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SPACE LAUNCH SYSTEM (SLS) PROGRAM SAFETY AND MISSION ASSURANCE (S&MA) REQUIREMENTS

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1.0 INTRODUCTION

1.1 Purpose

This document establishes the programmatic Safety and Mission Assurance (S&MA) requirements for the Space Launch System (SLS) Program. The purpose of the SLS S&MA requirements is to document the minimum S&MA requirements that must be allocated and implemented to help the National Aeronautics and Space Administration's (NASA's) Space Launch System (SLS) achieve the United States (U.S.) mission in space while protecting the public, the astronauts, the NASA workforce, and high-value equipment and property. Collectively, these requirements describe rigorous S&MA analyses and processes, which in turn assure safety and mission success.

1.2 Scope

The S&MA requirements encompass Safety, Reliability, Maintainability, Quality Assurance, Software Assurance, Risk Management, and Probabilistic Risk Assessment (PRA). The Program and Elements shall apply these S&MA requirements during all life cycle phases, beginning at concept development and continuing through disposal or decommissioning (SLS-SMA-GEN-001).

This document contains programmatic requirements. The SLS technical ("design-to" type) S&MA requirements are contained in SLS-SPEC-032, Space Launch System Vehicle Specification, and subordinate documents.

1.3 Applicability and Approach

The SLS S&MA requirements are applicable to the SLS Program and its Elements.

The Program and Element Offices shall apply these requirements to hardware and software designated as flight components, subsystems, systems, flight qualification hardware/software, Ground Support Equipment (GSE), Government Furnished Equipment (GFE), and any associated hazardous operations (SLS-SMA-GEN-002).

Each requirement in this document has a specific requirement number/identifier (e.g., SLS-SMA-GEN-000) that is later referenced in the applicability matrix in Appendix D. The requirements (shall statements) within this document do not require a formal verification plan but are subject to documentation review/approval, audit, surveillance, and inspection activities.

1.3.1 Applicability to "Development" Hardware or Software

When designing and manufacturing hardware and/or software for development purposes, the SLS Program and Elements may tailor these requirements as appropriate to a level commensurate with the risk imposed by the development test(s) in question. The Program and Elements will consider the implications of development test failures or anomalies to the safety of the public and ground personnel, as well as the potential impacts to the SLS Program's cost and/or schedule. The SLS Program and Elements shall document their approach to tailoring these

requirements in a corresponding development test plan, S&MA Plan, or other related plan (SLS-SMA-GEN-003).

Any development test meeting one or more of the criteria below shall be subject to the requirements of this document (SLS-SMA-GEN-004):

a. Involves human subjects.

b. Is carried out on manifested SLS missions, crewed or uncrewed.

c. Data from the test will be used to support the qualification of flight or GSE hardware and/or software.

1.4 Change Authority/Responsibility

Proposed changes, including waivers and deviations, to this document shall be submitted by an SLS Program Change Request (CR) to the SLS Program Control Board for consideration and disposition. All requests will be processed in accordance with SLS-PLAN-008, Space Launch System Program Configuration Management Plan (SLS-SMA-GEN-005). Any changes will require approval, at the SLS Program Control Board, by the SLS Chief S&MA Officer (CSO) as the S&MA Technical Authority.

The SLS CSO will assure that any deviation/waiver requests are processed in a manner that is consistent with NASA-STD-8709.20, Management of Safety and Mission Assurance Technical Authority Requirements.

The appropriate NASA Office of Primary Responsibility (OPR) identified for this document is Marshall Space Flight Center (MSFC) S&MA Directorate.

2.0 DOCUMENTS

2.1 Applicable Documents

The following documents include specifications, models, standards, guidelines, handbooks, and other special publications. The documents listed in this paragraph are applicable to the extent specified herein. Unless otherwise stipulated, the most recently approved version of a listed document shall be used. In those situations where the most recently approved version is not to be used, the pertinent version is specified in this list.

ANSI NCSL Z540.3-2006	Requirements for the Calibration of Measuring and Test Equipment
ANSI Z136.1-2007	American National Standard for Safe Use of Lasers
AS 9100	Quality Management Systems: Aviation, Space & Defense Organizations
GIDEP S0300-BU-GYD-010	Government-Industry Data Exchange Program (GIDEP) Requirements Guide
GIDEP SO300-BT-PRO-101	Government-Industry Data Exchange Program (GIDEP) Operations manual
NASA SP-2007-6105	NASA Systems Engineering Handbook
NASA-STD-8709.20	Management of Safety and Mission Assurance Technical Authority Requirements
NASA-STD-8717.9	Standard for Lifting Devices and Equipment
NASA-STD-8719.10	Standard for Underwater Facility and Non-Open Water Operations
NASA-STD-8719.11	Safety Standard for Fire Protection
NASA-STD-8719.13	NASA Software Safety Standard
NASA-STD-8719.7	Facility System Safety Guidebook
NASA-STD-8739.8	Software Assurance Standard

NPD 8730.1	Metrology and Calibration
NPR 7150.2	NASA Software Engineering Requirements
NPR 8621.1	NASA Procedural Requirements for Mishap and Close Call Reporting, Investigation, and Recordkeeping
NPR 8705.6B	Safety and Mission Assurance Audits, Reviews, and Assessments
NPR 8715.3	NASA General Safety Program Requirements
NPR 8735.2	Management of Government Quality Assurance Functions for NASA Contracts
SLS-PLAN-001	Space Launch System Program Plan
SLS-PLAN-008	Configuration Management Plan for the Space Launch System Program
SLS-RQMT-015	Space Launch System Program Hazard Analysis Requirements Document
SLS-RQMT-016	Space Launch System Program Failure Modes and Effects Analysis/Critical Items List (FMEA/CIL) Requirements Document

2.2 Reference Documents

The following documents contain supplemental information to guide the user in the application of this document.

AS 9003	Inspection and Test Quality System
ISO 9001	Quality Management System
NASA-STD-8719.12	Safety Standard for Explosives, Propellants, and Pyrotechnics
NASA-STD-8719.14	Process for Limiting Orbital Debris
NASA-STD-8719.17	NASA Requirements for Ground-Based Pressure Vessels and Pressurized Systems (PV/S)
NPD 1800.2	NASA Occupational Health Program
NPD 8700.1	NASA Policy for Safety and Mission Success
NPD 8710.5	NASA Safety Policy for Pressure Vessels and Pressurized Systems

NPD 8730.5	NASA Quality Assurance Program Policy
NPR 1800.1	NASA Occupational Health Program Procedure
NPR 8705.2	Human-Rating Requirements for Space Systems
NPR 8705.5	Technical Probabilistic Risk Assessment (PRA) Procedure for Safety and Mission Success for NASA Programs and Projects
NPR 8715.1	NASA Occupational Safety and Health Program
NPR 8715.2	NASA Emergency Preparedness Procedural Requirements
NPR 8715.5	Range Flight Safety Program
NPR 8715.6	NASA Procedural Requirements for Limiting Orbital Debris
SLS-SPEC-032	Space Launch System Vehicle Specification
<**TBD-003**>	SLS Program Tailored Range Safety Requirements

3.0 GENERAL S&MA REQUIREMENTS

3.1 Program Management

The Program Manager and Element Managers have responsibility for the safety and mission success of their respective Program/Elements. As part of fulfilling this responsibility, they shall implement an S&MA program which includes (SLS-SMA-GEN-008):

a. The identification of applicable S&MA requirements.

b. Establishing formal decision-making processes which are consistent with SLS-PLAN-001, SLS Program Plan.

SLS Program/Element Managers shall be responsible for the flow down of applicable S&MA requirements to the Element and any related contracts, memoranda of understanding, and other agreements (SLS-SMA-GEN-009). This includes organizations that provide products or services to SLS. These organizations may include other NASA Programs or Centers, other governmental entities, international partners, or contractors.

3.2 Contracts

SLS Program/Element Managers shall write contracts to hold contractors accountable for the safety of their employees, their services, and their products in accordance with NASA requirements (SLS-SMA-GEN-010).

The Element Office(s) shall flow applicable requirements from this document to a Prime Contractor, as noted in Appendix D (SLS-SMA-GEN-011).

3.3 Safety and Mission Assurance Plans

The Program shall develop an S&MA Plan, which addresses the Program Office and each Element Office S&MA program and will include the following information (SLS-SMA-GEN-012):

a. Description of the S&MA organizational structure.

b. Description of the S&MA roles and responsibilities, including Safety, Reliability, Maintainability, PRA, Quality, Software Assurance, and Risk Management.

c. Summary of the S&MA tasks to be performed throughout the Program life cycle.

d. Description of key external interfaces.

Similarly, each Element and/or performing Organization shall document and maintain an S&MA Plan describing how it will comply with the S&MA requirements (SLS-SMA-GEN-013). These plans may be in either a single document or multiple documents (TBR-001).

The Element S&MA Plan shall include (SLS-SMA-GEN-014):

a. Description of the S&MA organizational structure and relation to the Prime Contractor's organizational structure (if applicable).

b. Description of the S&MA roles and responsibilities.

c. Summary of the S&MA tasks to be performed throughout the Program life cycle.

d. Description of key external interfaces.

3.4 Human Rating

The SLS Program will assure that the human rating process is followed and inputs are delivered to the Multi-Purpose Crew Vehicle (MPCV) Program for the Human-Rated Certification Package as defined in the Cross Program Task Agreement. The technical Human-Rating requirements are in SLS-SPEC-032, Space Launch System Vehicle Specification, and subordinate documents.

3.5 Reviews

3.5.1 S&MA Pre-Flight Assessment

In preparation for the Certification of Flight Readiness (CoFR) reviews and the Safety and Mission Success Review, the Program/Element Chief Safety and Mission Assurance Officers (CSOs) chair the Pre-Flight Assessment (PFA) reviews, which consist of the Hardware and Software S&MA developers certifying their readiness for flight (SLS-SMA-GEN-015).

The objective of these reviews is to determine S&MA's flight readiness position by assessing, at a minimum, the status of the items below:

- Hazard Analysis Reports have been satisfactorily completed in accordance with the SLS S&MA Requirements.
- All Hazard Reports have been approved and all applicable review findings have been successfully closed.
- All hazard control verifications have been satisfactorily completed or have been formally incorporated into any planned work.
- Failure Modes and Effects Analysis/Critical Item Lists (FMEA/CILs) have been satisfactorily completed in accordance with the SLS S&MA Requirements, and CIL Retention Rationale has been satisfactorily completed or have been formally incorporated into any planned work.
- Limited Life Items – any limited life items are within time, cycle, and age life.
- Design Verification –the design has been satisfactorily verified to be in compliance with applicable requirements.
- Hardware/Software Acceptance.

  - Hardware and software conforms to released engineering and any departures have been documented in the applicable nonconformance reporting system.
  - All nonconformances have been satisfactorily dispositioned in accordance with SLS nonconformance and Material Review Board (MRB) requirements.
  - Government Mandatory Inspection Points (GMIPs) have been completed.
  - Any surveillance/audit findings applicable to the hardware/software in question have been satisfactorily dispositioned.

- PRA has been satisfactorily completed and shows compliance with applicable Loss of Crew/Loss of Mission (LOC/LOM) requirements.
- Deviations/Waivers – have been reviewed and S&MA concurs with their disposition.
- Acute Launch Emergency Restraint Tip (ALERTS) – Government-Industry Data Exchange Program (GIDEP) ALERTS and any NASA Advisories have been satisfactorily dispositioned.
- Operational Test and Verification Requirements for KSC processing, test, and checkout have been reviewed and concurred with by S&MA.
- Launch Commit Criteria (LCCs) – Concur that all necessary LCCs are in place.
- Range Safety – SLS Range Safety Requirements have been satisfied.
- Any Open issues have been identified and a satisfactory resolution plan exists.
- Any necessary constraints to continued ground processing, including rollout and launch, have been identified. [Note: Rationale must be provided for any proposed constraint(s)]

3.5.2 Safety and Mission Success Reviews

In accordance with Chapter 4 of NPR 8705.6, S&MA Audits, Reviews, and Assessments, a Safety and Mission Success Review (SMSR) is a review held to prepare Agency safety and engineering management to participate in program final readiness reviews preceding flights or launches, including experimental/test launch vehicles, or other reviews as determined by the Agency Chief of S&MA. Prior to each launch, the SMSR provides the knowledge, visibility, and understanding necessary for senior safety and engineering management to either concur or nonconcur in program decisions to proceed with a launch.

To prepare the Office of Safety and Mission Assurance (OSMA) and the Office of the Chief Engineer (OCE) for their participation in the Agency-chaired Flight Readiness Review (FRR), the Program CSO and Program Chief Engineer will be the focal points for planning and coordinating the SMSR.

The Program and Elements CSOs and chief engineers (CEs) will present their respective launch readiness assessment to the OSMA/OCE Chairs at the SMSR.

3.5.3 S&MA Deliverables Review

The S&MA deliverables, such as the hazard analyses, FMEAs, CILs, reliability predictions, etc., are developed during the formation and design concept phase and continuously matured throughout the Program life cycle as designs evolve and operations commence. The analyses shall be formally delivered, reviewed, and evaluated during milestone reviews (SLS-SMA-GEN-018). The purpose of these reviews is to evaluate the status of the system safety and risk analysis, risk management, verification techniques, technical safety requirements, and program implementation throughout all of the phases of the system life cycle.

For each Program/Element milestone review, the following success criteria shall be evaluated – "Safety/Reliability Analyses (e.g., Hazard Analyses, FMEA/CILs, PRA, etc.) meet requirements, are at the appropriate maturity level for this phase of the program's life cycle, and indicate the Program (Element) safety/reliability residual risks will be at an acceptable level" (SLS-SMA-GEN-028).

At each Program/Element milestone review, the Milestone Review Board shall be presented with a summary of the safety analysis, which documents the residual safety risks (SLS-SMA-GEN-019). The focused safety review of the S&MA analyses presented to the Milestone Review Board includes the S&MA analyses (Hazard Analysis, PRA, etc.) which identify the most significant safety risks. The presentation may include the control and verification strategy for the hazard causes, the resulting safety risk, and the identified level of failure tolerance (including identifying if any waivers will be required).

To assure that the safety risk is communicated to the appropriate stakeholders, the Milestone Review Board should include representatives from the stakeholder organizations.

3.5.4 Audits and External Reviews

The SLS Program and Elements shall support any Program Assessment and Review audits performed by or on behalf of the OSMA per NPR 8705.6B, Safety and Mission Assurance Audits, Reviews, and Assessments, Paragraphs 2.2.7 (SLS-SMA-GEN-020).

The Program and Elements shall be subject to Government audits, surveillance, and inspection activities to assure compliance with these SLS S&MA requirements and the associated implementing plans and procedures (SLS-SMA-GEN-021).

3.6 Change Evaluations

S&MA will review any Change Requests (CRs), Waiver requests, and Deviation requests to Program and Element documentation in order to assess these requests for potential impacts to S&MA requirements, safety and mission success risks, and S&MA products. All waivers and deviations submitted for review shall include an S&MA assessment to identify impacts if the request is approved (SLS-SMA-GEN-023).

The S&MA impact for every CR, Waiver, or Deviation that is proposed to the Program baseline shall be documented (even if the statement is "No Impact") (SLS-SMA-GEN-024).

Following the approval of CRs that affect an S&MA analysis, the S&MA analysis shall be revised prior to the next milestone review (SLS-SMA-GEN-025).

3.7 Use of Contractors and DCMA

NASA reserves the right to employ support contractor(s) and the Defense Contract Management Agency (DCMA) in the performance of S&MA activities. When an assurance contractor is used, the assurance contractor personnel shall be independent of product-development contractor personnel (SLS-SMA-GEN-026).

3.8 Use of Commercial-Off-the-Shelf and Heritage Hardware/Software

The SLS Elements shall participate in the evaluation and selection of commercial off-the-shelf (COTS) and/or heritage hardware and software to assure that their use will not impact the ability to comply with SLS requirements and include the following (SLS-SMA-GEN-027):

a. A comparison of the applicable SLS performance, design, safety, reliability, quality assurance, interface, manufacturing, processing, qualification, and acceptance test requirements with those attributes of the COTS or heritage item to determine the suitability of the COTS or heritage item for its intended SLS application.

b. The review and assessment of pertinent Reliability and Maintainability (R&M) data (e.g., failure history, failure modes, reliability predictions, demonstrated reliability, maintainability, etc.) to determine the suitability of the COTS or heritage item for its intended SLS application.

c. The documentation of the evaluation results and recommended design modifications or additional controls to assure compliance with applicable SLS requirements.

4.0 SAFETY

As stated in NPD 8700.1, NASA Policy for Safety and Mission Success, the objectives of the NASA Safety Program are to protect the public and employees from harm, and positively affect the overall success rate of missions and operations through preventing damage to high-value equipment and property.

4.1 Safety Planning

Each Element shall develop, document, and maintain a Safety Plan that identifies a system for managing safety by identifying, assessing, and analyzing hazards to eliminate, reduce, or control the hazard (SLS-SMA-SAF-001). The Safety Plan may be a stand-alone document or part of the overall S&MA Plan. The Element Safety Plan shall describe how the Element will comply with the Safety requirements and include (SLS-SMA-SAF-002):

a. Description of the S&MA organizational structure and relation to the Prime Contractor's organizational structure (if applicable).

b. Description of the Safety Engineering roles and responsibilities.

c. Description of the Safety Engineering tasks to be performed for the duration of the Element life cycle.

d. Description of key interfaces.

e. Description of Industrial Safety/Occupational Health system.

f. Description of the coordination between Program and Element Offices, System Safety, Industrial Safety/Occupational Health, Test and Operation Safety organizations, and NASA Centers to assure an effective and integrated total safety effort for each Element and to avoid redundant effort among technical disciplines.

g. Description of the process for acceptance of residual risk.

Each NASA Element Office shall review and approve the respective Prime Contractor's Safety plan (SLS-SMA-SAF-003) TBR-002.

4.2 Hazardous Operations and Test

In accordance with NPR 8715.3, NASA General Safety Program Requirements, hazardous operations and activities are defined as any operation or other work activity that, without implementation of proper mitigations, has a high potential to result in loss of life, serious injury to personnel or public, or damage to property due to the material or equipment involved or the nature of the operation/activity itself.

The Program/Elements shall assess all operations and tests to identify those that are considered hazardous or safety critical, or contain a level of risk that, if misused or mishandled, have a high potential to result in loss of life, serious injury or illness to personnel, or damage to systems, equipment, or facilities (SLS-SMA-SAF-004). The Program/Elements shall perform hazard

assessments and develop hazardous operating procedures for each hazardous operation and/or test identified in facilities they own and/or operate (SLS-SMA-SAF-005). Hazardous operations/tests may include manufacturing/assembly operations, transportation activities, ground tests, or flight operations.

The Program/Elements shall develop a test plan that describes a formal process to identify potential hazards and the safety control methods needed (as determined by a test hazard analysis), so that injury, illness, or loss of critical test hardware is mitigated prior to starting any operation, process, or testing involving hazardous operations and activities (SLS-SMA-SAF-006).

The Program/Elements shall assure that the appropriate hazard/risk mitigation technique or combinations of techniques are implemented to eliminate, reduce, or control the hazards/risks (SLS-SMA-SAF-007). The hazard/risk reduction precedence sequence is described in detail in SLS-RQMT-015, SLS Program Hazard Analysis Requirement Document.

The Program/Elements shall perform readiness reviews [Operational Readiness Inspection (ORI), Safety Readiness Team (SRT), Operational Readiness Review (ORR), or Test Readiness Review (TRR)], at a level to assure the appropriate level of management to accept the residual risk, prior to performing any operation or test which (SLS-SMA-SAF-008):

a. is potentially hazardous or a high risk to personnel or hardware;

b. has high risk in terms of Program importance;

c. involves test hardware, facilities, or effort having high-dollar value; and

d. involves test of flight hardware and/or software.

At a minimum, the readiness review shall assure that the hazards and risks associated with the hazardous operation, test, facilities, and equipment have been identified and mitigated to an acceptable level and are accepted by the appropriate level of management based on the risk level before proceeding with the operation or test (SLS-SMA-SAF-009).

[Note: By their nature, launches are hazardous. Flight Readiness Reviews (FRRs) are held in lieu of ORIs or TRRs for launches.]

Employees are empowered to call for the halt of any process, operation, or test when they believe there is a potential to result in loss of life, serious injury/illness to personnel or public, or damage to property or the environment and request a safety risk assessment by a trained and/or certified individual. If the activity is deemed unsafe, corrective actions needed to safe the process, operation, or test shall be implemented prior to restarting (SLS-SMA-SAF-010).

4.2.1 Hazardous Operations and Test Procedures

The Program and Elements shall identify, assess, and analyze operations, processes, and test activities that involve NASA property or equipment and develop adequate safety controls for the operations, processes, and test (SLS-SMA-SAF-011). The control methods, at a minimum,

include the development and implementation of Operating and/or Test Procedures. Operating and/or Test Procedures shall be developed and implemented for all operations and test activities identified as hazardous, safety critical, or contain a level of risk that, if misused or mishandled, have a high potential to result in loss of life, serious injury or illness to personnel, or damage to systems, equipment, or facilities (SLS-SMA-SAF-012). Operating and Test Procedures shall be written so that they provide a detailed plan that lists the step-by-step functions to be performed during the operation, process, or test to assure safe and efficient operations and be approved by the NASA and/or Contractor Safety Office (SLS-SMA-SAF-013). The Program and Element Offices shall identify the operations, processes, and test activities that are considered hazardous, safety critical, or contain the level of risk that can result in employee injury or property damage and are required to comply with NPR 8715.3, NASA General Safety Program Requirements, Chapter 3, Operational Safety (SLS-SMA-SAF-014).

4.2.2 Training and Certification

The Program and Elements shall develop and implement a training and certification program for personnel who perform hazardous, safety critical, or potentially high-risk operations, processes, or tests, or use or transport hazardous material to assure personnel have the necessary knowledge, skill, judgment, and physical ability (if specified in the job classification) to do the job safely (SLS-SMA-SAF-015). The training and certification program shall, at a minimum, include training (classroom or on-the-job), written examination, proficiency test (as necessary), periodic refresher training, and a recertification period that does not exceed a 4-year interval (SLS-SMA-SAF-016). The Program and Elements shall assure that only trained and/or qualified/certified personnel, as required, are permitted to perform operations, processes, and tests identified as hazardous, safety critical, or potentially high risk (SLS-SMA-SAF-017).

The Program and Elements shall assure that the training and certifications are maintained and current (SLS-SMA-SAF-018). The Program and Elements shall identify the operations and processes that will require the employees directly involved in performing the operation or process to be designated as qualified and obtain a safety certification as required by NPR 8715.3, NASA General Safety Program Requirements, Chapter 7, Safety Training and Personnel Certification (SLS-SMA-SAF-019).

4.3 System Safety

The SLS Program and Elements shall establish a System Safety activity to (SLS-SMA-SAF-020):

a. Implement a formal, closed-loop, risk acceptance system, as defined in the SLS S&MA Plan, which will systematically identify and track hazards, their associated causes, controls, and verifications throughout the Program's life cycle.

b. Assure residual safety risks are characterized and formally accepted by the Program Manager or delegated programmatic approval authority.

c. Assure that the system safety analyses are captured as part of the Program's technical baseline and support trade studies as applicable.

4.3.1 Hazard Analysis

The Program and each Element shall perform hazard analyses in accordance with SLS-RQMT-015, SLS Program Hazard Analysis Requirement Document (SLS-SMA-SAF-021), which describes the required Hazard Analysis activity including:

a. Identifying hazards and their associated causes.

b. Either eliminating identified hazards/causes or identifying verifiable hazard controls.

c. Verifying that the hazard controls are in place.

d. Providing a qualitative risk assessment of each hazard cause to characterize the residual safety risk.

Note: Quantitative methods may be used if the person responsible for accepting the risk finds that the qualitative methods do not provide an adequate understanding of the probabilities for failures, undesired events, or the consequences of hazards or potential failures (reference NPR 8705.5, Technical Probabilistic Risk Assessment (PRA) Procedures for Safety and Mission Success for NASA Programs and Projects).

4.4 Range Safety

The Program and Elements will comply with <**TBD-005**>, SLS Program Tailored Range Safety Requirements, as required by SLS-SPEC-032, SLS Vehicle Specification Document. These requirements will be tailored from NPR 8715.5, Range Flight Safety Program.

4.5 Orbital Debris

If the Program or Element has the potential to create orbital debris, it will conduct mission orbital debris assessments in accordance with NPR 8715.6A, NASA Procedural Requirements for Limiting Orbital Debris and NASA-STD-8719.14, Process for Limiting Orbital Debris, to determine the potential for orbital debris generation as invoked in the SLS-SPEC-032, Space Launch System Vehicle Specification, and subordinate documents. Per NPR 8715.6, NASA Procedural Requirements for Limiting Orbital Debris, Orbital Debris is defined as any object placed in space by humans that remains in orbit, no longer serves any useful function, exceeds 100 km (~62 mi) in altitude, and achieves or exceeds Earth orbital velocity. Objects may range from spacecraft to spent launch vehicle stages to components, and may also include materials, trash, refuse, fragments, and other objects which are overtly or inadvertently cast off or generated.

4.6 Industrial Safety

The Program and each Element performing activities on a NASA Center or at a NASA-managed facility (e.g., Michoud Assembly Facility) shall assure that activities, processes, operations, and

tests are conducted in compliance with applicable Federal, State, Agency, and Center safety requirements (SLS-SMA-SAF-022). Similarly, the Program and Elements shall assure that applicable safety and health requirements are included in contracts (SLS-SMA-SAF-023). The Program and Elements shall assure compliance with the latest revision of the NPD, NPR, and NASA Standard (SLS-SMA-SAF-024).

The Industrial Safety in the context of these requirements is focused on the prevention of occupational injuries and illnesses, while eliminating, reducing, and controlling hazards and risks that are directly associated with ground-based activities, processes, operations, and tests.

NOTE: The following NASA Procedural Requirements (NPRs), NASA Policy Directives (NPDs), and NASA Standards provide applicable industrial safety and occupational health requirements for contracts:

a. NPD 1800.2, NASA Occupational Health Program

b. NPR 1800.1, NASA Occupational Health Program Procedure

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

d. NPD 8710.5, NASA Safety Policy for Pressure Vessels and Pressurized Systems

e. NPR 8715.1, NASA Occupational Safety and Health Programs

f. NPR 8715.2, NASA Emergency Preparedness Procedural Requirements

g. NPR 8715.3, NASA General Safety Program Requirements

h. NASA-STD-8719.7, Facility System Safety Guidebook

i. NASA-STD-8719.9, Standard for Lifting Devices and Equipment

j. NASA-STD-8719.10, Standard for Underwater Facility and Non-Open Water Operations

k. NASA-STD-8719.11, Safety Standard for Fire Protection

l. NASA-STD-8719.12, Safety Standard for Explosives, Propellants and Pyrotechnics

m. NASA-STD-8719.17, NASA Requirements for Ground-Based Pressure Vessels and Pressurized Systems (PV/S)

Each Element performing operations that involve the use of ground-based Pressure Vessels and Pressurized Systems (PV/S) that contain commodities considered as hazardous, or where their release may result in toxic, fire, or explosion hazards, or if the PV/S connects directly to NASA property or equipment, or NASA has determined the PV/S poses a risk to NASA personnel or equipment, the PV/S shall comply with 29 CFR Part 1910 Subpart H, 29 CFR Part 1910.119, 29 CFR Part 1910.169 and 49 CFR Department of Transportation (DOT), American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (B&PVC), Compressed Gas Association (CGA), American National Standards Institute (ANSI/NB-23) National Board

Inspection Code, National Fire Protection Association (NFPA) applicable for the PV/S being used (SLS-SMA-SAF-025).

The Program and Elements operating lifting equipment that directly connects to or moves NASA property or equipment shall comply with 29 CFP Part 1910.178, 29 CFR Part 1910.179, 29 CFR Part 1910.180, 29 CFR 1910.181, and 29 CFR 1910.184, as applicable (SLS-SMA-SAF-026). The Program and Elements shall identify the lifting equipment that is required to comply with NASA-STD-8719.9, Standard for Lifting Devices and Equipment, when directly connected to or used to move NASA property or equipment (SLS-SMA-SAF-027).

Each Element performing operations that involve the use of explosives, propellants, or pyrotechnics while operating or testing NASA property or equipment shall develop and implement an Explosive Safety Program that is, at a minimum, compliant with Department of Defense (DoD) 6055.9, Department of Defense Ammunition and Explosive Safety Standards (SLS-SMA-SAF-028).

Each Element performing operations that involve the use of radiation-producing devices, such as lasers, while operating or testing NASA property or equipment, shall develop and implement a Radiation Safety Program that is, at a minimum, compliant with 21 CFR Part 1010, Performance Standards for Electronic Products: General, 21 CFR Part 1040, Performance standards for Light Emitting Products, 29 CFR 1910.97, “Nonionizing Radiation,” 29 CFR Part 1926.54, “Nonionizing Radiation,” ANSI Z136.1-2007, American National Standard for Safe Use of Lasers, Institute of Electrical and Electronics Engineers (IEEE) Standard C95.1, IEEE Standard for Safety levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHZ to 300 GHz, and IEEE C95.2, Radio-Frequency Energy and Current Flow Symbols (SLS-SMA-SAF-029). The Program and Elements shall identify which operations involve the use of radiation-producing devices while operating or testing NASA equipment and property, and if these operations are required to comply with NPR 8715.3, NASA General Safety Program Requirements, Chapter 3, Operational Safety (SLS-SMA-SAF-030).

The Program and Element Offices shall identify facilities that contain NASA high-valued equipment and property, and if these facilities are required to comply with NASA-STD-8719.7, Facility System Safety Guidebook and/or NASA-STD-8719.11, Safety Standard for Fire Protection (SLS-SMA-SAF-031).

The Program and Element Offices shall identify operations that involve underwater or open water operations and if these operations are required to comply with NASA-STD-8719.10, Standard for underwater Facility and Non-Open Water Operations (SLS-SMA-SAF-032).

4.7 Mishap Readiness and Contingency Action Planning

NPR 8621.1, NASA Procedural Requirements for Mishap and Close Call Reporting, Investigation, and Recordkeeping, provides requirements that specify how to respond to any mishap or close call, from discovery through corrective action and closure. The objective of mishap and close call investigations is to improve safety by identifying what happened, where it

happened, when it happened, why it happened, and what should be done to prevent recurrence and reduce the number and severity of mishaps.

To assure proper mishap or close call investigation and in accordance with NPR 8621.1, NASA Procedural Requirements for Mishap and Close Call Reporting, Investigation, and Recordkeeping, the SLS Program shall develop a single Mishap Readiness and Contingency Action Plan for all Program/Element activities, from initial system configuration through system decommissioning (SLS-SMA-SAF-033). This plan shall include the following (SLS-SMA-SAF-034):

a. A comprehensive plan for all mishaps and close calls that occur offsite, at offsite Program/Element (as defined by NPR 7120.5) contractor sites, or in flight.

b. Consistent with the Centers' Mishap Preparedness and Contingency Plans, for all Centers in which the Program operates.

c. Any information and procedures required specifically by the Program that are not covered in the Centers' Mishap Preparedness and Contingency Plans (i.e., special procedures for safing, handling, or containing hazardous chemicals present in the Program's/Elements' hardware).

d. Description of the procedures to comply with NPR 8621.1 notification, reporting, investigating, and recording requirements for all Program/Element activities not located at a Center or managed by a Center (e.g., Program/Element activities managed by Headquarters and located at a University, contractor site, or other off-Center location).

e. Description of the training requirements and the Interim Response Team's (IRT's) membership for mishaps and close calls that occur offsite, at offsite Program/Element (as defined by NPR 7120.5) contractor sites, or in flight.

f. Description of any special procedures for the emergency response personnel, the IRT, and the incident commander that are not covered in the Center Mishap Preparedness and Contingency Plan or the emergency response plan (e.g., identification and handling of hazardous commodities specific to the Program).

g. Description of the procedures to impound data, records, equipment, facilities, and property not located at a NASA facility.

h. Identification of existing memoranda of agreement with national, state, and local organizations and agencies that may be utilized during a mishap investigation.

i. Description of how offsite debris will be collected, transported, and stored.

j. Description of the investigation and debris collection process required for any mishap or close call occurring in a foreign country.

k. Documentation that, for NASA-investigated mishaps, NASA personnel will perform and control the impounding process.

l. Lists of the personnel who will assist in performing the procedures to impound data, records, equipment, facilities, and other property.

m. Identification of the national, state, and local (and, where applicable, international) organizations and agencies which are most likely to take part in debris collection; identifies the roles and responsibilities of each organization; and identifies a point of contact.

n. The responsibilities and procedures for mishap investigation in the bilateral or multilateral agreements when the program involves international partners, program managers, and element managers.

o. Description of the resources that may be needed from other government agencies [e.g., Federal Emergency Management Agency (FEMA), National Transportation Safety Board (NTSB), DoD, Department of Justice (DOJ)] during a Type A mishap or Type B mishap investigation; identifies the point of contact and contact information for each of these Agencies; describes the procedures to acquire their assistance; and identifies the potential roles and responsibilities of each Agency.

p. List of information such as databases, Web sites, documentation (including hardware history), drawings, basic system operation, and procedures that may be scrutinized in a Type A mishap involving loss of a vehicle and/or major facility damage, frequently updates this information so that it is easily deliverable to a mishap investigation board, and includes points of contact for the information.

q. Description of the information technology (IT) plan to provide computer data retrieval and data archive support to the investigating authority

r. Description of the requisite security clearances, if any, for investigating authority members, chair, and ex-officio participating in Program/Element investigations.

s. Description of the “chain of custody process” that will be used to secure and safeguard personal effects and sensitive information related to injured or deceased individuals.

t. Names of key personnel from the Agency Public Affairs Office and Office of External Relations (OER) that should be notified for all Type A and Type B mishaps.

u. Expiration date.

v. Description of appropriate steps to be taken in advance to assure that assigned IRT and potential Mishap Investigation Board (MIB) members have authority and resources (including, but not limited to, travel, contractual authority, and salaries) to expeditiously deploy to the mishap scene, effectively preserve mishap evidence, interview witnesses, and conduct an orderly investigation without administrative delay.

4.7.1 Mishap Preparedness and Contingency Plan Approval

The SLS Program shall approve the Mishap Readiness and Contingency Action Plan, verifying that it has the content required above, prior to submittal for the Chief, OSMA's signature (SLS-SMA-SAF-035).

Prior to approval of the Mishap Readiness and Contingency Action Plan, the Program shall, at a minimum, have the appropriate NASA Offices, General Counsel, Office of Public Affairs (OPA), Office of External Relations (OER), and Centers (all Centers at which the Program/Element has activities), review and comment on the Plan (SLS-SMA-SAF-036).

The Program Manager (or designee) shall provide the Program/Element Mishap Readiness and Contingency Action Plan to OSMA/Safety and Assurance Requirements Division (SARD), for posting on the NASA Mishap Investigation Web site, prior to the first SLS Safety and Mission Success Review (SMSR) (SLS-SMA-SAF-037).

4.7.2 Mishap Preparedness and Contingency Plan Practice and Implementation

In accordance with NPR 8621.1, NASA Procedural Requirements for Mishap and Close Call Reporting, Investigation, and Recordkeeping, the Program/Element Mishap Readiness and Contingency Action Plan, including emergency response where appropriate, shall be practiced (SLS-SMA-SAF-038):

a. During contingency simulations that occur prior to a major test, launch, or space activity.

b. At least every 18 months for repeated major test, launches, and space activities.

c. At the conclusion of the simulation, the Program/Elements shall identify any deficiencies in the Mishap Preparedness and Contingency Plan, update the plan as needed, and/or take other necessary corrective actions to assure that the plan can be effectively implemented if a mishap occurs (SLS-SMA-SAF-039).

   Note: Practice is intended to mean tabletop and/or full enactment simulations (where possible).

The Program and Elements shall (SLS-SMA-SAF-040):

a. Concur on the Program/Element Mishap Preparedness and Contingency Plan.

b. In the event of a mishap, activate the Program/Element Mishap Preparedness and Contingency Plan.

c. Provide funding and support for investigations within the Program jurisdiction or involving Program hardware and facilities.

d. Assist the investigating authority as requested.

e. When tasked by the appointing official, develop the Corrective Action Plan (CAP), implement the CAP, support the Center safety office personnel as they verify that the CAP has been completed, and generate the lessons learned.

5.0 RELIABILITY AND MAINTAINABILITY

The SLS Program and Elements shall implement a Reliability and Maintainability (R&M) program, in accordance with the requirements of this document, which is an integral part of the SLS concept, design, development, fabrication, test, and operational phases (SLS-SMA-RM-001).

5.1 R&M Management and Control

5.1.1 R&M Plan

The SLS Program and Elements shall develop and implement an R&M Plan that serves as the master planning and control document for the R&M Program, and includes the following (SLS-SMA-RM-002):

a. Description of the R&M organizational structure and its functions.

b. The interface between and the relationship of the R&M management organization to other program/element organizations.

c. Description of the R&M tasks to be performed for the program, including task schedules mapped to major milestones, which describe in detail the plan for execution and management of each task.

d. The relationship of R&M program tasks to verification of program design and operational R&M requirements.

e. Identification of each organization/discipline involved in meeting R&M program requirements (e.g., design engineering, manufacturing engineering, system safety engineering, quality engineering, logistics engineering, etc.), the basic R&M-related tasks they perform, and their responsibilities for R&M verification.

f. Description of critical task-related inputs/outputs associated with the R&M tasks.

The R&M Plan may be a standalone document or part of the overall S&MA Plan.

5.1.2 R&M Data and Databases

The SLS Program and Elements shall collect and maintain empirical reliability and maintainability data generated during SLS design, development, qualification/acceptance testing, production, and operation in an SLS R&M database to support SLS R&M analyses and other projects' reliability and maintainability programs (SLS-SMA-RM-003).

The specific R&M data elements, hardware indenture level at which they are to be collected and reported, and timeframe for the data collection, shall be jointly determined by the SLS Program and Elements based on Program and Element analysis needs, and documented in Element R&M plans (SLS-SMA-RM-004). Typical R&M data elements to be considered include accumulated operating time/cycles, number of observed failures, predicted or estimated failure rate, mean time between failure, and mean time to repair.

5.1.3 Limited Life Items

The SLS Elements shall identify limited life items and assure that they are tracked and controlled such that their operating characteristics will not be degraded beyond acceptable limits, including consideration for total mission time/cycles and safety factor margins, accumulated time and/or cycles at time of shipment, and required time and/or cycles that must be remaining prior to conducting each major milestone test and launch (SLS-SMA-RM-006). A limited life item is any item designated as having a limited useful life, regardless of whether it is a limited operating life, limited shelf life, operating life sensitivity, or combinations of these.

5.2 Reliability Engineering

The SLS reliability program implements the following reliability engineering activities to assure that reliability is designed into the system, continuously evaluated through qualitative and quantitative analyses, and verified and validated through analysis and test.

5.2.1 Reliability Requirement Development and Allocation

The SLS Program shall establish quantitative launch vehicle reliability requirements consistent with SLS mission risk requirements (e.g., LOC/LOM, Launch Availability) and allocate them to SLS elements for both the prelaunch and flight mission phases (SLS-SMA-RM-007). The SLS Elements shall assure that the quantitative reliability requirements are sub-allocated to element hardware and software to serve as design requirements (SLS-SMA-RM-008).

5.2.2 Reliability Modeling and Analysis

The SLS Program and Elements shall perform reliability modeling and analysis concurrently with the design process and jointly with design engineering (SLS-SMA-RM-008). Results shall be used to assess design compliance with reliability requirements, provided as feedback to SLS design, used to support design trades, and input as needed to other related analyses (e.g., PRA, logistics support analysis, etc.) (SLS-SMA-RM-010).

Reliability models and predictions shall be developed for SLS flight hardware/software and updated throughout the SLS life cycle to incorporate updates in analytical and empirical data collected during design, development, testing, processing, and operations (SLS-SMA-RM-011). Reliability predictions shall include assessment of design processes, design drivers, manufacturing variability, and design sensitivity (SLS-SMA-RM-012).

5.2.3 Failure Modes and Effects Analysis/Critical Items List

The SLS Elements shall develop a Failure Modes and Effects Analysis/Critical Items List (FMEA/CIL) for all SLS flight hardware/software and critical ground support equipment in accordance with SLS-RQMT-016, SLS Program FMEA/CIL Requirements Document (SLS-SMA-RM-013).

The SLS Elements shall assure that hardware test, inspection, and operational controls that form the basis for the CIL retention rationale are identified and tracked to assure that they are successfully implemented prior to flight (SLS-SMA-RM-014).

CIL retention rationale implementation status shall be formally reported at each Element's Design Certification Review (DCR) and at the vehicle System Acceptance Review (SLS-SMA-RM-015).

CIL retention rationale shall be verified complete at the vehicle Flight Readiness Review (FRR), except where forward work has been recorded in other formal requirement tracking systems (Operations and Maintenance Requirements and Specification Document (OMRSD), Launch Commit Criteria, etc.) (SLS-SMA-RM-016).

5.2.4 Government-Industry Data Exchange Program Participation

The SLS Program and Elements shall participate in the Government-Industry Data Exchange Program (GIDEP) in accordance with the requirements of the GIDEP Operations Manual (GIDEP S0300-BT-PRO-101) and the GIDEP Requirements Guide (S0300-BU-GYD-010) (SLS-SMA-RM-017).

The Performing Organization/ Contractor shall review all GIDEP ALERTS, GIDEP SAFE-ALERTS, GIDEP Problem Advisories, GIDEP Agency Action Notices, and NASA Advisories to determine if they potentially affect the SLS Program's/Elements' products produced for NASA (SLS-SMA-RM-023). For GIDEP ALERTS, GIDEP SAFE-ALERTS, GIDEP Problem Advisories, GIDEP Agency Action Notices, and NASA Advisories that are determined to affect the Program, the Performing Organization/Contractor shall identify and document the known or suspect product in their nonconformance system and take action to eliminate or mitigate any negative effect to an acceptable level (SLS-SMA-RM-024). The Performing Organization/Contractor shall notify the Element Chief Engineer and Chief Safety and Mission Assurance (S&MA) Officer of the impact (SLS-SMA-RM-025).

The Performing Organization/ Contractor shall generate the appropriate failure experience data report(s) (GIDEP ALERT, GIDEP SAFE-ALERT, GIDEP Problem Advisory) in accordance with the requirements of GIDEP S0300-BT-PRO-010 and S0300-BU-GYD-010 whenever failed or nonconforming items, available to other buyers, are discovered during the course of the contract (SLS-SMA-RM-026).

5.3 Maintainability Engineering

The SLS R&M program implements the following maintainability engineering activities to assure ease of maintenance and to minimize system downtime and life cycle costs.

5.3.1 Maintainability Requirement Development and Allocation

The SLS Program shall develop quantitative maintainability requirements from the top-level Launch Availability requirement and allocate them to SLS Elements to serve as design requirements (SLS-SMA-RM-018).

5.3.2 Maintainability Design Criteria

The SLS Elements shall assure the development and implementation of qualitative maintainability design criteria to facilitate ease of corrective and preventive maintenance (SLS-SMA-RM-019).

5.3.3 Maintainability Modeling and Analysis

The SLS Elements shall develop maintainability models and analyses concurrently with the SLS design process and jointly with design engineering (SLS-SMA-RM-020). Results shall be compared to maintainability allocations in order to determine the adequacy of the design, provided as feedback to SLS design, used to support design trades, and as input to other related analyses (e.g., launch availability analysis, logistics support analysis, etc.) (SLS-SMA-RM-021).

The maintainability models and analyses shall be updated throughout the SLS life cycle to incorporate updates in analytical and empirical data collected during design, development, testing, processing, and operations (SLS-SMA-RM-022).

6.0 QUALITY ASSURANCE

As stated in NPD 8730.5, NASA Quality Assurance Program Policy, it is NASA policy to comply with prescribed requirements for performance of work and to provide for independent assurance of compliance through implementation of a quality assurance program.

6.1 Quality System

The Performing Organization/Contractor shall have and maintain a quality system in accordance with AS9100 (SLS-SMA-QA-001). Alternate quality management systems such as ISO9001 or AS9003 may be considered when the work involved is not considered critical and complex. The responsible NASA Element Office shall review and approve the proposed alternate system (SLS-SMA-QA-002).

6.2 Quality Planning

The Performing Organization/Contractor shall document and maintain a Quality Plan that identifies a system for managing Quality risks and describes how the Element will comply with the Quality requirements (SLS-SMA-QA-003). The Quality Plan may be a standalone document or part of the overall S&MA Plan. The Element Quality Plan shall (SLS-SMA-QA-004):

1. Address each element of AS9100 requirements in sufficient detail to describe the philosophy and approach for implementation.
2. Address each of the following applicable requirements (existing policies and procedures may be utilized where these can meet requirements).

Each NASA Element Office shall review and approve the Prime Contractor's Quality Plan (SLS-SMA-QA-005) TBR-003.

6.3 Calibration

The Performing Organization/Contractor's metrology processes shall control the accuracy and reliability of Measuring and Test Equipment (MTE) through the use of a calibration system compliant with the requirements of ANSI NCSL Z540.3-2006, subject to the clarifications and modifications provided in Attachment B of NPD 8730.1 (SLS-SMA-QA-006).

The Program and each Element shall maintain calibration of all test and measuring equipment and safety instruments used to perform measurements associated with the following functions (SLS-SMA-QA-007):

1. Acceptance testing.
2. Inspection, maintenance, or calibration.
3. Flight hardware qualification.
4. Measurement of processes where test equipment accuracy is essential for the safety of personnel or the public.

5. Telecommunication, transmission, and test equipment where exact signal interfaces and circuit confirmation are essential to mission success.

6. Development, testing, and special applications where the specifications, end products, or data are accuracy-sensitive, including instruments used in hazardous and critical applications.

6.4 Nonconforming Product and Material Review Board

The Performing Organization/Contractor shall assure that product which does not conform to product requirements is identified and controlled to prevent its unintended use or delivery (SLS-SMA-QA-008). Hardware procured by the Program and each Element for direct shipment from the vendor or NASA contractor custody shall not be turned over to another NASA Center or NASA contractor, with open nonconformance, without prior NASA approval (SLS-SMA-QA-009).

6.4.1 Nonconformance Reporting

6.4.1.1 Controlled Closed Loop System

The Performing Organization/Contractor shall establish a controlled, closed-loop nonconformance documentation system, complete with appropriate and necessary electronic databases to support timely reporting of product/process nonconformance's and resolution/corrective action (SLS-SMA-QA-010). This Nonconformance reporting system shall (SLS-SMA-QA-011):

1. Support reporting, documenting, technical evaluation for conformance to design requirements, flight and processing safety, risk and quality assessment, nonconformance correction, and verification of preventive/recurrence control actions.

2. Provide a system for maintaining records of discrepancies and their dispositions. In addition, all Material Review Board (MRB) dispositions will be maintained in an electronic database and available to NASA for review.

3. Support the reporting and resolution of those nonconformances discovered by the Performing Organization/Element contractor, subcontractor, and supplier personnel, and the designated Government facility representative(s).

4. Apply to all hardware and software related to flight, Ground Support Equipment (GSE), and other support equipment (defined as those items requiring drawing numbers for configuration control) used for manufacturing, test, and checkout.

The reporting of nonconformances shall apply to all hardware and software, from development and testing stage through operational phases and ultimately to scrap or retirement (SLS-SMA-QA-012).

6.4.1.2 Routine Access to Databases

The Performing Organization/Contractor shall provide designated NASA Element management, engineering, and S&MA personnel, as well as other Government and support personnel, routine access to electronic nonconformance databases for review and approval (where approval is determined to be necessary as provided by NASA management direction) of corrective action steps and for assessment of quality- and safety-related trends in manufacturing, assembly, testing, and flight checkout (SLS-SMA-QA-013).

a. Where Performing Organizations/Contractors elect to use electronic authorizing signatures for nonconformance corrective action (i.e., disposition and supporting rationale), they shall provide designated Government personnel sufficient access availability to those nonconformance electronic databases and reporting systems, for unencumbered support to ongoing operations (SLS-SMA-QA-014).

6.4.2 Maintenance of Records of Material Review Board Actions

In addition, all records of MRB actions shall be maintained in an electronic database and available to NASA for review (SLS-SMA-QA-015). The documents prepared and issued for each discrepancy shall contain, as a minimum (SLS-SMA-QA-016):

1. A unique and traceable number.
2. The nomenclature and identification of the nonconforming article or material.
3. A description of the required characteristic or design criteria and the nonconformance.
4. Cause or reason for the nonconformance.
5. Preventive and/or recurrence control actions taken or recommended.
6. Disposition (remedial action) of the nonconforming article or material.
7. Initiator of the document.
8. Signatures of authorized personnel.
9. Date that the nonconformance occurred.
10. Type of activity being conducted (e.g., fabrication, assembly, qualification test, systems test, pre-delivery or pre-installation acceptance test, etc); reference must be made to applicable procedure numbers.
11. Area function or activity responsible for causing the failure or discrepancy.
12. Reference to documented repair procedure, as applicable.

6.4.3 Material Review Board Review of Nonconforming Articles and Materials

The MRB shall initially review nonconforming articles and material to determine one of the following listed dispositions (SLS-SMA-QA-017). Articles and materials shall be withheld from further processing until appropriate approval is obtained (SLS-SMA-QA-018).

1. *Waivers/Deviations*. Waivers/deviations may be submitted to the Program for approval prior to or as a result of consideration of other dispositions. Each waiver/deviation shall be submitted with written recommendations and proposed remedial and preventive action (SLS-SMA-QA-019).

2. *Return to Supplier*. When an article or material is found to be nonconforming on receipt, it should be returned to the supplier. The Element shall provide the supplier with nonconformance information and assistance, as necessary, to permit remedial and preventive action (SLS-SMA-QA-020).

3. *Use-as-is*. The MRB is authorized to continue using a nonconforming product when it has concluded that the nonconformance does not impact the form, fit, or function of the product, and results in an acceptable level of risk. Analysis or other data supporting the determination that form, fit, and function are not impacted, and risk level, shall be documented within the nonconformance report (SLS-SMA-QA-021).

4. *Repair*. When, in the opinion of the Board, an acceptable repair is possible, repair action shall be authorized (SLS-SMA-QA-022). Procedures shall be established and/or approved by the MRB to perform this repair (SLS-SMA-QA-023). Procedures shall include appropriate inspections and tests to verify the acceptability of this repair (SLS-SMA-QA-024).

5. *Scrap*. If the article or material is unfit for use, it shall be dispositioned in accordance with Government-approved procedures for identifying, controlling, and disposing of scrap (SLS-SMA-QA-025). Considerations should be given to alternate use of the scrapped article for NASA training programs, engineering laboratory work, etc., in order to minimize the financial loss resulting from scrap dispositions. The Element shall assure that scrap is accounted for as to its end use, and that it is not to be used for flight hardware (SLS-SMA-QA-026).

6.4.4 Material Review Board

1. Membership. For in-house development, the NASA Element MRB shall be comprised of at least one Element representative whose primary responsibility is engineering, and one Element representative whose primary responsibility is product quality (SLS-SMA-QA-027).

2. Contractor MRB shall be comprised of at least one contractor representative whose primary responsibility is engineering, one contractor representative whose primary

responsibility is product quality, one NASA quality representative, and one NASA Engineering representative (SLS-SMA-QA-028).

3. When material is found to be nonconforming after turnover to the entity responsible for integration, assembly, etc., and a MRB is required, that MRB membership shall contain at least one NASA representative from the Element team that was directly responsible for the design of the hardware, with concurrence from their respective Government S&MA and engineering team members (SLS-SMA-QA-029). Concurrence from one NASA representative from the Element team that was directly responsible for the development of the hardware is required on documents authorizing work to be performed on hardware after turnover to the entity responsible for integration, assembly, etc.

4. Each Element shall establish a Senior MRB to address nonconformances and/or process escapes that meet the criteria of the SLS Problem Assessment System (PAS) reporting (SLS-SMA-QA-030). The Senior MRB shall be comprised of at least the Element CSO and Chief Engineer (SLS-SMA-QA-031).

5. Contractor members for the MRB shall be selected by the contractor on the basis of technical competence and have sufficient authority to make appropriate dispositions of the articles or materials involved (SLS-SMA-QA-032). Copies of the MRB actions will be submitted to the NASA representative.

6. As nonconformances are presented for MRB review, the Element quality representative, in conjunction with the other MRB members, shall (SLS-SMA-QA-033):

    a. Evaluate material submitted.

    b. Determine or recommend disposition, such as scrap, repair, etc.

    c. Approve the method and procedure for repair, when repair is appropriate.

    d. Provide Program/Element recommendations to the contracting officer concerning nonconformance dispositions requiring his/her approval, and verify implementation after approval is obtained.

    e. Assure that effective remedial and preventive actions are documented on the nonconformance document.

    f. Assure that accurate records of MRB actions are maintained.

7. Dispositions, other than scrap, require the unanimous agreement of the Board members. In determining dispositions, the Board shall (SLS-SMA-QA-034): consider the effect of the nonconformance upon the intended use; classify nonconformance for processing on a priority basis; review records of earlier review actions affecting the same or like article or material; and consider the recommendations of personnel acting in an advisory capacity. The board shall specify on the nonconformance document one of the following dispositions (SLS-SMA-QA-035). When the disposition affects contract requirements,

the NASA contracting officer approval shall be required (SLS-SMA-QA-036). Articles and materials shall be withheld from further processing until appropriate approval is obtained (SLS-SMA-QA-037):

a. When, in the opinion of the Board, an acceptable repair is not possible, a request for waiver/deviation may be submitted to the Program for approval prior to or as a result of consideration of other dispositions. Each waiver/deviation shall be submitted with written recommendations and proposed remedial and preventive action (SLS-SMA-QA-038).

b. When, in the opinion of the Board, an acceptable repair is possible, repair action may be authorized. Procedures shall be established or approved by the MRB to perform this repair (SLS-SMA-QA-039). Procedures shall include appropriate inspections and tests to verify the acceptability of the repair (SLS-SMA-QA-040). Standard repair procedures, if developed, shall be under the control of the MRB (SLS-SMA-QA-041). Standard repair procedures shall be approved by the MRB (SLS-SMA-QA-042). Contractor MRBs shall include the NASA quality representative (SLS-SMA-QA-043). The MRB may grant authority to apply these approved standard repair procedures for similar nonconformances.

c. The standard repair procedure shall identify hardware applicability, extent of characteristic nonconformance, detailed instruction for accomplishing the repair, and inspection/test criteria for the repaired article or material (SLS-SMA-QA-044). The existence of standard repair procedures shall not relieve the Element/Contractor of the responsibility for initiating preventive action to the fullest extent practicable (SLS-SMA-QA-045).

d. Nonconformances which the MRB feels are suitable for use without repair may be authorized for use-as-is. The rationale for making a use-as-is disposition shall be documented on the nonconformance report (SLS-SMA-QA-046).

e. Articles or materials obviously unfit for use shall be scrapped in accordance with Government-approved procedures for identifying, controlling, and disposing of scrapped material (SLS-SMA-QA-047). This disposition shall be documented on the nonconformance report (SLS-SMA-QA-048).

8. The Elements/Performing Organization shall establish a system to positively control and track nonconforming hardware, software, and materials to prevent the inadvertent use of discrepant materials during all phases of processing, assembly, and use (SLS-SMA-QA-049). Whenever feasible, discrepant material should be removed from the processing area with positive controls to prevent against its inadvertent use.

9. The Element shall prepare manufacturing documents to accomplish repair operations, including standard repairs (SLS-SMA-QA-052). Prior to initiation of work, the Element shall review these documents to assure that they provide detailed step-by-step instructions, material requirements, dimensional and process parameters, and any other

considerations imposed by the MRB disposition (SLS-SMA-QA-053). Appropriate inspection and test accomplishment shall be performed by the contractor to verify acceptability of the repair (SLS-SMA-QA-054). Repair records and data traceable to the affected article shall be maintained on file by the Element (SLS-SMA-QA-055).

6.5 Problem Assessment System

6.5.1 Identification and Reporting of Significant Nonconformances

The Performing Organization/Contractor shall identify and report those significant nonconformances, issues, and anomalies that meet the criteria defined in Appendix B (MSFC Problem Assessment System Methodology), such that those significant nonconformances are identified, dispositioned, and retained within the contractor's electronic nonconformance database (SLS-SMA-QA-056). NASA will approve the technical and flight safety rationale in the comprehensive disposition provided. The PAS dispositions shall be adequately supported and documented in regards to flight readiness or for interim deferral of final technical, safety, corrective action, or recurrence control rationale, so that the article(s) or like article(s) can be used for flight on an interim basis (SLS-SMA-QA-057). Performing Organization shall retain and make available all supporting engineering or safety reports, studies, analysis, or test data as part of the final disposition for PAS items (SLS-SMA-QA-058).

a. Minimum required PAS information and data fields are provided in Appendix C. The NASA Element management will determine the required NASA approval signatures for PAS but, at a minimum, will include the MSFC Element Chief Safety and Mission Assurance Officer.

6.5.2 Implementation of Electronic Database

The Performing Organization/Contractor shall implement an electronic database for SLS PAS, for the purpose of providing the MSFC Integrated PAS electronic repository with interim and final closure of all PAS reports to support major SLS milestone events and as provided by SLS Program direction (SLS-SMA-QA-059). Each SLS Organization/Contractor's electronic database shall be configured to support electronic data (both text and image) transfer to the NASA MSFC Integrated Program PAS repository through the use of standard database exchange techniques, such as Extensible Markup Language (XML) or Delimited Test Format (SLS-SMA-QA-060). The data shall be described through free-form text and coded data (SLS-SMA-QA-061). The Performing Organization/Contractor electronic data transfer will be coordinated with NASA.

6.6 Final Acceptance

The Performing Organization/Contractor shall perform final acceptance and verification that all required documentation (e.g., material certifications, data packages, and certificates of compliance) meets the requirements of the contract and the purchase order (PO) (SLS-SMA-QA-062).

Acceptance constitutes acknowledgement that the supplies or services conform with applicable contract quality and quantity requirements, except where acceptance of nonconforming supplies is determined to be in the Government's interest (see Federal Acquisition Regulations (FAR) Section 46.407 and Subpart 46.5) or where provided for by other terms and conditions of the contract. The Government shall formally accept delivery of product or services based on performance of the following actions (SLS-SMA-QA-063):

a. Final product inspection.

b. Validation that there are no outstanding corrective actions resulting from contracting activity or contractor-identified nonconformances affecting acceptability of product.

c. Validation that there are no outstanding engineering departures/waivers/deviations impacting acceptability of product and that all applicable engineering departures/ waivers/deviations have been approved by the proper technical authority.

d. Validation that all required Government Mandatory Inspection Points (GMIPs) have been accomplished.

The Performing Organization/Contractor shall prepare an acceptance data package for each end-item required by the contract (SLS-SMA-QA-064). The data package shall be submitted as specified in <**TBD-008**>, SLS Acceptance Data Package Requirements (SLS-SMA-QA-065).

Performance of final acceptance is an inherently governmental function which is the responsibility of the NASA contracting officer or his/her Government delegate. Performance of final acceptance shall not be delegated to a non-Governmental entity (SLS-SMA-QA-066).

6.7 Government Contract Quality Assurance

The purpose of Government contract quality assurance is to assure that supplies and services acquired under Government contract conform to contract requirements. Each element of Government contract quality assurance will be discussed below.

6.7.1 Government Source Inspection

Source inspection performed by and for the convenience of the Government on procured articles or materials shall not, in any way, replace contractor source inspection or relieve the contractor of the responsibilities for ensuring product quality (SLS-SMA-QA-067). The Performing Organization/Contractor shall process procurement documents through the designated NASA MSFC S&MA channels for determination of the need for Government Source Inspection (SLS-SMA-QA-068).

When the Government elects to perform inspection at a procurement source, the following statement shall be included in the procurement document (SLS-SMA-QA-069):

"All work on this order is subject to inspection and test by the Government at any time and place. The Government quality representative who has been delegated NASA quality assurance functions on this procurement shall be notified immediately upon receipt of this order. The

Government representative shall also be notified 48 hours in advance of the time articles or materials are ready for inspection or test."

6.7.2 Quality Audits

The Program and each Element shall conduct audits of the in-house and contracted personnel, procedures, and operations which implement the quality program (SLS-SMA-QA-070). Each audit shall be performed by a team of personnel familiar with all written procedures and standards applicable to the operation or work areas being audited and include personnel not having specific line responsibilities in those areas (SLS-SMA-QA-071). Audits shall include review of compliance with the invoked SLS requirements, including examination of all operations and documentation, evaluation of actual operations as compared with established requirements, recommendations for remedial and preventive action, and follow-up to assess results of recommendations (SLS-SMA-QA-072). Audits shall include examination of articles and materials to verify the effectiveness of the quality system (SLS-SMA-QA-073).

6.7.2.1 Audit Schedule

The frequency of quality system audits shall be based on the Element's quality history, but no less than once every two years (SLS-SMA-QA-074).

6.7.2.2 Audit Reports

The results of audits in each area shall be documented in a report with appropriate recommendations for correction of deficiencies (SLS-SMA-QA-075). Management action shall be taken to assure effective correction of the reported deficiencies (SLS-SMA-QA-076). Follow-up reviews shall be made to assure that required corrections have been implemented (SLS-SMA-QA-077).

6.7.3 Government Quality Assurance Surveillance Plan

The Program and each Element shall develop a NASA Quality Assurance Surveillance Plan (SLS-SMA-QA-078). The Program Quality Assurance Surveillance Plan (PQASP) will identify all contractor work operations requiring Government surveillance and the specific method for providing surveillance. The PQASP may be a part of a larger Program/Element S&MA Plan or may be a stand-alone document.

The PQASP shall (SLS-SMA-QA-079):

1. Describe the activities, metrics, control mechanisms, and organizations that will be conducting quality assurance functions for the Program/Element.
2. Incorporate applicable requirements.
3. Be initially prepared in conjunction with preparation of the Statement of Work (SOW) and periodically adjusted thereafter based on changing risk factors as the Program/Element progresses through pre-award activities, Request for Proposal (RFP) responses, and post-award activities.

The PQASP shall contain the following (SLS-SMA-QA-080):

1. *Introduction*. Identify the Program/Element under surveillance; summarize the Program/Element objectives; and summarize the contents of the applicable contract(s).
2. *Objectives*. Identify the specific outcomes of quality assurance actions in terms that are quantifiable and measurable.
3. *Reference Documents*. Identify documents related to performance of quality assurance functions (e.g., NASA Directives, the Program/Element Plan, the Risk Management Plan, Program/Element requirements documents, the contract, and invoked quality system requirements).
4. *Surveillance Functions*. Identify the quality assurance surveillance functions to be performed for the Program and Element in accordance with the requirements contained in this document.
5. *Document Review*. Identify the quality system procedures to be reviewed and the periodicity or schedule for document review.
6. *Product Assurance*.
    a. Identify specific product examinations to be performed, including whether these actions are to be performed on a one-for-one, continuing, random, and/or periodic basis.
    b. Identify specific processes to be witnessed, including whether these actions are to be performed on a one-for-one, continuing, random, and/or periodic basis.
    c. Identify contractor records to be reviewed, including whether the records are to be verified on a one-for-one, continuing, random, and/or periodic basis.
    d. Where sampling is called out, identify specific statistically-based sampling plans for product examination, process witnessing, and record review.
    e. Describe the methodology utilized for inspections, including both GMIP and in-line assessment (ILA).
7. *Quality System Evaluation*.
    a. Identify the specific quality system elements to be reviewed.
    b. Develop an audit plan identifying the attributes to be audited.
    c. Provide a schedule for performance of quality system audits.
8. *Quality Data Analysis*.
    a. Identify the sources of contractor quality data.

b. Identify contractor performance metrics to be tracked.

c. Identify the format and periodicity for reporting contractor performance metrics.

9. *Nonconformance Reporting and Corrective/Preventive Action*. Identify the tools, methodology, and format for:

   a. Documentation of nonconformances.

   b. Tracking of nonconformance resolution.

   c. Track effectiveness of contractor recurrence control.

   d. Government follow-up to assure contractor implementation of effective corrective measures.

10. *Final Acceptance*. Identify the tools and methodology for:

    a. Validation that there are no outstanding corrective actions affecting acceptability of product.

    b. Validation that there are no outstanding or unauthorized engineering departures impacting acceptability of product.

    c. Validation that all GMIPs have been accomplished, including item-by-item accountability for each safety-critical GMIP.

11. *Government Metrics*. Identify the metrics to be used to assess and report accomplishment of Government quality assurance functions as prescribed in the PQASP and how these metrics will be used to adjust quality assurance activities.

12. Surveillance Organization. Identify the organizational entities of the Program/Element that will be performing surveillance (i.e., NASA, the delegated agency, and/or quality assurance support contractors), their assigned responsibilities, and their authority to act.

13. Quality Assurance Resources. Identify the personnel, funding, and material resources to be applied to the Program/Element quality assurance effort.

6.7.4 Government Surveillance and Inspection

The Government intends to use a combination of GMIPs and In-Line Assessment (ILA) to verify safety/mission critical attributes of the flight hardware and assembly/manufacturing and checkout processes. (Note: GMIPs can be assigned based on a process or sequence of steps in a procedure, or for a single point in the procedure). ILA is intended to be a methodology for the Government to maintain an appropriate level of knowledge and onsite experience with safety and mission critical operations, without imposing any mandatory inspection delays to the contractor's/performing organizations' processing schedules. The Government's utilization of ILA as an alternate to GMIP assignment for every safety/mission critical attributes shall not relieve the Element Contractor/Performing Organizations of their responsibility for 100%

performance of safety and mission critical attributes by their quality assurance organizations (SLS-SMA-QA-081). Determination of whether Government verification of a safety/mission critical attribute will be performed by either a GMIP or ILA will be based on a Risk-Based Assessment (RBA) and approved by designated NASA MSFC S&MA personnel.

6.7.4.1 Risk-Based Assessment Utilizing In-Line Assessment (ILA) or Similar Strategy

ILA – In Line Assessment: The Government may utilize ILA for those safety/mission critical attributes where a documented qualitative RBA is performed, which evaluates the safety and quality characteristics of the process and/or inspection point, and where it is shown that there is sufficiently low risk, as defined by NASA MSFC S&MA by utilizing a RBA, of an undetected defect inherent in that process or specific inspection point. The RBA will be performed in order to support GMIP determination and to utilize ILA, for both Prime Contractor/Performing Organization on-site operations, as well as for significant vendor/supplier operations performed off-site.

1. Characteristics of the RBA – An effective RBA is based on a comprehensive understanding of safety/mission critical processes, attributes, and inspections points, along with a thorough understanding of safety risks inherent in those processes and work steps. Process understanding includes those factors and procedures that introduce process variation and risk and those that enhance process stability and reduce risk. Use of such standard tools as Fault Trees, Process Failure Modes and Effects Analysis (FMEA), Value Stream Mapping, etc., are encouraged in order to develop a comprehensive process understanding to support the RBA. The Prime Contractor/Performing Organization should provide any available pertinent processing historical, safety, quality, and technical information to the Government in order to support a thorough RBA of safety and mission critical processes and attributes. Additionally, this would include appropriate information regarding vendors/suppliers in order to support the RBA for those materials, articles, and components manufactured off-site. Each RBA shall include a N by M risk matrix (such as a 3 by 3) for Likelihood versus Consequence to flight safety risk (or a N by M risk matrix as provided in the Element S&MA Plan) (SLS-SMA-QA-082). The N by M Risk Matrix may be developed in accordance with criteria provided in NASA SP-2007-6105, NASA Systems Engineering Handbook. The risk matrix will be used to communicate the risk of the process verification or inspection point as compared to the impact on flight safety risk. The Element Risk Matrix shall have a risk ranking system that has definitions and criteria that can be used to delineate between varying risk rankings such as low, moderate, and high (SLS-SMA-QA-083). Minimum factors for consideration in the RBA of safety/mission critical attributes shall include (SLS-SMA-QA-084):

    a. Determination if the attribute can be confirmed by any subsequent inspection or checkout.

b. Processing history of nonconformances and variation and stability (work planning/procedures, material, tooling, engineering requirements, etc.) of those processes.

c. Degree of sensitivity of the process to operator skill level and expertise, especially if there a significant amount of intangible personnel factors.

d. Determination if the process/task is very highly complex and that verification of the safety critical attributes can only be accomplished by Government personnel witnessing the entire procedure in question.

e. Repetitive nature of the process/inspection point (for example, whether it is performed numerous times during a flow or on a very infrequent basis).

2. Assignment of ILA Verifications – Determination of Government verification of safety/mission critical attributes utilizing ILA will be by those designated NASA MSFC S&MA personnel, supported by engineering, element, and other personnel as appropriate, and will be documented in order to provide traceability and support information for that decision. Those safety/mission critical inspections verified by ILA can be adjusted to a GMIP (100% performance verification) if conditions warrant. Safety/mission critical attributes verified by ILA should be reviewed on a periodic basis and updated accordingly, especially if there are significant process changes. The RBA shall be updated at a minimum of every 2 years (SLS-SMA-QA-085).

3. Performance of ILA Verifications – Unlike GMIPs, ILA inspection points are not considered mandatory on the part of the Element Contractor/Performing Organization. It is the Government's intention to maintain a continuous presence during processing operations in order to perform ILA. However, the Contractor/Performing Organization shall communicate/coordinate work planning in a timely manner with the Government so that appropriate Government resources will be readily available to support ILA by the Government (SLS-SMA-QA-086). This communication/coordination will be particularly important to support of ILA utilization at manufacturing/processing sites other than the Prime Contractor's/Performing Organization's main facility in order to effectively implement ILA for those vendor/supplier processes. If, for whatever reason, the designated NASA MSFC S&MA personnel determine that there are not a sufficient number of ILA verifications of safety/mission critical attributes being performed, in order to support a reasonable RBA, they shall be re-designated as GMIPs (SLS-SMA-QA-087).

4. The Government (Program/Element) S&MA Quality Plan will provide sufficient administrative controls to assure that only those designated NASA MSFC S&MA individuals will have the authority to determine or alter the level of Government Performance of Quality Assurance for safety/mission critical attributes, and that a tracking system is utilized to assure full compliance with the Element S&MA Plan.

6.7.4.2 Determination and Accomplishment of GMIPs

GMIPs may be assigned by the Government for at least three reasons: safety/mission critical attribute verification, contract compliance verification (such as count and condition upon receipt), and temporary GMIPs associated with special issues, anomalies, or repairs. Determination of those safety/mission critical attributes that require GMIP (and not ILA) will be made by those designated NASA MSFC S&MA personnel, as supported by engineering and other personnel as appropriate, and documented in the Element Contractor's/Performing Organization's work planning documents. Determination of a GMIP should be based on an RBA and documented by Element NASA MSFC S&MA to show traceability and supporting rationale. It is anticipated that GMIP determination will be periodically revisited and, as processing knowledge and other factors change, the determination may change from a GMIP to ILA inspection.

6.7.4.2.1 Sources of Information for Determining GMIPs

When conducting the RBA in order to assign GMIPs, the following minimum list of sources of information is to be considered:

1. Design, safety, drawing, engineering, configuration, and technical document reviews.
2. Reliability documents (including FMEA/CIL), maintainability information, and system safety tests and analyses.
3. Development, qualification, certification, and acceptance tests.
4. Interface and interchangeability requirements.
5. Contractor fabrication procedures, process control instructions, and design standards/manuals.
6. Root cause analyses and implementation of preventative and corrective actions.
7. Nonconformance reports and records of contractor/supplies/services history.
8. Feedback from the NASA Center or the delegated agency.
9. Critical process/item and key characteristic lists developed by the contractor.
10. Contractor quality assurance manuals, requirements, and selected quality system documents.

6.7.4.2.2 Placement of GMIPs in Processing Flow

When assigning GMIPs, the following conditions, operations, and quality assurance functions are factors to be considered during the RBA:

1. Validation of critical process controls.
2. Qualification, certification, and first article tests.

3. Acceptance tests and/or inspection of hardware and software end items and selected non-deliverable hardware, tooling, or software. This includes test readiness.
4. Pre-shipment review (data package review, shipment readiness, and shipping/acceptance document sign-off).
5. Inspection and test of repaired, re-worked, or modified supplies.
6. Teardown, buildup, test, and inspection of Government equipment returned for overhaul or refurbishment.
7. Failure analyses.
8. Refurbishment of previously accepted supplies.
9. Products/processes that have a history of frequent configuration changes or frequent fabrication, inspection, and test nonconformances.
10. Configuration verification.
11. Hazardous or critical industrial operations such as lifting operations, contamination inspections, and shipping operations.
12. Perform GMIPs as late as practicable in the material fabrication/installation/delivery cycle for circumstances where GMIP attributes can be altered (e.g., contamination).
13. Perform GMIPs at subcontractor facilities only when required in the Government's interest, as specified in FAR Section 46.405.

6.7.4.2.3 Special Consideration for Determining GMIPs

In addition to the good judgment and considerations documented in the RBA, special consideration of the following factors shall be used to determine if the following safety/mission critical attributes require GMIPs (SLS-SMA-QA-088):

1. Assessment of the functional risk characteristic of the hardware/process attribute as provided in the FMEA/CIL and Hazard Analysis.
2. Determination if the process or attribute is a special process, critical process, or key characteristic in that the pertinent attribute cannot be verified post-assembly or by any other method and that safety verification can only be achieved by precise adherence to work procedures.
3. Assessment that the work process and/or inspection point is either highly complex and subject to much variation, or has a history of significant nonconformances, or that the safety/mission critical attribute is highly sensitive to subtle changes in personnel skill/experience level, environmental conditions, or to tooling, material, or process changes.

6.7.4.3 Accomplishment of GMIPs

GMIPs shall be accomplished in the Element's/Performing Organization's planned processing procedures (SLS-SMA-QA-089). Reasonable accommodations should be made such that the Government can support accomplishing the GMIP without impacting the Element Contractor's production schedule. In the event that a GMIP associated with a safety/mission critical attribute is missed, for whatever reason, and it is not possible to conduct the GMIP at another point in the flow, the Element Contractor/Performing Organization shall document the occurrence in the appropriate nonconformance system with rationale for acceptance for approval by NASA MSFC S&MA designated official(s) (SLS-SMA-QA-090).

6.7.4.3.1 Administration of GMIPs

Personnel responsible for the administration and performance of GMIPs shall (SLS-SMA-QA-091):

1. Perform 100 percent of all assigned GMIPs.
2. Request formal disposition/authorization for GMIP omissions, waivers, or deviations from the designated NASA technical authority). The designated technical authority will normally be the person or office that selected and defined the GMIP requirement and may reside in the Center S&MA office, program office, or engineering office in accordance with local Center governance procedures.
3. Indicate as acceptable only those characteristics that have been personally examined, witnessed, or verified.
4. Perform GMIPs after contractor personnel have made their acceptance decisions, except in those cases where concurrent inspections/tests are necessary to avoid the need for destructive testing or to prevent excessive costs or potential time delays.
5. Periodically sign a statement indicating that they understand that their signature, application of a stamp, or data entry is a professional, individual warranty (guarantee) that they personally examined the product, witnessed the process, or verified the record as literally stated for the GMIP acceptance criteria.
6. Maintain positive controls, which assure that all assigned GMIPs are incorporated into planning documents, where applicable, and accomplished.
7. Report, track, and assure proper resolution of nonconformances identified during the conduct of GMIPs.
8. Where GMIP accomplishment is attested to by stamps/signatures on contractor developed/maintained planning records or data, assure that such records are dated and readily retrievable.
9. Consult management if there is significant uncertainty regarding the quality or safety attributes that they are responsible for verifying.

6.8 Letter of Delegation

The Contracting Officer shall take inputs from the Program/Element Manager and/or the Program/Element CSO to establish quality assurance requirements to be delegated to a non-NASA Federal agency via a Letter of Delegation (LOD) and/or to be performed under contract by a quality assurance support contractor (SLS-SMA-QA-092). The criteria contained in Appendix C of NPR 8735.2A shall be used in whole or in part as determined by the designated NASA MSFC S&MA personnel in support of that Program/Element (SLS-SMA-QA-093).

7.0 RISK MANAGEMENT

The SLS Program and Elements shall implement a Risk Management (RM) process in compliance with the requirements of this document, as further defined in the SLS Risk Management Plan, as an integral part of the SLS concept, design, development, fabrication, test, and operational phases (SLS-SMA-RSK-001).

7.1 Risk Manager

The SLS Program shall designate the risk manager(s) for the program (SLS-SMA-RSK-002).

7.2 Risk Management Training

The SLS Program and Elements shall assure that appropriate training is provided on risk management policies, tools, and processes, and assure that the training material is consistent with the requirements (SLS-SMA-RSK-003).

7.3 Database

The SLS Program shall implement and utilize a risk management database that is compatible at the Program and Element levels as the documenting source for all their risk management data (SLS-SMA-RSK-004).

7.4 NASA Risk Matrix

The SLS Program and Elements shall utilize a NASA matrix as defined in the SLS Risk Management Plan to provide a graphic representation of all Program risks (SLS-SMA-RSK-005).

7.5 Metric and/or Reports

The SLS Program and Elements shall develop metrics and/or reports that demonstrate that the Program's risks are being managed and updated for Program reviews (i.e., Risk List, Risk Waterfall Charts, Risk Staleness Report, Number of Open Risks versus Number of Closed Risks, etc.) (SLS-SMA-RSK-006).

8.0 PROBABILISTIC RISK ASSESSMENT

The SLS Program Manager shall (SLS-SMA-PRA-001):

1. Assure that an integrated Probabilistic Risk Assessment (PRA) is conducted in accordance with NPR 8705.5, Technical Probabilistic Risk Assessment (PRA) Procedures for Safety and Mission Success for NASA Programs and Projects, for the SLS Program.

2. Assure that an SLS Probabilistic Risk Assessment (PRA) Plan is written in compliance with NPR 8705.5, Technical Probabilistic Risk Assessment (PRA) Procedures for Safety and Mission Success for NASA Programs and Projects.

9.0 SOFTWARE ASSURANCE

The SLS Program and Elements shall establish and maintain a software assurance program in accordance with NASA-STD-8739.8, Software Assurance Standard (SLS-SMA-SWA-001). The software assurance program shall be applied to software classifications as defined in NPR 7150.2, Appendix E (SLS-SMA-SWA-002). The Software Assurance (SA) Program shall include the disciplines of software quality assurance, software safety, software reliability, software verification and validation, and independent verification and validation (SLS-SMA-SWA-003).

9.1 Software Assurance Independence

The SLS Program and Elements shall assure that software assurance is independent of the software development organization (SLS-SMA-SWA-004).

9.2 Software Assurance Planning

The implementation of the SA program shall be documented in the SLS S&MA Plan and respective Element S&MA plans (SLS-SMA-SWA-005). The plans provide the framework for defining the SA organization, tasks, and responsibilities.

9.3 Software Assurance Classification Assessments

The SLS Program/Elements shall perform an assessment to determine the classification and safety criticality of software (SLS-SMA-SWA-006).

9.4 Software Assurance Role in Acquisition

The SLS Program and Elements shall assure that software assurance is included in the software acquisition process per NASA-STD-8739.8, Section 5.0 and NASA-STD-8719.13B, paragraph 5.13 (SLS-SMA-SWA-007).

9.5 Software Quality Assurance

The SLS Program and Elements shall assure that software quality assurance activities are performed in accordance with Section 7.1 of NASA-STD-8739.8 (SLS-SMA-SWA-008).

9.6 Software Verification and Validation

The SLS Program and Elements shall assure that software verification and validation activities are performed in accordance with Section 7.4 of NASA-STD-8739.8 (SLS-SMA-SWA-009).

9.7 Software Safety

The SLS Program and Elements shall establish a software safety program in accordance with NASA-STD-8719.13B as designated in the following paragraphs (SLS-SMA-SWA-010). The Software Safety Program shall be integrated with the overall system safety program (SLS-SMA-SWA-011).

9.7.1 Initial Designation of Safety-Critical Software

The safety litmus test shall be used to determine initial designation of safety-critical software as outlined in Section 4 of NASA-STD-8719.13 (SLS-SMA-SWA-012).

9.7.2 Software Safety Planning

The Software Safety Program shall be documented in the overall system safety plan (SLS-SMA-SWA-013). Software safety activities shall be an integral part of the overall system safety and software development activities (SLS-SMA-SWA-014). The software safety tasks shall be coordinated with the overall SA disciplines to eliminate duplication of effort (SLS-SMA-SWA-015). Software safety shall be involved throughout the entire software development life cycle (SLS-SMA-SWA-016).

9.7.3 Software Safety Analysis

Software safety analyses shall include hazard analysis, requirements analysis, design analysis, implementation analysis, and testing analysis (SLS-SMA-SWA-017).

9.7.3.1 Hazard Analysis

Software safety shall perform hazard analyses in accordance with SLS-RQMT-015, SLS Program Hazard Analysis Requirement Document (SLS-SMA-SWA-018).

9.7.3.2 Requirements Analyses

Software safety shall perform requirements analyses to identify safety-critical requirements and assure that these requirements are included and uniquely identified in software requirements specifications (SLS-SMA-SWA-019).

9.7.3.3 Design Analyses

Software safety shall perform software design analyses to assure that safety-critical requirements are incorporated (SLS-SMA-SWA-020).

9.7.3.4 Implementation Analyses

Software safety shall perform software code analyses to assure that safety-critical design features and methods are incorporated (SLS-SMA-SWA-021).

9.7.3.5 Testing Analyses

Software safety shall assure that safety-critical requirements are tested to verify that system hazards related to software have been eliminated or controlled to an acceptable level of risk as defined in the SLS-RQMT-015, Space Launch System Hazard Analysis Document (SLS-SMA-SWA-022).

9.8 Software Reliability

The SLS Program and Elements shall establish a Software Reliability Program in accordance with NASA-STD-8739.8 (SLS-SMA-SWA-023). The Software Reliability Program shall be

integrated with the overall System Reliability Program (SLS-SMA-SWA-024). The SLS Program and Elements shall assure that software is included in reliability allocations and analyses (SLS-SMA-SWA-025).

9.9 Independent Verification and Validation (IV&V)

The SLS Program and Elements shall provide required data and information to the NASA IV&V Facility when IV&V has been determined by the Agency to be applicable to the Program (SLS-SMA-SWA-026).

APPENDIX A
ACRONYMS AND ABBREVIATIONS

ALERT	Acute Launch Emergency Restraint Tip
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
B&PCV	Boiler and Pressure Vessel Code
CAP	Corrective Action Plan
CDR	Critical Design Review
CE	Chief Engineer
CGA	Compressed Gas Association
CIL	Critical Items List
CoFR	Certificate of Flight Readiness
COTS	Commercial Off-The-Shelf
CR	Change Request
CSO	Chief Safety and Mission Assurance Officer
DCMA	Defense Contract Management Agency
DCR	Design Certification Review
DoD	Department of Defense
DOJ	Department of Justice
DOT	Department of Transportation
ESD	Exploration Systems Development
FAR	Federal Acquisition Regulations
FEMA	Federal Emergency Management Agency
FMEA	Failure Modes and Effects Analysis
FRR	Flight Readiness Review
FSW	Flight Software
FT	Failure Tolerance
GFE	Government Furnished Equipment
GIDEP	Government-Industry Data Exchange Program
GMIP	Government Mandatory Inspection Point
GSE	Ground Support Equipment
H/W	Hardware
IEEE	Institute of Electrical and Electronics Engineers
IIFA	Integrated In Flight Anomaly
ILA	In-Line Assessment
IRT	Interim Response Team

IV&V	Independent Verification and Validation
JPRB	Joint Program Review Board
LCC	Launch Commit Criteria
LOC	Loss of Crew
LOD	Letter of Delegation
LOM	Loss of Mission
MIB	Mishap Investigation Board
MPCV	Multi-Purpose Crew Vehicle
MRB	Material Review Board
MSFC	Marshall Space Flight Center
MTE	Measuring and Test Equipment
NASA	National Aeronautics and Space Administration
NFPA	National Fire Protection Association
NPD	NASA Policy Directive
NPR	NASA Procedural Requirement
NTSB	National Transportation Safety Board
OCE	Off of the Chief Engineer
OER	Office of External Relations
OMRSD	Operations and Maintenance Requirements and Specification Document
OPA	Office of Public Affairs
OPR	Office of Primary Responsibility
ORI	Operational Readiness Inspection
ORR	Operational Readiness Review
OSMA	Office of Safety and Mission Assurance
PAS	Problem Assessment System
PDR	Preliminary Design Review
PFA	Pre-Flight Assessment
PO	Purchase Order
PPE	Personal Protective Equipment
PQASP	Program Quality Assurance Surveillance Plan
PRA	Probabilistic Risk Assessment
PV/S	Pressure Vessels and Pressurized Systems
R&M	Reliability and Maintainability
RBA	Risk Based Assessment
RFP	Request for Proposal
RM	Risk Management

S&MA	Safety and Mission Assurance
S/W	Software
SA	Software Assurance
SARD	Safety and Assurance Requirements Division
SBU	Sensitive But Unclassified
SERP	Safety and Engineering Review Panel
SLS	Space Launch System
SMSR	Safety and Mission Success Review
SOW	Statement of Work
SRR	System Requirements Review
SRT	Safety Readiness Team
STD	Standard
TBD	To Be Determined
TBR	To Be Resolved
TRR	Test Readiness Review
U.S.	United States
VTL	Verification Tracking Log
XML	Extensible Markup Language

APPENDIX B
MSFC SLS PROBLEM ASSESSMENT SYSTEM (PAS) REPORTING CRITERIA AND REPORTABLE PROBLEM DEFINITION

The criteria below define a PAS reportable problem:

1) All conditions that occur on flight or flight-like hardware that have or will have the potential to adversely affect safety as defined in the Critical Items List (CIL) and/or Hazard Reports, or result in design change (i.e., failure; overstress or a result of an overstress of equipment and/or material; unsatisfactory condition; unexplained anomaly).

    a. Instances where the nonconformance evaluation indicts the integrity/functional capabilities of previously accepted/delivered flight or flight-like hardware are specifically included.

2) Flight Software (FSW) discrepancies (when the software has been released to the Element for flight support and integration with the vehicle) that impact critical flight performance as defined in the CIL, Hazard Reports, and/or other risk assessment documents, or result in software design change.

    a. Instances where the nonconformance evaluation indicts the integrity/functional capabilities of previously accepted/delivered software are specifically included.

3) Any problem recommended by the responsible Performing Organization/Contractor (including Engineering and S&MA).

4) An anomaly that occurs during the mission cycle time and has the potential to affect multiple Elements, integrated system performance, or integrated hazards - IIFA (Integrated In-Flight Anomaly).

5) The timeframe for occurrence and/or detection of a reportable problem begins upon baseline of the design (e.g., post-Critical Design Review (CDR)) and continues through the hardware/software life cycle. This includes baselined or heritage hardware/software that is used during development testing.

APPENDIX C
MSFC SLS PAS MINIMUM DATA FIELDS

1) Problem Identifier
2) Problem Occurrence Date
3) Occurrence Location
4) Program
5) Element
6) Nonconformance Description (including images where appropriate)
7) Nonconforming Assembly/Part Name
8) Problem Title/Summary
9) Nonconforming Part/Assembly Number
10) Nonconforming Part/Assembly Serial Number of Lot/Date Code
11) Nonconforming Part/Assembly Number Manufacturer
12) Nonconforming Article/Component Name
13) Nonconforming Article/Component Number
14) Nonconforming Component/Article Serial Number or Lot/Date Code
15) If a Software Problem:
    a. Software Build
    b. Software Classification
    c. Software Version (CSCI/CSC/CSU)
    d. Safety Critical Software?
    e. Software Type
    f. Defect Type
16) Functional Criticality
17) Corrective/Remedial Action/Disposition Description/Closure Rationale
18) Causes(s) (Root/Proximate)
19) Problem Closure concurrences As Required
20) If a Software Problem:
    a. Defect Impact
    b. System
    c. Defect Activity
    d. Defect Trigger

APPENDIX D
REQUIREMENTS APPLICABILITY MATRIX

The requirements within this document are applicable to the Program, Elements, and Prime Contractors as identified in the matrix below. The Element Office(s) shall flow applicable requirements from this document to a Prime Contractor, as noted in Appendix D (SLS-SMA-GEN-011).

	Applicability		
Requirement #	**Program**	**Element**	**Prime Contractor**
SLS-SMA-GEN-001	●	●	●
SLS-SMA-GEN-002	●	●	●
SLS-SMA-GEN-003	●	●	●
SLS-SMA-GEN-004	●	●	●
SLS-SMA-GEN-005	●		
SLS-SMA-GEN-008	●	●	●
SLS-SMA-GEN-009	●	●	
SLS-SMA-GEN-010	●	●	
SLS-SMA-GEN-011		●	
SLS-SMA-GEN-012	●		
SLS-SMA-GEN-013		●	●
SLS-SMA-GEN-014		●	●
SLS-SMA-GEN-015	●	●	
SLS-SMA-GEN-018	●	●	●
SLS-SMA-GEN-019	●	●	●
SLS-SMA-GEN-020	●	●	●
SLS-SMA-GEN-021	●	●	●
SLS-SMA-GEN-023	●	●	●
SLS-SMA-GEN-024	●	●	●
SLS-SMA-GEN-025	●	●	●
SLS-SMA-GEN-026	●	●	

Requirement #	Applicability		
	Program	Element	Prime Contractor
SLS-SMA-GEN-027		●	●
SLS-SMA-GEN-028	●	●	●
SLS-SMA-SAF-001		●	●
SLS-SMA-SAF-002		●	●
SLS-SMA-SAF-003		●	
SLS-SMA-SAF-004	●	●	●
SLS-SMA-SAF-005	●	●	●
SLS-SMA-SAF-006	●	●	●
SLS-SMA-SAF-007	●	●	●
SLS-SMA-SAF-008	●	●	●
SLS-SMA-SAF-009	●	●	●
SLS-SMA-SAF-010	●	●	●
SLS-SMA-SAF-011	●	●	●
SLS-SMA-SAF-012	●	●	●
SLS-SMA-SAF-013	●	●	●
SLS-SMA-SAF-014	●	●	●
SLS-SMA-SAF-015	●	●	●
SLS-SMA-SAF-016	●	●	●
SLS-SMA-SAF-017	●	●	●
SLS-SMA-SAF-018	●	●	●
SLS-SMA-SAF-019	●	●	●
SLS-SMA-SAF-020	●	●	●
SLS-SMA-SAF-021	●	●	●
SLS-SMA-SAF-022	●	●	●
SLS-SMA-SAF-023	●	●	●
SLS-SMA-SAF-024	●	●	●
SLS-SMA-SAF-025		●	●
SLS-SMA-SAF-026	●	●	●
SLS-SMA-SAF-027	●	●	●
SLS-SMA-SAF-028		●	●
SLS-SMA-SAF-029		●	●
SLS-SMA-SAF-030	●	●	

Requirement #	Applicability		
	Program	Element	Prime Contractor
SLS-SMA-SAF-031	●	●	
SLS-SMA-SAF-032	●	●	
SLS-SMA-SAF-033	●		
SLS-SMA-SAF-034	●		
SLS-SMA-SAF-035	●		
SLS-SMA-SAF-036	●		
SLS-SMA-SAF-037	●		
SLS-SMA-SAF-038	●	●	●
SLS-SMA-SAF-039	●	●	●
SLS-SMA-SAF-040	●	●	●
SLS-SMA-RM-001	●	●	●
SLS-SMA-RM-002	●	●	●
SLS-SMA-RM-003	●	●	●
SLS-SMA-RM-004	●	●	●
SLS-SMA-RM-006		●	●
SLS-SMA-RM-007	●		
SLS-SMA-RM-008		●	●
SLS-SMA-RM-009	●	●	●
SLS-SMA-RM-010	●	●	●
SLS-SMA-RM-011	●	●	●
SLS-SMA-RM-012	●	●	●
SLS-SMA-RM-013		●	●
SLS-SMA-RM-014		●	●
SLS-SMA-RM-015		●	●
SLS-SMA-RM-016		●	●
SLS-SMA-RM-017	●	●	●
SLS-SMA-RM-018	●		
SLS-SMA-RM-019		●	●
SLS-SMA-RM-020		●	●
SLS-SMA-RM-021		●	●
SLS-SMA-RM-022		●	●

Requirement #	Applicability		
	Program	Element	Prime Contractor
SLS-SMA-RM-023		●	●
SLS-SMA-RM-024		●	●
SLS-SMA-RM-025		●	●
SLS-SMA-RM-026		●	●
SLS-SMA-QA-001	●	●	●
SLS-SMA-QA-002		●	
SLS-SMA-QA-003		●	●
SLS-SMA-QA-004		●	●
SLS-SMA-QA-005		●	
SLS-SMA-QA-006	●	●	●
SLS-SMA-QA-007	●	●	●
SLS-SMA-QA-008	●	●	●
SLS-SMA-QA-009	●	●	●
SLS-SMA-QA-010	●	●	●
SLS-SMA-QA-011	●	●	●
SLS-SMA-QA-012	●	●	●
SLS-SMA-QA-013	●	●	●
SLS-SMA-QA-014	●	●	●
SLS-SMA-QA-015		●	●
SLS-SMA-QA-016		●	●
SLS-SMA-QA-017		●	●
SLS-SMA-QA-018		●	●
SLS-SMA-QA-019		●	●
SLS-SMA-QA-020		●	●
SLS-SMA-QA-021		●	●
SLS-SMA-QA-022		●	●
SLS-SMA-QA-023		●	●
SLS-SMA-QA-024		●	●
SLS-SMA-QA-026		●	●
SLS-SMA-QA-027		●	●
SLS-SMA-QA-028		●	
SLS-SMA-QA-029		●	●

Requirement #	Applicability		
	Program	Element	Prime Contractor
SLS-SMA-QA-030		●	●
SLS-SMA-QA-031		●	
SLS-SMA-QA-032			●
SLS-SMA-QA-033		●	
SLS-SMA-QA-034			●
SLS-SMA-QA-035		●	●
SLS-SMA-QA-036		●	●
SLS-SMA-QA-037		●	●
SLS-SMA-QA-038		●	●
SLS-SMA-QA-039		●	●
SLS-SMA-QA-040		●	●
SLS-SMA-QA-041		●	●
SLS-SMA-QA-042		●	●
SLS-SMA-QA-043		●	●
SLS-SMA-QA-044		●	●
SLS-SMA-QA-045		●	●
SLS-SMA-QA-046		●	●
SLS-SMA-QA-047		●	●
SLS-SMA-QA-048		●	●
SLS-SMA-QA-049		●	●
SLS-SMA-QA-052		●	●
SLS-SMA-QA-053		●	●
SLS-SMA-QA-054		●	●
SLS-SMA-QA-055		●	●
SLS-SMA-QA-056		●	●
SLS-SMA-QA-057		●	●
SLS-SMA-QA-058	●	●	●
SLS-SMA-QA-059	●	●	●
SLS-SMA-QA-060	●	●	●
SLS-SMA-QA-061	●	●	●

Requirement #	Applicability		
	Program	Element	Prime Contractor
SLS-SMA-QA-062	●	●	●
SLS-SMA-QA-063	●	●	●
SLS-SMA-QA-064	●	●	●
SLS-SMA-QA-065	●	●	●
SLS-SMA-QA-066	●	●	●
SLS-SMA-QA-065	●	●	●
SLS-SMA-QA-066	●	●	
SLS-SMA-QA-067	●	●	
SLS-SMA-QA-068	●	●	
SLS-SMA-QA-069	●	●	
SLS-SMA-QA-070	●	●	
SLS-SMA-QA-071	●	●	
SLS-SMA-QA-072	●	●	
SLS-SMA-QA-073	●	●	
SLS-SMA-QA-074	●	●	
SLS-SMA-QA-075	●	●	
SLS-SMA-QA-076	●	●	
SLS-SMA-QA-077	●	●	
SLS-SMA-QA-078	●	●	
SLS-SMA-QA-079	●	●	
SLS-SMA-QA-080	●	●	
SLS-SMA-QA-081		●	●
SLS-SMA-QA-082	●	●	
SLS-SMA-QA-083	●	●	
SLS-SMA-QA-084	●	●	
SLS-SMA-QA-085	●	●	
SLS-SMA-QA-086		●	●
SLS-SMA-QA-087	●	●	
SLS-SMA-QA-088	●	●	
SLS-SMA-QA-089	●	●	
SLS-SMA-QA-090	●	●	
SLS-SMA-QA-091	●	●	

Requirement #	Applicability		
	Program	Element	Prime Contractor
SLS-SMA-QA-092	●	●	
SLS-SMA-QA-093	●	●	
SLS-SMA-RSK-001	●	●	●
SLS-SMA-RSK-002	●		
SLS-SMA-RSK-003	●	●	●
SLS-SMA-RSK-004	●		
SLS-SMA-RSK-005	●	●	●
SLS-SMA-RSK-006	●	●	●
SLS-SMA-PRA-001	●		
SLS-SMA-SWA-001	●	●	●
SLS-SMA-SWA-002	●	●	●
SLS-SMA-SWA-003	●	●	●
SLS-SMA-SWA-004	●	●	●
SLS-SMA-SWA-005	●	●	●
SLS-SMA-SWA-006	●	●	●
SLS-SMA-SWA-007	●	●	
SLS-SMA-SWA-008	●	●	●
SLS-SMA-SWA-009	●	●	●
SLS-SMA-SWA-010	●	●	●
SLS-SMA-SWA-011	●	●	●
SLS-SMA-SWA-012	●	●	●
SLS-SMA-SWA-013	●	●	●
SLS-SMA-SWA-014	●	●	●
SLS-SMA-SWA-015	●	●	●
SLS-SMA-SWA-016	●	●	●
SLS-SMA-SWA-017	●	●	●
SLS-SMA-SWA-018	●	●	●
SLS-SMA-SWA-019	●	●	●
SLS-SMA-SWA-020	●	●	●
SLS-SMA-SWA-021	●	●	●
SLS-SMA-SWA-022	●	●	●
SLS-SMA-SWA-023	●	●	●

Requirement #	Applicability		
	Program	**Element**	**Prime Contractor**
SLS-SMA-SWA-024	●	●	●
SLS-SMA-SWA-025	●	●	●
SLS-SMA-SWA-026	●	●	●

APPENDIX E
OPEN WORK

E1.0 TO BE DETERMINED

Table E1-1 lists the specific To Be Determined (TBD) items in the document that are not yet known. The TBD is inserted as a placeholder wherever the required data is needed and is formatted in bold type within carets. The TBD item is sequentially numbered as applicable (i.e., **<TBD-001>** is the first undetermined item assigned in the document). As each TBD is resolved, the updated text is inserted in each place that the TBD appears in the document and the item is removed from this table. As new TBD items are assigned, they will be added to this list in accordance with the above described numbering scheme. Original TBDs will not be renumbered.

***Note**: When documenting open work, the book manager shall identify those items whose completion is dependent upon the delivery of data from organizations other than the Program office, including SLS Elements. This dependency shall be clearly identified in the description portion of that open task. This information is important for closure tracking purposes, and for capturing Integrated Master Schedule dependencies. (Delete this note for draft or baselined documents.) **Note**: Only TBDs and TBRs are used to designate Open Work items. (Delete this note for draft or baselined documents.)*

Table E1-1. To Be Determined Items

TBD	Section	Description
TBD-003	2.2	Document number for SLS Program Tailored Range Safety Requirements
TBD-004	3.4	
TBD-005	4.4	Document number for SLS Program Tailored Range Safety Requirements
TBD-008	6.6	Document number for SLS Acceptance Data Package Requirements

E2.0 TO BE RESOLVED

Table E2-1 lists the specific To Be Resolved (TBR) issues in the document that are not yet known. The TBR is inserted as a placeholder wherever the required data is needed and is formatted in bold type within carets. The TBR issue is sequentially numbered as applicable (i.e., **<TBR-001>** is the first unresolved issue assigned in the document). As each TBR is resolved, the updated text is inserted in each place that the TBR appears in the document and the issue is removed from this table. As new TBR issues are assigned, they will be added to this list in accordance with the above described numbering scheme. Original TBRs will not be renumbered.

Table E2-1. To Be Resolved Issues

TBR	Section	Description
TBR-001	3.3	PCB gave direction to add a TBR to each statement in the S&MA Requirement document that addresses the review and approval of the Prime Contractor's plan.
TBR-002	4.1	PCB gave direction to add a TBR to each statement in the S&MA Requirement document that addresses the review and approval of the Prime Contractor's plan.
TBR-003	6.2	PCB gave direction to add a TBR to each statement in the S&MA Requirement document that addresses the review and approval of the Prime Contractor's plan.