COMPLIANCE IS MANDATORY

Responsible Office: Code LS/Systems Engineering and Architecture Division

Subject: Systems Engineering for Flight and Ground Systems w/Change 2 (11/04/2024)

TABLE OF CONTENTS

PREFACE

P.1 PURPOSE

a. The purpose of this document is to set forth the systems engineering (SE) requirements and processes established by the NASA Glenn Research Center (GRC) for space flight, atmospheric flight, and technology development projects performed at GRC. These projects are typically governed under NASA Procedural Requirements (NPR) 7120.5, NASA Space Flight Program and Project Management Requirements, and NPR 7120.8, NASA Research and Technology Program and Project Management Requirements. It specifically responds to NPR 7123.1 requirement SE-01 for the Center Director to "establish policies, procedures, and processes to execute the requirements of this SE NPR."

b. This document defines the Center's approach to the 17 systems engineering processes called for by NPR 7123.1, and is intended to aid the user in tailoring and customization of approaches to specific efforts.

P.2 APPLICABILITY

a. This directive is applicable to all organizations at GRC Lewis Field and Plum Brook Station.

b. This directive is applicable to those projects, sub-projects and lower level efforts (herein just referred to as projects) where the GRC is responsible for producing or delivering a system, or portion thereof, in support of space flight, atmospheric flight, research, and technology development. This includes projects that have been designated NPR 7120.5 or NPR 7120.8 compliant by an assigning NASA Mission Directorate and/or Program Office, or by GRC Center or Project Directorate Management. This includes when the system effort (or portion thereof) is contracted (i.e., "buy" acquisition approach), a shared responsibility of GRC and a partner, or implemented in an "in-house" (i.e., "make" approach) mode. Further, it includes ground support equipment, critical technical facilities, and ground systems specifically developed or significantly modified in direct support of these projects.

c. This directive does not apply to Agency Level I offices or Level II programs hosted and/or managed by GRC on behalf of an Agency Mission Directorate, or to selected reimbursable projects performed for non-NASA customers, as approved by the Center Management Council (CMC). It is expected that Programs will follow the general requirements as defined by NPR 7123.1. It is expected that reimbursable projects not identified as exempted by the CMC, would appropriately tailor this Glenn Procedural Requirements (GLPR) to meet the customer's unique requirements.

d. This directive does not apply to institutional programs and projects (including Information Technology (IT)). It is expected that institutional programs and projects (including IT) will follow the general requirements as defined by NPR 7123.1.

e. The requirements enumerated in this document are applicable to all new and existing projects as of the effective date of this document. The Engineering Technical Authority (ETA) may grant waivers/deviations for existing projects, allowing continuation of current practices that do not comply with all or part of this GLPR (see section 1.3).

f. This directive is applicable to documents developed or revised after the effective date of this GLPR.

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

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

i. For projects involving more than one Center, the governing Mission Directorate or mission support office determines whether a Center executes a project in a lead role or in a supporting role. If GRC is not responsible for producing or delivering a system, or portion thereof, this GLPR does not apply, as stated above in P.2 b. When GRC is identified as the lead Center and another Center is responsible for producing or delivering a system, or portion thereof, GRC and the supporting Center will jointly negotiate any additional requirements to be met, in addition to the supporting Center's implementation of NPR 7123.1, and document the additional requirements in the GRC project Systems Engineering Management Plan (SEMP) along with approval through the GRC ETA process. When GRC is the supporting Center and responsible for producing or delivering a system, or portion thereof, compliance to this GLPR is expected in addition to any additional lead Center requirements to be met, that are jointly negotiated and documented in the lead Center's project SEMP along with approval through the lead Center's ETA process.

P.3 AUTHORITY

a. NPR 7123.1, NASA Systems Engineering Processes and Requirements

b. Glenn Policy Directive (GLPD) 1000.1, GRC Governance and Strategic Management Structure

c. GLPR 1280.1, Glenn Research Center Quality Manual

P.4 APPLICABLE DOCUMENTS AND FORMS

a. NASA Policy Directive (NPD) 4200.1, Equipment Management Program

b. NPD 4500.1, Administration of Property in the Custody of Contractors

c. NPR 4200.1, NASA Equipment Management Procedural Requirements

d. NPR 4500.1, Administration of Property in the Custody of Contractors

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

f. NPR 7120.8, NASA Research and Technology Program and Project Management Requirements

g. NPR 7123.1, NASA Systems Engineering Processes and Requirements

h. NASA Interim Directive (NID) 1600.55, Sensitive But Unclassified (SBU) Controlled Information

i. GLPR 1440.1, Records Management

j. GLPR 7123.35, GRC Project Technical Review Procedure

k. GLPR 8000.4, Risk Management

l. Glenn Procedure (GLP)-LS-7123.17, Trade Study Handbook

m. Glenn Template (GLT)-7123-SEMP, System Engineering Management Plan (SEMP) Template

n. NASA SP-2016-6105, NASA Systems Engineering Handbook

o. SAE EIA-649-2 2016-04, Configuration Management Requirements for NASA Enterprises

P.5 MEASUREMENT/VERIFICATION

a. Evidence of compliance with this document can be found in the form of a completed Compliance Matrix (see Appendix C) appended to the project's SEMP or equivalent.

b. In addition to the Compliance Matrix, further evidence can be found in the form of data items (i.e., documents, electronic files/models, etc.) produced by projects that result from following the requirements listed herein.

c. The performance of the GRC Internal Audit Program.

P.6 CANCELLATION

None

approved

Laurence A. Sivic
Associate Director

CHAPTER 1: Introduction

1.1 Procedural Introduction

1.1.1 The systems engineering process is the collection of processes by which a system is developed. The system may be represented at various phases by descriptive and analytical models, a set of requirements, a design, and various builds of the system used to evaluate it. The resulting system, along with supporting products (data and/or systems), may be delivered to the end user or to the next higher level of integration.

1.1.2 The system being developed may include an operational element being delivered to an end user and/or enabling elements used to support the development or delivery of the operational element.

1.1.3 The NASA has defined 17 common technical processes to be implemented as part of a NASA Systems Engineering Engine, as illustrated in Figure 1. There are three sets of processes, the system design processes, the product realization processes, and the cross cutting technical planning processes. These processes are applied iteratively throughout the system development lifecycle during each applicable life-cycle phase and they are applied recursively to the various levels of product layer system structure.

1.1.4 The NPR 7123.1 defines the systems engineering processes and requirements for NASA. This GLPR captures the GRC implementation of these requirements. As a result, a project that follows this GLPR is in compliance with NPR 7123.1, and does not need to refer to it, other than as reference material.

1.2 Tailoring and Customization Considerations

1.2.1 The requirements and processes contained herein should be tailored and customized as appropriate for the project being performed, based on system/product size, complexity, criticality, and architectural level. Tailoring is seeking relief from requirements and processes while customization is modification of recommended practices. Any tailoring of the requirements in this GLPR should be captured in the project's SEMP (or equivalent plan), using the compliance matrix found in Appendix C of this document.

1.2.2 This document provides requirements applicable to the development of any system within the scope of this document. Appendix E provides tailoring/customization recommendations, based on the criticality of the system or technology being developed. However, Appendix E is only guidance, and not pre-approved tailoring/customization. Compliance and approval of tailoring/customization needs to be done with respect to the full set of requirements.

1.2.3 While many processes may be consistent within a project, considerations should be given to the need for tailoring and customization for different types of efforts within a project. For instance, if a project is developing both a flight system and a ground testbed, the engineering approach may be different between them, but both approaches should be planned and documented.

1.2.4 The technical planning and engineering effort needed to develop technology can vary widely. At the low end of technology criticality, planning might be done ad hoc with little rigor, while at the high end, planning and the amount of rigor may approach that of a flight system development. Technology may be developed for a potential future use or may be developed to support a specific flight system development. If in support of a flight system development, the flight project's technical planning may need to be overlaid on top of the technology development planning. For a technology portfolio project, much of the planning/compliance can be handled at the project or sub-project level. The planning/compliance does not necessarily need to be done individually by each individual technology development effort.

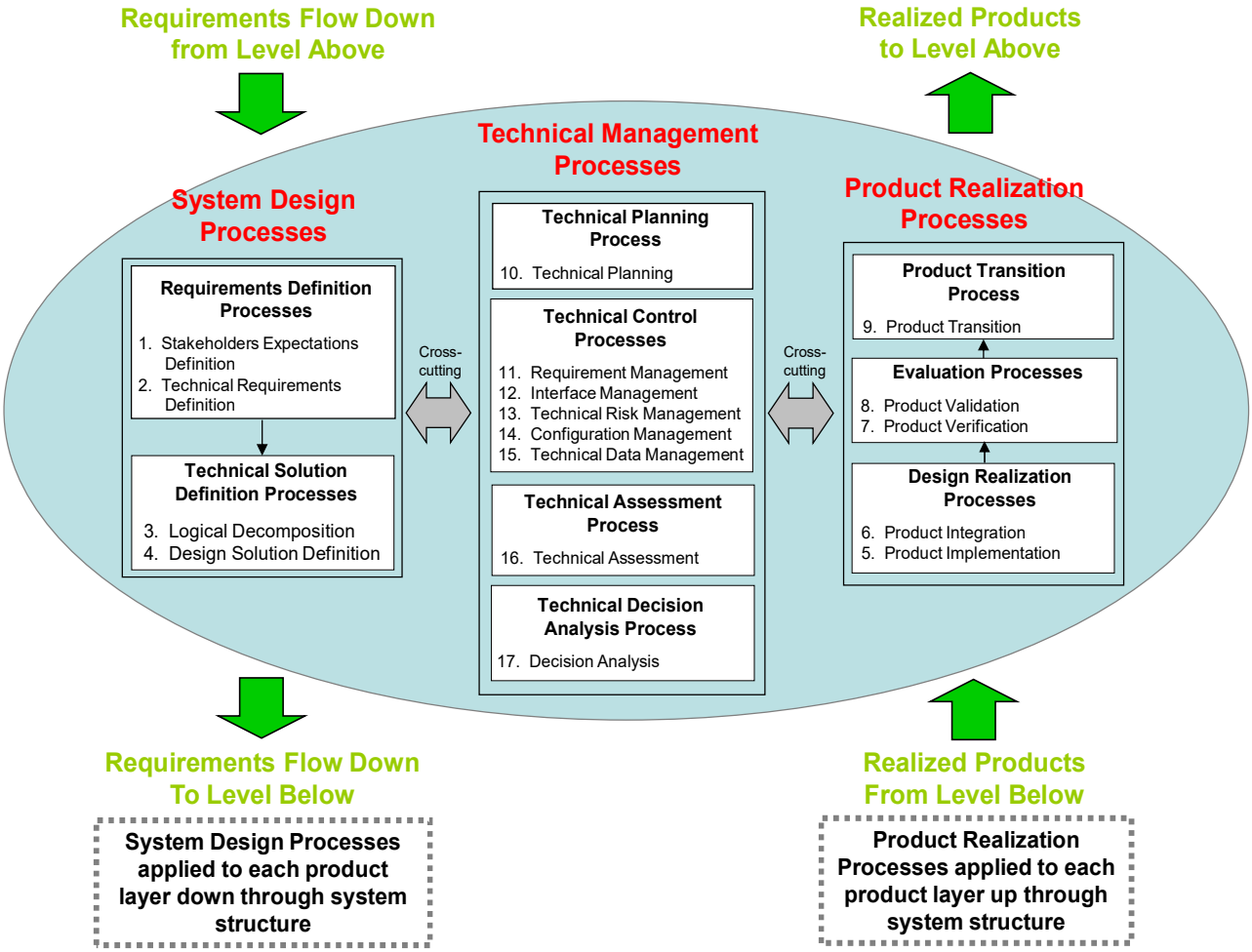

Figure 1. NASA Systems Engineering Engine

1.3 Tailoring and Customization Approval

1.3.1 Tailoring of the requirements within this document requires approval from ETA. Approval of tailoring is accomplished through GRC ETA approval of a project's SEMP (or equivalent), including the compliance matrix incorporated therein. See below for who is designated as the GRC ETA for SEMP approval. Prior to seeking approval, there should be

consultation with the appropriate independent Institutional Authority subject matter expert and Discipline Lead Engineer, as to the feasibility and acceptance of the tailoring. The ETA approval authority will ensure that the appropriate independent Institutional Authority subject matter expert for the associated requirement has concurred with the decision to approve the requirement tailoring.

1.3.2 If a need arises to tailor requirements after SEMP release, a change request should be submitted using the project's configuration management process to capture approval of the specific change. The change request would require, as a minimum, the same approvers as the SEMP. The approved change request would then be incorporated in the next general revision of the SEMP.

1.3.3 The Director of Research and Engineering is delegated by the Center Director to be the ETA approval authority for NPR 7123.1 technical efforts and requirements as implemented by this GLPR, including approval of program/project SEMPs, incorporated tailoring, and waiver/deviation approval of requirements within this GLPR. These roles may be further delegated to an individual with formally delegated Engineering Technical Authority at the Director of's discretion. For efforts associated only with technology development at the Technology Readiness Level (TRL) of 1-3, the GRC level of ETA is delegated to the Chief of the Division in which the bulk of the effort resides. Other signatories, such as Project Manager, Project Chief Engineer, and/or Discipline Lead Engineer may be required as determined by project and institutional leadership, depending upon the complexity of the effort.

1.3.4 If approval authority is to be delegated for the SEMP and any incorporated tailoring, the delegation shall be documented in an official retrievable Research and Engineering Directorate record **[REQ-01]**. An example of such a record would be minutes of a Research and Engineering Directorate Engineering Management Board (EMB). Any delegation of SEMP approval, in effect, also delegates approval of tailoring of the requirements of this GLPR.

1.3.5 If delegation of SEMP approval authority is desired, it is recommended that it be brought before an EMB meeting for discussion early in the formulation stages of a project.

1.4 Transition from Technology to Flight

1.4.1 Special considerations should be given when a flight project is relying upon technology that has not yet demonstrated a TRL of 6. In this case, the general guideline is that TRL 6 should be demonstrated for any components used in a system prior to that system's Preliminary Design Review (PDR). If a technology is being demonstrated as part of a flight project, but is not part of a system required to conduct the mission, this would not apply. TRL definitions can be found in NPR 7123.1.

1.4.2 Technology development often follows a different lifecycle than the development of flight systems. Extra care should be taken when integrating the two lifecycles, especially for technical milestone reviews. Technology development efforts may choose to have reviews that blend technology development with flight-like content. This may better prepare those efforts for transition to flight, but in most cases should not take the place of flight system technical milestone reviews.

1.4.3 In addition to the blending of technical milestone reviews, care also needs to be given to terminology being used, as the terminology used for technology development and flight system development can be similar, yet have different meanings. One example is the term prototype, where in technology development it is a unit that demonstrates form, fit, and function at a scale deemed to be representative of the final product, whereas in flight development it is often a unit built to the flight design and processes that is used for qualification purposes. Terminology guidance can be found in NPR 7120.8 and special publication (SP) NASA SP-2016-6105.

CHAPTER 2: Systems Engineering Requirements

2.1 Introduction to the Systems Engineering Process Areas

2.1.1 The sections in this chapter define for GRC what needs to be done in each of the 17 processes in the NASA Systems Engineering Engine and/or expected outcomes of each.

2.1.2 Guidance on how to implement these processes can be found in NASA SP-2016-6105, industry standards, and other handbooks.

2.1.3 The application of these processes is not intended to be in a linear fashion as many need to be done in parallel, however because some processes require information (input) from another process (output), iterations of portions of the processes may need to be done serially.

2.1.4 Some of the expected outcomes/artifacts of the processes are tied to specific lifecycle milestones. This does not mean that those processes are only performed in certain lifecycle phases. They may be more prevalent in certain phases, but are intended to be applied iteratively throughout the development lifecycle. For instance, stakeholder expectations need to be defined early on in the lifecycle (as part of the Stakeholder Expectations process), but should occasionally be reviewed and revised as needed during later phases.

2.1.5 Process areas in this section identify outcomes/artifacts that are required at specific technical milestone reviews. Table 1, which can be found at the end of this section, provides a summary of those that are tied to a specific technical milestone review. This table contains the set of outcomes/artifacts called for by this GLPR. Other outcomes/artifacts are driven by entrance/success criteria defined for each review and project needs. Refer to NPR 7123.1 Appendix G for potential criteria, which can be customized for a specific project.

2.2 Stakeholder Expectations

2.2.1 A list of key stakeholders for the effort to be performed at GRC shall be defined and maintained **[REQ-02]**. Stakeholders are groups or individuals who are affected by or has an interest or stake in a program or project.

2.2.2 Stakeholder technical expectations for the effort to be performed at GRC shall be defined and maintained **[REQ-03]**. Formal definition of the Measures of Effectiveness (MOEs) should be included.

2.2.3 The list of stakeholders and the stakeholder expectations shall be captured in a released data item and made available at the Mission Concept Review (MCR) **[REQ-04]**. The data item containing the expectations should be baselined following the incorporation of any comments from MCR.

2.2.4 A Concept of Operations (ConOps) shall be developed and maintained **[REQ-05]**. The ConOps describes the overall high-level concept of how the system will be used to meet stakeholder expectations. The ConOps might be in a standalone data item or included with stakeholder expectations.

2.2.5 The ConOps shall be captured in a released data item and made available at the MCR **[REQ-06]**. The data item containing the ConOps should be baselined following the incorporation of any comments from MCR.

2.2.6 Multiple concepts that meet the stakeholder expectations should be developed. The recommended concept shall be documented and presented at the MCR **[REQ-07]**. The alternative concepts should also be presented. Following incorporation of comments from the MCR, the revised concept is considered the baseline concept.

2.3 Technical Requirements Definition

2.3.1 A set of technical requirements (e.g. constraints, performance, functional, safety, interface, etc.) in "shall" statements for the system(s) to be developed and associated verification criteria shall be established, baselined and maintained **[REQ-08]**. This may require deriving requirements from higher levels, including performing functional decomposition. The verification criteria should, at a minimum include the verification method(s) to be used, but may include environments, special conditions (e.g. item configurations), success criteria, and phases in which the verification is to be performed.

2.3.2 The technical requirements, and the associated verification criteria, shall be captured in a released data item and made available at the System Requirements Review (SRR) **[REQ-09]**. The data item containing the requirements should be baselined following the incorporation of any comments from SRR.

2.3.3 For each technical requirement, a corresponding verification requirement (including success criteria) shall be established, baselined and maintained **[REQ-10]**.

2.3.4 As part of requirements definition, Project Chief Engineers and associated Discipline Lead Engineers should ensure appropriate standards are selected for use on the project.

2.4 Logical Decomposition

2.4.1 A system architecture shall be established, baselined and maintained **[REQ-11]**. A system architecture is consistent with the Product Breakdown Structure (PBS) and Work Breakdown Structure (WBS). Logical (functional and behavioral) and physical views are often used for representing the fundamental aspects of the system architecture.

2.4.2 The system architecture shall be captured in a released data item and made available at the Mission Definition Review (MDR)/System Definition Review (SDR) **[REQ-12]**. The data item containing the system architecture should be baselined following the incorporation of any comments from MDR/SDR.

2.4.3 The technical requirements shall be allocated to the next lower level of the product structure **[REQ-13]**. This data serves as a starting point for requirements definition at the next level of the product structure.

2.4.4 The requirements allocation shall be captured in a released data item and made available at the MDR/SDR **[REQ-14]**. The data item containing the requirements should be baselined following the incorporation of any comments from MDR/SDR.

2.4.5 When requirements are to be decomposed to multiple levels, the systems engineer should determine how to appropriately perform the iterative requirements development loop, with respect to planned technical milestone reviews.

2.5 Design Solution Definition

2.5.1 A technical data package, consisting of engineering drawings and product specifications or digital model equivalents, which represents a preliminary design level of maturity shall be produced prior to the PDR **[REQ-15]**.

2.5.2 A technical data package, consisting of engineering drawings and product specifications or digital model equivalents, which represents a final design level of maturity shall be produced prior to the Critical Design Review (CDR) **[REQ-16]**.

2.6 Product Implementation

Center procedures are to be utilized for procurement and fabrication, as make/buy/re-use decisions are made. If a "buy" decision is made to procure non-commercial-off-the-shelf (COTS) items, there are requirements identified in the Technical Planning section (2.11) related to planning for and executing responsibilities prior to, during, and after the procurement process.

2.7 Product Integration

2.7.1 Integration/assembly procedures shall be developed to guide the integration of lower level products and to provide a record of the integration **[REQ-17]**. The record should include traceability to the components used (serial numbers, lot numbers, versions, etc.), quantities used (when not pre-specified), mandatory inspection points, and signoffs (technicians, engineers, quality assurance, etc.)

2.7.2 Product Integration does not occur at the lowest product level, since in that case, the parts or components are being fabricated or procured individually (or as a COTS item).

2.8 Product Verification

2.8.1 As part of Technical Planning, the approach to product verification shall be established, baselined, and maintained **[REQ-18]**. The approach should define:

a. The overall verification philosophy.

b. The verification activities, typically analysis, demonstration, inspection, and/or test, that will be performed to provide objective evidence of compliance with requirements/specification in order to satisfy each of the verification requirements.

c. Which requirements (critical ones) will be addressed in which early phases of the project through preliminary verification activities.

d. When more than one unit of a product is produced, thought should be given to how verification is integrated with qualification and acceptance programs.

2.8.2 Requirements compliance shall be assessed and documented throughout the development phase from post-SRR until the system is delivered **[REQ-19]**.

2.8.3 Preliminary verification results shall be available at the SIR for the products ready to be integrated **[REQ-20]**.

2.8.4 A verification tracking matrix is often used to track the status for each verification requirement/event. This status would include planned and actual completion dates, the state of the verification closure, and data items where verification results are documented.

2.8.5 Final verification results shall be available at the Flight Readiness Review (FRR), or, for non-flight systems, at an operational Test Readiness Review (TRR) or equivalent **[REQ-21]**.

2.9 Product Validation

2.9.1 As part of Technical Planning, the approach to product validation shall be established, baselined, and maintained **[REQ-22]**. Product validation is the process of showing proof that the product accomplishes the intended purpose based on stakeholder expectations and the Concept of Operations. The approach should define the overall validation philosophy, how stakeholders will be involved, and the validation activities that will be performed in each phase of the project.

2.9.2 Preliminary validation results shall be available at the System Integration Review (SIR) for the products ready to be integrated **[REQ-23]**.

2.9.3 Final validation results shall be available at the FRR, or, for non-flight systems, at an operational TRR or equivalent **[REQ-24]**.

2.10 Product Transition

2.10.1 As part of technical planning, any supporting data needed to accompany products during transition (either internally or externally) shall be defined **[REQ-25]**. Product transition is the process used to transition a verified and validated end product that has been generated by product implementation or product integration to the customer at the next level in the system structure for integration into an end product or, for the top level end product, transitioned to the intended end user. The form of the product transitioned will be a function of the product life-cycle phase and the location within the system structure of the product layer in which the end product exists.

2.10.2 Transfer of government property between different organizations may require specific paperwork to be completed. Transfers include contractor to contractor, contractor to NASA, one NASA Center to another NASA Center, and NASA to another Governmental Agency. Transfers within the Federal Government (within or external to NASA) are covered by NPD 4200.1 and NPR 4200.1. Transfers between, or from, a contractor are covered by NPD 4500.1 and NPR 4500.1. Additional guidance can be obtained from the GRC Logistics and Technical Information Division.

2.10.3 Updated operational plans shall be provided at the Operational Readiness Review (ORR) **[REQ-26]**. Operational plans include mission objectives, and mission timelines

2.10.4 Updated operational procedures shall be provided at the ORR **[REQ-27]**.

2.10.5 Final certification for flight/use shall be provided at FRR or for non-flight systems at an operational TRR **[REQ-28]**.

2.10.6 A System Acceptance Review (SAR) is held to ensure development of a system is complete. It is also used to ensure the system is ready to transition to the next level of integration or end user, which may be another organization outside of Glenn, such as a launch site. When a system is completed, but will not be transitioned right away, a separate Pre-Ship Review (PSR) may be conducted prior to the transition. For some organizations at Glenn, the PSR serves the function of a SAR. And in some cases, the Review is conducted as a two-step review, the first review (Engineering) at the project level, followed by a summary review (Executive) with Center Management.

2.10.7 When space flight hardware is being shipped from GRC for final launch processing, a GRC 643 Form, *Glenn Research Center Approval to Ship Space Flight Hardware*, shall be completed **[REQ-29]**.

2.11 Technical Planning

2.11.1 The technical team, in conjunction with project management, shall perform the planning necessary to define and execute the technical approach to the project and capture the resulting plan in a GRC SEMP and related technical and discipline plans **[REQ-30]**. The approach, as documented in the SEMP will define how the processes, defined in this GLPR, including tailoring, will be recursively applied to the various levels of project product layer system structure during each applicable life-cycle phase.

2.11.2 The compliance matrix in Appendix C of this GLPR shall be completed and included in the SEMP **[REQ-31]**.

2.11.3 The GRC ETA approval shall be obtained for the SEMP, waiver authorizations, and other key technical data items to ensure independent assessment of technical content **[REQ-32]**. As stated in section 1.3.3., this is the GRC Director of Research and Engineering, or Division Chief for TRL 1-3 efforts, unless formally delegated.

2.11.4 A released SEMP shall be made available at the SRR **[REQ-33]**. The SEMP should be baselined following the incorporation of any comments from the SRR. The SEMP is critical to the technical planning and guiding the initial conceptual development, so development of the SEMP and its initial release is encouraged to be done earlier, as part of the preparations for a MCR.

2.11.5 For projects with all or portions of the engineering work contracted out (i.e., a contractor is providing an end item [all or part of a system] that is not COTS), the scope and plan for the NASA portion of the project implementation of the technical processes before, during, and at the completion of the contracted effort shall be defined and captured in the GRC SEMP **[REQ-34]**. The GRC SEMP content will include planning for the technical team's involvement in the Request for Proposal (RFP) preparation (product requirements definition, statement of work tasks, and work products to be delivered), in source selection activities (in accordance with NASA and GRC source Selection procedures), in oversight/surveillance, in acceptance of deliverables, and transition of the end product.

2.11.6 An Integration Plan shall be provided for review no later than at the SIR **[REQ-35]**. An integration plan documents the integration strategy, and along with supporting data items, identifies the optimal sequence of receipt, assembly, and activation of the various components that make up the system. This will help to identify any effort needed to establish and equip the assembly facilities; e.g., raised floor, hoists, jigs, test equipment, input/output, and power connections. A sample outline of a plan can be found in NASA SP-2016-6105.

2.11.7 Preliminary decommissioning plans shall be provided for review no later than at the ORR **[REQ-36]**.

2.11.8 Baseline decommissioning plans shall be provided for review no later than at the Decommissioning Review (DR) **[REQ-37]**.

2.11.9 Baseline disposal plans shall be provided for review no later than at the FRR **[REQ-38]**.

2.11.10 Updated disposal plans shall be provided for review no later than at the Disposal Readiness Review (DRR) **[REQ-39]**.

2.12 Requirements Management

2.12.1 The technical requirements/specifications architecture and metadata shall be established, baselined, and maintained (e.g., Technical Requirements/Specification tree) **[REQ-40]**.

2.12.2 Bi-directional traceability of technical requirements shall be established and maintained **[REQ-41]**.

2.13 Interface Management

2.13.1 The approach for managing interfaces (e.g., responsibilities, agreements used, or assess changes to) shall be established, controlled, and maintained **[REQ-42]**. The interface management approach is typically captured in the SEMP.

2.13.2 An interface block diagram shall be established, controlled, and maintained as part of the architectural definition of the system **[REQ-43]**.

2.13.3 Control of the interface design solution(s) shall be established, baselined, and maintained **[REQ-44]**. Interface design solutions are typically captured in an Interface Control Document (ICD) or Drawing (e.g., details the interface solution between two or more systems).

2.14 Technical Risk Management

The GRC technical risk management process is defined in GLPR 8000.4, Risk Management.

2.15 Configuration Management

2.15.1 As part of Technical Planning, the approach to configuration management shall be established, baselined, and maintained **[REQ-45]**. The approach should define the configuration

management strategy and processes for configuration identification, release, configuration change management, configuration status accounting, and configuration verification and audit.

2.15.2 Unless otherwise specified in higher level project data items, SAE EIA-649-2 should be used to guide the implementation of configuration management.

2.16 Technical Data Management

2.16.1 As part of Technical Planning, the approach to technical data management shall be established, baselined, and maintained **[REQ-46]**. The approach should define the technical management strategy and processes for technical data identification and definition, technical data formatting, and control of/ access to the technical data.

2.16.2 Technical data management processes are required to comply with Agency and Center requirements for SBU identification, marking, and safeguarding (NID 1600.55); export control, proprietary information, forms establishment, and program/project/activity records identification, retention, and archival (GLPR 1440.1).

2.16.3 When the project is responsible for operation of the system, if management of engineering data gathered during operations is not addressed elsewhere, it should be included as part of technical data management.

2.16.4 When the project is responsible for operation of the system and the system is for scientific purposes, if management of scientific data gathered during operations is not addressed elsewhere, it should be included as part of technical data management.

2.17 Technical Assessment

2.17.1 As part of Technical Planning, the life-cycle and technical milestone reviews to be conducted during Project execution, and the approach to them, shall be defined, documented, and maintained **[REQ-47]**. At a minimum, all projects should conduct SRR, PDR, CDR, and SAR technical milestone reviews. Additional independent technical review requirements apply to NPR 7120.5 designated projects, as defined in GLPR 7123.35, GRC Project Technical Review Procedure.

2.17.2 This document calls for data items to be available at specific milestone reviews. When the milestone review called for is not being planned, the requirement for when the data item is due will need to be tailored appropriately.

2.17.3 When parts of a project are at different levels of maturity, especially for larger projects, consideration should be given to having multiple reviews, one for the system and ones targeted at parts of the system. For example a System SRR that addresses the system and all but one subsystem, followed at some later point in time by a SRR that addresses the remaining subsystem. GLPR 7123.35 and NPR 7123.1 provide additional requirements and guidance on how to conduct independent and project technical reviews.

2.17.4 Entrance and success criteria shall be established for each technical milestone review **[REQ-48]**. These criteria should be finalized prior to the preceding review, if not before, to

allow for adequate planning of the work needed between the two reviews. Refer to NPR 7123.1 Appendix G for potential criteria, which can be customized for a specific project.

2.17.5 The review discrepancies/actions (e.g., Review Item Discrepancies (RIDs)/Request for Actions (RFAs)) resulting from the life-cycle and technical milestone reviews, their disposition, and the objective evidence supporting closure shall be identified and tracked **[REQ-49]**.

2.17.6 During the normal course of business, periodic technical status reviews shall be held to monitor and assess the technical effort **[REQ-50]**.

2.17.7 The list of leading indicators (systems engineering and technical performance measures) to be tracked by the project and their reporting frequency shall be defined, documented, and approved **[REQ-51]**.

2.17.8 Mass and power margins should be included as a technical performance measure for applicable systems.

2.17.9 The leading indicators to be tracked and their initial trend shall be presented at the MDR/SDR **[REQ-52]**.

2.17.10 The leading indicators shall be tracked and their trends reported to the project on the agreed-upon interval **[REQ-53]**.

2.18 Decision Analysis

2.18.1 The approach to perform decision analysis shall be established and maintained **[REQ-54]**. This information is typically captured in the SEMP.

2.18.2 The GLP-LS-7123.17 provides guidance on the performance of Trade Studies, in support of Decision Analysis.

Table 1. Required Systems Engineering Data Items by Milestone Review

Technical Milestone Review	Required Data Items
MCR	Stakeholders and stakeholder expectations Concept of Operations Chosen baseline concept
SRR	Technical requirements
MDR/SDR	SEMP (or equivalent) Leading indicators to be tracked and their initial trend System architecture Requirements allocation
PDR	Technical data package that represents a preliminary design
CDR	Technical data package that represents a final design
SIR	Integration Plan Preliminary verification results Preliminary validation results

Technical Milestone Review	Required Data Items
ORR	Updated operational plans Updated operational procedures Preliminary decommissioning plans
FRR (or TRR for ground test articles)	Baseline disposal plans Final verification results Final validation results Final certification for flight/use
DR	Baseline decommissioning plans
DRR	Updated disposal plans

CHAPTER 3: Systems Engineering Planning

3.1 Planning Introduction

This chapter is intended to provide expectations and information related to planning the technical effort, which culminates in the creation of, or a revision to, a project's SEMP and other technical plans, such as a verification plan.

3.2 Technical Planning

3.2.1 Project technical planning should be occurring as a normal part of project execution. Understanding the intended content of a SEMP can provide a framework for performing the top level planning. This planning should be done collaboratively among key project members and is not solely the responsibility of a systems engineer, although they will often lead, or be a critical part of, the planning effort.

3.2.2 Either consciously, or subconsciously, this technical planning takes place. Lack of planning, or ad hoc planning, can present schedule and budget risk for a project. For example, good technical planning will result in artifacts being needed to support technical milestone review being developed as a normal part of the project, rather than a last minute effort to produce them prior to holding a review. Planning can also help to make sure that aspects of the system are properly assessed in all phases of the project. This can help catch system issues early on, when they are easier and less expensive to correct.

3.2.3 Technical planning should not be a one-time event that only occurs early in a project's life-cycle. Planning should be reassessed on a regular basis to see if adjustments need to be made to address changes, to address new needs, or add details that could not be planned in earlier phases. When there are unknowns in a project, it may be beneficial to do top level planning for the whole lifecycle and then only detailed planning for the next phase or two. One example of this phased approach could be a Verification Plan, where an overall approach is specified, and details for the verifications to be performed in the next phase are provided in detail, and then information for the following phases added in subsequent revisions. The disadvantage of this approach is if something needs to be done in an earlier phase to prepare for a later phase that is not known until that later phase is defined it may get missed, and cost and schedule estimates can only be made based on the overall plan and not the details of future phases, resulting in less confidence in the estimates.

3.3 Cycles

3.3.1 Application of the systems engineering process areas described above is intended to be done iteratively. For instance, one iteration could be completed a) during the initial concept work, b) during the technology development/requirements definition, c) during the preliminary design, and d) during the final design and build. In each of these phases, the final deliverable system is represented by various models: a concept, a set of requirements, the design, and eventually the physical system itself.

3.3.2 Technical planning should consider how to apply the processes to each model, individual parts of the model, and physical build of system. For instance, in some cases it may make sense to have a preliminary design review of breadboard design or engineering model design, even though there is a preliminary design review planned for the full flight design. The approach and process for a breadboard design review might be significantly different from one for an engineering model design review, and an engineering model design review different from that for a flight design.

3.3.3 Some projects like to do work in "cycles." These are often called requirements analysis cycles or design analysis cycles. These essentially provide for multiple iterations of the systems engineering process areas during a single phase – such as requirements or design phases. A requirements analysis cycle might include requirement development, decomposition of these requirements, analysis of the requirements, assessment of the results and an update to the requirements based on the outcome to use as a starting point for the next cycle. These are just another way of describing the design and realization process area groups.

3.4 Documenting the Plans

3.4.1 Creation of, or update to, the SEMP or other technical plan is just the culmination of the planning effort. It is important to document the result of the planning effort because it encourages the planning effort to be a conscious preplanned effort rather than spur of the moment decision. The documentation provides a way to communicate with team members so they know expectations and how to accomplish various tasks within the project structure. It also provides a means for stakeholders to understand the plan and gain approval from those who need to accept the plans.

3.4.2 The SEMP does not need to be a standalone data item, but could be incorporated in another data item, such as a Project Management Plan, or be called something other than a SEMP. This applies as well to other technical plans. Care should be taken when combining data items, because the more that is included in one data item, then all individuals who might need to approve individual pieces should approve the one data item, which opens it up for broader review and may cause delays in getting all the approvals.

3.4.3 Guidance on the content of a SEMP can be found in a number of places, including NASA SP-2016-6105. A GRC SEMP Template (GLT-7123-SEMP) can be found in the GRC BMS.

3.4.4 Technical plans, and especially the SEMP should be reviewed prior to technical milestone reviews to determine if updates are needed to help guide the next phase of the project.

3.4.5 One area to specifically look at for potential revisions is the entrance and exit criteria for the following technical milestone review. This criteria is needed prior to the initiation of the next phase, so that the proper planning can be done and artifacts produced as part of the normal effort, rather than at the last minute, prior to a review. This criteria is often included in convening memos for a review, but the criteria must be defined and approved by the ETA prior to work beginning in the phase that the review is being conducted in.

3.4.6 As mentioned in Section 2.11, ETA approval of the SEMP is required. Enough lead time should be allocated for the necessary review and signature.

Appendix A: Definitions

Bidirectional Traceability: The ability to trace any given requirement/expectation to its parent requirement/expectation and to its allocated children requirements/expectations.

Concept of Operations (ConOps): Developed early in Pre-Phase A, describes the overall high-level concept of how the system will be used to meet stakeholder expectations, usually in a time sequenced manner. It describes the system from an operational perspective and helps facilitate an understanding of the system goals. It stimulates the development of the requirements and architecture related to the user elements of the system. It serves as the basis for subsequent definition data items and provides the foundation for the long-range operational planning activities.

Data Item: A document, electronic file/model or collection of them that must be submitted by the performing activity to the procuring or tasking activity to fulfill a contract or tasking directive requirement for the delivery of information.

Entrance Criteria: Guidance for minimum accomplishments each program or project fulfills prior to a life-cycle review

Key Decision Point: The event at which the Decision Authority determines the readiness of a program/project to progress to the next phase of the life cycle (or to the next Key Decision Point (KDP)).

Leading Indicator: A measure for evaluating the effectiveness of how a specific activity is applied on a program in a manner that provides information about impacts likely to affect the system performance objectives. A leading indicator may be an individual measure or collection of measures predictive of future system (and project) performance before the performance is realized. The goal of the indicators is to provide insight into potential future states to allow management to take action before problems are realized. A technical leading indicator is a subset of the TPMs that provides insight into the potential future states.

Measure of Effectiveness: A measure by which a stakeholder's expectations will be judged in assessing satisfaction with products or systems produced and delivered in accordance with the associated technical effort. An MOE is deemed to be critical to not only the acceptability of the product by the stakeholder but also critical to operational/mission usage. An MOE is typically qualitative in nature or not able to be used directly as a "design-to" requirement.

Product Layer: The end product is decomposed into a hierarchy of smaller and smaller products. Each of these product layers includes both the end product and associated enabling products.

Product Realization: The act of making, buying, or reusing a product or the assembly and integration of lower level realized products into a new product, as well as the verification and validation that the product satisfies its appropriate set of requirements and the transition of the product to its customer.

Product Transition: The process used to transition a verified and validated end product that has been generated by product implementation or product integration to the customer at the next level in the system structure for integration into an end product or, for the top level end product, transitioned to the intended end user.

Recursive: Value that is added to the system by the repeated application of processes to design next lower layer system products or to realize next upper layer end products within the system structure. This also applies to repeating application of the same processes to the system structure in the next life-cycle phase to mature the system definition and satisfy phase exit criteria.

Stakeholder: A group or individual who is affected by or has an interest or stake in a program or project. There are two main classes of stakeholders: customers and other interested parties.

Success Criteria: Specific accomplishments that need to be satisfactorily demonstrated to meet the objectives of a life-cycle and technical review so that a technical effort can progress further in the life cycle. Success criteria are documented in the corresponding technical review plan.

Technical Authority: Part of NASA's system of checks and balances that provides independent oversight of programs and projects in support of safety and mission success through the selection of individuals at delegated levels of authority. These individuals are the Technical Authorities. Technical Authority delegations are formal and traceable to the Administrator. Individuals with Technical Authority are funded independently of a program or project.

Technical Performance Measures: The set of performance measures that are monitored by comparing the current actual achievement of the parameters with that anticipated at the current time and on future dates. Used to confirm progress and identify deficiencies that might jeopardize meeting a system requirement. Assessed parameter values that fall outside an expected range around the anticipated values indicate a need for evaluation and corrective action. Technical performance measures are typically selected from the defined set of Measures of Performance.

Technical Team: A multidisciplinary group of individuals with appropriate domain knowledge, experience, competencies, and skills assigned to a specific technical effort.

Technology Readiness Level: A scale against which to measure the maturity of a technology. TRLs range from 1 (Basic Technology Research) to 9 (Systems Test, Launch, and Operations).

Validation (of a product): The process of showing proof that the product accomplishes the intended purpose based on stakeholder expectations and the Concept of Operations. May be determined by a combination of test, analysis, demonstration, and inspection. (Answers the question, "Am I building the right product?")

Validation (of Requirements): The continuous process of ensuring that requirements are well-formed (clear and unambiguous), complete (agrees with customer and stakeholder needs and expectations), consistent (conflict free), and individually verifiable and traceable to a higher level requirement or goal. (Answers the question, "Will I build the right product?")

Verification (of a product): Proof of compliance with requirements/specifications. Verification may be determined by test, analysis, demonstration, inspection, or a combination thereof. (Answers the question, "Did I build the product right?")

Appendix B: Acronyms

BMS	Business Management System
CDR	Critical Design Review
CMC	Center Management Council
ConOps	Concept of Operations
COTS	commercial-off-the-shelf
DR	Decommissioning Review
DRR	Disposal Readiness Review
EMB	Engineering Management Board
ERB	Engineering Review Board
ETA	Engineering Technical Authority
FOM	Figure of Merit
FRR	Flight Readiness Review
GLPR	Glenn Procedural Requirements
GRC	Glenn Research Center
ICD	Interface Control Document
ID	identifier
IT	information technology
KDP	Key Decision Point
MCR	Mission Concept Review
MDR	Mission Definition Review
MOE	Measure of Effectiveness
MRB	Material Review Board
NID	NASA Interim Directive
NPD	NASA Policy Directive
NPR	NASA Procedural Requirements
ORR	Operational Readiness Review
PBS	Product Breakdown Structure
PCB	Project Change Boards
PDR	Preliminary Design Review
PSR	Pre-Ship Review
RFA	Request for Action
RFP	Request for Proposal

RID	Review Item Discrepancy
SAR	System Acceptance Review
SBU	Sensitive But Unclassified
SDR	System Definition Review
SE	Systems Engineering
SEMP	Systems Engineering Management Plan
SIR	System Integration Review
SP	Special Publication
SRR	System Requirements Review
TRL	Technology Readiness Level
TRR	Test Readiness Review
WBS	Work Breakdown Structure

Appendix C: Compliance Matrix

C.1 The following Compliance Matrix is used to document the project's compliance or intent to comply with the requirements of this GLPR or justification for tailoring. It is attached to the SEMP when submitted for approval. The matrix lists:

a. The unique requirement identifier (ID)

b. The paragraph reference

c. The GLPR 7123.2 requirement statement

d. A "Comply?" column (see description below)

e. A "Compliance Statement" column (see description below)

C.2 The "Comply?" column is filled in to identify the project's approach to the requirement or intent to tailor. An "FC" is inserted for "fully compliant," "T" for "tailored," or "NA" for a requirement that is "not applicable."

C.3 The "Compliance Statement" column should be filled in with the section of the SEMP where additional information related to the requirement is located, proposed tailoring of any requirement and the rationale for the tailoring, and/or justification on why the requirement is not applicable. Text contained in Appendix E of this GLPR can be used as a basis for the proposed tailoring portion of this information, but is not pre-approved tailoring, and compliance is still back to the requirement statement listed herein, not the guidance in appendix E of this GLPR.

Req. ID	GLPR Paragraph	Requirement Statement	Comply ?	Compliance Statement
REQ-01	1.3.4	If approval authority is to be delegated for the SEMP and any incorporated tailoring, the delegation shall be documented in an official retrievable Research and Engineering Directorate record.		
REQ-02	2.2.1	A list of key stakeholders for the effort to be performed at GRC shall be defined and maintained.		
REQ-03	2.2.2	Stakeholder technical expectations for the effort to be performed at GRC shall be defined and maintained.		
REQ-04	2.2.3	The list of stakeholders and the stakeholder expectations shall be captured in a released data item and made available at the MCR.		
REQ-05	2.2.4	A ConOps shall be developed and maintained.		
REQ-06	2.2.5.	The ConOps shall be captured in a released data item and made available at the MCR		
REQ-07	2.2.6	The recommended concept shall be documented and presented at the MCR.		
REQ-08	2.3.1	A set of technical requirements (e.g. constraints, performance, functional, safety, interface, etc.) in "shall" statements for the system(s) to be developed shall be established, baselined and maintained.		
REQ-09	2.3.2	The technical requirements shall be captured in a released data item and made available at the SRR		
REQ-10	2.3.3	For each technical requirement, a corresponding verification requirement (including success criteria) shall be establish, baselined and maintained.		

Req. ID	GLPR Paragraph	Requirement Statement	Comply ?	Compliance Statement
REQ-11	2.4.1	A system architecture shall be established, baselined and maintained.		
REQ-12	2.4.2	The system architecture shall be captured in a released data item and made available at the MDR/SDR.		
REQ-13	2.4.3	The technical requirements shall be allocated to the next lower level of the product structure.		
REQ-14	2.4.4	The requirements allocation shall be captured in a released data item and made available at the MDR/SDR		
REQ-15	2.5.1	A technical data package, consisting of engineering drawings and product specifications or digital model equivalents, which represents a preliminary design level of maturity shall be produced prior to the PDR.		
REQ-16	2.5.2	A technical data package, consisting of engineering drawings and product specifications or digital model equivalents, which represents a final design level of maturity shall be produced prior to the CDR.		
REQ-17	2.7.1	Integration/assembly procedures shall be developed to guide the integration of lower level products and to provide a record of the integration.		
REQ-18	2.8.1	As part of Technical Planning, the approach to product verification shall be established, baselined, and maintained.		
REQ-19	2.8.2	Requirements compliance shall be assessed and documented throughout the development phase from post-SRR until the system is delivered.		
REQ-20	2.8.3	Preliminary verification results shall be available at the SIR for the products ready to be integrated		
REQ-21	2.8.5	Final verification results shall be available at the FRR, or, for non-flight systems, at an operational TRR or equivalent		
REQ-22	2.9.1	As part of Technical Planning, the approach to product validation shall be established, baselined, and maintained.		
REQ-23	2.9.2	Preliminary validation results shall be available at the SIR for the products ready to be integrated.		
REQ-24	2.9.3	Final validation results shall be available at the FRR , or, for non-flight systems, at an operational TRR or equivalent		
REQ-25	2.10.1	As part of technical planning, any supporting data needed to accompany products during transition (either internally or externally) shall be defined.		
REQ-26	2.10.3	Updated operational plans shall be provided at the ORR.		
REQ-27	2.10.4	Updated operational procedures shall be provided at the ORR.		
REQ-28	2.10.5	Final Certification for flight/use shall be provided at FRR or for non-flight systems at TRR.		
REQ-29	2.10.7	When flight hardware is being shipped from GRC, a GRC 643, *Glenn Research Center Approval to Ship Space Flight Hardware* form shall be completed		
REQ-30	2.11.1	The technical team shall perform the planning necessary to define the technical approach to the project and capture the resulting plan in a GRC SEMP and related technical and discipline plans		
REQ-31	2.11.2	The compliance matrix in Appendix C of this GLPR shall be completed and included in the SEMP.		
REQ-32	2.11.3	The GRC Engineering Technical Authority approval shall be obtained for the SEMP, waiver authorizations, and other key technical data items to ensure independent assessment of technical content		

Req. ID	GLPR Paragraph	Requirement Statement	Comply ?	Compliance Statement
REQ-33	2.11.4	A released SEMP shall be made available at the SRR.		
REQ-34	2.11.5	For projects with all or portions of the engineering work contracted out (i.e. a contractor is providing an end item [all or part of a system] that is not COTS), the scope and plan for the NASA portion of the project implementation of the technical processes before, during, and at the completion of the contracted effort shall be defined and captured in the GRC SEMP.		
REQ-35	2.11.6	An Integration Plan shall be provided for review no later than at the SIR		
REQ-36	2.11.7	Preliminary decommissioning plans shall be provided for review no later than at the ORR.		
REQ-37	2.11.8	Baseline decommissioning plans shall be provided for review no later than at the DR.		
REQ-38	2.11.9	Baseline disposal plans shall be provided for review no later than at the FRR.		
REQ-39	2.11.10	Updated disposal plans shall be provided for review no later than at the DRR.		
REQ-40	2.12.1	The technical requirements/specifications architecture and metadata shall be established, baselined, and maintained (e.g., Technical Requirements/Specification tree).		
REQ-41	2.12.2	Bi-directional traceability of technical requirements shall be established and maintained.		
REQ-42	2.13.1	The approach for managing interfaces (e.g., responsibilities, agreements used, or assess changes to) shall be established, controlled, and maintained.		
REQ-43	2.13.2	An interface block diagram shall be established, controlled, and maintained as part of the architectural definition of the system.		
REQ-44	2.13.3	Control of the interface design solution(s) shall be established, baselined, and maintained.		
REQ-45	2.15.1	As part of Technical Planning, the approach to configuration management shall be established, baselined, and maintained.		
REQ-46	2.16.1	As part of Technical Planning, the approach to technical data management shall be established, baselined, and maintained.		
REQ-47	2.17.1	As part of Technical Planning, the life-cycle and technical milestone reviews to be conducted during Project execution, and the approach to them, shall be defined, documented, and maintained.		
REQ-48	2.17.4	Entrance and success criteria shall be established for each technical milestone review.		
REQ-49	2.17.5	The review discrepancies/actions (e.g. RIDs/ RFAs) resulting from the life-cycle and technical milestone reviews, their disposition, and the objective evidence supporting closure shall be identified and tracked.		
REQ-50	2.17.6.	During the normal course of business, periodic technical status reviews shall be held to monitor and assess the technical effort.		
REQ-51	2.17.7	The list of leading indicators (systems engineering and technical performance measures) to be tracked by the project and their reporting frequency shall be defined, documented, and approved.		
REQ-52	2.17.9	The leading indicators to be tracked and their initial trend shall be presented at the MDR/SDR.		
REQ-53	2.17.10	The leading indicators shall be tracked and their trends reported to the project on the agreed-upon interval.		
REQ-54	2.18.1	The approach to perform decision analysis shall be established and maintained.		

Appendix D: Traceability to NPR 7123.1

NPR 7123.1 Req. ID	NPR Requirement	Implemented in
SE-01 to 05	Deleted in NPR	
SE-06	The ETA shall approve the SEMP, waiver or deviation authorizations, and other key technical documents to ensure independent assessment of technical content.	GLPR 7123.2 section 2.11.3 requires ETA approval
SE-07	Program/Project Managers shall identify and implement an ETA-approved Stakeholder Expectations Definition process to include activities, requirements, guidelines, and documentation, as tailored and customized for the definition of stakeholder expectations for the applicable product layer.	GLPR 7123.2 section 2.2
SE-08	Program/Project Managers shall identify and implement an ETA-approved Technical Requirements Definition process to include activities, requirements, guidelines, and documentation, as tailored and customized for the definition of technical requirements from the set of agreed upon stakeholder expectations for the applicable product layer.	GLPR 7123.2 section 2.3
SE-09	Program/Project Managers shall identify and implement an ETA-approved Logical Decomposition process to include activities, requirements, guidelines, and documentation, as tailored and customized for logical decomposition of the validated technical requirements of the applicable product layer.	GLPR 7123.2 section 2.4
SE-10	Program/Project Managers shall identify and implement an ETA-approved Design Solution Definition process to include activities, requirements, guidelines, and documentation, as tailored and customized for designing product solution definitions within the applicable product layer that satisfy the derived technical requirements.	GLPR 7123.2 section 2.5
SE-11	Program/Project Managers shall identify and implement an ETA-approved Product Implementation process to include activities, requirements, guidelines, and documentation, as tailored and customized for implementation of a design solution definition by making, buying, or reusing an end product of the applicable product layer.	GLPR 7123.2 section 2.6
SE-12	Program/Project Managers shall identify and implement an ETA-approved Product Integration process to include activities, requirements, guidelines, and documentation, as tailored and customized for the integration of lower level products into an end product of the applicable product layer in accordance with its design solution definition.	GLPR 7123.2 section 2.7
SE-13	Program/Project Managers shall identify and implement an ETA-approved Product Verification process to include activities, requirements/specifications, guidelines, and documentation, as tailored and customized for verification of end products generated by the product implementation process or product integration process against their design solution definitions.	GLPR 7123.2 section 2.8
SE-14	Program/Project Managers shall identify and implement an ETA-approved Product Validation process to include activities, requirements, guidelines, and documentation, as tailored and customized for validation of end products generated by the product implementation process or product integration process against their stakeholder expectations.	GLPR 7123.2 section 2.9
SE-15	Program/Project Managers shall identify and implement an ETA-approved Product Transition process to include activities, requirements, guidelines, and documentation, as tailored and customized for transitioning end products to the next higher level product layer customer or user.	GLPR 7123.2 section 2.10
SE-16	Program/Project Managers shall identify and implement an ETA-approved Technical Planning process to include activities, requirements, guidelines, and documentation, as tailored and customized for planning the technical effort.	GLPR 7123.2 section 2.11

NPR 7123.1 Req. ID	NPR Requirement	Implemented in
SE-17	Program/Project Managers shall identify and implement an ETA-approved Requirements Management process to include activities, requirements, guidelines, and documentation, as tailored and customized for management of requirements throughout the system life-cycle.	GLPR 7123.2 section 2.12
SE-18	Program/Project Managers shall identify and implement an ETA-approved Interface Management process to include activities, requirements, guidelines, and documentation, as tailored and customized for management of the interfaces defined and generated during the application of the system design processes.	GLPR 7123.2 section 2.13
SE-19	Program/Project Managers shall identify and implement a Technical Risk Management process to include activities, requirements, guidelines, and documentation, as tailored and customized for management of the risk identified during the technical effort.	GLPR 7123.2 section 2.14
SE-20	Program/Project Managers shall identify and implement an ETA-approved Configuration Management process to include activities, requirements, guidelines, and documentation, as tailored and customized for configuration management.	GLPR 7123.2 section 2.15
SE-21	Program/Project Managers shall identify and implement an ETA-approved Technical Data Management process to include activities, requirements, guidelines, and documentation, as tailored and customized for management of the technical data generated and used in the technical effort.	GLPR 7123.2 section 2.16
SE-22	Program/Project Managers shall identify and implement an ETA-approved Technical Assessment process to include activities, requirements, guidelines, and documentation, as tailored and customized for making assessments of the progress of planned technical effort and progress toward requirements satisfaction.	GLPR 7123.2 section 2.17
SE-23	Program/Project Managers shall identify and implement an ETA-approved Decision Analysis process to include activities, requirements, guidelines, and documentation, as tailored and customized for making technical decisions.	GLPR 7123.2 section 2.18
SE-24	The NASA technical team shall define the engineering activities for the periods before contract award, during contract performance, and upon contract completion in the SEMP or other equivalent program/project documentation.	GLPR 7123.2 section 2.11.5
SE-25	The NASA technical team shall establish the technical inputs to the solicitation appropriate for the product(s) to be developed, including product requirements and Statement of Work tasks.	GLPR 7123.2 section 2.11.5
SE-26	The NASA technical team shall determine the technical work products to be delivered by the offeror or contractor, to include contractor documentation that specifies the contractor's SE approach to the scope of activities described by the 17 common technical processes.	GLPR 7123.2 section 2.11.5
SE-27	The NASA technical team shall provide the requirements for technical insight and oversight activities planned in the NASA SEMP or other equivalent program/project documentation to the contracting officer for inclusion in the solicitation.	GLPR 7123.2 section 2.11.5
SE-28	The NASA technical team shall participate in the evaluation of offeror proposals in accordance with applicable NASA and Center source selection procedures.	GLPR 7123.2 section 2.11.5
SE-29	The NASA technical team, under the authority of the contracting officer, shall perform the technical insight and oversight activities established in the contract including modifications to the original contract.	GLPR 7123.2 section 2.11.5
SE-30	The NASA technical team shall participate in the review(s) to finalize Government acceptance of the deliverables.	GLPR 7123.2 section 2.11.5
SE-31	The NASA technical team shall participate in product transition as defined in the NASA SEMP or other equivalent program/project documentation.	GLPR 7123.2 section 2.11.5

NPR 7123.1 Req. ID	NPR Requirement	Implemented in
SE-32	The technical team shall develop and document plans for life-cycle and technical reviews for use in the program/project planning process.	GLPR 7123.2 section 2.17.1
SE-33	The technical team shall participate in the life-cycle and technical reviews as indicated in the governing program/project management NPR.	GLPR 7123.2 section 2.17.1
SE-34	The technical team shall participate in the development of entrance and success criteria for each of the respective reviews.	GLPR 7123.2 section 2.17.4
SE-35	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: MCR: Baselined stakeholder identification and expectation definitions.	GLPR 7123.2 section 2.2.3
SE-36	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: MCR: Baselined concept definition.	GLPR 7123.2 section 2.2.6
SE-37	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: MCR: Approved Measures of Effectiveness (MOE) definition.	GLPR 7123.2 section 2.2.2
SE-38	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: SRR: Baselined SEMP (or other equivalent program/project documentation) for projects, single-project programs, and one-step AO programs.	GLPR 7123.2 section 2.11.4
SE-39	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: SRR: Baselined requirements.	GLPR 7123.2 section 2.3.2
SE-40	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: MDR/ SDR: Approved TPM definitions.	GLPR 7123.2 section 2.17.9
SE-41	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: MDR/ SDR: Baselined architecture definition.	GLPR 7123.2 section 2.4.2
SE-42	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: MDR/ SDR: Baselined allocation of requirements to next lower level.	GLPR 7123.2 section 2.4.4
SE-43	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: MDR/ SDR: Initial trend of required leading indicators.	GLPR 7123.2 section 2.17.9
SE-44	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: MDR/ SDR: Baseline SEMP (or other equivalent program/project documentation) for uncoupled, loosely coupled, tightly coupled, and two-step AO programs.	GLPR 7123.2 section P.2 c. points Programs to comply with NPR 7123.1
SE-45	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: PDR: Preliminary design solution definition.	GLPR 7123.2 section 2.5.1
SE-46	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: CDR: Baseline detailed design.	GLPR 7123.2 section 2.5.2
SE-47	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: SIR: Updated integration plan.	GLPR 7123.2 section 2.11.6
SE-48	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: SIR: Preliminary V&V results.	GLPR 7123.2 section 2.8.3 and 2.9.2
SE-49 and 50	Deleted in NPR	
SE-51	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: ORR: Preliminary decommissioning plans.	GLPR 7123.2 section 2.11.7

NPR 7123.1 Req. ID	NPR Requirement	Implemented in
SE-52	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: FRR: Baseline disposal plans.	GLPR 7123.2 section 2.11.9
SE-53	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: FRR: Baseline V&V results.	GLPR 7123.2 section 2.8.5 and 2.9.3
SE-54	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: FRR: Final certification for flight/use.	GLPR 7123.2 section 2.10 5
SE-55	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: DR: Baseline decommissioning plans.	GLPR 7123.2 section 2.11.8
SE-56	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: DRR: Updated disposal plans.	GLPR 7123.2 section 2.11.10
SE-57	Technical teams shall monitor technical effort through periodic technical reviews.	GLPR 7123.2 section 2.17.6
SE-58	The technical teams shall define in the program/project SEMP how the required 17 common technical processes, as tailored, will be recursively applied to the various levels of program/project product layer system structure during each applicable life-cycle phase.	GLPR 7123.2 section 2.11.1
SE-59	The technical team shall ensure that any technical plans and discipline plans are consistent with the SEMP (or equivalent program/project documentation) and are accomplished as fully integrated parts of the technical effort.	GLPR 7123.2 section 2.11.1
SE-60	The technical team shall establish TPMs for the program/project that track/describe the current state versus plan.	GLPR 7123.2 section 2.17.7
SE-61	The technical team shall report the TPMs to the Program/Project Manager on an agreed-to reporting interval.	GLPR 7123.2 section 2.17.10
SE-62	The technical team shall ensure that the set of TPMs include the following leading indicators: Mass margins for projects involving hardware.	GLPR 7123.2 section 2.17.8
SE-63	The technical team shall ensure that the set of TPMs include the following leading indicators: Power margins for projects that are powered.	GLPR 7123.2 section 2.17.8
SE-64	The technical team shall ensure that a set of review trends is created and maintained that includes closure of review action documentation (RIDs, RFAs, and/or Action Items as established by the project).	GLPR 7123.2 section 2.17.5

Appendix E: Tailoring by Project Type

E.1 This Appendix provides implementation tailoring and customization guidance for different project types, depending upon their criticality, which includes risk, payload classification, need for rigor, TRL maturity, safety, complexity, team size, impact of success or failure, visibility, cost, product hierarchy level (system, subsystem, component), and other factors. The technical planning and engineering effort needed to develop systems and technology can vary widely, based on these factors. This table is not intended to provide guidance for Programs. The first four criticality categories primarily reflect development of systems while the last three primarily reflect technology development at a component level.

E.2 Examples of projects that may fall into the different levels of criticality are as follows:

a. High: human rated spaceflight vehicle, major spacecraft, Class A/B payloads

b. Medium: Class C/D payloads, significant new research/test facility capability, X-planes, specialized IT for spaceflight

c. Low: Balloon systems, CubeSats, ground support equipment/test support equipment, major adaptive systems (in test facilities), facility complex research test models, specialized IT

d. Minor: Sub-D payloads, aircraft payloads/research equipment, ground test research hardware

e. Technology Development High: TRL 6-7, required for a flight system

f. Technology Development Medium: TRL 4-5

g. Technology Development Low: TRL 1-3, development associated with fundamental research

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-01	If approval authority is to be delegated for the SEMP and any incorporated tailoring, the delegation shall be documented in an official retrievable Research and Engineering Directorate record.	It is recommended that this be presented at a GRC EMB and recorded in EMB minutes as a delegation.	It is recommended that this be presented at a GRC EMB and recorded in EMB minutes as a delegation.	Delegation can be done through some other mechanism, but still needs to be documented in an official record, such as an official memo.	Delegation can be done through some other mechanism, but still needs to be documented in an official record, such as an official memo.	If delegated beyond what is defined in REQ-32 for this criticality, then it shall be documented in an official retrievable Research and Engineering Directorate record.	If delegated beyond what is defined in REQ-32 for this criticality, then it shall be documented in an official retrievable Research and Engineering Directorate record.	If delegated beyond what is defined in REQ-32 for this criticality, then it shall be documented in an official retrievable Research and Engineering Directorate record.

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-02	A list of key stakeholders for the effort to be performed at GRC shall be defined and maintained.	This is typically captured in a SEMP	This is typically captured in a SEMP	This is typically captured in a SEMP, or Project Plan	This is typically captured in a Project Plan or equivalent data item	As a minimum, identify stakeholders/customers /infusion path	As a minimum, identify stakeholders/customers /infusion path	As a minimum, identify stakeholders/customers /infusion path
REQ-03	Stakeholder technical expectations for the effort to be performed at GRC shall be defined and maintained.	This can be in the form of a higher-level requirements data item (e.g. Level 2 requirements), a Science Requirements Document (for scientific investigations), or a project generated Stakeholder Expectations Document. Formal definition of Measure of Effectiveness (MOEs) should be included.	This can be in the form of a higher-level requirements data item (e.g. Level 2 requirements), a Science Requirements Document (for scientific investigations), or a project generated Stakeholder Expectations Document.	This can be in the form of a higher-level requirements data item (e.g. Level 2 requirements), a Science Requirements Document (for scientific investigations), a project generated Stakeholder Expectations Document, or even captured in the SEMP	The expectations might be captured in the SEMP, Project Plan, or equivalent data item	HQ objectives that drive the technology development, customer needs and high-level threshold requirements should be defined	HQ objectives that drive the technology development, customer needs and high-level threshold requirements should be defined	HQ objectives that drive the technology development, customer needs and high-level threshold requirements should be defined
REQ-04	The list of stakeholders and the stakeholder expectations shall be captured in a released data item and made available at the MCR.	At MCR or tailored equivalent, prior to KDP A	At MCR or tailored equivalent, prior to KDP A	At MCR or tailored equivalent, prior to KDP B	At MCR or tailored equivalent, prior to KDP B	Document in the Project Plan (or a technology development plan or equivalent), at the time of project Authority to Proceed	Document in the Project Plan (or a technology development plan or equivalent), at the time of project Authority to Proceed	Document in the Project Plan (or a technology development plan or equivalent), at the time of project Authority to Proceed
REQ-05	A ConOps shall be developed and maintained.	The ConOps is typically in a standalone document or part of a system model.	The ConOps might be in a standalone document, part of a system model, or included with stakeholder expectations.	The ConOps might be in a standalone document, part of a system model, or included with stakeholder expectations.	The ConOps might be included as a part of a data item.	Document the concept of how the technology would be used	Document the concept of how the technology would be used	Document the concept of how the technology would be used

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-06	The ConOps shall be captured in a released data item and made available at the MCR.	At MCR or tailored equivalent, prior to KDP A	At MCR or tailored equivalent, prior to KDP A	At MCR or tailored equivalent, prior to KDP B	At MCR or tailored equivalent, prior to KDP B	Include in the Project Plan at the time of its submission for approval	Include in the Project Plan at the time of its submission for approval	Include in the Project Plan at the time of its submission for approval
REQ-07	The recommended concept shall be documented and presented at the MCR.	At MCR or tailored equivalent, prior to KDP A	At MCR or tailored equivalent, prior to KDP A	At MCR or tailored equivalent, prior to KDP B	At MCR or tailored equivalent, prior to KDP B	Capture alternatives, should the primary development path have issues, in the Project Plan	Capture alternatives, should the primary development path have issues, in the Project Plan	Capture alternatives, should the primary development path have issues, in the Project Plan
REQ-08	A set of technical requirements (e.g. constraints, performance, functional, safety, interface, etc.) in "shall" statements for the system(s) to be developed shall be established, baselined and maintained.	This may start at the Mission level, and there may be multiple levels of requirements, for each product/system of interest. The levels and products/systems of interest for which requirements will be developed is documented and approved in the SEMP.	Technical requirements are as a minimum created for the top level system, and typically include at least functional/performance requirements at the next lower product level, but depending on the complexity, may warrant more than one level.	Technical requirements are typically only created for the top level system, but depending on the complexity, may warrant more than one level.	Technical requirements definition is typically limited to interface and safety requirements for the overall system.	Identify key driving requirements (including mission and safety) that the technology will need to meet in order to advance to high TRL levels, expected operational environment, and the Figures of Merit for the technology development	Identify key driving requirements (including mission and safety, if known) that the technology will need to meet in order to advance to high TRL levels, expected operational environment, and the Figures of Merit for the technology development	Identify the expected operational environment and Figures of Merit for the technology development

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-09	The technical requirements shall be captured in a released data item and made available at the SRR.	The data item should consist of multiple levels of requirements / specifications and be presented at their corresponding SRR or tailored equivalent, prior to KDP B. Requirements controlled in other data item (e.g. ICDs, safety hazard reports) can be incorporated by reference.	The data item should consist of one or more levels of requirements / specification and be presented at the SRR or tailored equivalent, prior to KDP B. Requirements controlled in other data item (e.g. ICDs, safety hazard reports) can be incorporated by reference.	The data item should consist of a requirements collection/ specification and be presented at the SRR or tailored equivalent, prior to KDP B. Requirements controlled in other data item (e.g. ICDs, safety hazard reports) can be incorporated by reference.	No unique requirements data item is required, provided that all necessary technical requirements are controlled in other data item (ICDs, Safety Hazard Reports). Preliminary versions are desired at the SRR or tailored equivalent prior to KDP B, but are typically dependent upon their own development process time frames.	This information should be documented prior to Project Approval	This information should be documented prior to Project Approval	This information should be documented prior to Project Approval
REQ-10	For each technical requirement, a corresponding verification requirement (including success criteria) shall be establish, baselined and maintained.	Verification requirements are typically created at the same time as the set of technical requirements and captured with them.	Verification requirements are typically created at the same time as the set of technical requirements and captured with them.	Verification requirements are typically created at the same time as the set of technical requirements and captured with them.	Verification requirements are typically created at the same time as the set of technical requirements and captured with them.	The technology development approach should include what assessments of the technology will be conducted to show that it will eventually meet the key driving requirements, and progress on meeting the Figure of Merits (FOMs).	The technology development approach should include what assessments of the technology will be conducted to show that it will eventually meet the key driving requirements, and progress on meeting the FOMs.	The technology development approach should include what assessments of the technology will be conducted to show progress on meeting the FOMs.

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-11	A system architecture shall be established, baselined and maintained.	The architecture is developed at multiple levels of the system, consistent with the plan for requirements development. Depending on the complexity of the project, formal Frameworks could be used. An architecture description document/model may be created.	A system level only architecture is developed. Views might be captured in the SEMP or a separate data item.	A system level only architecture is developed. It might only include the physical view. Views might be captured in the SEMP or a separate data item.	The architecture is focused on interfaces and safety functions only. Any views are typically captured in presentation charts/diagrams for reviews.	Not required	Not required	Not required
REQ-12	The system architecture shall be captured in a released data item and made available at the MDR/SDR.	At MDR/SRR or tailored equivalent, prior to KDP B	At MDR/SRR or tailored equivalent, prior to KDP B	At MDR/SRR or tailored equivalent, prior to KDP C	At MDR/SRR or tailored equivalent, prior to KDP C	Not required	Not required	Not required
REQ-13	The technical requirements shall be allocated to the next lower level of the product structure.	The allocation of requirements is done formally and may be captured in models or requirements documents.	Allocation may be performed formally or informally. If only one level of requirements are planned, allocation of requirements to one lower level may be beneficial.	Allocation would most often be performed informally. If only one level of requirements are planned, allocation of requirements to one lower level may be beneficial.	No allocation is required	Not required	Not required	Not required
REQ-14	The requirements allocation shall be captured in a released data item and made available at the MDR/SDR.	At MDR/SRR or tailored equivalent, prior to KDP B	At MDR/SRR or tailored equivalent, prior to KDP B	At MDR/SRR or tailored equivalent, prior to KDP C	Not required	Not required	Not required	Not required

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-15	A technical data package, consisting of engineering drawings and product specifications or digital model equivalents, which represents a preliminary design level of maturity shall be produced prior to the PDR.	The usual metric is that 10% of the final drawings (i.e. flight) are complete/ released by PDR. For projects utilizing engineering models (or equivalent), drawings for those parts should be almost complete.	The usual metric is that 10% of the final drawings (i.e. flight) are complete/ released by PDR. For projects utilizing engineering models (or equivalent), drawings for those parts should be almost complete.	The usual metric is that 10% of the final drawings (i.e. flight) are complete/ released by PDR or equivalent review prior to KDP-C. For projects utilizing engineering models (or equivalent), drawings for those parts should be almost complete.	The usual metric is that 10% of the final drawings (i.e. flight) are complete/ released by PDR or equivalent review prior to KDP-C. For projects utilizing engineering models (or equivalent), drawings for those parts should be almost complete.	A set of engineering drawings or digital model equivalents that represents a preliminary design level of maturity should be produced for a Periodic Project Reviews	A set of engineering drawings or digital model equivalents that represents a preliminary design level of maturity should be produced for a Periodic Project Reviews	Not required
REQ-16	A technical data package, consisting of engineering drawings and product specifications or digital model equivalents, which represents a final design level of maturity shall be produced prior to the CDR.	The usual metric is that 90% of the final drawings (i.e. flight) are complete/ released by CDR.	The usual metric is that 90% of the final drawings (i.e. flight) are complete/ released by CDR.	The usual metric is that 90% of the final drawings (i.e. flight) are complete/ released by CDR or equivalent review prior to KDP-D.	The usual metric is that 90% of the final drawings (i.e. flight) are complete/ released by CDR or equivalent review prior to KDP-D.	A set of engineering drawings or digital model equivalents that represents a final design level of maturity should be produced for a Periodic Project Review	A set of engineering drawings or digital model equivalents that represents a final design level of maturity should be produced for a Periodic Project Review	A set of engineering drawings that represents a final design level of maturity should be produced prior to project completion
REQ-17	Integration/assembly procedures shall be developed to guide the integration of lower level products and to provide a record of the integration.	Procedures should include a high level of detail and rigor. Procedures should be reviewed and approved by more than just the author, prior to use.	Procedures should include a high level of detail and rigor. Procedures should be reviewed and approved by more than just the author, prior to use.	Procedures should include at least a medium level of detail and rigor.	Procedures may be written at a high level and rely upon real-time determination of the detailed steps required	Integration/assembly procedures should be produced and used during the buildup, recording any changes, such that it could be repeated in the future if needed.	A record should be kept of the integration/assembly, such that it could be repeated in the future if needed.	A record should be kept of the integration/assembly, such that it could be repeated in the future if needed.

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-18	As part of Technical Planning, the approach to product verification shall be established, baselined, and maintained.	The verification approach is typically captured in a Verification Plan. Some projects capture the verification philosophy in one data item and the details in another. Preliminary verification activities are likely done in phases with more activities/ requirements included in each subsequent phase.	The verification approach is typically captured in a Verification Plan. Some projects capture the verification philosophy in one data item and the details in another. Preliminary verification activities are likely done in phases with more activities/ requirements included in each subsequent phase.	The verification approach is typically captured in a Verification Plan. Some projects capture the verification philosophy in one data item and the details in another. The philosophy might be captured in the SEMP or another plan and the details might get captured in a controlled spreadsheet. Preliminary verification activities are likely done in phases with more activities/ requirements included in each subsequent phase.	The verification approach is typically captured in a Verification Plan. Some projects capture the verification philosophy in one data item and the details in another. The philosophy might be captured in the SEMP or another plan and the details might get captured in a controlled spreadsheet. Preliminary verification activities are likely done in phases with more activities/ requirements included in each subsequent phase.	The technology development approach should include what assessments of the technology will be conducted to show that it will eventually meet the key driving requirements, and progress on meeting the FOMs.	The technology development approach should include what assessments of the technology will be conducted to show that it will eventually meet the key driving requirements, and progress on meeting the FOMs.	The technology development approach should include what assessments of the technology will be conducted to show progress on meeting the FOMs.

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-19	Requirements compliance shall be assessed and documented throughout the development phase from post-SRR until the system is delivered.	Compliance is typically documented in a requirements compliance matrix that is presented at each major milestone review starting post-SRR and lasting through SAR. The compliance matrix identifies the planned/known compliance of the design to the requirements along with rationale/evidence for the compliance. As verification results become available, they become the rationale/evidence of compliance	Compliance is typically documented in a requirements compliance matrix that is presented at each major milestone review starting post-SRR and lasting through SAR. The compliance matrix identifies the planned/known compliance of the design to the requirements along with rationale/evidence for the compliance. As verification results become available, they become the rationale/evidence of compliance	Compliance is typically documented in a requirements compliance matrix that is presented at each major milestone review starting post-SRR (or equivalent) and lasting through SAR (or equivalent). The compliance matrix identifies the planned/known compliance of the design to the requirements along with rationale/evidence for the compliance. As verification results become available, they become the rationale/evidence of compliance	Compliance is typically documented in charts presented at each major milestone review starting post-SRR (or equivalent) and lasting through SAR (or equivalent). It may only focus on critical driving requirements. As verification results become available, they become the rationale/evidence of compliance	Progress on meeting the key driving requirements and FOMs should be available at every Periodic Project Review and continuation review.	Progress on meeting the key driving requirements and FOMs should be available at every Periodic Project Review and continuation review.	Progress on meeting the FOMs should be available at every Periodic Project Review and continuation review.

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-20	Preliminary verification results shall be available at the SIR for the products ready to be integrated.	Prior to any product being integrated in to the next higher level, the verification results for that product should be checked to make sure there is an acceptable level of risk before beginning the integration. For major products, a SIR (or equivalent) may be conducted to do this review. At the highest level of assembly at GRC, this review may be the SAR	Prior to any product being integrated in to the next higher level, the verification results for that product should be checked to make sure there is an acceptable level of risk before beginning the integration. For major products, a SIR (or equivalent) may be conducted to do this review. At the highest level of assembly at GRC, this review may be the SAR. If requirements were not created for lower levels of product, for those lower level products, this may just be a check of any analysis and testing (e.g. functional checkout) done prior to integration.	Prior to any product being integrated in to the next higher level, the verification results for that product should be checked to make sure there is an acceptable level of risk before beginning the integration. For major products, a SIR (or equivalent) may be conducted to do this review. At the highest level of assembly at GRC, this review may be the SAR. If requirements were not created for lower levels of product, for those lower level products, this may just be a check of any analysis and testing (e.g. functional checkout) done prior to integration.	Prior to any product being integrated in to the next higher level, the verification results for that product should be checked to make sure there is an acceptable level of risk before beginning the integration. This review is likely done informally, internal to the project. At the highest level of assembly at GRC, this review may be the SAR. If requirements were not created for lower levels of product, for those lower level products, this may just be a check of any analysis and testing (e.g. functional checkout) done prior to integration.	Not required	Not required	Not required

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-21	Final verification results shall be available at the FRR, or, for non-flight systems, at an operational TRR or equivalent.	All verification results need to be available to support the FRR or, for non-flight systems, at an operational TRR or equivalent.	All verification results need to be available to support the FRR or, for non-flight systems, at an operational TRR or equivalent. Where unique FRRs are not held, the next higher integrator may define when final verification results are required, if not available at the SAR (or PSR).	All verification results need to be available to support the FRR or, for non-flight systems, at an operational TRR or equivalent. Where unique FRRs are not held, the next higher integrator may define when final verification results are required, if not available at the SAR (or PSR).	All verification results need to be available to support the FRR or, for non-flight systems, at an operational TRR or equivalent. Where unique FRRs are not held, the next higher integrator may define when final verification results are required, if not available at the SAR (or PSR).	A final assessment of meeting the key driving requirements and FOMs should be available at the Closeout Review	A final assessment of meeting the key driving requirements and FOMs should be available at the Closeout Review	A final assessment of meeting the FOMs should be available at the Closeout Review
REQ-22	As part of Technical Planning, the approach to product validation shall be established, baselined, and maintained.	The approach is typically captured in a Plan (sometimes combined with Verification)	The approach is typically captured in a Plan (sometimes combined with Verification)	The approach maybe captured in the SEMP, with validation activities only described at a top level.	The approach maybe captured in the SEMP or Project Plan, only discussing the validation philosophy	The approach to TRL assessment, including the need for any interim assessments, should be defined and an initial TRL assessment should be conducted prior to Project Approval	The approach to TRL assessment should be defined and an initial TRL assessment should be conducted prior to Project Approval	The approach to TRL assessment should be defined and an initial TRL assessment should be conducted prior to Project Approval

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-23	Preliminary validation results shall be available at the SIR for the products ready to be integrated.	Prior to any product being integrated in to the next higher level, the validation results for that product should be checked to make sure there is an acceptable level of risk before beginning the integration. For major products, a SIR (or equivalent) may be conducted to do this review. At the highest level of assembly at GRC, this review may be the SAR	Prior to any product being integrated in to the next higher level, the validation results for that product should be checked to make sure there is an acceptable level of risk before beginning the integration. For major products, a SIR (or equivalent) may be conducted to do this review. At the highest level of assembly at GRC, this review may be the SAR. If requirements were not created for lower levels of product, for those lower level products, this may just be a check of any analysis and testing (e.g. functional checkout) done prior to integration	Prior to any product being integrated in to the next higher level, the validation results for that product should be checked to make sure there is an acceptable level of risk before beginning the integration. For major products, a SIR (or equivalent) may be conducted to do this review. At the highest level of assembly at GRC, this review may be the SAR. If requirements were not created for lower levels of product, for those lower level products, this may just be a check of any analysis and testing (e.g. functional checkout) done prior to integration	Prior to any product being integrated in to the next higher level, the validation results for that product should be checked to make sure there is an acceptable level of risk before beginning the integration. This review is likely done informally, internal to the project. At the highest level of assembly at GRC, this review may be the SAR.	Not required	Not required	Not required

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-24	Final validation results shall be available at the FRR, or, for non-flight systems, at an operational TRR or equivalent.	All validation results need to be available to support the FRR, or, for non-flight systems, at an operational TRR or equivalent.	All validation results need to be available to support the FRR, or, for non-flight systems, at an operational TRR or equivalent. Where unique FRRs are not held, the next higher integrator may define when final validation results are required, if not available at the SAR (or PSR).	All validation results need to be available to support the FRR, or, for non-flight systems, at an operational TRR or equivalent. Where unique FRRs are not held, the next higher integrator may define when final validation results are required, if not available at the SAR (or PSR).	All validation results need to be available to support the FRR, or, for non-flight systems, at an operational TRR or equivalent. Where unique FRRs are not held, the next higher integrator may define when final validation results are required, if not available at the SAR (or PSR).	A TRL Assessment should be available at the Closeout Review	A TRL Assessment should be available at the Closeout Review	A TRL Assessment should be available at the Closeout Review
REQ-25	As part of technical planning, any supporting data needed to accompany products during transition (either internally or externally) shall be defined.	Required supporting data should be captured in the SEMP. When the system is being turned over to another organization for launch, deployment, or operations, an Acceptance Data Package may be required as part for the supporting data.	Required supporting data should be captured in the SEMP. When the system is being turned over to another organization for launch, deployment, or operations, an Acceptance Data Package may be required as part for the supporting data.	Required supporting data might be captured in the SEMP, Project Plan, or as tasks in a Project schedule. When the system is being turned over to another organization for launch, deployment, or operations, an Acceptance Data Package may be required as part for the supporting data.	Required supporting data might be captured in the SEMP, Project Plan, or as tasks in a Project schedule. When the system is being turned over to another organization for launch, deployment, or operations, an Acceptance Data Package may be required as part for the supporting data.	Expected final deliverables should be defined prior to project approval	Expected final deliverables should be defined prior to project approval	Expected final deliverables should be defined prior to project approval

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-26	Updated operational plans shall be provided at the ORR. Operational plans include mission objectives, and mission timelines	Operational plans should have been presented at prior milestone reviews, so updated versions, reflecting full maturity of the information, would be part of the ORR, or tailored equivalent, prior to operations. The amount of information in the plans would correspond to the level of complexity of the project	Operational plans should have been presented at prior milestone reviews, so updated versions, reflecting full maturity of the information, would be part of the ORR, or tailored equivalent, prior to operations. The amount of information in the plans would correspond to the level of complexity of the project	Operational plans should have been presented at prior milestone reviews, so updated versions, reflecting full maturity of the information, would be part of the ORR, or tailored equivalent, prior to operations. The amount of information in the plans would correspond to the level of complexity of the project	Operational plans should have been presented at prior milestone reviews, so updated versions, reflecting full maturity of the information, would be part of the ORR, or tailored equivalent, prior to operations. The amount of information in the plans would correspond to the level of complexity of the project	Not required	Not required	Not required
REQ-27	Updated operational procedures shall be provided at the ORR.	Operational procedures should have been presented at prior milestone reviews, so updated versions, reflecting full maturity of the information, would be part of the ORR, or tailored equivalent, prior to operations. The amount of information in the procedures would correspond to the level of complexity of the project	Operational procedures should have been presented at prior milestone reviews, so updated versions, reflecting full maturity of the information, would be part of the ORR, or tailored equivalent, prior to operations. The amount of information in the procedures would correspond to the level of complexity of the project	Operational procedures should have been presented at prior milestone reviews, so updated versions, reflecting full maturity of the information, would be part of the ORR, or tailored equivalent, prior to operations. The amount of information in the procedures would correspond to the level of complexity of the project	Operational procedures should have been presented at prior milestone reviews, so updated versions, reflecting full maturity of the information, would be part of the ORR, or tailored equivalent, prior to operations. The amount of information in the procedures would correspond to the level of complexity of the project	Not required	Not required	Not required

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-28	Final Certification for flight/use shall be provided at FRR or for non-flight systems at TRR	Certification of readiness for flight should be provided at the FRR or equivalent review. The FRR may be a project specific FRR, or the project may be providing the certification in support of a higher level FRR. The Certification may require Center management endorsement.	Certification of readiness for flight should be provided at the FRR or equivalent review. The FRR may be a project specific FRR, or the project may be providing the certification in support of a higher level FRR. The Certification may require Center management endorsement.	Certification of readiness for flight should be provided at the FRR or equivalent review. The FRR may be a project specific FRR, or the project may be providing the certification in support of a higher level FRR. For non-flight systems, the FRR equivalent would be a TRR, conducted prior to the start of a test program.	Certification of readiness for flight should be provided at the FRR or equivalent review. The FRR may be a project specific FRR, or the project may be providing the certification in support of a higher level FRR. For non-flight systems, the FRR equivalent would be a TRR, conducted prior to the start of a test program.	Not required	Not required	Not required
REQ-29	When flight hardware is being shipped from GRC for final launch processing, a GRC 643, Glenn Research Center Approval to Ship Space Flight Hardware form shall be completed.	Approvers of the form should be consistent with those required to approve Project Plans, SEMPs, and Safety and Mission Assurance Plans.	Approvers of the form should be consistent with those required to approve Project Plans, SEMPs, and Safety and Mission Assurance Plans.	Approvers of the form should be consistent with those required to approve Project Plans, SEMPs, and Safety and Mission Assurance Plans.	Approvers of the form should be consistent with those required to approve Project Plans, SEMPs, and Safety and Mission Assurance Plans.	Not required	Not required	Not required

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-30	The technical team shall perform the planning necessary to define the technical approach to the project and capture the resulting plan in a GRC SEMP and related technical and discipline plans.	The approach will be coordinated with the project plan to ensure compatibility with the allocated resources/enabling products (cost, schedule, personnel, and facilities), milestones, risk assessment, and deliverables. A GRC SEMP is required for any work where GRC is responsible for delivering all or part of the system being developed.	The approach will be coordinated with the project plan to ensure compatibility with the allocated resources/enabling products (cost, schedule, personnel, and facilities), milestones, risk assessment, and deliverables. A GRC SEMP is required for any work where GRC is responsible for delivering all or part of the system being developed.	The approach will be coordinated with the project plan to ensure compatibility with the allocated resources/enabling products (cost, schedule, personnel, and facilities), milestones, risk assessment, and deliverables. A GRC SEMP, or equivalent plan, is required for any work where GRC is responsible for delivering all or part of the system being developed.	Depending upon the scope of the effort, A SEMP should be developed, or the content incorporated in the Project Plan or equivalent data item. If a separate SEMP (or equivalent plan) is developed, the approach captured in the SEMP will be coordinated with the project plan to ensure compatibility with the allocated resources/enabling products (cost, schedule, personnel, and facilities), milestones, risk assessment, and deliverables. GRC SEMP content is required for any work where GRC is responsible for delivering all or part of the system being developed.	The technical approach should be documented in the Project Plan or in another plan. This should include how the requirements of this GLPR have been incorporated.	The technical approach should be documented in the Project Plan or in another plan. This should include how the requirements of this GLPR have been incorporated.	The technical approach should be documented in the Project Plan or in another plan. This should include how the requirements of this GLPR have been incorporated.
REQ-31	The compliance matrix in Appendix C of this GLPR shall be completed and included in the SEMP	Include in the SEMP	Include in the SEMP	Include in the SEMP or equivalent plan	Include in the SEMP, equivalent plan, or project plan	Compliance matrix to be completed	Compliance matrix needed only if significantly tailoring this column.	Not required

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-32	The GRC ETA approval shall be obtained for the SEMP, waiver authorizations, and other key technical data items to ensure independent assessment of technical content.	The required level of ETA approval is the Director of Research and Engineering, unless further delegated. It is recommended that if delegation is desired, the delegation be proposed at an EMB early in the project lifecycle, and if the Director of Research and Engineering approves, the delegation be captured in the EMB meeting minutes.	The required level of ETA approval is the Director of Research and Engineering, unless further delegated. It is recommended that if delegation is desired, the delegation be proposed at an EMB early in the project lifecycle, and if the Director of Research and Engineering approves, the delegation be captured in the EMB meeting minutes.	The required level of ETA approval is the Director of Research and Engineering, unless further delegated. It is recommended that if delegation is desired, the delegation be proposed at an EMB early in the project lifecycle, and if the Director of Research and Engineering approves, the delegation be captured in the EMB meeting minutes. If SEMP content is captured in another plan, the equivalent SEMP content still requires Director of Research and Engineering approval.	The required level of ETA approval is the Director of Research and Engineering, unless further delegated. It is recommended that if delegation is desired, the delegation be proposed at an EMB early in the project lifecycle, and if the Director of Research and Engineering approves, the delegation be captured in the EMB meeting minutes. If SEMP content is captured in another plan, the equivalent SEMP content still requires Director of Research and Engineering approval.	The required level of ETA approval is the Director of Research and Engineering, unless further delegated. It is recommended that if delegation is desired, the delegation be proposed at an EMB early in the project lifecycle, and if the Director of Research and Engineering approves, the delegation be captured in the EMB meeting minutes. If SEMP content is captured in another plan, the equivalent SEMP content still requires ETA approval.	The required level of ETA approval is the Director of Research and Engineering, unless further delegated. It is recommended that if delegation is desired, the delegation be proposed at an EMB early in the project lifecycle, and if the Director of Research and Engineering approves, the delegation be captured in the EMB meeting minutes. If SEMP content is captured in another plan, the equivalent SEMP content still requires ETA approval.	The required level of ETA approval is the Division Chief, unless further delegated. It is recommended that if further delegation is desired, the delegation be proposed at early in the project lifecycle. If SEMP content is captured in another plan, the equivalent SEMP content still requires ETA approval.
REQ-33	A released SEMP shall be made available at the SRR.	At SRR or tailored equivalent, prior to KDP B	At SRR or tailored equivalent, prior to KDP B	At SRR or tailored equivalent, prior to KDP B	At SRR or tailored equivalent, prior to KDP B	The plan capturing the technical approach should be released at the time of Project Approval.	The plan capturing the technical approach should be released at the time of Project Approval.	The plan capturing the technical approach should be released at the time of Project Approval.

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-34	For projects with all or portions of the engineering work contracted out (i.e. a contractor is providing an end item [all or part of a system] that is not COTS), the scope and plan for the NASA portion of the project implementation of the technical processes before, during, and at the completion of the contracted effort shall be defined and captured in the GRC SEMP.	The details of the technical team role will depend upon the planned procurement scope.	The details of the technical team role will depend upon the planned procurement scope.	The details of the technical team role will depend upon the planned procurement scope.	The details of the technical team role will depend upon the planned procurement scope.	The details of the technical team role will depend upon the planned procurement scope.	The details of the technical team role will depend upon the planned procurement scope.	The details of the technical team role will depend upon the planned procurement scope.
REQ-35	An Integration Plan shall be provided for review no later than at the SIR.	The content is unique to the project. If a SIR is not planned, the Integration Plan should be available at the CDR.	The content is unique to the project. If a SIR is not planned, the Integration Plan should be available at the CDR.	The content is unique to the project. Content is likely incorporated in another plan. If a SIR is not planned, the Integration Plan should be available at the CDR.	The content is unique to the project. Content is likely incorporated in another plan. If a SIR is not planned, the Integration Plan should be available at the CDR.	Not required	Not required	Not required

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-36	Preliminary decommissioning plans shall be provided for review no later than at the ORR.	The content is unique to the project. If the project is not responsible for final decommissioning, required information is often provided to the responsible organization prior to the equipment being turned over for launch/ deployment/operation.	The content is unique to the project. If the project is not responsible for final decommissioning, required information is often provided to the responsible organization prior to the equipment being turned over for launch/ deployment/operation.	The content is unique to the project. If the project is not responsible for final decommissioning, required information is often provided to the responsible organization prior to the equipment being turned over for launch/ deployment/operation.	The content is unique to the project. If the approach is simple, it can be included in a Project Plan. If the project is not responsible for final decommissioning, required information is often provided to the responsible organization prior to the equipment being turned over for launch/ deployment/operation.	Not required	Not required	Not required
REQ-37	Baseline decommissioning plans shall be provided for review no later than at the DR.	Any final update needed should be complete.	Any final update needed should be complete. If a DR is not planned, this Plan is still needed prior to decommissioning of the system.	Any final update needed should be complete. If a DR is not planned, this Plan is still needed prior to decommissioning of the system. The Plan may be part of a higher level document.	Any final update needed should be complete. If a DR is not planned, this Plan is still needed prior to decommissioning of the system. The Plan may be part of a higher level document.	Not required	Not required	Not required

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-38	Baseline disposal plans shall be provided for review no later than at the FRR.	The content is unique to the project and hazards associated with disposal of the project systems. If the project is not responsible for final disposal, required information is often provided to the responsible organization prior to the equipment being turned over for launch/ deployment/ operation.	The content is unique to the project and hazards associated with disposal of the project systems. If the project is not responsible for final disposal, required information is often provided to the responsible organization prior to the equipment being turned over for launch/ deployment/operation. If a Project does not have a FRR, the plans should be made available no later than the last milestone review prior to launch/ deployment/ operation).	The content is unique to the project and hazards associated with disposal of the project systems. If the project is not responsible for final disposal, required information is often provided to the responsible organization prior to the equipment being turned over for launch/ deployment/ operation. If a Project does not have a FRR, the plans should be made available no later than the last milestone review prior to launch/ deployment/ operation).	The content is unique to the project and hazards associated with disposal of the project systems. If the approach is simple, it can be included in a Project Plan. If the project is not responsible for final disposal, required information is often provided to the responsible organization prior to the equipment being turned over for launch/ deployment/ operation. If a Project does not have a FRR, the plans should be made available no later than the last milestone review prior to launch/ deployment/ operation).	The technical approach should address disposal, if there are any special requirements needed (e.g. hazardous materials)	The technical approach should address disposal, if there are any special requirements needed (e.g. hazardous materials)	The technical approach should address disposal, if there are any special requirements needed (e.g. hazardous materials)
REQ-39	Updated disposal plans shall be provided for review no later than at the DRR.	Any final update needed should be complete.	Any final update needed should be complete.	Any final update needed should be complete.	Any final update needed should be complete.	Not required	Not required	Not required

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-40	The technical requirements/specifications architecture and metadata shall be established, baselined, and maintained (e.g., Technical Requirements/Specification tree).	The requirements/specification architecture includes hierarchical levels and interrelationships, while metadata is any information that describes the actual requirement/specification, (ownership, subject matter, assessments, synopsis, identification or location, etc.). The requirements management approach is typically captured in a Project Plan and/or SEMP.	The requirements/specification architecture includes hierarchical levels and interrelationships, while metadata is any information that describes the actual requirement/specification, (ownership, subject matter, assessments, synopsis, identification or location, etc.). The requirements management approach is typically captured in a Project Plan and/or SEMP.	The requirements/specification architecture includes hierarchical levels and interrelationships, while metadata is any information that describes the actual requirement/specification, (ownership, subject matter, assessments, synopsis, identification or location, etc.). The requirements management approach is typically captured in a Project Plan and/or SEMP. When only one level of requirements are developed, the levels are not applicable, but the interrelation ship to higher level requirements should still be defined.	The requirements/specification architecture includes hierarchical levels and interrelationships, while metadata is any information that describes the actual requirement/specification, (ownership, subject matter, assessments, synopsis, identification or location, etc.). The requirements management approach is typically captured in a Project Plan and/or SEMP. When the project only works to safety and interface requirements, all that is needed is to identify those requirement sources.	Not required	Not required	Not required

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-41	Bi-directional traceability of technical requirements shall be established and maintained	Traceability should be established between each of the hierarchical levels of requirements and to stakeholder/ customer requirements and expectations. Note that requirements at lower levels can be traced directly to a stakeholder/ customer requirement, and do not have to flow from the system level. Traceability may include one to many and many to one relationships, and is difficult to document, without the use of a tool.	Traceability should be established between each of the hierarchical levels of requirements and to stakeholder/ customer requirements and expectations. Note that requirements at lower levels can be traced directly to a stakeholder/ customer requirement, and do not have to flow from the system level. Traceability may include one to many and many to one relationships, and is difficult to document, without the use of a tool.	Traceability should be established between the projects technical requirements and the stakeholder/ customer requirements.	When the project only works to safety and interface requirements, traceability is not required	Traceability from mission, safety, and any other key driving requirements should be established and maintained	Traceability from mission, safety, and any other key driving requirements should be established and maintained	Traceability from mission, safety, and any other key driving requirements should be established and maintained

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-42	The approach for managing interfaces (e.g., responsibilities, agreements used, or assess changes to) shall be established, controlled, and maintained.	The approach should consider approval processes for both internal and external interface requirements, what organization controls them, and the data item to be used/generated to capture the interface requirements. The level of internal interfaces to be controlled should be consistent with the level of requirements being developed.	The approach should consider approval processes for both internal and external interface requirements, what organization controls them, and the data item to be used/generated to capture the interface requirements. The level of internal interfaces to be controlled should be consistent with the level of requirements being developed.	The approach should consider approval processes for both internal and external interface requirements, what organization controls them, and the data item to be used/generated to capture the interface requirements. The level of internal interfaces to be controlled should be consistent with the level of requirements being developed.	The majority of these project only need to consider external interfaces, and most of those are controlled by other organizations. At a minimum, the approach to approve changes to externally controlled interface requirements should be captured.	Not required	Not required	Not required
REQ-43	An interface block diagram shall be established, controlled, and maintained as part of the architectural definition of the system.	The block diagram should be developed to correspond to the level of requirements being developed	The block diagram should be developed to correspond to the level of requirements being developed	The block diagram should be developed to correspond to the level of requirements being developed	The block diagram should be developed to correspond to the level of requirements being developed. At a minimum, external interfaces should be captured.	Interface block diagram included as part of interface requirements.	Not required	Not required

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-44	Control of the interface design solution(s) shall be established, baselined, and maintained.	The interface design solution for internal and external interfaces should be captured. If interfacing to existing systems or interfaces are controlled by some other organization, the design solution should already exist or be the responsibility of the other organization	The interface design solution for internal and external interfaces should be captured. If interfacing to existing systems or interfaces are controlled by some other organization, the design solution should already exist or be the responsibility of the other organization	The interface design solution for internal and external interfaces should be captured. If interfacing to existing systems or interfaces are controlled by some other organization, the design solution should already exist or be the responsibility of the other organization	The majority of these projects will be interfacing to existing systems or the interfaces are controlled by some other organization. The design solution should already exist or be the responsibility of the other organization	Interface requirements are defined and maintained. Design solution(s) are included only if critical to the technology.	Only key interface requirements are defined and maintained.	Not required
REQ-45	As part of Technical Planning, the approach to configuration management shall be established, baselined, and maintained.	The approach is typically captured in a Configuration and Data Management Plan. The approach should be consistent with EIA-649 and EIA-649-2.	The approach is typically captured in a Configuration and Data Management Plan. The approach should be consistent with EIA-649 and EIA-649-2.	The approach is typically captured in a Configuration and Data Management Plan. The approach should be consistent with EIA-649 and EIA-649-2. As project criticality reduces, the same processes are needed, but the processes can be simplified. For instance, configuration audits may be done informally.	The approach is typically captured in a Configuration and Data Management Plan, but could be incorporated in a Project Plan, SEMP, or equivalent data item. The approach should be consistent with EIA-649 and EIA-649-2. As project criticality reduces, the same processes are needed, but the processes can be simplified. For instance, configuration audits may be done informally.	As part of Technical Planning, the approach to configuration management, customized as appropriate for the scope of the project, shall be established, baselined, and maintained.	As part of Technical Planning, the approach to configuration management, customized as appropriate for the scope of the project, shall be established, baselined, and maintained. For projects of this type, there may be little configuration management, as the focus is mostly data management.	As part of Technical Planning, the approach to configuration management, customized as appropriate for the scope of the project, shall be established, baselined, and maintained. For projects of this type, there may be little to no configuration management, as the focus is data management.

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-46	As part of Technical Planning, the approach to technical data management shall be established, baselined, and maintained.	The approach is typically captured in a Configuration and Data Management Plan.	The approach is typically captured in a Configuration and Data Management Plan.	The approach is typically captured in a Configuration and Data Management Plan.	The approach is typically captured in a Configuration and Data Management Plan, but could be incorporated in a Project Plan, SEMP or equivalent data item.	As part of Technical Planning, the approach to technical data management, customized as appropriate for the scope of the project, shall be established, baselined, and maintained. There may be some level of control needed, but the primary purpose is to assure all appropriate data is captured.	As part of Technical Planning, the approach to technical data management, customized as appropriate for the scope of the project, shall be established, baselined, and maintained. The primary purpose is to assure all appropriate data is captured.	As part of Technical Planning, the approach to technical data management, customized as appropriate for the scope of the project, shall be established, baselined, and maintained. The primary purpose is to assure all appropriate data is captured.

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-47	As part of Technical Planning, the life-cycle and technical milestone reviews to be conducted during Project execution, and the approach to them, shall be defined, documented, and maintained.	The planned reviews should be consistent with the governing project NPR. They are typically documented in the Project Plan and SEMP. For high criticality projects, a full suite of reviews should be conducted.	The planned reviews should be consistent with the governing project NPR. They are typically documented in the Project Plan and SEMP. For medium criticality projects, reviews like SRR and SDR might be combined, but the purposes behind reviews that are combined should not be eliminated	The planned reviews should be consistent with the governing project NPR. They are typically documented in the Project Plan and SEMP. For low criticality projects, reviews like SRR and SDR might be combined, and some like SIR or ORR might be conducted internal to a project, however use of external reviewers is still encouraged. But the purposes behind reviews that are combined should not be eliminated. At a minimum, reviews should be held around SRR, PDR, CDR and SAR timeframes.	The planned reviews should be consistent with the governing project NPR. They are typically documented in the Project Plan. For minor criticality projects, reviews may be combined and/ or conducted internal to a project, however use of external reviewers is still encouraged. But the purposes behind reviews that are combined should not be eliminated. At a minimum, reviews should be held around SRR, PDR, CDR and SAR time frames.	As part of Technical Planning, the life-cycle and technical milestone reviews to be conducted during Project execution, and the approach to them, shall be defined prior to project approval, documented, and maintained.	As part of Technical Planning, the life-cycle and technical milestone reviews to be conducted during Project execution, and the approach to them, shall be defined prior to project approval, documented, and maintained.	As part of Technical Planning, the life-cycle and technical milestone reviews to be conducted during Project execution, shall be defined prior to project approval, documented, and maintained.
REQ-48	Entrance and success criteria shall be established for each technical milestone review.	Entrance and success criteria are typically captured in a stand-alone review plan for each of the respective reviews or the SEMP. The criteria should be established at the beginning of any project phase so	Entrance and success criteria are typically captured in a stand-alone review plan for each of the respective reviews or the SEMP. The criteria should be established at the beginning of any project phase so	Entrance and success criteria are typically captured in a stand-alone review plan for each of the respective reviews or the SEMP. The criteria should be established at the beginning of any project phase so	Entrance and success criteria are often captured in a convening memo. The criteria should be established at the beginning of any project phase so that the supporting data can be incorporated as	Entrance and success criteria shall be established for each technical milestone review.	Entrance and success criteria shall be established for each technical milestone review.	Entrance and success criteria shall be established for each technical milestone review.

Req ID	Requirement	Criticality High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
		that the supporting data can be incorporated as part of normal development, rather than being generated just prior to a review. The technical data required to demonstrate entrance readiness or success should be captured in a project schedule (or Data Requirements List for contracted efforts) to make sure that its preparation is properly planned. NPR 7123.1 Appendix G "Life-Cycle and Technical Reviews Entrance and Success Criteria" provides typical entrance and success criteria for each review. The products and their required maturities will vary based upon the project and should be aligned with the purpose for that for that review.	that the supporting data can be incorporated as part of normal development, rather than being generated just prior to a review. The technical data required to demonstrate entrance readiness or success should be captured in a project schedule (or Data Requirements List for contracted efforts) to make sure that its preparation is properly planned. NPR 7123.1 Appendix G "Life-Cycle and Technical Reviews Entrance and Success Criteria" provides typical entrance and success criteria for each review. The products and their required maturities will vary based upon the project and should be aligned with the purpose for that for that review.	that the supporting data can be incorporated as part of normal development, rather than being generated just prior to a review. The technical data required to demonstrate entrance readiness or success should be captured in a project schedule (or Data Requirements List for contracted efforts) to make sure that its preparation is properly planned. NPR 7123.1 Appendix G "Life-Cycle and Technical Reviews Entrance and Success Criteria" provides typical entrance and success criteria for each review. The products and their required maturities will vary based upon the project and should be aligned with the purpose for that for that review.	part of normal development, rather than being generated just prior to a review. Care should be taken when capturing the criteria in a Convening Memo, because it is often released too late to allow for proper planning. The technical data required to demonstrate entrance readiness or success should be captured in a project schedule (or Data Requirements List for contracted efforts) to make sure that its preparation is properly planned. NPR 7123.1 Appendix G "Life-Cycle and Technical Reviews Entrance and Success Criteria" provides typical entrance and success criteria for each review. The products and their required maturities will vary based upon the project and should be			

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
					aligned with the purpose for that for that review.			
REQ-49	The review discrepancies/ actions (e.g. RIDs/ RFAs) resulting from the life-cycle and technical milestone reviews, their disposition, and the objective evidence supporting closure shall be identified and tracked.	The review discrepancies/actions (e.g. RIDs/ RFAs) resulting from the life-cycle and technical milestone reviews, their disposition, and the objective evidence supporting closure shall be identified and tracked.	The review discrepancies/actions (e.g. RIDs/ RFAs) resulting from the life-cycle and technical milestone reviews, their disposition, and the objective evidence supporting closure shall be identified and tracked.	The review discrepancies/actions (e.g. RIDs/ RFAs) resulting from the life-cycle and technical milestone reviews, their disposition, and the objective evidence supporting closure shall be identified and tracked.	The review discrepancies/actions (e.g. RIDs/ RFAs) resulting from the life-cycle and technical milestone reviews, their disposition, and the objective evidence supporting closure shall be identified and tracked.	The review discrepancies/actions (e.g. RIDs/ RFAs) resulting from the life-cycle and technical milestone reviews, their disposition, and the objective evidence supporting closure shall be identified and tracked.	The review discrepancies/actions (e.g. RIDs/ RFAs) resulting from the life-cycle and technical milestone reviews, their disposition, and the objective evidence supporting closure shall be identified and tracked.	The review discrepancies/actions (e.g. RIDs/ RFAs) resulting from the life-cycle and technical milestone reviews, their disposition, and the objective evidence supporting closure shall be identified and tracked.
REQ-50	During the normal course of business, periodic technical status reviews shall be held to monitor and assess the technical effort.	Planned reviews and their frequency should be captured in the SEMP.	Planned reviews and their frequency should be captured in the SEMP.	Planned reviews and their frequency should be captured in the SEMP.	Planned reviews and their frequency should be captured in the SEMP or equivalent data item.	Not required	Not required	Not required

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-51	The list of leading indicators (systems engineering and technical performance measures) to be tracked by the project and their reporting frequency shall be defined, documented, and approved.	Leading indicators, in addition to review discrepancies/actions, mass and power margins, shall be considered for inclusion. Reporting frequency may need to be monthly for critical items, especially when margins are small. The lists, their definition, and reporting frequency should be captured in the SEMP or a project Leading Indicators Plan.	Leading indicators, in addition to review discrepancies/actions, mass and power margins, shall be considered for inclusion. Reporting frequency may need to be monthly for critical items, especially when margins are small. The lists, their definition, and reporting frequency should be captured in the SEMP.	Leading indicators, in addition to review discrepancies/actions, mass and power margins, shall be considered for inclusion. Reporting frequency may need to be monthly for critical items, especially when margins are small. As a minimum, reporting should be done prior to (and reported at) any life-cycle or technical milestone review. The lists, their definition, and reporting frequency should be captured in the SEMP.	Leading indicators, in addition to review discrepancies/actions, mass and power margins, shall be considered for inclusion. Reporting frequency may need to be monthly for critical items, especially when margins are small. As a minimum, reporting should be done prior to (and reported at) any life-cycle or technical milestone review. The lists, their definition, and reporting frequency should be captured in the SEMP, or equivalent data item.	Satisfied by FOMs	Satisfied by FOMs	Satisfied by FOMs
REQ-52	The leading indicators to be tracked and their initial trend shall be presented at the MDR/SDR.	At MDR/SDR, or tailored equivalent prior to KDP-B.	At MDR/SDR, or tailored equivalent prior to KDP-B.	At MDR/SDR, or tailored equivalent prior to KDP-B.	At MDR/SDR, or tailored equivalent prior to KDP-B.	Not required	Not required	Not required
REQ-53	The leading indicators shall be tracked and their trends reported to the project on the agreed-upon interval.	Reporting of the leading indicator trends should be captured as part of project data items.	Reporting of the leading indicator trends should be captured as part of project data items.	Reporting of the leading indicator trends should be captured as part of project data items.	Reporting of the leading indicator trends should be captured as part of project data items.	Estimated performance with respect to the FOMs shall be documented at each technical milestone reviews and a trend shown	Estimated performance with respect to the FOMs shall be documented at each technical milestone reviews	Estimated performance with respect to the FOMs shall be documented at each technical milestone reviews

		Criticality						
Req ID	Requirement	High	Medium	Low	Minor	Technology Development High	Technology Development Medium	Technology Development Low
REQ-54	The approach to perform decision analysis shall be established and maintained.	The approach should include decision making bodies, such as Engineering Review Boards (ERBs), Risk Boards, Material Review Boards (MRBs), and Project Change Boards (PCBs); what trade studies need to be performed or criteria for when they are to be performed; and the process to be used for trade studies.	The approach should include decision making bodies, such as ERBs, Risk Boards, MRBs, and PCBs; and if formal trade are to be performed capture which ones or criteria for when they are to be performed; and the process to be used for trade studies.	The approach should include decision making bodies, such as ERBs, Risk Boards, MRBs, and PCBs. Trade studies are usually performed informally.	The number of boards is kept to a minimum, and trade studies are performed informally.	Rational for key technical decisions on the architecture of the technology shall be documented	Rational for key technical decisions on the architecture of the technology shall be documented	Rational for key technical decisions on the architecture of the technology shall be documented

Change History

Change	Date	Description/Comments
Basic	12/18/2019	Initial release.
Change 1	03/26/2020	Administrative changes include minor punctuation edits and wording in Appendix D updated to meet recent change to NPR 7123.1.
Change 2	11/04/2024	Administrative change: Extend expiration date one year to complete substantive changes in parallel with GLPR 7120.5.10 per GLPR 1410.1. Minor grammatical changes.