NASA Procedural Requirements

NPR 8715.6A
Effective Date: May 14, 2009
Expiration Date: July 14, 2016

COMPLIANCE IS MANDATORY

NASA Procedural Requirements for Limiting Orbital Debris (w/ Change 1 - 5/14/09)

Responsible Office: Office of Safety and Mission Assurance

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Ch#	Office	Date	Description
1	Chief, Safety and Mission Assurance	05/14/2009	Replace new paragraphs to P.1.4, P.1.5, P.1.6, P.2.4.a, P.2.4.b, P.2.4.e, P.4.1, P.6, 1.1.4, 1.3.2.1, move paragraph 1.3.93 to become 1.3.10.4, replace new paragraph to 1.3.14.1, 2.1.2, 2.1.4.a, 2.1.5.b, 2.2.1.4, 2.2.1.6 thru 2.2.1.9, 2.2.2.1, 2.2.2.5, 2.2.27, 2.2.2.8, 2.2.4.2, 2.2.4.3, 2.2.4.5, 3.1.3, 3.2.8.b, 3.3.1.2, 3.3.3.5, 3.3.3.6, 3.4.1, 3.5.1, Delete Applied Physics Laboratory from P.2.1. , delete "or launch vehicle states are" from para. 2.2.2.6, delete "in the Cheyenne Mountain Operations Center" from para. 3.2.10 Adding a Note after paragraph P.2.2, 3.3.15, 3.3.3.1, 3.3.3.4 and adding abbreviations to Appendix B. Change "SMA to SMSR in para. 2.2.2.9

Preface

P.1 Purpose

P.1.1 The purpose of this NASA Procedural Requirements (NPR) is to provide requirements to implement NASA's policy for limiting orbital debris generation per the U.S. National Space Policy of 2006, Section 11, the U.S. Government Orbital Debris Mitigation Standard Practices, and as a part of NASA's policy for safety and mission assurance programs as defined in NASA Policy Directive (NPD) 8700.1, paragraph 1a. Any noncompliances to orbital debris requirements, including those for reasons of mission requirements and cost effectiveness, require a variance to this NPR.

P.1.2 The U.S. National Space Policy of 2006, Section 11, states:

"Orbital debris poses a risk to continued reliable use of space-based services and operations and to the safety of persons and property in space and on Earth. The United States shall seek to minimize the creation of orbital debris by government and non-government operations in space in order to preserve the space environment for future generations. Toward that end:
- Departments and agencies shall 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 operation or tests and experiments in space;
- The Secretaries of Commerce and Transportation, in coordination with the Chairman of the Federal Communications Commission, shall continue to address orbital debris issues through their respective licensing procedures; and
- The United States shall take a leadership role in international fora to encourage foreign nations and international organizations to adopt policies and practices aimed at debris minimization and shall cooperate in the exchange of information on debris research and the identification of improved debris mitigation practices."

P.1.3 The U.S. Government Orbital Debris Mitigation Standard Practices provides guidance on what areas to include in an orbital debris program.

P.1.4 NPD 8700.1, NASA Policy for Safety and Mission Success, addresses the inclusion of Safety and Mission Assurance (SMA) as an integral part of every NASA program and project to protect the public, NASA workforce, high-value equipment and property, and the environment. Orbital debris is stated as one of the SMA disciplines to be included.

P.1.5 This NPR specifies how to implement requirements and responsibilities for limiting orbital debris as a part of the NASA program/project and NASA SMA activities, including requirements on orbital debris assessments (ODA), reporting, and engineering processes. Those requirements and responsibilities for limiting orbital debris which are solely the responsibility of NASA personnel are defined in this NPR. As companions to this NPR, NASA Safety Standard (NSS) 1740.14, Guidelines and Assessment Procedures for Limiting Orbital Debris; NASA Standard (NASA-STD) 8719.14, Process for Limiting Orbital Debris; and NASA-Handbook (NHBK) 8719.14, Handbook for Limiting Orbital Debris, provide details on orbital debris assessments (ODA), reporting, and engineering processes needed for limiting orbital debris.

P.1.6 This NPR, the associated NSS 1740.14, NASA-STD 8719.14, and NHBK 8719.14 are the NASA implementation of the applicable documents listed in paragraph P.4. Full implementation and compliance with this document will ensure NASA compliance with the applicable documents in paragraph P.4, to the extent cited in this NPR.

P.1.7 This NPR shall not be construed as conferring upon any international body, agency, or committee the right to place upon the U. S. Government or NASA any restrictions or conditions as to its space operations unless required by separate agreement or treaty.

P.2 Applicability

P.2.1 This NPR is applicable to NASA Headquarters and Centers, including Component Facilities; the Jet Propulsion Laboratory, a Federally Funded Research and Development Center, and other NASA contractors and grantees as specified in their contracts or grants; and to other organizations (i.e., commercial partners, other Federal agencies, educational institutions, international parties, and tenants on Centers) as specified and described in written operating agreements.

P.2.2 This NPR is applicable to all objects launched into space in which NASA has lead involvement and control or has partial involvement with control over design or operations via U.S. internal or international partnership agreements, including the launch vehicle. This document has no automatic exclusions for any program or project due to limited funding, responsibility, or involvement of NASA in the program or project. NASA involvement includes design, manufacture, or funding of instruments, spacecraft bus, spacecraft systems, and the launch vehicle and includes launch processing. Additionally, this NPR only applies to objects which exceed 100km (~62mi) in altitude and achieve or exceed Earth orbital velocity.

Note: It is recognized that NASA has no involvement or control in the design or operation of Federal Aviation Administration (FAA)-licensed launches or foreign or Department of Defense (DoD)-furnished launch services, and, therefore, these are not

subject to the requirements in this NPR for the launch portion. This currently applies to Commercial Orbital Transportation Services (COTS), International Space Station (ISS) Commercial Resupply Services (CRS), and some NASA payloads for which unique launch services have been or plan to be acquired; e.g., Geostationary Operational Environmental Satellite (GOES-O), James Webb Space Telescope (JWST), and Lunar Atmosphere and Dust Environment Explorer (LADEE). Such launches are under the authority of other Federal agencies (FAA or DoD) or foreign governments for direction and compliance of applicable orbital debris requirements. The payloads of such missions; e.g., COTS and CRS orbital vehicles and GOES-O, JWST, and LADEE spacecraft, that have a NASA involvement in the design and operation, are subject to the requirements of this document and process. It is intended that COTS and CRS launch vehicle stages or spacecraft carrying NASA cargo, that will be in the proximity of the ISS or could leave debris near ISS orbit, would be reviewed per the requirements in this document as a part of the approval process to approach the ISS.

P.2.3 A requirement is identified by the word "shall." The word "may" is used to denote permission.

P.2.4 The following subparagraphs (a-e below) limit the scope of this NPR:

a. NASA spacecraft, launch vehicles, and instruments that passed Preliminary Design Review (PDR) prior to August 1995 (release of NSS 1740.14, Guidelines and Assessment Procedures for Limiting Orbital Debris) are not required to perform an ODA unless a large change in design, as determined by the SMA Technical Authority, or changes in space object capability or risk affect the ability to achieve compliance with the requirements. If one or more of these conditions occur, an ODA Report (ODAR) shall be performed (Requirement 57283).

b. Programs/projects that passed mission PDR, as of November 1, 2007, may elect to follow the mission and hardware design and operation requirements of this NPR and the procedures in either NSS 1740.14 or NASA-STD 8719.14 for ODARs.

Note: For future changes to this NPR and its companion NASA Standard, programs may request a waiver to the new requirements per NPR 8715.3, paragraph 1.13.

Note: Programs using the NSS 1740.14 may continue to use Chapter 8 for the ODAR format or use the format in NASA-STD 8719.14 Appendix A. The format in NASA-STD 8719.14 is preferred.

c. Programs that launched prior to December 31, 2007, are not required to submit the prelaunch End-of-Mission (EOM) Plans (EOMP), but are required to submit an EOMP for operational portions of the mission.

Note: Programs using NSS 1740.14 may either submit a full ODAR, per NSS 1740.14 Chapter 8.2, or the format specified in NASA-STD 8719.14 Appendix B. The format in NASA-STD 8719.14 is preferred.

d. Programs with EOM prior to December 31, 2007, are not required to submit an EOMP; however, it is desirable to develop an EOMP in conjunction with performing the requirements contained in NPD 8010.3, Notification of Intent to Decommission or Terminate Operating Space Systems and Terminate Missions.

e. All applicable programs/projects not listed in paragraphs P.2.4.a through P.2.4.d shall use NASA-STD 8719.14 (Requirement 57290).

P.2.5 While this NPR has no automatic exclusions for any spaceflight program or project, it is recognized that the current state of spacecraft and launch vehicles precludes total compliance. For noncompliances, the spaceflight program or project shall assess the overall cost and technical impacts as described in paragraph 2.2.4 of this NPR to justify the noncompliance (Requirement 57291).

Note: The process for requesting and granting of waivers and/or exceptions to the requirements in this NPR, NSS 1740.14, and NASA-STD 8719.14 is defined in NPR 8715.3, paragraph 1.13.

Note: The clause in the U.S. National Space Policy of 2010, Section 11, which states "consistent with mission requirements and cost effectiveness" will be used in adjudication of requests for relief from the requirement in this NPR when specified by the program's rationale for the waiver/exception.

P.2.6 Orbital debris requirements for space vehicles and spacecraft while operating beyond Earth orbit are identified within this NPR.

P.2.7 NASA-STD 8719.14 applies to system developers at NASA and shall be applied to system developers under contract to NASA for all space-related mission portions being developed by NASA unless paragraph P.2.4 permits use of NSS 1740.14.

P.3 Authority

a. 42 U.S.C. S 2473 (c)(1), Section 203 (c)(1) of the National Aeronautics and Space Act of 1958, as amended.

b. U.S. National Space Policy, August 31, 2006.

c. NPD 8700.1, NASA Policy for Safety and Mission Success.

P.4 Applicable Documents

a. U.S. Government Orbital Debris Mitigation Standard Practices, February 2001.

b. NPD 8010.3, Notification of Intent to Decommission or Terminate Operating Space Systems and Terminate Missions.

c. NPD 8020.7, Biological Contamination Control for Outbound and Inbound Planetary Spacecraft.

d. NPR 7120.5, NASA Space Flight Program and Project Management Requirements.

e. NPR 8000.4, Risk Management Procedural Requirements.

f. NPR 8020.12, Planetary Protection Provisions for Robotic Extraterrestrial Missions.

g. NPR 8705.5, Probabilistic Risk Assessment (PRA) Procedures for NASA Programs and Projects.

h. NPR 8705.6, Safety and Mission Assurance Audits, Reviews, and Assessments.

i. NPR 8715.3, NASA General Safety Program Requirements.

j. NSS 1740.14, Guidelines and Assessment Procedures for Limiting Orbital Debris.

k. NASA Standard (NASA-STD) 8719.14, Process for Limiting Orbital Debris.

l. NASA Handbook 8719.14, Handbook for Limiting Orbital Debris.

2. 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. http://www.unoosa.org/oosa/natact/sdnps/sd_nps_docsidx.html

m. IADC-02-01, Space Debris Mitigation Guidelines, Inter-Agency Space Debris Coordination Committee, October 15, 2002. http://www.iadc-online.org/index.cgi?item=docs_pub

P.5 Measurement/Verification

Compliance with the requirements contained in this NPR will be verified through processes contained in NPR 8705.6, Safety and Mission Assurance Audits, Reviews, and Assessments.

P.6 Cancellation

NPR 8715.6, NASA Procedural Requirements for Limiting Orbital Debris, dated August 17, 2007.

/S/

Bryan O'Connor

Chief, Safety and Mission Assurance

Chapter 1. General Information

1.1 Objectives of Limiting Orbital Debris

1.1.1 The objective of the NASA Orbital Debris Program is to limit the generation of debris in Earth orbit. Debris can damage spacecraft, provide a source for false scientific readings, and become a hazard to people and property on the ground. The United Nations, the Inter-Agency Space Debris Coordination Committee (IADC), and the International Organization for Standardization (ISO) have repeatedly asserted that all spacefaring nations should endeavor to limit the generation of debris in orbit.

1.1.2 In addition to limiting generation of debris in all Earth orbits, NASA also desires to limit the generation of debris in other space locations where future spacecraft may travel. All missions leaving 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.

1.1.3 Compliance with this NPR meets the guidelines and intent of the following documents (as of the date of this NPR): the U.S. Government Orbital Debris Mitigation Standard Practices and the IADC-0201, Space Debris Mitigation Guidelines.

1.1.4 This NPR requires each program and project to conduct formal assessments and plans for the disposition of spacecraft anticipated to reach the orbit or the surface of the Moon.

1.2 Description of Orbital Debris

1.2.1 Orbital debris is defined as any object placed in space (see P.2.2) by humans that remains in orbit and no longer serves any useful function or purpose. Objects range from spacecraft to spent launch vehicle stages to components and also include materials, trash, refuse, fragments, or other objects which are overtly or inadvertently cast off or generated.

1.2.2 Reusable vehicles are not considered as orbital debris in this NPR.

1.3 Roles and Responsibilities

1.3.1 Chief, Safety and Mission Assurance, Office of Safety and Mission Assurance (Chief/OSMA)

1.3.1.1 The Chief/OSMA shall lead the NASA Orbital Debris Program (Requirement 56733).

1.3.1.2 The Chief/OSMA shall establish requirements for limiting NASA's orbital debris generation from spacecraft, payloads, and launch vehicle components (Requirement 56734).

1.3.1.3 The Chief/OSMA shall establish policies for the safe disposal of NASA's spacecraft, payloads, and launch vehicle components during all phases of space missions (Requirement 56735).

1.3.1.4 The Chief/OSMA shall provide requirements and assessment procedures for orbital debris generation potential and associated risks (Requirement 56736).

1.3.1.5 The Chief/OSMA shall provide, or make available, software tools, models, and their associated data bases to aid programs in orbital debris risk analysis and evaluation of mitigation options (Requirement 56737).

1.3.1.6 The Chief/OSMA shall review all ODARs and all EOMPs (as defined in Chapter 2) to determine compliance with requirements and to review the level of associated risk (Requirement 56738).

1.3.1.7 The Chief/OSMA shall promote the adoption and use of international orbital debris mitigation guidelines through international forums, such as the IADC and the ISO (Requirement 56739).

1.3.2 Program's Mission Directorate Associate Administrator (MDAA)

1.3.2.1 The MDAA shall be the NASA official accepting the orbital debris risk as determined by the SMA Technical Authority due to noncompliances to this NPR and NSS 1740.14 or NASA-STD 8719.14 as documented in the ODAR and EOMP (Requirement 56741).

1.3.2.2 The MDAA shall ensure that a mission orbital debris assessment has been conducted in accordance with NSS 1740.14 or NASA-STD 8719.14, as applicable per paragraph P.2.4, to determine the potential for orbital debris generation from the launch vehicle and the payload (Requirement 57296).

1.3.2.3 The MDAA shall ensure that orbital debris mitigation measures identified in the ODAR are implemented and included in the EOMP (Requirement 56743).

1.3.2.4 The MDAA shall ensure that a formal review of the potential to generate orbital debris is conducted before implementing the EOMP (Requirement 56744).

1.3.2.5 The program's MDAA shall provide to the Chief/OSMA, for Chief/OSMA concurrence, a phase-in plan and schedule for either development of new EOMPs, modification of existing EOMPs, or grandfathering of existing EOMPs within four months of the approval of this NPR (Requirement 56745).

1.3.2.6 The MDAA shall ensure that the orbital debris requirements of this NPR are included as an integral part of their program/project, to include proposals and Announcements of Opportunity for future missions (Requirement 56746).

1.3.3 Associate Administrator, Space Operations Mission Directorate (AA/SOMD)

1.3.3.1 The AA/SOMD shall review ODARs and EOMPs, in conjunction with the responsible MDAA(s), that are associated with missions that could pose a risk to humans in space (Requirement 56748).

1.3.4 Associate Administrator, Exploration Systems Mission Directorate (AA/ESMD)

1.3.4.1 The AA/ESMD shall review ODARs and EOMPs, in conjunction with the responsible MDAA(s), to determine if each ESMD-procured/controlled launch vehicle is in compliance with Agency orbital debris policy and standards (Requirement 56750).

1.3.4.2 The AA/ESMD shall incorporate the requirements of this NPR and NSS 1740.14 or NASA-STD 8719.14, as applicable per paragraph P.2.4, into the development of new launch and space transportation vehicles (Requirement 57297).

1.3.5 Assistant Administrator, Office of External Relations (AA/OER)

1.3.5.1 The AA/OER shall endeavor to incorporate the NASA debris mitigation defined in this NPR and NSS 1740.14 or NASA-STD 8719.14, as applicable per paragraph P.2.4, in negotiated international agreements for space activities and launch services (Requirement 57298).

1.3.5.2 To augment existing national procedures where the U.S. Department of Defense alerts Government agencies to the impending reentry of NASA-related space objects (See section P.2.2), the AA/OER shall, in consultation with the program's MDAA, Chief/OSMA, Office of Public Affairs, and the Office of the General Counsel, coordinate amplifying information with other U.S. Government agencies (Requirement 56754).

1.3.5.3 The AA/OER shall coordinate all NASA pre-reentry press releases for reentries with the Office of the General Counsel, the National Security Council, and the Office of Science and Technology Policy (Requirement 56755).

1.3.5.4 The AA/OER shall review and provide comments on ODARs and EOMPs as required in paragraphs 2.2.1.5 and 2.2.2.6 (Requirement 56756).

1.3.6 Assistant Administrator, Office of Public Affairs

1.3.6.1 The Office of Public Affairs shall coordinate all NASA pre-reentry press releases with the United States Strategic Command (USSTRATCOM) (via Department of Defense Public Affairs), the Chief/OSMA, the NASA AA/OER, the Office of the General Counsel, and the U.S. Department of Homeland Security, as needed (Requirement 56758).

1.3.7 NASA Office of the General Counsel

1.3.7.1 The NASA Office of the General Counsel shall review and provide comments on ODARs and EOMPs as required in paragraph 2.2.1.5 and 2.2.2.6 (Requirement 56760).

1.3.7.2 The NASA Office of the General Counsel shall consider conducting a liability assessment upon learning of an impending Earth impact into a populated area (Requirement 56761).

1.3.7.3 The NASA Office of the General Counsel shall review pre-entry press releases as required in 1.3.5.3 and 1.3.6.1 (Requirement 56762)..

1.3.8 NASA Headquarters Environmental Management Division

1.3.8.1 The NASA Headquarters Environmental Management Division shall review and provide comments on ODARs and EOMPs as required in paragraphs 2.2.1.5 and 2.2.2.6 (Requirement 56763).

1.3.9 John F. Kennedy Space Center Launch Services Program Manager (KSC/LSPM)

1.3.9.1 The KSC/LSPM shall incorporate program orbital debris requirements in launch service and launch operations planning activities and contracts unless a request for relief to the requirements has been granted per NPR 8715.3, paragraph 1.13 (Requirement 56765).

1.3.9.2 The KSC/LSPM shall provide debris assessment information for launch vehicles (and associated payload adapters) to the NASA spacecraft Program/Project Manager for integration into the mission ODAR (Requirement 56766).

1.3.10 NASA Center SMA Directors

1.3.10.1 NASA Center SMA Directors shall ensure spacecraft and launch vehicle program/project personnel incorporate applicable NASA orbital debris policies and requirements into their programs/projects (Requirement 56769).

1.3.10.2 NASA Center SMA Directors shall provide assistance to the program/project by reviewing and providing comments to ODARs and EOMPs to assist in determining compliance with this NPR and NSS 1740.14 or NASA-STD 8719.14, as applicable per paragraph P.2.4, (Requirement 57299).

1.3.10.3 NASA Center SMA Directors shall ensure that orbital debris requirements are reviewed at each major Program/Project review such as the spacecraft or mission PDR, the Critical Design Review (CDR), and other Key Decision Points (KDP) as defined in NPR 7120.5 (Requirement 56771).

1.3.10.4 For launches under NASA management occurring outside of KSC/LSPM control, the NASA manager for the launch shall perform the requirements in paragraphs 1.3.9.1 and 1.3.9.2 (Requirement 56767).

1.3.11 NASA Orbital Debris Program Office (NASA ODPO)

1.3.11.1 The NASA ODPO shall maintain a list of predicted reentry dates for NASA spacecraft and their associated orbital stages and notify the OSMA at least 60 days prior to their reentry (Requirement 56773).

1.3.11.2 The NASA ODPO shall develop, maintain, and update the orbital debris environment models to support this NPR (Requirement 56774).

1.3.11.3 The NASA ODPO shall assist NASA mission program/project managers in technical orbital debris assessments by providing information and/or directing queries to the knowledgeable technical staff (Requirement 56775).

1.3.11.4 The NASA ODPO shall provide assistance to 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 (Requirement 56776).

1.3.11.5 The NASA ODPO shall participate in 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 the ISO (Requirement 56777).

1.3.12 SMA Technical Authority

1.3.12.1 The SMA Technical Authority shall determine the risk associated with any noncompliances to this NPR as documented in the ODAR (Requirement 56779).

1.3.12.2 The SMA Technical Authority shall provide a written determination of the risk associated with any noncompliances to this NPR as contained in the ODAR to the Program MDAA prior to launch and within 30 days of receipt (Requirement 56780).

1.3.12.3 The SMA Technical Authority shall determine the risk associated with any noncompliances to this NPR as documented in the EOMP (Requirement 56781).

1.3.12.4 The SMA Technical Authority shall provide a written determination of the risk associated with any noncompliances to this NPR as contained in the EOMP to the Program MDAA prior to implementation of the EOMP and within 30 days of receipt (Requirement 56782).

1.3.12.5 The SMA Technical Authority shall use the techniques and methods required in NPR 8000.4, Risk Management Procedural Requirements, and NPR 8705.5, Probabilistic Risk Assessment (PRA) Procedures for NASA Programs and Projects, for providing risk assessments (Requirement 56783).

1.3.12.6 The SMA Technical Authority shall establish and implement a mechanism for soliciting, receiving, and dispositioning comments and resolving issues prior to the formal issuance of NASA-STD 8719.14 and any of its revisions (or the creation of any successor documents), such that proposed changes are appropriately staffed through and issues resolved with all affected Programs at

NASA Headquarters and Centers (Requirement 56784).

1.3.13 NASA Program/Project Manager

1.3.13.1 The NASA Program/Project Manager shall establish an orbital debris mitigation activity as a part of every spaceflight program/project as defined by paragraph P.2.2 (Requirement 56786).

1.3.13.2 The NASA Program/Project Manager shall provide copies of any plans describing generation of orbital debris to the SMA Technical Authority for review (Requirement 56787).

1.3.14 NASA Planetary Protection Officer (NASA PPO)

Note: See NPR 8020.12, Planetary Protection Provisions for Robotic Extraterrestrial Missions, for NASA policy and requirements for the role of the NASA PPO.

1.3.14.1 The NASA PPO shall review and concur in the final ODAR and EOMP for disposition of spacecraft on a solar system body other than the Earth (Requirement 56790).

Chapter 2. Program/Project Development and Prelaunch Preparations

2.1 Orbital Debris Program Setup and Control

2.1.1 The NASA Program/Project Manager shall implement orbital debris requirements for those portions of a spaceflight program/project over which NASA has control as defined by paragraph P.2.2 (Requirement 56793).

2.1.2 The NASA Program/Project Manager shall include the applicable design requirements stated in NASA-STD 8719.14 or NSS 1740.14, as applicable per paragraph P.2.4, in the program/project requirements unless a request for relief from the requirements has been granted per NPR 8715.3, paragraph 1.13 (Requirement 56794).

2.1.3 The NASA Program/Project Manager and the contracting officer for the program/project shall include requirements in this NPR in agreements and contracts necessary to ensure compliance with this NPR unless a request for relief to the requirements has been granted per NPR 8715.3, paragraph 1.13 (Requirement 56795).

2.1.4 When a spacecraft is jointly developed/built/managed by multiple NASA Centers/facilities using NASA-STD 8719.14, the Program/Project Manager at each NASA Center/facility shall deliver an abbreviated ODAR per NASA-STD 8719.14, Appendix A, Section A.3, as a part of the hardware delivery to the program/project integrator covering those spacecraft portions under their control (Requirement 57300).

2.1.4.a When a spacecraft is jointly developed/built/managed by multiple NASA Centers/facilities using NSS 1740.14, the Program/Project Manager at each NASA Center/facility shall deliver either a full ODAR per NASA-STD 8719.14 Appendix A, Section A.1 (or NSS 1740.14 as applicable per paragraph P.2.4 above), or an abbreviated ODAR per NASA-STD 8719.14, Appendix A, Section A.3, as a part of the hardware delivery to the program/project integrator covering those spacecraft portions under their control (Requirement 57301).

2.1.5 When a spacecraft is jointly developed/built by multiple organizations where NASA is using NASA-STD 8719.14, and NASA is not the launching or lead Agency, the NASA Program/Project Manager shall provide an abbreviated ODAR to the non-NASA launching or lead Agency per NASA-STD 8719.14, Appendix A, Section A.3, as a part of the delivery of the hardware data package covering only those spacecraft portions being developed/integrated by the NASA organization as permitted by International Traffic in Arms (ITAR) and other data restrictions (Requirement 57302).

2.1.5.a When a spacecraft is jointly developed/built by multiple organizations where NASA is using NSS 1740.14, and NASA is not the launching or lead Agency, the NASA Program/Project Manager shall provide either a full ODAR per NSS 1740.14 Chapter 8 or an abbreviated ODAR per NASA-STD 8719.14, Appendix A, Section A.3, to the non-NASA launching or lead Agency as a part of the delivery of the hardware data package covering only those spacecraft portions being developed/integrated by the NASA organization as permitted by International Traffic in Arms Regulations (ITAR) and other data restrictions (Requirement 57303).

Note: This NPR does not specify how the non-NASA lead Agency uses the provided ODAR or what orbital debris requirements apply. The delivery of an abbreviated ODAR

is intended to assist the lead Agency in meeting their local, national, or international orbital debris requirements. Note: Processing of ITAR and other restricted data/information generated or handled by personnel who are not civil service personnel (i.e., Jet Propulsion Laboratory, Applied Physics Laboratory) should be reviewed with the NASA contract manager prior to shipment outside of NASA.

2.1.5.b When a space launch is jointly developed/built by multiple organizations where NASA is only providing launch services, the NASA Program/Project Manager shall provide a final ODAR including only those sections addressing the launch vehicle per NASA-STD 8719.14, Appendix A to the Chief/OSMA 30 days prior to the SMSR review and shall get MDAA concurrence (Requirement). Other ODAR and EOMP versions are not required.

2.1.6 When a spacecraft is jointly developed/built by multiple organizations outside of the United States or is restricted by national defense or corporate proprietary restrictions, and the ODAR contains material restricted by export control laws and regulations, the ODAR material delivered to the NASA ODPO needs to contain all ITAR/restricted information in addition to the "filtered" ODAR being provided to organizations outside of the United States by NASA.

2.1.7 The NASA Program/Project Manager shall include a review of the orbital debris requirements derived from this NPR and NSS 1740.14 or NASA-STD 8719.14, as applicable per paragraph P.2.4, as a part of the program/project System Requirements Review (or equivalent early review) (Requirement 57306).

2.2 Orbital Debris Risk Assessments

2.2.1 Orbital Debris Assessment Report (ODAR)

2.2.1.1 The NASA Program/Project Managers shall assess the mission for compliance with this NPR and NSS 1740.14 or NASA-STD 8719.14, as applicable per paragraph P.2.4, for generation of orbital debris during all mission phases (Requirement 57307).

2.2.1.2 The NASA Program/Project Managers shall prepare and deliver the mission orbital debris assessments to the MDAA in an ODAR per the format and content defined in NSS 1740.14 or NASA-STD 8719.14, as applicable per paragraph P.2.4, for all objects being launched as defined in paragraph P.2.2 (Requirement 57308).

2.2.1.3 The MDAA shall submit each draft/final ODAR to the Chief/OSMA and AA/SOMD (for missions that could pose a risk to humans in space) for review (Requirement 56806).

2.2.1.4 The PDR and CDR versions of the ODAR may be submitted in electronic (preferred) or paper format. The final ODAR shall be submitted in paper and electronic formats (Requirement).

2.2.1.5 If orbital debris is assessed to impact the Earth's surface within 25 years, copies of the updated and final ODAR shall be submitted by the MDAA to the NASA Headquarters Environmental Management Division, the AA/OER, and the Office of the General Counsel (Requirement 56808).

2.2.1.6 The cognizant MDAA shall approve the final ODAR after review and signed concurrence by Chief/OSMA and SOMD (for missions that could pose a risk to humans in space) and, if required, the offices listed in paragraph 2.2.1.5 of this NPR (Requirement 56809).

2.2.1.7 The Program/Project Manager shall submit the initial mission ODAR prior to the mission PDR or equivalent NASA program or project milestone (Requirement 56810).

2.2.1.8 The Program/Project Manager shall submit the updated mission ODAR no later than 45 days prior to the mission CDR or equivalent NASA program or project milestone (Requirement 56811).

2.2.1.9 The Program/Project Manager shall submit the final mission ODAR no later than 30 days prior to the opening of the launch window or 30 days prior to the NASA Safety and Mission Success Review (SMSR) described in NPR 8705.6, whichever comes first (Requirement 56812).

2.2.1.10 ODA analyses and discussions are not needed, and may be replaced with a placeholder explanatory text, for mission portions which occur beyond Earth orbit and are not (or will not be) in an orbit about another solar system body.

2.2.2 End-of-Mission Plan (EOMP)

2.2.2.1 Program/Project Managers shall assess the mission for compliance with this NPR and NSS 1740.14 or NASA-STD 8719.14, as applicable per paragraph P.2.4, for proper disposal of the spacecraft for the portion of the program/project funded, managed, or operated by NASA (Requirement 56815).

> *Note: If any stages of the launch vehicle are being operated as free-flying operational spacecraft then they shall have a separate EOMP, otherwise, their disposal is covered by the ODAR. Note: Programs/projects are not required to submit an EOMP for spacecraft planned to return to Earth while carrying humans.*

2.2.2.2 Program/Project Managers shall prepare, update, and deliver an EOMP per the format and content defined in NSS 1740.14 or NASA-STD 8719.14, as applicable per paragraph P.2.4, for the configuration of the space vehicles anticipated at EOM for all objects as defined in paragraph P.2.2 (Requirement 57309).

2.2.2.3 The Program/Project Manager shall submit each draft EOMP to the Chief/OSMA, the AA/SOMD (for missions that could pose a risk to humans in space), and the cognizant MDAA for review (Requirement 56817).

2.2.2.4 For missions traveling beyond geosynchronous Earth orbit (GEO) disposal orbits, the MDAA shall submit each draft EOMP to the NASA Planetary Protection Office for review, subject to NPR 8020.12 (Requirement 56818).

2.2.2.5 The initial EOMP may be submitted in electronic (preferred) or paper format. The prelaunch and final EOMPs shall be submitted in paper and electronic formats (Requirement).

2.2.2.6 If the spacecraft designed for reentry at EOM and assessed to impact the Earth's surface, copies of the prelaunch and final EOMPs shall be submitted by the MDAA to the NASA Headquarters Environmental Management Division, the AA/OER, and the Office of the General Counsel (Requirement 56820).

2.2.2.7 The cognizant MDAA shall approve the prelaunch and final EOMPs after review and signed concurrence by Chief/OSMA (Requirement 56821).

2.2.2.8 The Program/Project Manager shall submit the initial draft EOMP no later than 45 days prior to the spacecraft CDR or equivalent program or project milestone (Requirement 56822).

a. For missions that could pose a risk to humans in space, the AA/SOMD shall concur in the Final EOMP before signing by the cognizant MDAA (Requriement).

b. The cognizant MDAA shall ensure that the offices listed in paragraph 2.2.2.6 of this NPR have concurred in the final EOMP if their programs/projects/responsibilities may be affected (Requirement).

2.2.2.9 The Program/Project Manager shall submit the Prelaunch EOMP no later than 30 days prior to the opening of the launch window or 30 days prior to the SMSR described in NPR 8705.6, whichever comes first (Requirement 56823).

2.2.2.10 The MDAA shall ensure the EOMP is periodically (annually at a minimum) reviewed and updated throughout the life of the program/project per the schedule in the EOMP (Requirement 56824).

NOTE: It is recommended that the EOMP updates and reviews occur with the Mission Directorate senior management programmatic, budget, and instrumentation reviews that are conducted for the mission and the spacecraft. It is also intended that the EOMP be used as an integral input to the series of decisions leading up to the decision to decommission the spacecraft.

2.2.2.11 The MDAA shall approve the EOMP no later than 30 days prior to the submission of the EOM notification per NPD 8010.3 or 30 days prior to the commencement of EOM maneuvers or passivation, whichever comes first (Requirement 56826).

2.2.2.12 EOMP analyses and discussions are not needed and may be replaced with a placeholder explanatory text for mission portions which occur beyond Earth orbit and are not (or will not be) in an orbit about another solar system body.

2.2.2.13 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/conditions, subject to NPR 8020.12.

2.2.3 NASA ODPO Review

2.2.3.1 The NASA ODPO shall provide technical review of each ODAR and EOMP to assist in determination of compliance with this NPR and NASA-STD 8719.14 (with allowances for formatting differences if NSS 1740.14 is being used per Paragraph P.2.4) (Requirement 57310).

2.2.3.2 The NASA ODPO shall provide reviews of ODARs and EOMPs to OSMA using the formats specified in NASA-STD 8719.14, Appendices A and B (with allowances for formatting differences if NSS 1740.14 is being used per Paragraph P.2.4 (Requirement 57311).

2.2.3.3 OSMA shall provide the results of the technical reviews of ODARs and EOMPs to the MDAA, the Headquarters Program Executive, and the Program/Project Manager within 30 days of receipt of the ODAR or EOMP (Requirement 56832).

2.2.4 Risk Acceptance

2.2.4.1 The MDAA shall review all noncompliances identified in ODARs and EOMPs and perform a risk tradeoff on meeting the requirements stated in this NPR and NSS 1740.14 or NASA-STD 8719.14, as applicable per paragraph P.2.4, with other programmatic restrictions such as cost, schedule, and launch constraints (Requirement 57312).

2.2.4.2 For any noncompliances to these requirements, the responsible organization shall submit a request for relief from the requirements to the Chief/OSMA per NPR 8715.3 paragraph 1.13 (Requirement 56835).

a. Requests for relief from requirements which apply to the mission after launch shall be referenced in the final EOMP (Requirement).

2.2.4.3 For any noncompliances that are repetitive in nature, applying to a class of spacecraft

systems or launch vehicles and therefore multiple missions, the responsible organization is encouraged to submit a single request for relief from requirements to the Chief/OSMA which encompasses all instances that will use the waiver and any limitations to the waiver's scope in the future.

> *Note: The process for requesting and granting of variances (e.g.: waivers, deviations, exceptions) to the requirements in this NPR and NSS 1740.14 is defined in NPR 8715.3, paragraph 1.13.*

2.2.4.4 MDAA memoranda accepting orbital debris risk associated with launch and flight operations shall be provided a minimum of 30 days prior to launch or prior to the prelaunch Safety and Mission Success Review, whichever is earlier (Requirement 56838).

2.2.4.5 MDAA memoranda accepting orbital debris risk associated with EOM shall be provided a minimum of four weeks prior to commencement of the EOM maneuvers or passivation or prior to the decommissioning review, whichever is earlier (Requirement 56839).

2.2.4.6 Any decision to deviate from the mitigation requirements shall be reviewed and concurred in by the Chief/OSMA prior to launch and/or commencement of EOM maneuvers or passivation (Requirement 56840).

Chapter 3. Program/Project Operations

3.1 Design

3.1.1 The NASA Program/Project Manager shall ensure that all NASA and NASA-funded or NASA-controlled spacecraft and launch vehicles are designed to be disposed of in accordance with the remainder of this chapter (Requirement 56843).

3.1.2 The NASA Program/Project Manager, with the NASA Center SMA organization, shall track and monitor the noncompliances (to this NPR and NSS 1740.14 or NASA-STD 8719.14, as applicable per paragraph P.2.4) with the design and operations of the spacecraft and orbital launch vehicle stages beginning at PDR and shall have the tracking reviewed by the Center SMA organization prior to CDR and launch (Requirement 57313).

3.1.3 The NASA Program/Project Manager shall ensure that all spacecraft and launch vehicles placed in orbit about Earth or the Moon are designed to prevent/preclude, to the extent possible/feasible, a self-initiated unintentional on-orbit breakup from launch through reentry (Requirement 57314).

> *Note: See the U.S. Space Policy Section 11 (contained in paragraph P.1.1) for direction to NASA on limiting orbital debris NSS 1740.14, paragraph 4.4, or NASA-STD 8719.14, as applicable per paragraph P.2.4, for implementation of this requirement.*

3.2 Monitoring During Spaceflight

3.2.1 The NASA Program/Project Manager shall monitor their spacecraft and launch vehicle stages, to the extent possible/feasible, to detect intended or unintended operations that generate orbital debris around Earth, the Moon, or Mars, or at an Earth-Sun Lagrange point (Requirement 56848).

3.2.2 If the NASA Program/Project Manager has determined that a spacecraft in orbit around Earth or the Moon has (or may have) generated intended or unintended orbital debris which is outside of the ODAR or EOMP analyses, then the following offices shall be notified within 48 hours of identifying the release by the identifying party: MDAA, OSMA, and NASA ODPO and SOMD for debris generated in LEO (Requirement 56849).

3.2.3 The NASA Program/Project Manager shall ensure that all generated orbital debris in Earth orbit (planned and unplanned) is analyzed by the program/project to determine if within three months the orbital debris may either pose a risk to another spacecraft in a similar or crossing orbit or will return to Earth (Requirement 56850).

> *Note: The NASA ODPO will assist with this analysis when requested.*

3.2.4 If analyses determines that orbital debris in orbit around the Earth or the Moon will pose a risk of occurrence greater than one in a thousand to another uninhabited spacecraft in a similar or crossing orbit for the three months after generation or decommissioning, then the MDAA shall notify the Chief/OSMA within 48 hours of completion of the analysis. Should the other spacecraft be inhabited (or inhabitable) and the risk of occurrence exceeds one in one million, then the MDAA shall notify the Chief/OSMA within 48 hours of completion of the analysis (Requirement 57316).

3.2.5 The NASA Program/Project Manager shall, for orbits about the Earth or the Moon, monitor spacecraft and launch vehicle stage items defined as critical in the ODAR or EOMP which may lead

to a breakup or loss of control function or any items which may affect the planned maneuvers, passivation, or disposal at EOM (Requirement 56853).

3.2.6 For orbits about the Earth or the Moon, when an event is detected that may affect the generation of orbital debris or implementation of the EOMP, the NASA Program/Project Manager shall ensure that appropriate measures are taken to limit further generation of orbital debris that may preclude intended passivation and disposal of the spacecraft and launch vehicle stages (Requirement 56854).

3.2.7 The Program/Project Manager shall notify the Program's MDAA, who in turn, shall notify the Chief/OSMA and the NASA Chief Engineer, and SOMD (for missions that could pose a risk to humans in space) for events in LEO, within 96 hours of identifying the event when any of the following conditions occur (Requirement 56855):

a. The spacecraft no longer serves any useful function or purpose.

b. Redundancy or other key functionality is lost in the end-of-life disposal or deorbit system.

3.2.8 The Chief/OSMA and the NASA Chief Engineer shall be notified by the MDAA within one week when any of the following conditions occur (Requirement 56858):

a. The nominal propellant level required for controlled deorbit or disposal maneuvers is projected to occur in six months.

b. . Insufficient fuel remains onboard the spacecraft to perform all planned EOM maneuvers plus a 15 percent fuel margin.

3.2.9 The NASA Program/Project Manager shall provide copies of all actions per NPD 8010.3, Notification of Intent to Decommission or Terminate Operating Space Systems and Terminate Missions, to the OSMA with EOMP updates (Requirement 56861).

3.2.10 The NASA Program/Project Manager shall inform the Department of Defense's Space Surveillance Network prior to spacecraft and launch vehicle EOM maneuvers that result in a change of Earth orbit altitude of greater than 1 km (Requirement 56862).

3.3 EOM Actions

3.3.1 EOM Planning

3.3.1.1 The MDAA and the NASA Program/Project Manager shall periodically review and update the EOMP as a part of the Mission Directorate senior management review process (Requirement 56865).

3.3.1.2 All spacecraft planned for reentry into Earth's atmosphere or remaining in orbit about the Earth or the Moon shall be passivated at some point prior to abandonment of the spacecraft (Requirement 56866).

3.3.1.3 When significant capabilities affecting the spacecraft's planned ability to passivate, maneuver, or reenter at end-of-life change either through graceful degradation, malfunction, or via command, the EOMP shall be updated/annotated by the NASA Program/Project Manager (Requirement 56867).

3.3.1.4 EOM passivation includes all of the actions needed to prevent a breakup, either by explosion or disassembly from internally stored energy, of the spacecraft and launch vehicle from the point in time where EOM actions are begun and reentry of the spacecraft occurs.

3.3.1.5 The following systems shall be analyzed when passivation is required (Requirement 57317) (for further information on passivation, see NSS 1740.14 or NASA-STD 8719.14, as applicable per paragraph P.2.4):

Note: NASA-STD 8719.14 and NHBK 8719.14 provide assistance with developing methods of passivation that are consistent with preventing premature passivation errors or malfunctions.

a. Electrical Systems: Batteries and charging circuits.

b. Mechanical Pressure Systems: Propulsion, fluid loop, gas-pressurized batteries, and cryogenics.

c. Chemical Systems: Propulsion and solid motors.

d. Mechanical Systems: Rotating machinery and springs.

Note: NASA-STD 8719.14 provides further details on methods of passivation on avoiding nonreversible passivation methods or unrecoverable passivation errors or malfunctions.

3.3.2 EOM Requirements for Spacecraft and Launch Vehicles Planned for Reentry Into Earth's Atmosphere or Remaining in Orbit About the Earth or the Moon

3.3.2.1 Maneuverable spacecraft that are terminating their operational phases at altitudes of less than 2000 km above the Earth shall be maneuvered to reduce their orbital lifetime, commensurate with 25-year low-Earth orbit lifetime limitations, or relocated, when feasible, if analysis shows the probability of collision with large objects exceeds criteria for objects in these highly utilized orbit regions (Requirement 56876).

Note: Highly utilized orbits include those of the International Space Station and the NASA Earth Observing System. Note: This requirement is not intended to affect mission or spacecraft design/operations requirements established for portions of the mission that occur prior to EOM disposal.

3.3.2.2 For controlled, commanded, or targeted reentries into Earth's atmosphere, the MDAA shall ensure that the OER notifies appropriate authorities for warnings to shipping lanes and airline routes in the area of the reentry a minimum of one week prior to reentry (Requirement 56879).

3.3.2.3 All spacecraft and launch vehicles shall be passivated as a part of EOM disposal/decommissioning to a level where the remaining internal stored energy is insufficient to cause breakup (Requirement 56880).

3.3.2.4 The Program/Project Manager shall include evaluation of the long-term perturbations on, and the future trajectories of, orbital spacecraft and launch vehicle stages in the EOMP (Requirement 56881).

3.3.2.5 The NASA Program/Project Manager shall ensure that all spacecraft and launch vehicles designed to be operated in GEO are designed to be able to maneuver at least 300 km above GEO altitude (closest approach to GEO greater than 300 km above GEO altitude) (Requirement 56882).

3.3.3 EOM Requirements While in Orbit About the Moon

3.3.3.1 The NASA Program/Project Manager shall not plan to leave objects in lunar orbit unless a documented need is stated in the ODAR (Requirement 56884).

Note: "Object" includes upper stage, spacecraft, free flyer, and debris.

3.3.3.2 The NASA Program/Project Manager shall document the orbital parameters of all objects intended to be left in lunar orbit in the EOMP (Requirement 56885).

3.3.3.3 For disposal of spacecraft left in lunar orbit, the NASA Program/Project Manager shall document consideration of a change to the orbital parameters of the spacecraft such that it is not in an orbit where it may interfere with another active spacecraft and include this analysis in the EOMP (Requirement 56886).

3.3.3.4 The plan for disposal of a spacecraft on the lunar surface shall be concurred in by the Chief/OSMA (Requirement 56887).

Note: Concurrence may be noted using the EOMP.

3.3.3.5 Reserved.

3.3.3.6 The Chief/OSMA, working with the MDAA or their designee, shall establish an advisory mechanism to assist in evaluating potential lunar crash sites for NASA spacecraft (Requirement 56889).

3.4 Conjunction Assessments during Mission Operations (for Earth-Orbiting Spacecraft)

3.4.1 The NASA Program/Project Manager shall have conjunction assessment analyses performed routinely for all maneuverable Earth-orbiting spacecraft with a perigee height of less than 2000 km in altitude or within 200 km of GEO (Requirement 56891).

3.4.2 Conjunction assessment analyses shall be performed using the USSTRATCOM high-accuracy catalog as a minimum (Requirement 56892).

3.4.3 The NASA Program/Project Manager shall have a collision risk assessment and risk mitigation process in place for all maneuverable Earth-orbiting spacecraft that are performing routine conjunction assessment analyses (Requirement 56893).

3.5 Special Requirements for Spacecraft Carrying Humans

3.5.1 The NASA Program/Project Manager shall have conjunction assessment analyses performed routinely for all maneuverable Earth-orbiting spacecraft with a mission orbit or temporary/transfer orbit perigee height of less than 2000 km in altitude or with orbits crossing within 200 km of GEO (Requirement 56895).

3.5.2 The Program/Project Manager shall notify the Chief/OSMA 48 hours in advance of a planned jettison of an object(s) (Requirement 56896).

Appendix A. Terms and Definitions

Breakup - an explosion or disassembly of the spacecraft or launch vehicle which generates orbital debris.

Conjunction Assessment - an analysis done to predict the closest point of approach of two space objects based on their orbital parameters.

End-of-Mission - the time of completion of all mission activities, experimental operations, and stand-by status, immediately preceding passivation and disposal of the spacecraft or launch vehicle stage.

Orbital debris - any object placed in space 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 include materials, trash, refuse, fragments, and other objects which are overtly or inadvertently cast off or generated.

Passivation - the process of removing all forms of stored energy from spacecraft, launch vehicle stages, and propulsion units. Passivation includes, but is not limited to, the depletion of all residual propellants, pressurants, electrical storage devices, and forms of kinetic energy to a level where the remaining internal stored energy is insufficient to cause breakup/disassembly. Some sealed batteries and heat pipes need not be depressurized if their potential for explosion is extremely low.

Appendix B. Acronyms

AA/ESMD	Associate Administrator, Exploration Systems Mission Directorate
AA/OER	Assistant Administrator, Office of External Relations
AA/SOMD	Associate Administrator, Space Operations Mission Directorate
CEV	Crew Exploration Vehicle
CDR	Critical Design Review
COTS	Commercial Orbital Transportation Services
DoD	Department of Defense
EOM	End-of-Mission
EOMP	EOM Plan
ESMD	Exploration Systems Mission Directorate
FAA	Federal Aviation Administration
GEO	Geosynchronous Earth Orbit
GOES	Geostationary Operational Environmental Satellite
IADC	Inter-Agency Space Debris Coordination Committee
ISO	International Organization for Standardization
ISS	International Space Station
ITAR	International Traffic in Arms Regulations
JWST	James Webb Space Telescope
KSC	Kennedy Space Center
KSC/LSPM	Kennedy Space Center Launch Services Program Manager
LADEE	Lunar Atmosphere and Dust Environmental Explorer
LSPM	Launch Services Program Manager
MDAA	Mission Directorate Associate Administrator
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
OER	Office of External Relations
OSMA	Office of Safety and Mission Assurance
PDR	Preliminary Design Review
PPO	Planetary Protection Officer
PRA	Probabilistic Risk Assessment
SMA	Safety and Mission Assurance
SMSR	Safety and Mission Success Review
SOMD	Space Operations Mission Directorate
USSTRATCOM	United States Strategic Command