5, NASA Space Flight Program and Project Management Requirements.
- B.6 NPR 7123.1, NASA Systems Engineering Processes and Requirements.
- B.7 NPR 8020.12, Planetary Protection Provisions for Robotic Extraterrestrial Missions.
- B.8 NPR 8705.6, Safety and Mission Assurance Audits, Reviews, and Assessments.
- B.9 NPR 8715.3, NASA General Safety Program Requirements.
- B.10 NSS 1740.14, Guidelines and Assessment Procedures for Limiting Orbital Debris.
- B.11 NASA Handbook 8719.14, Handbook for Limiting Orbital Debris.
- B.12 Technical Report on Space Debris, Scientific and Technical Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space, A/AC.105/720, 1999.
- B.13 International Space Station (ISS) Partner Program Directive (PPD) 1011, Multilateral Jettison Policy.
- B.14 Memorandum of Agreement (MOA) Between the Department Of Defense (DoD) and the National Aeronautics And Space Administration (NASA) For DoD Support To NASA Spaceflight Operations, 15 Mar 2005.