NASA Procedural Requirements

COMPLIANCE IS MANDATORY

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Safety and Mission Assurance Audits, Reviews, and Assessments

Responsible Office: Office of Safety and Mission Assurance

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Preface

P.1 Purpose

This NPR provides procedural requirements for the performance of independent Safety and Mission Assurance (SMA) audits, reviews, and assessments of NASA programs, projects, supporting facilities, and operations. These reviews and assessments are implemented to verify compliance with Federal, State, and local Occupational Safety and Health Administration (OSHA) requirements and Agency SMA process and technical requirements. Specifically, this document provides the basic requirements for the Agency implementation of the NASA Institutional/Facility/Operational (IFO) SMA Audit; Programmatic Audit and Review (PA&R); and Safety and Mission Assurance Readiness Review (SMARR) processes.

P.2 Applicability

a. This NPR applies to NASA Headquarters, NASA Centers, Component Facilities, and to the Jet Propulsion Laboratory (JPL) and other service providers to the extent specified in their respective contracts with NASA. The requirements in this NPR are applicable to contractors and grantees only through contract clauses, specifications, or statements of work in conformance with the NASA Federal Acquisition Regulation supplement and not as direct instructions to contractors.

b. This NPR applies to all NASA programs and projects.

c. The requirements in this NPR apply to internationally provided space systems as documented in distinct and separate agreements, such as joint or multilateral agreements.

P.3 Authority

a. NPD 1000.3, The NASA Organization.

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

c. NPD 1210.2, NASA Surveys, Audits, and Reviews Policy.

P.4 References

a. NPD 1440.6, NASA Records Management.

b. NPR 7120.5, NASA Program and Project Management Processes and Requirements.

c. NPR 8621.1, NASA Procedural Requirements for Mishap Reporting, Investigating, and Recordkeeping.

d. NPR 8705.2, Human-Rating Requirements for Space Systems.

e. NPR 8715.3, NASA Safety Manual.

P.5 Cancellation

None.

/S/ Bryan O'Connor Chief Safety and Mission Assurance Officer

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Chapter 1. Safety and Mission Assurance Audits, Reviews, and Assessments Introduction

1.1 Introduction

1.1.1 Per NPD 1000.3, The NASA Organization, the Chief Safety and Mission Assurance Officer is responsible for providing leadership, policy direction, functional oversight, assessment, and coordination for the following:

a. Strategies, policies, procedures and guidelines, and standards for safety and mission assurance (hereinafter referred to as SMA requirements).

b. Implementation of SMA requirements in NASA programs/projects and institutions.

c. Application of safety, reliability, maintainability, and quality disciplines and tools, knowledge, techniques, and practices throughout the program/project life cycle, including risk assessment and risk management.

Verification of the effectiveness of SMA programs and processes.

1.1.2 NPD 1000.3, The NASA Organization, also specifies SMA-related responsibilities for other key Agency management. Specifically, Center Directors are chartered and accountable to protect the safety and health of the public, NASA team members, and those national assets entrusted to NASA by fully integrating safety, reliability, quality, and statutory and regulatory compliance within and across the Center's plans, facilities, operations, functions, and products. Further, the Center SMA Directors are responsible and accountable for implementing and assuring compliance with Agency, Center, and program SMA requirements.

1.1.3 NPD 8700.1, NASA Policy for Safety and Mission Success, instructs OSMA to establish formal review processes to certify the safety and operational readiness of flight hardware/software, mission-critical support equipment, hazardous facilities/operations, and high-energy ground-based systems. OSMA has implemented the Review and Assessment Division (and Center-based counterparts) to accomplish this process.

1.1.4 This document outlines processes for reviews and assessments to verify compliance with NASA SMA process and technical requirements as required by NPD 8700.1, NASA Policy for Safety and Mission Success. A subset of these requirements, uniquely applicable to a given NASA program/project, facility, or operation, is established as a baseline requirements set (BRS).

1.2 Objective

1.2.1 The objectives of this NPR are to:

a. Determine the institution's compliance with Federal, State, and local OSHA requirements and Agency SMA process and technical requirements.

b. Determine the program/project's compliance with SMA process and technical requirements.

c. Determine the Agency's readiness to test, operate, fly, or launch.

1.2.2 The principal chapters of this NPR provide requirements for supporting the three key processes (summarized in the following subparagraphs) to achieve the objectives of this NPR.

a. The Institutional/Facility/Operational (IFO) SMA Audit process provides independent verification that institutions, facilities, and operations are in compliance with the applicable IFO BRS containing applicable NASA SMA process and technical requirements.

b. The Programmatic Audit and Review (PA&R) process provides independent compliance verification of applicable NASA SMA process, technical, and engineering performance specification requirements within the applicable programmatic BRS.

c. The Safety and Mission Assurance Readiness Review (SMARR) is conducted to prepare SMA management to participate in program/project management pre-operations or major milestone review forums. The SMARR provides the knowledge, visibility, and understanding necessary for SMA managers to concur or nonconcur in program decisions to proceed.

1.3 The Basics. The following paragraphs provide general definitions, descriptions, and examples critical to understanding this NPR.

1.3.1 Compliance Verification. Compliance verification is defined as those activities required to: 1) verify Agency-level SMA process and technical requirements are appropriately documented and flowed down, 2) verify that documented SMA processes are in place and capable, and 3) verify implementation and compliance with process and technical requirements (e.g., through onsite in-process audits and reviews for verification of work discipline). The objectives are accomplished by collecting and examining objective quality evidence (OQE) to verify that the appropriate requirements are established and are being implemented.

1.3.2 SMA Process Requirements.

1.3.2.1 SMA process requirements are defined as those requirements necessary to ensure that safety engineering, reliability engineering, maintainability engineering, and quality engineering and assurance processes are in place for Agency programs, projects, facilities, and operations. These process requirements are structured to ensure that 1) public safety risks are at or below accepted norms and 2) mission success and safety risks for NASA activities are within acceptable bounds.

Note: Examples include requirements that address system safety, range safety, worker safety, human rating, reliability, maintainability, quality assurance, pre-operational review forums, surveillance, audit, inspection, and review panels.

1.3.2.2 SMA process requirements are found in all of the following areas: procurement, software design/engineering, software design verification, hardware design/engineering, hardware design verification, manufacturing, manufacturing verification, integrated test and evaluation, assembly, scheduled hardware transportation activities, ground and on-orbit operations, end-of-life disposition, human factors, sustaining engineering, communications, and maintenance. The NASA SMA community has the primary responsibility to establish and to verify compliance with SMA process requirements.

1.3.3 SMA Technical Requirements. For the purpose of this document, technical requirements are defined as engineering requirements established for assuring the conduct of safe and successful activities and missions. These requirements include both "how to do it" requirements (e.g., soldering standard, welding standards, coatings, packaging) as well as "how to check it" requirements (e.g.,

manufacturing process control, mechanical and electrical testing standards, nondestructive evaluation). The NASA SMA community has the responsibility to verify compliance with technical requirements affecting safe and reliable operations.

1.3.4 Engineering Performance Specification (EPS) Requirements.

1.3.4.1 EPS requirements are quantitative engineering specifications related to a specific aerospace system design, test, manufacturing, assembly integration, communications, or ground and on-orbit operational activity. Typically, EPS requirements evolve from top-level mission objective requirements, process and technical requirements, and appropriate technical standards, military standards, and military specifications.

Note: Examples include tank wall thickness, a voltage range, a current value, a heating rate, or an erosion rate.

1.3.4.2 NASA program managers supported by Center-based matrixed discipline engineering personnel, systems engineering personnel, and SMA personnel typically conduct compliance verification for EPS requirements, including safety-critical items. While the NASA SMA community in general does not directly verify compliance for EPS requirements, the SMA community does verify compliance with the safety, reliability, maintainability, and quality assurance technical and process requirements that govern the establishment of EPS requirements.

1.3.5 BRS. The BRS represents a set of requirements jointly negotiated among the program/project, engineering community, SMA community, and, as appropriate, institutional organizations. Typically, the BRS represents a subset of Agency SMA process, technical, and engineering performance specification requirements uniquely applicable to a given NASA program, project, facility, or operation. For existing programs/projects, the existing requirements will be "grandfathered" as the BRS.

Chapter 2. Institutional/Facility/Operational (IFO) SMA Audits

2.1 Objective of IFO SMA Audits

2.1.1 IFO SMA Audits verify the flow-down of Federal, State, local, and Agency SMA and technical directives, policies, and requirements into organization requirements and procedures, and assess whether local practices reflect these procedures and processes. The purpose of the audits is twofold:

a. To provide management with an independent, objective, and constructive evaluation of the compliance of the institution, facility, and operation with the applicable BRS.

b. To assess the effectiveness of implementation of SMA directives, policies, and requirements in achieving desired outcomes relevant to the areas being audited.

2.1.2 Headquarters-led IFO SMA Audits are conducted by OSMA's Review and Assessment Division. Center-led IFO SMA Audits are undertaken on behalf of the Center Director and are conducted by the Center SMA Director and SMA staff using Center requirements documents to verify organizational compliance with the applicable IFO BRS.

2.1.3 IFO SMA Audits verify compliance with SMA-related requirements (both SMA process and technical) contained in applicable documents. These requirement areas within the IFO BRS include, but are not limited to, the following:

a. Public/Worker Safety: NASA Safety Manual, personnel certifications for hazardous operations, and personnel safety requirements.

b. Facility System Safety: facility safety, fire protection, and underwater facility and non-open water operations safety requirements.

c. Mishap Investigation.

d. Equipment Safety: metrology and calibration, lifting devices and equipment, pressure vessels and systems, and Government Industry Data Exchange Program (GIDEP) Alerts.

e. Explosives Safety.

f. Range Safety.

g. Electrical Safety.

2.1.4 IFO SMA Audits are conducted onsite at the Center's organizational level. Verification of compliance with SMA process and technical requirements is accomplished by: 1) reviewing organization SMA requirements and procedures to ensure that Agency-level SMA process and technical requirements are appropriately flowed down and implemented, 2) reviewing documentation and records of completed work and training, 3) assessing the capability of the organization to implement the SMA requirements, 4) interviewing organization personnel, 5)

observing the practices that reflect the organization's procedures and processes, and 6) verifying the effective implementation of corrective actions.

2.1.4.1 It is not the intent of the IFO SMA Audit process to duplicate the effort of other audits; rather, the intent is to leverage audits, reviews, and assessments conducted by other NASA or governmental organizations or certified nongovernmental organizations to facilitate verification of compliance with requirements. IFO SMA Audits will include reviews of previous findings, corrective actions, and an evaluation of the effectiveness of those corrective actions.

2.1.4.2 Required actions resulting from completed audits are tracked to effective completion via a closed-loop corrective action system.

2.1.5 The Operations and Engineering Panel (OEP), as chartered by NPR 8715.3, NASA Safety Manual, Appendix K, is one component of the IFO SMA Audit Process. The OEP provides an independent technical engineering and operational review of specifically selected NASA facilities and operations in support of the OSMA, the Headquarters Office responsible for institutional management, NASA Mission Directorates, and NASA Centers and Component Facilities, including JPL. The OEP produces written evaluations and recommendations to improve NASA engineering and operations.

2.2 IFO SMA Audit Roles and Responsibilities

2.2.1 The Agency Associate Administrator shall:

2.2.1.1 Ensure that Centers comply with and implement institutional, facility, and operational-related SMA and technical requirements (Requirement).

2.2.1.2 Ensure that Centers have adequate resources to perform IFO SMA Audits and to support Headquarters-led IFO SMA Audits (Requirement).

2.2.2 The Chief Safety and Mission Assurance Officer shall:

2.2.2.1 Implement the Headquarters-led IFO SMA Audit process (Requirement).

2.2.2.2 Develop annual integrated audit plans for OSMA (Requirement).

2.2.2.3 Work with the NASA Chief Engineer and Associate Administrator for Institutions and Management to define the applicable IFO BRS (Requirement).

2.2.2.4 Provide an auditor selection and screening process to ensure that potential audit team members have the requisite institutional, facility, and/or operational safety experience and competency to participate in the Headquarters IFO SMA Audit process (Requirement).

2.2.2.5 Conduct Headquarters IFO SMA Audits on a biennial basis at all NASA Centers, Component Facilities, and the JPL NASA Management Office and include all focus areas applicable to each organization (Requirement).

2.2.2.6 Provide NASA Centers access to current Headquarters IFO SMA Audit schedule (Requirement).

2.2.2.7 Select the IFO SMA Audit requirement set for review from the applicable IFO BRS with concurrence from the responsible Center SMA organization (Requirement).

2.2.2.8 Request the Center to identify participants to act as audit liaisons and to facilitate assistance from the Center SMA organization (Requirement).

2.2.2.9 Conduct follow-up activities to verify implementation of effective corrective and preventive actions for Headquarters IFO SMA Audit findings (Requirement).

2.2.10 Provide feedback of IFO SMA Audit results and corrective actions to affected/applicable institutional offices within Headquarters organizations.

2.2.3 The NASA Chief Engineer shall:

2.2.3.1 Ensure that relevant program Chief Engineer(s) supports the OSMA Review and Assessment Division by explicitly defining and documenting the applicable IFO BRS and the associated OQE (Requirement).

2.2.3.2 Assist the Chief Safety and Mission Assurance Officer in defining the applicable IFO BRS (Requirement).

2.2.4 The Associate Administrator for Institutions and Management shall:

2.2.4.1 Assist the Chief Safety and Mission Assurance Officer in selecting the pertinent set of requirements for audit from the IFO BRS (Requirement).

2.2.5 Center Directors shall:

2.2.5.1 Provide the necessary review materials to facilitate the audit planning stage of the IFO SMA Audit (Requirement).

2.2.5.2 Identify and provide subject matter experts to the OSMA as requested for Headquarters-led IFO SMA Audit activities (Requirement).

2.2.5.3 Provide the logistic and resource support required for successful execution of Center-led IFO SMA Audit activities (Requirement).

2.2.5.4 In concert with the Center SMA Director and applicable facility or project manager, provide a Corrective Action Plan to the OSMA for resolution of Headquarters-led IFO SMA Audit findings within 60 calendar days of the audit (Requirement).

2.2.5.5 Present periodic status of IFO SMA Audit corrective actions to the Chief Safety and Mission Assurance Officer or designee every 60 calendar days thereafter until all findings have been closed (Requirement).

2.2.6 Center SMA Directors shall:

2.2.6.1 Support and participate in the IFO SMA Audit process (Requirement).

2.2.6.1.1 Incorporate IFO SMA Audit activities into Center SMA plans (Requirement).

2.2.6.1.2 Provide to the IFO SMA Audit Team Leader all necessary review materials to facilitate the planning and execution of the IFO SMA Audit (Requirement).

2.2.6.1.3 Identify to the IFO SMA Audit Team Leader other relevant IFO audits, reviews, or assessments that may have previously verified compliance with requirements (Requirement).

2.2.6.1.4 Provide logistic and resource support required for the execution of the IFO SMA Audit Plan (Requirement).

2.2.6.1.5 Coordinate with Center procurement and Center institutions, facilities, and/or operations personnel to ensure that contracts provide for adequate contractor support of Headquarters-led and Center-led IFO SMA Audit activities.

2.2.6.1.6 Prepare and present a Closed-loop Corrective Action Plan to the Chief Safety and Mission Assurance Officer or designee for resolution of Headquarters-led IFO SMA Audit findings within 60 calendar days of the audit (Requirement).

2.2.6.1.7 Submit a Closed-loop Corrective Action Plan to the Center Director for resolution of Center-led IFO SMA Audit findings (Requirement).

2.2.6.2 Establish a Center-led IFO SMA Audit process by planning, obtaining Center funds, and executing Center-based IFO SMA Audits to verify organizational compliance with institutional, facility, operational, and SMA process and technical requirements (Requirement).

2.2.6.3 Present status of Headquarters-led IFO SMA Audit corrective actions to the Chief Safety and Mission Assurance Officer or designee every 60 calendar days thereafter until all findings have been closed (Requirement).

2.2.7 Center Organizations with responsibility for institutions, facilities, or operations shall:

2.2.7.1 Incorporate IFO SMA Audit activities into program/project plans (Requirement).

2.2.7.2 Support the audit plan by providing program/project logistic and resource support required for successful execution of and response to the IFO SMA Audit (Requirement).

2.2.7.3 Coordinate with Center SMA and Center procurement to ensure that contracts provide for adequate contractor support of Headquarters-led and Center-led IFO SMA Audit activities.

2.2.7.4 Provide a Closed-loop Corrective Action Plan to the OSMA for resolution of Headquarters-led IFO SMA Audit findings within 60 calendar days of the audit (Requirement).

2.2.8 SMA Managers (matrixed/assigned to the Program/Project Manager) shall:

2.2.8.1 Support the IFO SMA Audit by providing the IFO SMA Audit Team Leader the necessary review materials to facilitate the audit planning stage (Requirement).

2.2.8.2 Identify to the IFO SMA Audit Team Leader any other relevant audits, reviews, or assessments that may have previously verified compliance with requirements (Requirement).

2.2.8.3 In concert with the Center Director, Center SMA Director, and Program/Project Manager, provide a Closed-loop Corrective Action Plan to the OSMA within 60 calendar days for resolution of Headquarters-led IFO SMA Audit findings (Requirement).

2.2.9 Headquarters- or Center-led IFO SMA Audit Team Leader shall:

2.2.9.1 Develop and execute the IFO SMA Audit Plan (Requirement), including:

2.2.9.1.1 Coordinate the audit with the organization to be audited by identifying the general scope of the audit and the expected start and finish dates (Requirement).

2.2.9.1.2 Recruit subject matter experts to be audit team members (Requirement).

2.2.9.1.2.1 Audit team members shall be independent of the organization or program/project being audited (Requirement).

2.2.9.1.2.2 Subject matter experts will be recruited from NASA Headquarters and Center organizations with IFO SMA policy/procedures responsibilities and may also include other government agency experts.

2.2.9.1.3 Ensure that each team member is qualified to conduct the IFO SMA Audit; i.e., has requisite institutional, facility, and operational SMA experience and training (Requirement).

2.2.9.2 Provide findings in a formal report to the appropriate Center Director, SMA Director, Program Manager, and affected institutional organizations (Requirement).

2.2.9.3 Ensure that appropriate records of audit activities are maintained (Requirement).

2.2.9.4 Ensure that each auditor collects and documents the OQE verifying the Center meets the IFO BRS appropriate to the audit objective(s) (Requirement).

Note: Information derived from IFO SMA Audits often contains lessons learned and best practices. Headquarters- or Center-led IFO SMA Audit Team Leaders may share this information via appropriate Web-based resources; e.g., Lessons Learned Information System (LLIS), Process Based Mission Assurance-Knowledge Management System (PBMA-KMS).

Chapter 3. Programmatic Audit and Review (PA&R)

3.1 Objective

3.1.1 The objectives of the PA&R process are to provide independent compliance verification of the program/project BRS and to assess the health of the program/project SMA assurance activities.

3.1.2 The PA&R process may be Headquarters-led or Center-led. While Headquarters-led PA&R activities are conducted by the OSMA Review and Assessment Division for the Chief Safety and Mission Assurance Officer, Center-led programmatic audits and reviews are undertaken on behalf of the Center Director and are conducted by the Center SMA Director and SMA staff incorporating the elements described in paragraph 3.1.5 herein.

3.1.3 The PA&R process is designed to be applied during any phase or before/between any major decision points of a program/project life cycle. Emphasis typically evolves from concentration on flow-down and capability verification early in a program/project to rigorous compliance verification in later life cycle phases. As no two programs/projects are identical, the PA&R process adapts to the unique complexity of each individual program/project. The process is designed to take full advantage of information gained in earlier phases, as well as other internal and external audits, reviews, and assessments.

3.1.4 The PA&R process is designed to provide actionable inputs to the Chief Safety and Mission Assurance Officer via reports and/or corrective action plans prepared at completion of each of the intermediate process steps defined in paragraph 3.1.5. These represent individual SMA decision points where major requirements compliance issues and associated risks are considered by the Chief Safety and Mission Assurance Officer, in concert with the Chief Engineer and program management, relative to the continuation of the program/project.

3.1.5 PA&R process activities are defined by the following eight major elements:

a. Make decision to conduct program audit/review/assessment - Select program/project based on established selection criteria or by request or by direction.

b. Conduct program discovery - Identify and document program-specific SMA roles, responsibilities, and relationships. This is accomplished through a program-unique mission assurance process map and matrix developed and maintained by the program/project with appropriate support and guidance of the Headquarters and/or Center SMA organization. Program/project management and the responsible Center SMA organization use these products to actively manage the SMA function and to develop and support required inputs to the SMARR.

c. Understand baseline requirements - Understand and document the applicable programmatic BRS and associated OQE as jointly established with the independent Technical Authority and the program/project. For existing programs, conduct a requirements gap analysis between the existing set of program requirements and the governing set of Agency SMA process and technical

requirements.

d. Verify requirements flow-down - Verify flow-down of Agency-level requirements to the program/project. Verify that requirements flow from the program/project to prime and subtier contractors.

e. Verify process capability - Verify that SMA process capabilities (e.g., funding, personnel training, certifications, experience, skill mix) are sufficient to support the program/project.

f. Verify compliance - Perform ongoing surveillance and conduct onsite in-process audits and reviews including preaudit planning, audit guide development, and postaudit report production.

g. Provide feedback -Provide feedback on audit/review results and findings to OSMA divisions, the cognizant Center SMA organization, program management, and Office of the Chief Engineer to provide lessons learned and to support program/project continuation decisions.

h. Support operational readiness decision - Identify and define any program/project requirement noncompliance risks in support of the SMARR.

3.2 Programmatic Audit and Review Roles and Responsibilities

3.2.1 The Agency Associate Administrator shall:

3.2.1.1 Ensure that Centers implement the applicable programmatic BRS (Requirement).

3.2.1.2 Ensure that Centers support the PA&R processes described in this document (Requirement).

3.2.2 Associate Administrators for Mission Directorates shall:

3.2.2.1 Ensure that programs/projects under the Mission Directorate implement the applicable programmatic BRS (Requirement).

3.2.2.2 Ensure that programs/projects under the Mission Directorate are prepared to support the PA&R process described in this document (Requirement).

3.2.3 The Chief Safety and Mission Assurance Officer shall:

3.2.3.1 Identify programs/projects requiring a Headquarters-led PA&R. The determination will be based on general criteria including such factors as size, complexity, visibility, cost, risk, and human rating (Requirement).

3.2.3.2 Assist in defining the applicable programmatic BRS and associated OQE (Requirement).

3.2.3.3 Implement and execute the Headquarters-led PA&R process for selected programs/projects in concert with the appropriate Center SMA organization(s) to provide assurance that the program/project has complied with the applicable programmatic BRS (Requirement).

3.2.3.4 For multi-Center programs/projects, identify the lead SMA organization for coordination of Headquarters-led PA&R process activities and implementation of Center-led PA&R process activities (Requirement)

3.2.3.5 Employ Center-based SMA independent assessment groups as a resource to conduct Headquarters-led programmatic audits, reviews, and assessments in accordance with the PA&R process defined herein (Requirement).

3.2.3.6 Coordinate the direct supply chain audits/reviews conducted by the Agency Supplier

Assurance Contract in support of the PA&R process (Requirement).

3.2.3.7 Provide appropriate Mission Directorates, Program/Project Managers, and other independent assessment organizations with current PA&R implementation plans and schedules (Requirement).

3.2.3.8 Provide an auditor selection and screening process to ensure that potential audit/review team members have the requisite program/project, subject matter, and auditor experience and competency to participate in PA&R onsite audits and reviews (Requirement).

3.2.3.9 Establish a PA&R records management system compliant with NPD 1440.6, NASA Records Management (Requirement).

3.2.4 The NASA Chief Engineer shall:

3.2.4.1 Ensure that program Chief Engineers support the OSMA in defining and documenting the applicable programmatic BRS and associated OQE (Requirement).

3.2.5 Center Directors shall:

3.2.5.1 Provide the necessary Center support to the PA&R process (Requirement).

3.2.5.2 Identify and provide Center subject matter experts to the OSMA, as requested, to support Headquarters-led PA&R process activities (Requirement).

3.2.5.3 Establish and support Center-led PA&R process activities by providing the logistic and resource support required for successful planning and execution of the PA&R process at the Center (Requirement).

3.2.5.4 In concert with the Center SMA Director, Program/Project Manager, and Program/Project SMA Manager, provide a Closed-loop Corrective Action Plan to the OSMA for resolution of Headquarters-led PA&R findings within 60 calendar days of the completion of the audit/review (Requirement).

3.2.5.5 Present periodic status of all PA&R process corrective actions to the Chief Safety and Mission Assurance Officer or designee every 60 calendar days thereafter until all findings have been closed (Requirement).

3.2.6 Center SMA Directors shall:

3.2.6.1 Support and participate in Headquarters-led PA&R process activities (Requirement).

3.2.6.1.1 Incorporate Headquarters-led PA&R process activities into Center SMA plans (Requirement).

3.2.6.1.2 Provide to the PA&R Audit/Review Lead all necessary review materials to facilitate the planning and execution of the Headquarters-led audit/review (Requirement).

3.2.6.1.3 Submit a copy of the most recent applicable Center-led PA&R report(s) to the OSMA sufficiently in advance of Headquarters-led PA&R process activities to facilitate review, planning, and execution of such activities (Requirement).

3.2.6.1.4 In concert with the Center Director, Program/Project Manager, and Program/Project SMA Manager, prepare and present a Closed-loop Corrective Action Plan to the Chief Safety and Mission Assurance Officer or designee for resolution of Headquarters-led PA&R findings within 60 calendar days of the completion of the audit/review (Requirement).

3.2.6.1.5 In concert with the Center Director, present periodic status of Headquarters-led PA&R

corrective actions to the Chief Safety and Mission Assurance Officer or designee every 60 calendar days thereafter until the findings are closed (Requirement).

3.2.6.2 Implement a Center-led PA&R process, consistent with the elements outlined in paragraph 3.1.5, by planning and executing Center-managed and/or Center-located activities to provide: 1) requirements flow-down verification; 2) assessment of program/project SMA process capability; 3) independent verification of in-process work discipline and compliance with requirements based on OQE; and 4) communication of attendant SMA residual risk to the program/project and to OSMA (Requirement).

3.2.6.2.1 Incorporate Center-led PA&R process activities into Center SMA plans (Requirement).

3.2.6.2.2 Support the Center-led PA&R process with the appropriate logistic and resource support required for successful execution of required audits/reviews (Requirement).

3.2.6.2.3 Provide to the PA&R Audit/Review Lead all necessary review materials to facilitate the planning and execution of the Center-led audit/review (Requirement).

3.2.6.2.4 In concert with the Program/Project Manager and Program/Project SMA Manager, prepare and present a Closed-loop Corrective Action Plan to the Center Director for resolution of Center-led PA&R findings within 60 calendar days of the audit/review (Requirement).

3.2.6.2.5 Present periodic status of Center-led PA&R corrective actions to the Center Director and provide periodic status to the Chief Safety and Mission Assurance Officer or designee (Requirement).

3.2.6.3 Coordinate with program/project management and Center procurement to ensure that contracts provide for adequate contractor support of Headquarters-led and Center-led PA&R process activities.

3.2.7 Program/Project Managers shall:

3.2.7.1 Incorporate PA&R process activities into program/project plans, including a program/project-unique mission assurance process map and matrix developed and maintained by the program/project with appropriate support and guidance of the Headquarters and/or Center SMA organization (Requirement). Program/project management and responsible Center SMA organization use these products to actively manage the SMA function and to develop and support required inputs to the SMARR.

3.2.7.2 Support the PA&R process (either Headquarters-led or Center-led) by providing logistic and resource support required for successful execution of and response to PA&R process activities (Requirement).

3.2.7.3 Coordinate with Center SMA and Center procurement to ensure that contracts provide for adequate contractor support of Headquarters-led and Center-led PA&R activities.

3.2.7.4 Provide the PA&R Audit/Review Lead with the applicable programmatic BRS and OQE to facilitate PA&R process activities (Requirement).

3.2.7.5 Provide authorization for the program/project contractors to support PA&R process activities (Requirement).

3.2.7.6 In concert with the Center Director, Center SMA Director, and Program/Project SMA Manager, provide a Corrective Action Plan to the OSMA for resolution of Headquarters-led PA&R findings within 60 calendar days of the audit/review (Requirement).

3.2.7.7 In concert with the Program/Project SMA Manager, provide a Corrective Action Plan to the Center Director for resolution of Center-led PA&R findings (Requirement).

3.2.8 SMA Managers Reporting (matrixed or direct) to the Program/Project Manager shall:

3.2.8.1 Support the program/project manager in the development and maintenance of the program Assurance Process Map and Matrix (Requirement).

3.2.8.2 Develop and maintain a program-specific Mission Assurance Portfolio which contains the OQE necessary to support the PA&R audits, reviews, and assessments (Requirement).

3.2.8.3 Identify to the PA&R Audit/Review Lead (either Headquarters-led or Center-led) other audits, reviews, or assessments that may have previously verified compliance with the applicable programmatic BRS (Requirement).

3.2.9 Other Independent Assessment organizations shall:

3.2.9.1 Communicate and coordinate their program or project audit/review plans, schedules, and findings with OSMA Review and Assessment Division to minimize duplication and overlap among the various independent assessment activities (Requirement).

Note: This includes, but is not limited to, the Office of Program Analysis and Evaluation, Independent Verification and Validation (IV&V) Facility, and NASA Engineering and Safety Center (NESC).

3.2.10 Headquarters-led or Center-led PA&R Audit/Review Lead shall:

3.2.10.1 Develop and execute the PA&R audit/review plan (Requirement).

3.2.10.2 For each PA&R audit/review, coordinate with the specific Program/Project Manager by supplying notification of the general scope of the audit/review and the expected start and finish dates (Requirement).

3.2.10.3 Recruit appropriate subject matter experts to be audit/review team members (Requirement).

3.2.10.4 Ensure audit/review team members are independent of the program/project being audited (Requirement).

3.2.10.5 Ensure that all team members are qualified to conduct programmatic audits, reviews, and assessments; i.e., have the requisite program/project, subject matter, and auditor experience and competency (Requirement).

3.2.10.6 Develop a program/project-specific audit/review guide to support the onsite audit/review (Requirement).

3.2.10.7 Conduct the onsite audit/review and ensure that records of all audit/review activities are maintained; specifically, ensure that each auditor collects/documents evidence that the program/project meets the applicable programmatic BRS relevant to the audit/review objectives (Requirement). Acceptable OQE includes the following:

a. List of personnel interviewed.

b. Organization/functions/facilities visited/assessed.

c. Documentation requested and reviewed.

d. Findings: specifically noncompliances and observations.

3.2.10.8 Provide findings in a formal report to the participating Mission Directorate, Center Director, SMA Director, Program Manager, and Program Risk Management Officer for disposition of findings (Requirement).

Note: Information derived from PA&R activities often contains lessons learned and best practices. Headquarters- or Center-led PA&R Audit/Review Lead may share this information via appropriate Web-based resources; e.g., LLIS, PBMA-KMS.

Chapter 4. Safety and Mission Assurance Readiness Review (SMARR)

4.1 Objective

4.1.1 The SMARR is a review held to prepare SMA management to participate in program or project management pre-operations or major milestone review forums. The SMARR provides the knowledge, visibility, and understanding necessary for SMA managers to concur or nonconcur in program decisions to proceed.

4.1.2 SMARRs can be Headquarters-led or Center-led. The Headquarters-led SMARR is held for the Chief Safety and Mission Assurance Officer. Center-led SMARRs are conducted for Center SMA management by the cognizant Center SMA organization.

4.1.3 SMARRs are conducted for Human Space Flight, Expendable Launch Vehicle (which typically would not include sounding rockets and balloons), and selected Experimental Aerospace Vehicle flights. In addition, the Chief Safety and Mission Assurance Officer may request a SMARR (either Headquarters-led or Center-led) prior to other SMA-critical program or project activities, including test readiness reviews, design certification reviews, and extravehicular activities.

4.1.4 The SMARR is designed to:

(1) review and affirm that assurance processes and requirements have been implemented over the life of the program, including review of the program-developed Assurance Process Map and Matrix,

(2) verify compliance with the applicable BRS,

(3) provide adequate knowledge and visibility for senior SMA managers to understand the managed risks associated with the safety and mission success of program launches, operational stages, or selected critical tests, utilizing input from cognizant program and Center-based safety and reliability review panels (e.g., ground safety, payload safety, range safety, facility safety),

(4) examine mission preparation status, open work issues and concerns, and assess overall systems readiness, and

(5) provide an SMA position on whether to concur or nonconcur in proceeding with the event/operation in question.

4.1.5 Data presented at the Headquarters-led SMARR is developed by the program, cognizant Center SMA organization(s), the Review and Assessment Division IFO SMA Audits, PA&R process activities, other Independent Assessment groups (e.g., NESC, IV&V Facility), the applicable Safety Review Panels, and any individuals or organizations representing minority or dissenting opinions.

4.1.6 A record of each Headquarters SMARR shall be prepared and maintained by the OSMA Review and Assessment Division for six years after mission completion (Requirement).

4.2 SMARR Roles and Responsibilities

4.2.1 The Agency Associate Administrator shall:

4.2.1.1 Ensure that Centers support the SMARR processes described in this document (Requirement). 4.2.2 Associate Administrators for Mission Directorates shall:

4.2.2.1 Ensure that programs and projects within the Mission Directorate support the SMARR requirements described in this document (Requirement).

4.2.3 The Chief Safety and Mission Assurance Officer shall:

4.2.3.1 Direct the conduct of a SMARR for any high-risk program or project activity requiring Mission Directorate-level or higher decision to proceed, and, as necessary, to ensure the safety and mission success of program or project activities (Requirement).

4.2.3.2 Chair each Headquarters-led SMARR and conduct a poll of selected SMARR participants for a recommendation to proceed. (Requirement).

4.2.4 Center Directors shall:

4.2.4.1 Provide the logistic and resource support required for successful execution of the Headquarters- and Center-led SMARR activities (Requirement).

4.2.5 Center SMA Directors shall:

4.2.5.1 Participate in the Headquarters-led SMARR process for each program/project applicable to their Center (Requirement).

4.2.5.2 Direct the implementation of a Center-led SMARR process for any major milestone event or program line management operational review chaired below the Agency Directorate level in which the Center SMA organization is asked to concur/nonconcur and capitalize on a Headquarters-led SMARR to meet the intent of the Center-led SMARR, if applicable (Requirement).

4.2.5.3 Chair each Center-led SMARR and conduct a poll of selected SMARR participants for a recommendation to proceed (Requirement).

4.2.5.4 Include an assurance process analysis and an SMA residual risk-centric approach to assessing program/project readiness prior to a critical milestone in Center-led SMARRs.

4.2.5.5 Ensure that the basic elements of a Center-led SMARR, at a minimum, address the Headquarters-led SMARR elements and, to the extent possible, parallel Headquarters-led SMARR residual risk reporting formats (Requirement).

4.2.5.6 Coordinate with program/project management and Center procurement to ensure that contracts provide for adequate contractor support of Headquarters-led and Center-led SMARR activities (Requirement).

4.2.6 Program/Project Managers shall:

4.2.6.1 Provide the necessary logistics and resources required to support the preparation and conduct of Headquarters-led or Center-led SMARRs (Requirement).

4.2.6.2 Coordinate with Center SMA and Center procurement to ensure that contracts provide for adequate contractor support of Headquarters-led and Center-led SMARR activities (Requirement).

4.2.7 SMA Managers reporting (matrix or direct) to the Program/Project Manager shall:

4.2.7.1 Help to identify all independent organizations which have assessed portions of the program or project (Requirement).

4.2.7.2 Compile the program/project SMARR material, including the program's assessment of residual safety and mission success risk related to the upcoming milestone, identifying risk consequence and likelihood with supporting rationale and uncertainty associated with estimated likelihood (Requirement).

4.2.7.3 Coordinate the presentation of the Center and program/project SMARR material to the Chief Safety and Mission Assurance Officer (Requirement).

4.2.7.4 Coordinate within the program/project and support Headquarters-led and Center-led SMARR preparation meetings, as required (Requirement).

4.2.7.5 Participate in SMARR polling as described in paragraphs 4.2.3.2. and 4.2.6.3 (Requirement).

4.2.8 Other Independent Assessment organizations shall:

Note: This includes, but is not limited to, IV&V Facility and NESC.

4.2.8.1 Identify program/project assessments conducted by their respective organizations, summarize, and provide them to the OSMA Review and Assessment Division to ensure that the Chief Safety and Mission Assurance Officer has all relevant data at the SMARR and to avoid duplication of effort on the part of other independent assessment organizations (Requirement).

4.2.8.2 Identify any issues or SMA residual risks related to their respective assessments (Requirement).

4.2.8.3 Identify any areas where the findings of the independent assessments differ from the program/project assessment (Requirement).

4.2.8.4 Participate, as applicable, in SMARR polling described in paragraph 4.2.3.2 (Requirement).

4.2.8.5 Complete SMARR action items as assigned (Requirement).

4.2.9 The OSMA Review and Assessment Division SMARR Manager shall:

4.2.9.1 Coordinate with the OSMA Mission Manager, Center-based SMA managers, and independent assessment organizations (e.g., IV&V Facility, NESC) to identify participants for the review (Requirement).

4.2.9.2 Coordinate with the OSMA Mission Manager, Center-based SMA managers, and independent assessment organizations (e.g., IV&V Facility, NESC) to establish an appropriate schedule and agenda for the upcoming SMARR (Requirement).

4.2.9.3 Coordinate with the program/project SMA Managers to establish the team members for the SMARR polling group in coordination with the Chief Safety and Mission Assurance Officer (Requirement).

4.2.9.4 Maintain and update, based on operational experience, detailed SMARR process documentation and work instructions (Requirement).

Appendix A. Definitions

Audit/Review Guide. A guide defining the overall scope, authority, procedures, applicable documents, and administrative and logistic details necessary to conduct an onsite audit or review. It also includes a set of detailed questions to be covered during the onsite audit/review based on requirements from Agency-level SMA documents, industry standards, and NASA Center-specific procedures and requirements.

Audit/Review Report. A document that provides the results of an onsite audit or review. This report contains, at a minimum, an Executive Summary and a comprehensive discussion/description of all the findings resulting from the onsite audit or review.

Audit/Review Team. A team comprised of subject matter experts from NASA Headquarters, NASA Centers, and potentially non-NASA organizations selected to conduct the NASA Headquarters-led onsite audits and reviews supporting IFO SMA Audits and PA&R process activities.

Audit Team Leader or Audit/Review Lead. The NASA employee assigned to execute the required preaudit, audit, and postaudit actions for NASA Headquarters-led or Center-led onsite audits and reviews conducted in support of IFO SMA Audits and the PA&R process, respectively. For Headquarters-led audits, the employee will be from the Office of Safety and Mission Assurance. For Center-led onsite audits/reviews, the employee will be from the appropriate Center SMA organization.

Baseline Requirements Set (BRS). The BRS represents a set of requirements jointly negotiated among the program/project, engineering community, SMA community, and, as appropriate, institutional organizations. Typically, the BRS represents a subset of Agency SMA process, technical, and engineering performance specification requirements uniquely applicable to a given NASA program, project, facility, or operation.

Capable/Capability. For the purpose of this document, capability refers to specific organizational and workforce adequacy attributes as follows: organizational funding/structure/stability, staffing level, workforce experience, workforce skill mix, workforce training, tools, techniques, and methodologies.

Center SMA Director. As used in this directive, this term includes all Center management personnel designated by the Center Director to implement Agency IFO SMA Audits, PA&R, and SMARR requirements.

Compliance Verification. Compliance verification includes: 1) verifying that appropriate technical and process requirements are in place (requirement flow-down verification), 2) verifying that documented SMA requirements are in place and capable, and 3) observing work activities and products to verify process implementation and compliance with process and technical requirements (e.g., onsite in-process audits and reviews for verification of work discipline).

Corrective Action Plan. A document that addresses root causes for findings and the actions to

correct specific individual problems, as well as actions taken to correct any potential systemic or process problems in order to prevent recurrence. This plan includes designation of a schedule for completing the actions, as well as designating the responsible party(ies) assigned to perform the actions.

Engineering Performance Specification Requirements. Requirements that are typically quantitative engineering specifications related to a specific aerospace system design, test, manufacturing, assembly integration, or operational activity.

Findings. A conclusion, positive or negative, based on facts established during the investigation by the investigating authority (i.e., cause, contributing factor, and observation (per NPR 8621.1, NASA Procedural Requirements for Mishap Reporting, Investigating, and Recordkeeping). For the purposes of this NPR, the word "investigation" refers to SMA audits, reviews, and assessments.

IFO SMA Audit. An independent review of NASA Center compliance with Institutional, Facility, and Operational SMA requirements. This includes Federal, State, or local safety requirements, NASA SMA process requirements, and technical requirements.

Mission Assurance Portfolio. A compendium of objective quality evidence (e.g., analyses, test results, build reviews, records of decisions necessary) to support the IFO SMA Audit, PA&R, and SMARR processes.

Mission Assurance Process Map. The Mission Assurance Process Map is a high-level, graphical representation of governing SMA policy and requirements, processes, and key participant roles, responsibilities, and interactions. It also includes the reporting structure that constitutes a program's/project's SMA functional flow.

Mission Assurance Process Matrix. The Mission Assurance Process Matrix is constructed to identify program life cycle assurance agents and specific assurance activities, processes, responsibilities, accountability, depth of penetration, and independence. The matrix includes key assurance personnel in Engineering, Manufacturing, Program Management, Operations, and SMA.

Noncompliance. A failure to comply with Federal, State, local, Agency, and/or Center requirements. A noncompliance could lead to the loss of life or injury to NASA personnel or the public, loss of or damage to high-value equipment, or reduction of the likelihood for mission success.

Objective Quality Evidence. Any statement of fact, either quantitative or qualitative, pertaining to the quality of a product or service based on observations, measurements, or tests which can be verified (Evidence will be expressed in terms of specific quality requirements or characteristics. These characteristics are identified in drawings, specifications, and other documents which describe the item, process, or procedure.) (per NPR 8705.2, Human-Rating Requirements for Space Systems).

Observation. A condition that is not contrary to or in violation of documented requirements but, in the judgment of an auditor, warrants additional information, clarification, or improvement.

Residual Risk. Any risk that remains after all mitigation and controls have been applied.

Residual Risk Profile. A summary of individual safety and/or mission success residual risks associated with the program/project. These individual risks may be associated with technical issues, minority opinions, establishment of requirements, nonconformance with requirements, lack of process/organizational capability, and institutional, facility, or operational related risks. It is presented as a severity vs. likelihood matrix per the program/project risk management plan.

Risk. The combination of the probability that a program or project will experience an undesired

event (some examples include a cost overrun, schedule slippage, safety mishap, health problem, malicious activities, environmental impact, failure to achieve a needed scientific or technological breakthrough or mission success criteria) and the consequences, impact, or severity of the undesired event, were it to occur. Both the probability and consequences may have associated uncertainties (per NPR 7120.5, NASA Program and Project Management Processes and Requirements).

Safety. Freedom from those conditions that can cause death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment (per NPR 8715.3, NASA Safety Manual).

Safety and Mission Assurance Manager. An individual assigned from the Center SMA organization to provide SMA support to a specific program/project and to act as liaison between the program/project and the Center SMA organization.

Safety and Mission Assurance Process Requirements. For the purpose of this document, SMA process requirements are defined as those requirements imposed to ensure that safety engineering, reliability engineering, maintainability engineering, and quality assurance processes are in place for Agency programs, projects, facilities, and operations.

Safety and Mission Assurance Technical Requirements. For the purpose of this document, SMA technical requirements are defined as engineering requirements established for assuring the conduct of safe and successful activities and missions. These requirements include both "how to do it" requirements as well as "how to check it" requirements.

Appendix B. Acronyms

BRS	**Baseline Requirements Set**
EPS	Engineering Performance Specification
IFO	Institutional/Facility/Operational
IV&V	Independent Verification and Validation
JPL	Jet Propulsion Laboratory
LLIS	Lessons Learned Information System
NASA	National Aeronautics and Space Administration
NESC	NASA Engineering and Safety Center
NPD	NASA Policy Directive
NPR	NASA Procedural Requirement
OEP	Operations and Engineering Panel
OQE	Objective Quality Evidence
OSMA	Office of Safety and Mission Assurance
PA&R	Programmatic Audit and Review
PBMA-KMS	Process Based Mission Assurance - Knowledge Management System
SMA	Safety and Mission Assurance
SMARR	Safety and Mission Assurance Readiness Review