Langley Research Center

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SPACE FLIGHT INDEPENDENT LIFE CYCLE REVIEW PROCEDURAL REQUIREMENTS

National Aeronautics and Space Administration

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Responsible Office: Systems Management Office

Preface

P.1 Purpose

a. NPR 7120.5D, "NASA Space Flight Program and Project Management Requirements," and NPR 7123.1A, "NASA Systems Engineering Processes and Requirements," define space flight and ground systems program and project management requirements and systems engineering processes and requirements. These documents specify required reviews and products necessary for space flight and ground systems programs and projects

b. This Center Procedural Requirements (LPR) establishes Langley Research Center (LaRC) requirements for space flight and ground systems program and project independent life cycle reviews that comply with the agency-wide requirements specified in NPR 7120.5D and NPR 7123.1A.

P.2 Applicability

a. This LPR is applicable to all NASA employees, including Component Facilities and Technical and Service Support Centers, supporting formal NASA-recognized space flight and ground support programs and projects produced for or managed by LaRC. This language applies to JPL, other contractors, grant recipients, or parties to agreements only to the extent specified or referenced in the appropriate contracts, grants, or agreements.

b. Formal NASA programs/projects are identified in the NASA Meta-Data Manager database. These requirements are imposed as described below on all formal NASA-recognized space flight and ground support programs and projects produced for or managed by LaRC. For consistency with the intent of NPR 7120.5D, a space flight program or project involves orbital, lunar, or interplanetary spacecraft and their associated ground systems. It does not include suborbital vehicles and payloads.

c. For clarity, when requirements are explicitly stated, formal NASA projects and/or programs will refer to work explicitly identified in the NASA Meta-Data Manager database. Subprojects of the above and projects that do not qualify as space flight and ground systems projects will be called subprojects. Applicable sections of this LPR may be required for subprojects managed at LaRC as described in LPR 7130, section 3. Where no distinction is needed between formal NASA programs/projects and subprojects, the term project is used.

d. Note that the independent reviews described here, when performed for subprojects, may be considered internal reviews for the parent subproject or project.

P.3 Authority

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

P.4 Applicable Documents

a. NPR 7120.5D, “NASA Space Flight Program and Project Management Requirements.”

b. NPR 7123.1A, “NASA Systems Engineering Processes and Requirements.”

c. NPR 7150.2, “NASA Software Engineering Requirements.”

d. “NASA Standing Review Board Handbook”, in preparation (current version available on LaRC NX in the collection:
https://nx.larc.nasa.gov/dsweb/View/Collection-9058
that can be found by navigating to:
Home » 1. Projects and Programs » SMO » SMO Public » Reference Material)

e. LPR 7130, “Project and Task Review Procedural Requirements”

f. LMS-CP-7151, “Obtaining Waivers from LMS Requirements”

g. LMS-CP-7152, “Project Requests for Action (RFA)”

P.5 Cancellation

None

Original signed on file, August 24, 2009
Stephen G. Jurczyk for Cynthia C. Lee

Cynthia C. Lee
Associate Director

Distribution:
Approved for public release via the Langley Management System; distribution is unlimited.

1. Overview

1.1 This LPR describes the timing, documents, success criteria, and content required for independent life cycle reviews of space flight programs and projects. These reviews are sometimes referred to as Standing Review Board or SRB Reviews because they are intended to be performed by a review board that remains substantially the same throughout the life of the project. The reviews discussed herein are part of the overarching LaRC review structure described in LPR 7130, “LaRC Project and Task Review Procedural Requirements.”

1.2 The requirements for these reviews flow from NPR 7120.5D NASA Space Flight Program and Project Management Requirements, (in particular, Tables 4-2, 4-3, and 4-4) and NPR 7123.1A, NASA Systems Engineering Processes and Requirements (in particular, Chapter 5 and Appendix G) with additions and interpretations appropriate to LaRC. For systems that contain software, the software developed within NASA or acquired by NASA shall comply with NPD 2820.1, NASA Software Policy, and NPR 7150.2, NASA Software Engineering Requirements. Note that NPR 7150.2 elaborates on the requirements in this document. NPR 7150.2 contains additional Agency requirements on the content of software products that are called out in the reviews defined in this document.

1.3 All reviews are to be conducted according to processes described in the agreed-to review Terms of Reference (ToR). Requests for Action (RFA) generated as a result of reviews are to be handled in accordance with LMS-CP-7152, “Project Requests for Action.” The 60-Day Review is treated as a LaRC Special Center Management Council meeting.

1.4 The remainder of this document is laid out as follows: Section 2 outlines what reviews are required for human space flight and non-human space flight programs and projects. Section 3 discusses the Standing Review Board and their responsibilities for running independent life cycle reviews. Section 4 provides detailed information relating to the content of all required reviews. Section 5 discusses how to obtain waivers from requirements in this document.

1.5 The imperative, “shall” is used sparingly in this document and it highlights requirements levied on particular individuals or groups of individuals. Various forms of the verb “to be” (e.g., is, are, will) are used to describe descriptive material and expectations. The word “should” is used where the statement is recommended, but not required. The word “may” is used to give permission, but is not required. Except where otherwise noted, the detailed structure of the referenced examples, samples, and templates available on NX in the SMO collections are not required, but provide strong guidance and should be tailored to the needs of the project. The absence in this LPR of particular review requirements imposed by other applicable LaRC and/or NASA documents does not relieve programs or projects of those requirements.

1.6 All formal NASA space flight and ground systems programs and projects as defined in section P.2 shall meet all the requirements of NPR 7120.5D and NPR 7123.1A. Any apparent discrepancies between this document and NPR 7120.5D or NPR 7123.1A should be reported to the LaRC Systems Management Office (SMO) for resolution. All subprojects shall rely on the relevant requirements stated in this LPR, using the NPRs as guidance, where appropriate.

2. Program / Project Life Cycles and Required Life Cycle Reviews

2.1 NPR 7120.5D lays out the life cycles for formal NASA space flight projects and programs. Figure 2.1 shows the life cycle for formal NASA projects and Figure 2.2 shows the life cycle for formal NASA programs. As discussed in NPR 7120.5D, a KDP is a Key Decision Point at which the Decision Authority for the program/project determines the readiness of a formal NASA program/project to progress to the next phase of the life cycle.

2.2 For formal NASA human space flight projects, the project shall perform the following minimum set of life cycle reviews [Ref. NPR 7123.1A]:

a. Mission Concept Review (MCR)
b. System Requirements Review (SRR)
c. System Definition Review (SDR)
d. Preliminary Design Review (PDR)
e. Critical Design Review (CDR)
f. System Integration Review (SIR)
g. Test Readiness Review (TRR)
h. System Acceptance Review (SAR)
i. Operational Readiness Review (ORR)
j. Flight Readiness Review (FRR)
k. Post-Launch Assessment Review (PLAR)
l. Critical Event Readiness Review (CERR)
m. Post-Flight Assessment Review (PFAR)
n. Decommissioning Review (DR)

2.3 For formal NASA non-human space flight projects, the project shall perform the following minimum set of life cycle reviews [Ref. NPR 7123.1A]:

a. Mission Concept Review (MCR)
b. System Requirements Review (SRR)
c. Mission Definition Review (MDR)
d. Preliminary Design Review (PDR)
e. Critical Design Review (CDR)
f. System Integration Review (SIR)
g. Test Readiness Review (TRR)
h. Operational Readiness Review (ORR)
i. Flight Readiness Review (FRR)
j. Post-Launch Assessment Review (PLAR)
k. Critical Event Readiness Review (CERR)
l. Decommissioning Review (DR)

For formal NASA non-human space flight projects, the SRR and the MDR may be combined into a single review.

2.4 Although not explicitly required by NPR 7123.1A, all formal NASA space flight projects shall perform a Launch Readiness Review (LRR) just prior to launch.

2.5 Although not required by NPR 7123.1A for non-human space flight projects, formal NASA space flight projects shall perform a Systems Acceptance Review.

2.6 A Production Readiness Review (PRR) shall be performed for both human and non-human formal NASA projects developing or acquiring more than three similar systems. Any project not executing a PRR shall include production considerations as part of the CDR. [Ref. NPR 7123.1A]

2.7 For formal NASA projects, the required project life-cycle reviews are to be performed in accordance with the following timelines [Ref. NPR 7123.1A]:

a. MCR prior to KDP A.
b. Human space flight project SRR prior to SDR and non-human missions SRR and MDR prior to KDP B.
c. Human space flight project SDR prior to KDP B.
d. PDR prior to KDP C.
e. CDR prior to starting fabrication of system end products and SIR.
f. PRR prior to starting fabrication of system end products for projects requiring multiple units.
g. SIR prior to KDP D.
h. TRR prior to starting product verification and product validation testing.
i. Human space flight project SAR after completion of KDP D.
j. ORR after SAR or KDP D and before FRR.
k. FRR prior to KDP E.
l. PLAR after system end product launch.
m. CERR after PLAR and before KDP F.
n. Human space flight project PFAR at end of flight and before KDP F.
o. DR after KDP F.

2.8 Both formal NASA programs/projects and subprojects shall define their reviews in a Review Plan as described in Section 3 of LPR 7130. A template for a stand-alone review plan is available in the NX collection:
https://nx.larc.nasa.gov/dsweb/View/Collection-9766
or by navigating through the LaRC NX collections to:
Home » 1. Projects and Programs » SMO » SMO Public » Examples and Templates » Review Plan
However, the review plan may be part of another document.

2.9 In addition, projects managed at LaRC undergo a 60-Day Review at the discretion of the CMC Chairperson or designee. The 60-Day Review is presented to the LaRC Center Management Council approximately 60 days after the sponsor of the project expects LaRC to initiate the project's formation.

2.10 Furthermore, both formal NASA programs/projects and subprojects managed at LaRC shall have a Lessons Learned Review. The Lessons-Learned Review is typically performed at the completion of the project, however for long-duration projects, it may be

performed incrementally at defined stages in the project to help ensure that appropriate lessons are not forgotten or personnel dispersed. Performing lessons learned incrementally relieves the project of the requirement for a separate lessons-learned review.

2.11 The Safety and Mission Success Review (SMSR) is conducted prior to launch or other mission critical events/activities by the Chief SMA Officer and Chief Engineer (or senior Center-based SMA and engineering officials) to prepare for SMA and engineering participation in critical program/ project reviews/decision forums. [Ref. NPR 7120.5D] The LaRC Safety and Mission Assurance Office shall coordinate with NASA Headquarters regarding the necessity for a SMSR and address it in the S&MA Plan and/or the Product Assurance Plan. Further details of the SMSR are outside the scope of this document.

2.12 For formal NASA space flight programs, the program shall perform the following reviews [Ref. NPR 7120.5D]:

a. Program Systems Requirements Review (P/SRR) / Preliminary Program Approval Review (PPAR)
b. Program / System Definition Review (P/SDR) / Program Approval Review (PAR)
c. Program Status Review (PSR) / Program Implementation Review (PIR)

The P/SRR is performed before KDP 0 and the P/SDR is performed prior to KDP 1. [NPR 7123.1A] The PSR is performed periodically as required by NPR 7120.5D. This LPR provides no additional requirements or guidance for conducting these program reviews. Affected individuals are to consult NPR 7120.5D, NPR 7123.1A (in particular Appendices G.1 and G.2), and the NASA Standing Review Board Handbook for information as to the requirements for and the content of these reviews.

2.13 For formal NASA single-project and tightly coupled programs the program shall perform the following reviews. [Ref. NPR 7120.5D] These reviews use the same criteria as are used for same named project reviews previously enumerated.

a. Preliminary Design Review (PDR)
b. Critical Design Review (CDR)
c. System Integration Review (SIR)
d. Operations Readiness Review (ORR)
e. Safety and Mission Success Review (SMSR)
f. Flight Readiness Review (FRR)
g. Launch Readiness Review (LRR)
h. Post-Launch Assessment Review (PLAR)
i. Critical Events Readiness Review (CERR)

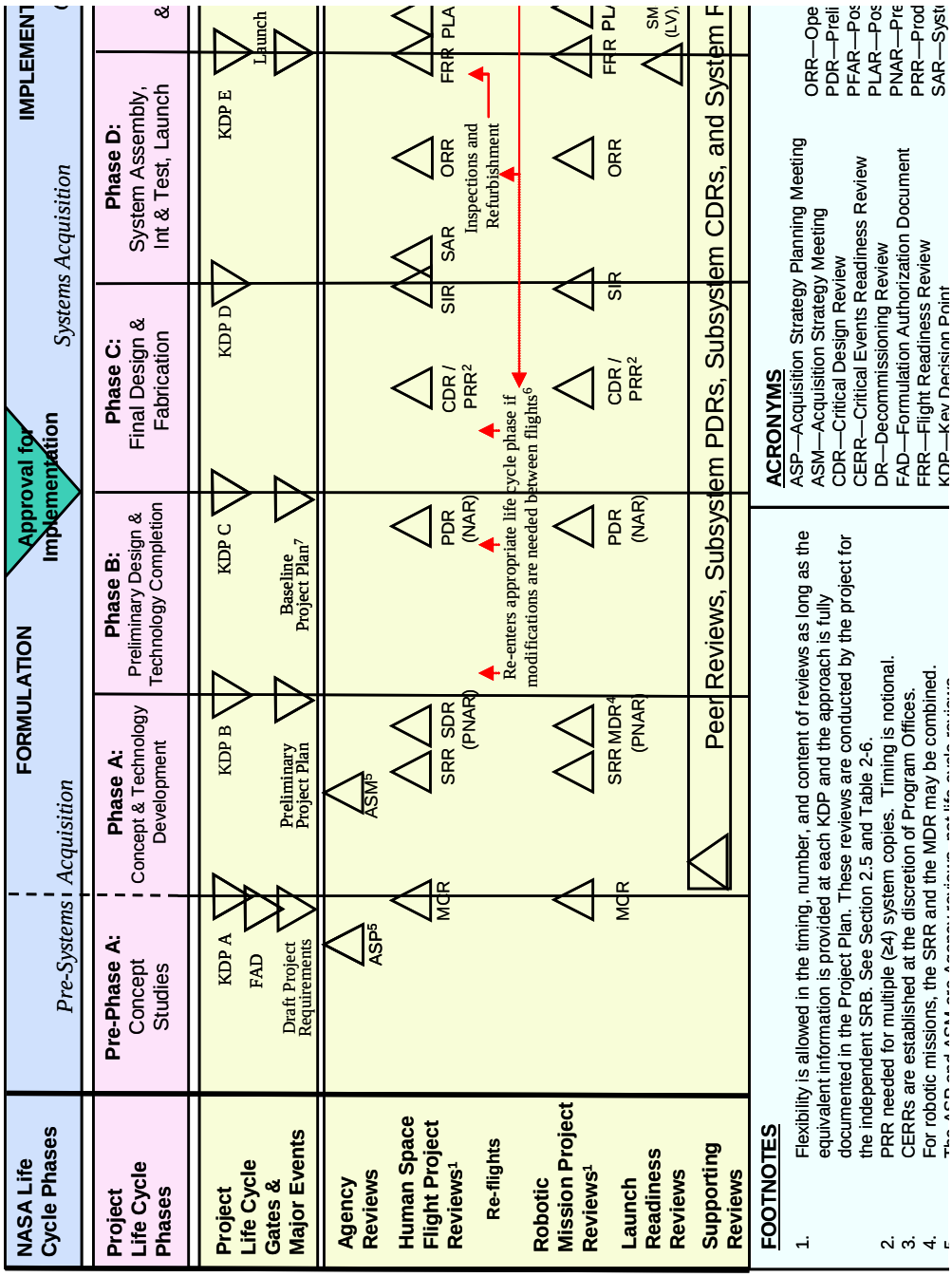


Figure 2.1. Space Flight and Ground System Project Life cycle [Ref. NPR 7120.5D, Figure 2.4]

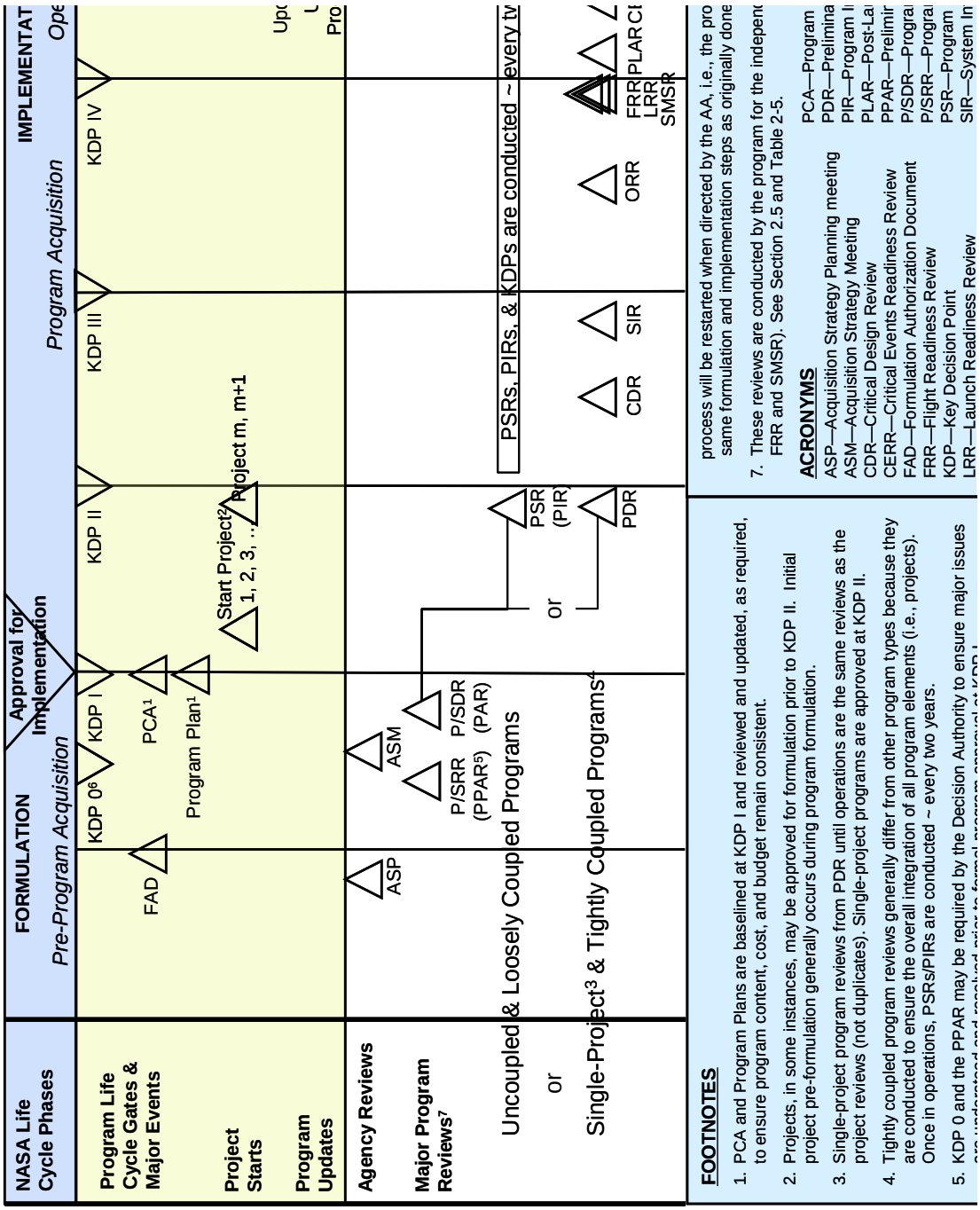


Figure 2.2. Space Flight and Ground System Program Life cycle [Ref. NPR 7120.5D Figure 2-3]

3. Requirements for Running Life Cycle Reviews

a. The NASA Standing Review Board Handbook provides extensive details for the conduct of independent reviews required by NPR 7120.5D and NPR 7123.1A. The guidelines provided in the handbook are strongly recommended for formal NASA programs/projects.

b. Review-specific details are defined in a project-specific document called the ToR, which is discussed in more detail below. The ToR is generally divided into a Baseline ToR, which remains substantially the same for all project reviews and Addendum ToRs, which address review-specific material. ToR templates are available in the LaRC NX collection:
https://nx.larc.nasa.gov/dsweb/View/Collection-6872
that can be found by navigating to:
Home » 1. Projects and Programs » SMO » SMO Public » Examples and Templates
Among other items, a Review Plan template, an example Request for Action (RFA) document, a Standing Review Board Final Report template, and a Standing Review Board Briefing template can also be found in the above collection. Except where otherwise noted, the detailed structures of the examples and templates available on NX are not required, but provide strong guidance and should be tailored to the needs of the project.

3.1 Review Board Membership and Approval

a. For formal NASA projects, the guidance in the NASA Standing Review Board Handbook states: The SRB Chair, RM, Cost Analyst and Schedule Analyst will be funded by an independent account and all other members will be funded by the program/project budget. Contracts for members will be through an independent means; i.e., not the program/project organization. Budgeting for these members of the SRB will be handled on a case-by-case basis.

b. For subprojects, the subproject shall provide funding for the Review Board and the Review Manager. The details on how this is done will be handled on a case-by-case basis.

c. NPR 7120.5D provides details related to the Review Board. These details are summarized below. The NASA Standing Review Board Handbook also provides guidance on the selection and operation of the review board. Formal NASA programs/projects are referred to both NPR 7120.5D and the handbook for a more complete description. For subprojects, compliance with the statements herein is sufficient.

d. The review board is expected to remain intact, with the goal of having the same core membership for the duration of the project. Hence, it is known as a Standing Review Board (SRB). However, the SRB may be augmented over time with specialized

reviewers as needed. Board members are to be independent of the project[1], and some members are to be selected that are independent of the project's participating Centers[2]. Board members are chosen based on their management, technical, safety and mission assurance expertise, their objectivity, and their ability to make a broad assessment of the implementation of the project.

e. Although the SRB is intended to run most life cycle reviews, NPR 7120.5D, paragraph 2.5.2.9 discusses some exceptions. In particular, an SRB is not used for the SMSR. For formal NASA programs, NPR 7120.5D, Table 2-5 indicates that the SRB may not have been formed for the P/SRR / PPAR. In addition the Mission Management Team performs the PLAR and the CERR for human space flight. For tightly coupled programs, the use of the SRB for the FRR and PFAR is at the discretion of the MDAA. (Rather than utilizing a complete independent review board for these flight and mission operations reviews, the program SRB chair and project SRB chairs that are a part of the mission are included as advisory members to the flight and mission operations review boards. The SRB input is provided during the board meeting.) In addition, for formal NASA projects, Table 2-6 of NPR 7120.5D indicates that the SRB may not have been formed for the MCR and that the Mission Management Team performs the PLAR and CERR for human space flight. For both formal NASA programs/projects and subprojects, these and other exceptions to the use of the SRB for life cycle reviews are documented in the Review Plan and in the review plan summary that is approved by the customer. The Review Plan and the review plan summary are discussed in Section 3 of LPR 7130 and a template for a Review Plan is available in the Examples and Templates NX collection identified above.

f. Projects are responsible for the maintaining of all formal documents associated with their reviews. These documents include the ToR, the presentation materials, RFAs, all reports from the Review Board, and records of all related approvals and concurrences. Upon conclusion of the project, maintenance of these documents is the responsibility of the LaRC Organizational Unit (or its successor) responsible for the project.

g. The SRB has a Chairperson and a NASA (or JPL) Review Manager (RM). For formal NASA programs/projects, the Chairperson and the RM are approved/concurred by the individuals identified in Table 3-1. The RM for programs, Category 1 projects, and Category 2 projects with life cycle costs that are $250M and above is assigned by the Associate Administrator for PA&E; the RM for Category 2 projects with life cycle

[1] The NASA SRB Handbook provides an excellent discussion of the meaning of independence in the context of an SRB member. Formal NASA Programs and Projects should follow the guidelines for independence provided in the SRB Handbook. For subprojects, the smaller size, rapid pace, and limited resources of the subproject may not facilitate complete compliance with the guidelines. However, to the extent practical, the subprojects are urged to follow the spirit of the guidelines for independence, which are summarized as, "In all matters relating to the review work, the review organization and the individual reviewer, should be free from personal, external, and organizational impairments to independence, and should avoid the appearance of such impairments of independence."

[2] For subprojects, all of the Board members may come from the project's participating Centers.

costs that are below $250M and Category 3 projects is assigned by the Technical Authority. Note that project category assignments are approved by the NASA Associate Administrator and maintained in the official listing of the Office of Chief Engineer (see NPR 7120.5D, 2.1.4).

h. The RM actively supports each program/project independent life-cycle review by assisting the SRB Chairperson, DA, MDAA (if not the DA), and TA in preparing the ToR; preparing team nomination letters; interfacing with the Program/Project Manager; managing review team administrative functions; ensuring that documented Agency and Center review policies and practices are followed; ensuring that RFAs are tracked and closed; documenting and distributing SRB findings and recommendations; and preparing management briefings and reports.

i. For subprojects, the Chairperson and the RM are assigned by the LaRC Chief Engineer with approval from the Director of the LaRC SMO. The specific responsibilities are set forth in the baseline ToR (see section 3.3). For subprojects, the formal assignment and approval of the Chairperson and the RM may be accomplished as part of the approval of the ToR. For small subprojects a separate RM might not be assigned. In such cases, the Chairperson is expected to handle the duties of both the Chairperson and the RM.

j. The Project Manager provides the Chairperson and RM with a preliminary list of skill areas desired for the Review Board and potential candidate Board Members that would fill those skill areas. Expertise in the area of Safety and Mission Assurance is required to be included in the listed skill areas.

k. The Chairperson, with support from the RM, considers the preliminary list of skill areas and potential Review Board candidates and organizes a proposed review board. The Chairperson ensures that at least one member of the Review Board has expertise in the area of Safety and Mission Assurance. The Chairperson submits the names of proposed board members for approval/concurrence to the same individuals who approved/concurred with his/her assignment (i.e., those named in Table 3-1 approve/concur on the Board membership for formal NASA programs and projects; for subprojects, the LaRC Chief Engineer and Director of the LaRC SMO concur, if appropriate, as part of the ToR approval). For subprojects, last minute substitutions of Review Board members may be made as long as the substitutions do not change the Review Board characterization from a CS-only Review Board to a mixed CS and outside consultant Review Board (see Section 3.2a). Last minute substitutions of Review Board members are subject to Chairperson approval at the time the substitution is made and post-facto concurrence by the LaRC Chief Engineer and Director of the LaRC SMO. If either the LaRC Chief Engineer or the Director of the LaRC SMO refuses to concur, they and the Chairperson meet to decide on an appropriate course of action.

	Decision Authority		Technical Authority		Associate Administrator, PA&E
	NASA AA	MDAA	NASA CE	Center Director	
Programs	Approve	Approve	Approve		Approve
Category 1 Projects	Approve	Approve	Concur	Approve	Approve
Category 2 Projects		Approve		Approve	Approve*
Category 3 Projects		Approve		Approve	

* Only for Category 2 projects that are $250M or above

Table 3-1 Agency-level Approvals (adapted from NPR 7120.5D, Table 2-3)

l. The RM invites the following individuals or their designees to the project reviews and provides them with access to the same information provided to other Review Board members:

(1) LaRC SMO Director
(2) LaRC OUM in charge of the project
(3) LaRC Chief Engineer
(4) LaRC SMAO Director

3.2 Review Board Composition

In accordance with the 29 April 2008 PA&E guidance on issues concerning FACA and SRB independence, the Civil Service (CS) / outside consultant composition of SRB influences the details of how the SRB conducts its reviews and reports on its findings. In short, SRBs that contain a mixture of CS and outside consultants may not form consensus recommendations. A summary of the differences is shown in Table 3-2.

Description	**SRB contains only CS**	**SRB contains CS with expert support from outside Consultants**	**SRB contains a mix of CS and outside Consultants**
SRB Chair	CS	CS	CS or Consultant
SRB RM	CS	CS	CS or JPL
SRB Composition	CS only	CS only on the SRB; Consultants provide expert analysis to the SRB	CS and Consultants
SRB Product * RFAs can contain individual	SRB (or equivalent for R&T) produces report & briefings	SRB produces written report & briefings with	RM produces written report identifying most

recommendations	with findings of facts & recommendations; RFAs (or equivalent) from individual members*; Chair briefs report	findings of facts & recommendations; includes RFAs (or equiv) from any individual*; Chair briefs SRB report	significant findings of facts and recommendations, based on RFAs from all individuals*; Chair briefs his/her personal findings of facts & recommendations
Minority Reports	Minority reports documented in report and in RFAs	Minority reports documented in report and in RFAs	No Minority Reports
SRB Consensus	Consensus allowed	Consensus allowed among SRB members	No consensus forming is allowed
SRB Independence	Normal CS ethics rules apply	Normal CS ethics rules apply to SRB	Revised independence standards allow some impairments, if approved
SRB Interactions	Everyone can participate in open discussion with the Program/Project and discuss individual points of view.		

Table 3-2 Summary of SRB composition-dependent differences.

3.3 Terms of Reference (ToR)

a. A ToR is a contract between the SRB and the convening or approval authority (For formal NASA programs and projects see Table 3-1). For subprojects, the convening authority is the LaRC CMC. The Director of the LaRC SMO is delegated the responsibility to approve ToRs with concurrence from the LaRC Organizational Unit Manager responsible for managing the project. At the discretion of the LaRC SMO Director, one or more project customers/funders may be asked to concur on the ToR. In general, a ToR documents the SRB charter, scope, and agreements between the convening authority and the SRB. Input and concurrence from the project team, although not required, facilitates the development of a realistic ToR and ultimately the conduct of a useful review.

b. Because many portions of a ToR remain the same or similar across numerous reviews, the NASA Standing Review Board Handbook suggests the use of a Baseline ToR that is written once and approved once for the entire project life cycle and Addendum ToRs that provide review-specific material.

c. The Baseline ToR contains:

(1) A high level description of the functional purpose and objectives of the SRB
(2) Identification of the approving/concurring authorities as specified in Section 3.1.i of LPR 7120.7.
(3) A statement of cooperation that, between life-cycle reviews and prior to an addendum ToR being written for a specific review, the program/project and the Chair will work together for the appropriate notice and participation of internal reviews or subsystem reviews that are necessary and appropriate for the SRB to attend.
(4) A description of the project and top level objectives.
(5) An identification of the customer(s) of the project.
(6) Identification of life-cycle reviews the SRB will attend/assess (see Section 2). For projects, a list of reviews identified in Section 2 of this LPR that will not be performed (for which waivers will be sought).
(7) Provide a high-level schedule of the Program/Project life-cycle reviews

d. A sample template for a Baseline ToR and a sample template for an Addendum ToR are provided on NX in the collection:
https://nx.larc.nasa.gov/dsweb/View/Collection-6872
that can be found by navigating to:
Home » 1. Projects and Programs » SMO » SMO Public » Examples and Templates
Assistance in developing the Baseline and Addendum ToRs is available from the LaRC SMO.

e. For formal NASA programs/projects approval/concurrence of ToRs is by the appropriately identified individuals in Table 3.1. Prior to LaRC Center Director approval, the following concurrences are obtained:
(1) LaRC Director, Systems Management Office
(2) LaRC Director, Organizational Unit (managing the project)
(3) LaRC Chief Engineer

f. For subprojects, the following are signatories:

(1) Review Manager (signs as co-submitter)
(2) Review Chair (signs as co-submitter)
(3) LaRC Systems Management Office Director (approves)
(4) LaRC Chief Engineer (concurs)
(5) LaRC Organizational Unit Manager (concurs)
(6) Customer/Funders (concurs, as required by SMO Director)
(7) Additional signatures may be required by SMO Director. For subprojects, these may be necessitated by combining the review plan approval and/or the review board membership approval with the ToR.

g. An Addendum ToR is written for each specific independent life-cycle review and is attached to the Baseline ToR. The Addendum ToR requires signatures from those in the same positions as the Baseline ToR. The Addendum ToR for the first project review is typically submitted simultaneously with the Baseline ToR.

h. The typical content of an Addendum ToR includes:

(1) A short description of the program/project as it exists at the time of writing (omitted if this is the first review and the addendum is being written simultaneously with the Baseline ToR). The purpose of this section for addendum ToRs is specifically to call out changes in budget and/or content that might affect the size or the makeup of the SRB. This is most relevant when addendum ToRs are produced years after the baseline ToR was produced, and budget and content have changed.
(2) The specific entrance and exit/success criteria for that review.
(3) Center or Mission Directorate review requests.
(4) Support assessments to be performed.
(5) A list of program/project deliverables (documents requested) and SRB products (reports, e.g., oral and written)
(6) A schedule of events, including all reports and venues. A timetable of events anchored by a project controlled milestone event, e.g. conclusion of the internal reviews.
(7) Unless specified in the Baseline ToR, specify the basic rules or procedures for how the reviews will be conducted.

i. The ToR development process is spearheaded by the Review Chair and facilitated by the RM. The Chair/RM work collaboratively with the convening authorities and the program/project to develop a ToR that meets the expectations for the Agency and embraces the needs of the program/project to become a value-added effort for all stakeholders. The RM facilitates the vetting process with all convening authorities prior to circulating the ToR for approvals/concurrences. When there is substantial agreement amongst the convening authorities, the Review Manager submits each ToR for approval/concurrence. The LaRC SMO Director circulates the proposed ToR to the LaRC Chief Engineer and the LaRC Safety and Mission Assurance Office Director for inputs prior to SMO approval.

3.4 Review Reports and Briefings

a. The number, type, level of detail, and recipients of review reports and briefings are detailed in the project review ToR. The review reports and briefings are generally prepared by the Review Chair and the RM with input (as appropriate) from the other members of the SRB. In cases where the SRB consists of only Civil Servants or Civil Servants with expert support from outside contractors, the reports and briefings are expected to reflect a consensus amongst the SRB members, with the inclusion of minority reports where consensus was not achieved. In the case of an SRB with mixed

Civil Servant and outside contractor membership, the reports and briefings reflect the opinions of the Review Chair after consideration of the inputs from all the SRB members. The following paragraphs provide guidance to be used in developing the reporting requirements to be included in the project review ToR. Formal NASA projects should also consider the guidance in the SRB Handbook.

b. For formal NASA programs and projects, as per NPR 7120.5D, each written report is submitted to the relevant individuals (e.g., Decision Authority, MDAA, Program Manager, Project Manager, Technical Authority, Associate Administrator for PA&E, and participating Center Director(s)).

c. For subprojects each written report is submitted to:
Project,
Director of LaRC SMO
LaRC OUM in charge of the project
LaRC Chief Engineer
Director of LaRC SMAO
LaRC Chief Financial Officer
The review ToR may specify additional individuals for receiving reports. For subprojects, the customer (e.g., the organization funding the work, the organization receiving the deliverables), typically receives a copy of the report.

d. A template for a complete SRB report and one for a briefing are available on NX in the collection:
https://nx.larc.nasa.gov/dsweb/View/Collection-9442
which can be found by navigating to:
Home » 1. Projects and Programs » SMO » SMO Public » Examples and Templates » Standing Review Board (SRB)

e. The written report provides a relatively complete narrative documentation of the review. It is intended to provide the details of the review process with particular emphasis on the findings and possible recommendations.

f. For formal NASA projects, the report serves as a stand-alone archive of the products and process of the review. For these formal NASA projects, the SRB's reports and briefings are predecisional and incomplete without the final decisions made by the project, program, center and decision authorities. The SRB will add an addendum to their report that documents the final decisions and outcomes for each review so that the final report represents the final outcome. Once completed, the RM distributes the report, in accordance with NPR 7120.5D. Only the appropriate NASA authorities can distribute SRB reports external to the agency. Any release of SRB work must include the decisional addendum, so that the final outcome is included.

g. For subprojects, the written report may reference other documents (e.g. ToR) and thereby reduce the size of the final report. In addition, for subprojects, a decisional

addendum does not need to become part of the review report. The subproject is responsible for archiving the written report and any referenced documents.

h. The ToR may specify that the RM and Review Chair provide the LaRC SMO Director with a short preliminary report prior to the release of full report. In such cases, the preliminary report typically includes the anticipated overall recommendation(s) and the major reasons for those recommendations.

i. The SRB Review Chair is responsible for a briefing to the LaRC CMC. The LaRC CMC meets on a monthly basis. The Review Chair is responsible for contacting the LaRC SMO and coordinating the date and time of the brief. Whether the Review Chair delivers the brief in person or through a proxy is determined by the CMC Chair or designee. In the case of a mixed CS / Consultant SRB, although a proxy may deliver the briefing, the briefing consists of the personal findings and recommendations of the Review Chair and is not a consensus of the entire SRB. The Project Manager is expected to be in attendance during the brief although the CMC Chair or designee may waive this expectation.

j. Formal NASA programs and projects and projects may be required to provide additional briefings (see NPR 7120.5D section 2.5.2).

k. The project assesses and dispositions the findings and recommendations of the SRB. Once project internal reviews and the SRB independent life-cycle review are complete, the life-cycle review milestone is considered complete.

3.5 Summary Flow for Life Cycle Reviews

a. Figure 3-3 shows the flow of events associated with life cycle reviews.

b. Referring to Figure 3-3, the Project Manager starts review planning as described in LPR 7130.

c. The Chairperson and the Review Manager (RM) are approved as discussed in Section 3.1 above. Note that the approval process depends upon whether the project is a formal NASA space-flight project as determined by criteria in P.2 above.

d. The Project Manager develops a list of skill areas for reviewers and a preliminary list of candidate reviewers to match the skill areas.

e. The Chairperson and RM work with the project team and others to organize and obtain approvals for the review board as discussed in Section 3.1i above. They also develop and gain approvals for a review plan and the Baseline ToR as discussed in Section 3.3 above. A template for a review plan is available in the NX collection:
https://nx.larc.nasa.gov/dsweb/View/Collection-6872
that can be found by navigating to:

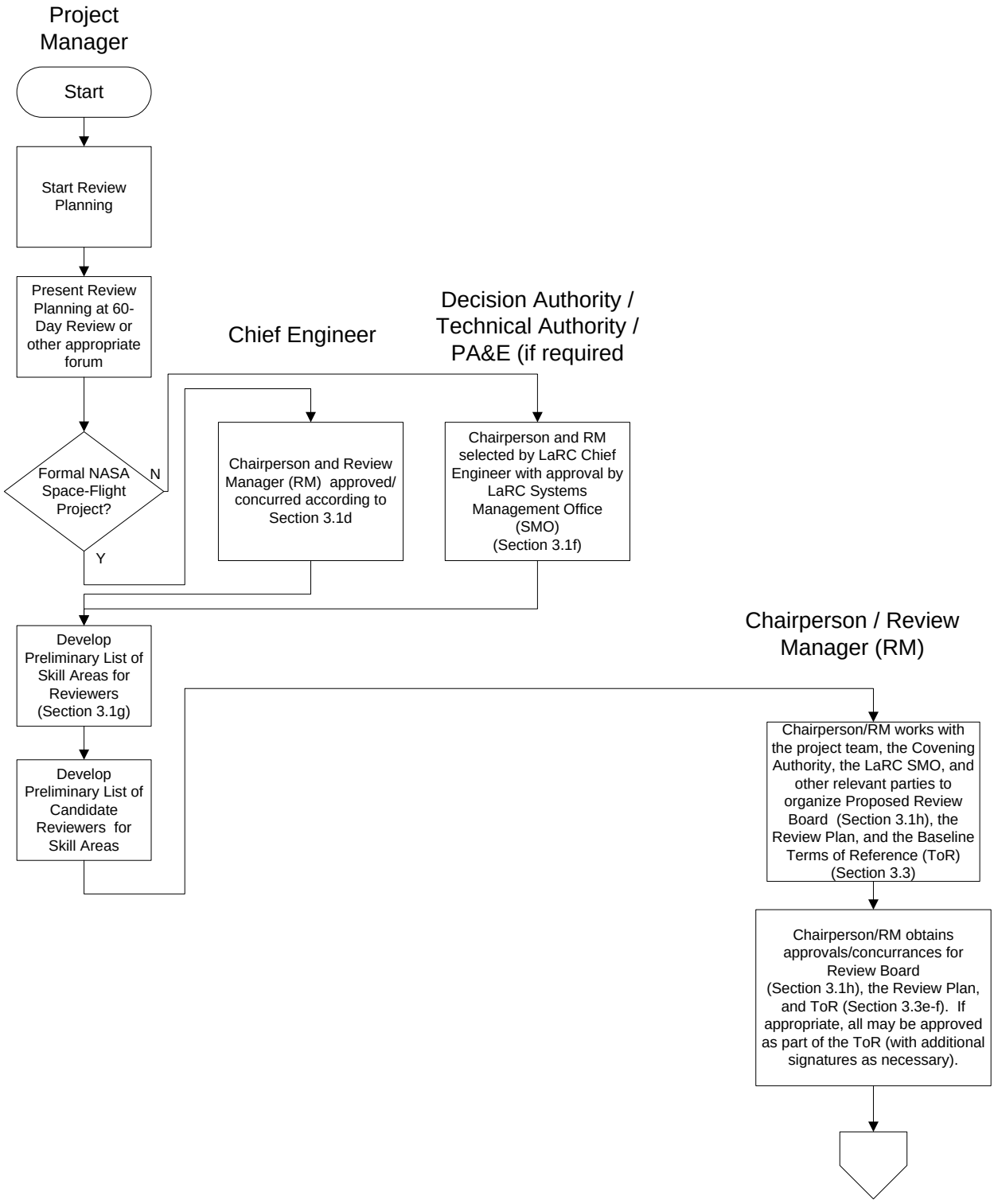
The review plan may be incorporated into the Baseline ToR provided that the ToR is signed by the appropriate LaRC individual (as described in LPR 7130, paragraph 3k).

f. Referring again to Figure 3-3, as the cycle of technical reviews commence, Addendum ToR are developed and approved for each review. The Addendum ToR for the first review may be developed and approved simultaneously with the Baseline ToR.

g. For each review the project prepares material as per the Addendum ToR for that review. The project team and the RM work together to make review materials available. Preferably, the materials are made available electronically

h. The review is conducted as per the Addendum ToR for that review. The results of the review are reported as described in Section 3.2 above with any additions and modifications as described in the Addendum ToR.

i. The project addresses any RFAs as described in CP-7152, “Project Requests for Action (RFA)” and then starts the cycle for the next life cycle review.


Project Manager
Start
Start Review Planning
Present Review Planning at 60-Day Review or other appropriate forum
Formal NASA Space-Flight Project?
N
Y
Chief Engineer
Chairperson and Review Manager (RM) approved/ concurred according to Section 3.1d
Decision Authority / Technical Authority / PA&E (if required
Chairperson and RM selected by LaRC Chief Engineer with approval by LaRC Systems Management Office (SMO) (Section 3.1f)
Develop Preliminary List of Skill Areas for Reviewers (Section 3.1g)
Develop Preliminary List of Candidate Reviewers for Skill Areas
Chairperson / Review Manager (RM)
Chairperson/RM works with the project team, the Covening Authority, the LaRC SMO, and other relevant parties to organize Proposed Review Board (Section 3.1h), the Review Plan, and the Baseline Terms of Reference (ToR) (Section 3.3)
Chairperson/RM obtains approvals/concurrances for Review Board (Section 3.1h), the Review Plan, and ToR (Section 3.3e-f). If appropriate, all may be approved as part of the ToR (with additional signatures as necessary).

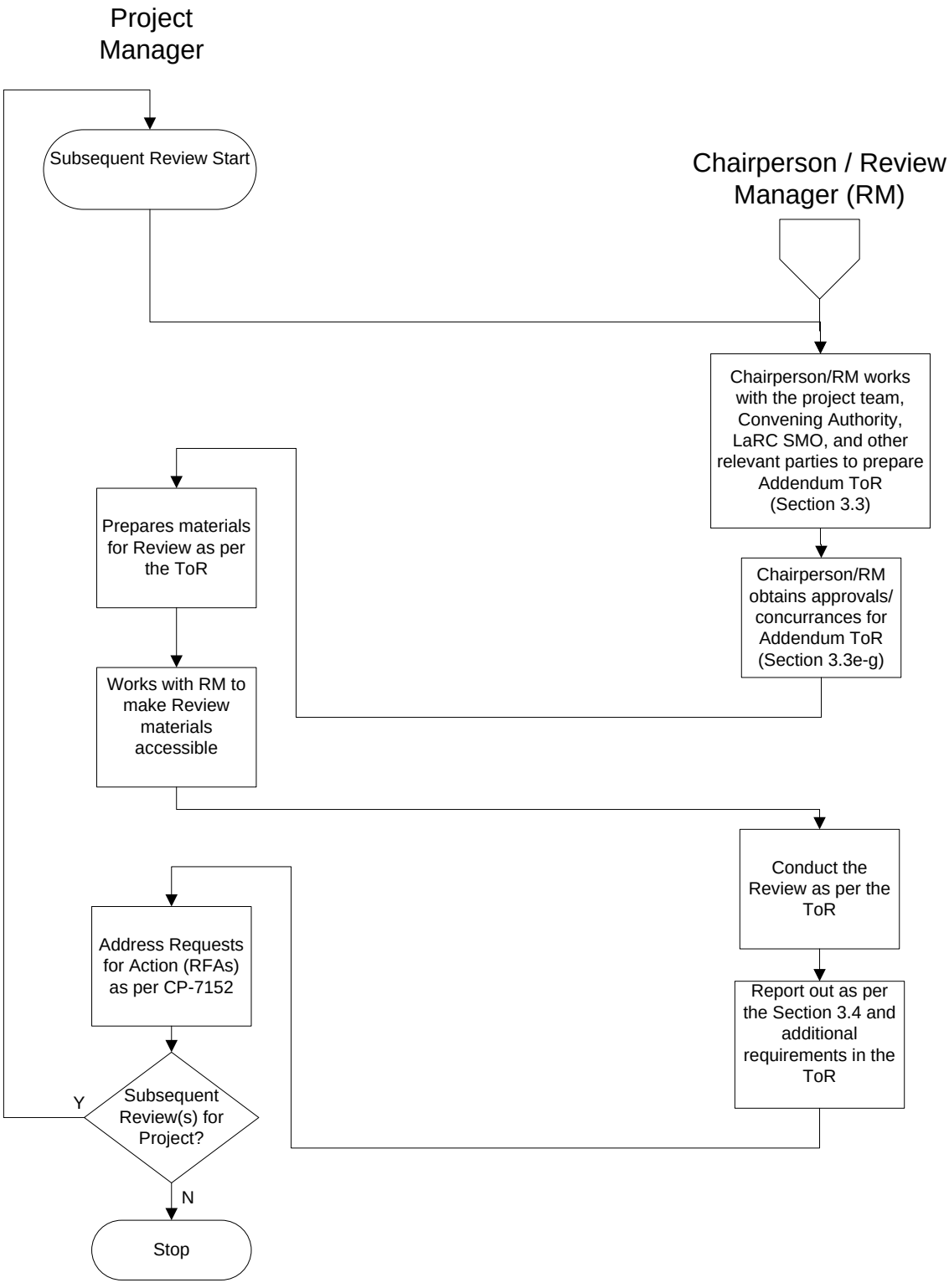


Figure 3-3: Flow chart for life cycle reviews

4. Life Cycle Reviews in Detail

4.1 Overview

a. The following sections contain review-specific material, including review content, required project management and technical products, and success criteria. An electronic file with commented spreadsheets containing the review contents, products, and success criteria is available in the LaRC NX collection:
https://nx.larc.nasa.gov/dsweb/View/Collection-15488
that can be found by navigating to:
Home » 1. Projects and Programs » SMO » SMO Public » Examples and Templates » Review Contents and Technical Products Spreadsheets

b. The spreadsheets are arranged to show the evolution of the review content and products as the project matures. The comments identify the source document(s) for the various elements in the spreadsheets. The source documents often provide additional information regarding the element. In addition, LPR 7120.5, NPR 7120.5D, NPR 7123.1A, and the Standing Review Board Handbook provide templates and explanations for many of the required documents and plans.

c. As per NPR 7123.1A, systems aspects represented or implemented in software shall be included in all technical reviews to demonstrate that project technical goals and progress are being achieved and that all NPR 7150.2 software review requirements are implemented.

d. For formal NASA programs and projects, the project management and technical products and success criteria discussed in the sections below and in the above spreadsheets are required unless formally waived. The review content may be tailored to fit individual project reviews without a formal waiver provided that:

(1) The absence of a particular item from the review content does not violate an agency requirement and
(2) The missing items are catalogued in the Addendum ToR for the specific review.

e. For subprojects, the project management and technical products, review content, and success criteria discussed in the sections below and in the above spreadsheets may be tailored to fit individual project reviews without a formal waiver provided that:

(1) The absence of a particular item does not violate an agency requirement and
(2) The project management and technical products, review content, and success criteria to be used are enumerated in the Addendum ToR for the specific review.

f. Project management and technical products, (e.g., project implementation plan, system requirements document, formal test reports) that are available for any review are expected to remain available or to be updated at all subsequent reviews. The

availability of a document does not require the SRB to consider it, but members of the SRB may comment on any document.

g. Further assistance in planning for reviews may be obtained from the LaRC SMO.

4.2 60-Day Review

The objectives of the review are to find out how well the Center did in setting up the Project and to see that the Project has what it needs for the next phase of formulation.

4.2.1 Timing:

This review is presented to the LaRC Center Management Council at the end of the 60-day project initiation activity at LaRC.

4.2.2 Review Content:

The review will be scheduled for 2 hours and cover the following agenda. A presentation template for the 60-Day Review is available from Flight Projects Directorate. The template includes notes on the required content.

4.3 Mission Concept Review

a. The MCR affirms the mission need and examines the proposed mission's objectives and the concept for meeting those objectives. Key technologies are identified and assessed. It is an internal review that usually occurs at the cognizant system development organization (the Standing Review Board may not have been formed at the project level.) Rough order of magnitude (ROM) budget and schedules are presented.

b. Successful completion of the MCR will result in recommended approval of the science/mission objectives and serves as a prerequisite to proceeding with formal requirements development.

4.3.1 Timing

a. The project has a clear requirement of what are the mission objectives. The MCR comes at the end of the Pre-Phase A concept studies.

b. An MCR ToR, with agenda and success criteria, has been agreed to by the appropriate parties.

4.3.2 Entrance Criteria

The following Entrance Criteria are specified in NPR 7123.1A and are required for all formal NASA projects. For subprojects, tailored Entrance Criteria may be used as long as they are enumerated in the ToR for the review.

1. Mission goals and objectives.
2. Analysis of alternative concepts to show at least one is feasible.
3. Concept of operations.
4. Preliminary mission descope options.
5. Preliminary risk assessment, including technologies and associated risk management/mitigation strategies and options.
6. Conceptual test and evaluation strategy.
7. Preliminary technical plans to achieve next phase.
8. Defined MOEs and MOPs.
9. Conceptual life-cycle support strategies (logistics, manufacturing, and operation).

4.3.3 Management and Technical Products

Table Note: Items in angle brackets are not required to be formal documents at this stage.

For formal NASA programs and projects, the project shall make available to the Review Board the following Management and Technical Products with the indicated maturity. For subprojects, tailored Management and Technical Products may be used as long as they are enumerated in the ToR for the review. The rightmost column indicates the source of the requirement for that particular product.

Product	Maturity	Source
Agency Documents		
Formulation Authorization Document	Approved	NPR-7120.5D, Table 4-3
Program Requirements on Project	Draft	NPR-7120.5D, Table 4-3
Management Planning and Control		
ITA (or equivalent authorization)	Updated	LaRC
<Project Implementation Plan a.k.a. Project Plan>	Conceptual (WBS, ROM cost, schedule, resources, acquisition concept, descope options)	LaRC
<Integrated Baseline>	Draft	NPR-7120.5D, Table 4-3
<Risk assessment and mitigations>	Preliminary	NPR-7123.1A, Table G-3
Review Plan	Preliminary	LaRC (LPR-7130)
Requirements		
Mission Concept Report	Preliminary	NPR 7120.5D, Table 4-3,
Concept of Operations	Baseline	NPR 7123.1A, Table G-3 for Concept of Operations
Build and Test		
<Integration and Test Plan>	Conceptual test and evaluation strategy	NPR 7123.1A, Table G-3

4.3.4 Review Content:

The following content is typically expected at an MCR.

Science/Mission Goals and Objectives
Minimum Mission Success Criteria
Mission/Project Overview & Status
Mission/Project Organization
Implementation Concept Alternatives and Analyses
Conceptual System Architectures
Conceptual Operational Concept(s)
Descope Options
Design Solution
Development Approach
Technology Assessment

Test and Evaluation Strategy
Mission Analysis
    Orbits and Trajectories
    Launch Windows
Mission Assurance
Safety Considerations
Conceptual Life-Cycle Support Strategies
Programmatics / Project Plan
    Work Breakdown Structure (WBS)
    Schedule
    Budget / Life Cycle Cost
    Deliverables
    Assessment of Infrastructure, Workforce Needs
    Potential Partnerships
    Information & Configuration Management
    Conceptual Acquisition Strategies
    Potential Security Considerations
    Review Plan

4.3.5 Success Criteria:

For formal NASA programs and projects, the Review Board shall evaluate the project using the success criteria indicated below. For subprojects, tailored success criteria may be used provided they are enumerated in the ToR for the review.

(1) Mission objectives are clearly defined and stated and are unambiguous and internally consistent.
(2) The preliminary set of requirements satisfactorily provides a system that will meet the mission objectives.
(3) The mission is feasible. A solution has been identified that is technically feasible. A rough cost estimate is within an acceptable cost range.
(4) The concept evaluation criteria to be used in candidate systems evaluation have been identified and prioritized.
(5) The need for the mission has been clearly identified.
(6) The cost and schedule estimates are credible.
(7) An updated technical search was done to identify existing assets or products that could satisfy the mission or parts of the mission.
(8) Technical planning is sufficient to proceed to the next phase.
(9) Risk and mitigation strategies have been identified and are acceptable based on technical risk assessments.

4.4 System Requirements Review (SRR)

a. The SRR examines the functional and performance requirements defined for the system and the preliminary program or project plan, and ensures that the requirements and the selected concept will satisfy the mission. The SRR also confirms that a concept is presented that identifies lower level systems of interest and their resource allocations, and that traceability exists among the mission science, operations and technical requirements.

b. Note that if the MDR or SDR is combined with the PDR, then the PNAR activities and related document development (see MDR and SDR) occur as part of the SRR.

c. Successful completion of the SRR will result in recommended approval of the science/mission objectives, system and segment requirements, and subsystem requirement allocations to establish a functional baseline. It will also serve as a prerequisite to proceeding with preliminary design.

4.4.1 Timing

The project has refined the system concept studies and technology readiness assessment, and selected a system architecture and operational concept that will satisfy negotiated goals and objectives within project constraints.

4.4.2 Entrance Criteria

The following Entrance Criteria are specified in NPR 7123.1A and are required for all formal NASA projects. For subprojects, tailored Entrance Criteria may be used as long as they are enumerated in the ToR for the review.

1. Successful completion of the MCR and responses made to all MCR RFAs and Review Item Discrepancies (RIDs).
2. A preliminary SRR agenda, success criteria, and charge to the board have been agreed to by the technical team, project manager, and review chair prior to the SRR.
3. The following technical products for hardware and software system elements are available to the cognizant participants prior to the review:
    a. system requirements document;
    b. system software functionality description;
    c. updated concept of operations;
    d. updated mission requirements, if applicable;
    e. baselined SEMP;
    f. risk management plan;
    g. preliminary system requirements allocation to the next lower level system;
    h. updated cost estimate;
    i. Technology Development Maturity Assessment Plan;
    j. updated risk assessment and mitigations (including PRA as applicable).

k. logistics documentation (e.g., preliminary maintenance plan);
l. preliminary human rating plan, if applicable;
m. Software Development Plan (SDP);
n. system safety and mission assurance plan;
o. configuration management plan;
p. initial document tree;
q. verification and validation approach;
r. preliminary system safety analysis; and
s. other specialty disciplines, as required.

4.4.3 Management and Technical Products

Table Note: Items in angle brackets are not required to be formal documents at this stage.

For formal NASA programs and projects, the project shall make available to the Review Board the following Management and Technical Products with the indicated maturity. For subprojects, tailored Management and Technical Products may be used as long as they are enumerated in the ToR for the review. The rightmost column indicates the source of the requirement for that particular product.

Product	Maturity	Source
Agency Documents		
Formulation Authorization Document	Approved	NPR-7120.5D, Table 4-3
Program Requirements on Project	Draft	NPR-7120.5D, Table 4-3
Management Planning and Control		
ITA (or equivalent authorization)	Updated	LaRC
Project Implementation Plan, a.k.a. Project Plan	Draft (WBS, ROM cost, schedule, resources, acquisition concept, descope options)	NPR-7120.5D, Table 4-3
<Integrated Baseline>	Draft (updated)	NPR-7120.5D, Table 4-3
<Document Tree>	Preliminary	NPR-7123.1A, Table G-4
Systems Engineering Management Plan	Baseline	NPR-7120.5D, Table 4-4 NPR-7123.1A, Table G-4
Information & Configuration Management Plan	Preliminary	NPR-7120.5D, Table 4-4 NPR-123.1A, Table G-4
Risk Management Plan	Preliminary	NPR-7120.5D, Table 4-4 NPR-7123.1A, Table G-4
Software Management Plan	Preliminary	NPR-7120.5D, Table 4-4

<Risk assessment and mitigations>	Updated	NPR-7123.1A, Table G-4
Review Plan	Baseline	LaRC
Technology Development Plan, a.k.a., Technology Development Maturity Assessment Plan	Baseline	NPR-7120.5D, Table 4-4 NPR-7123.1A, Table G-4
Safety & Mission Assurance		
Safety & Mission Assurance Plan / Product Assurance Plan	Preliminary	NPR-7120.5D, Table 4-4 NPR-7123.1A, Table G-4 LPR-5300.1
<System Safety Analysis>	Preliminary	NPR-7123.1A, Table G-4
Requirements		
Mission Concept Report	Preliminary	NPR-7120.5D, Table 4-4
Concept of Operations	Updated	NPR-7123.1A, Table G-4
System Requirements Document	Baseline	NPR-7120.5D, Table 4-3 NPR-7123.1A, Table G-4
Subsystem Requirements Documents (including software)	Preliminary	NPR-7123.1A, Table G-4
Design		
Software Development Plan	Preliminary	NPR-7123.1A, Table G-4
Photographic Documentation Plan	Draft	LaRC – LPR-7600
<Integration and Test Plan>	Conceptual test and evaluation strategy	NPR-7123.1A, Table G-3
Verification, Validation, Certification		
Human Rating Plan, if applicable	Preliminary	NPR-7123.1A, Table G-4
<Verification Plan (may be combined with Validation Plan below)>	Draft	NPR-7123.1A, Table G-4
<Validation Plan (may be combined with Verification Plan above)>	Draft	NPR-7123.1A, Table G-4
Operations and Logistics		
Mission Operations Concept Document <Logistics Plan>	Preliminary Preliminary	NPR-7120.5D, Table 4-3 NPR-7120.5D, Table 4-4 NPR-7123.1A, Table G-4

4.4.4 Review Content:

The following content is typically expected at an SRR.

Science/Mission Goals and Objectives
- Minimum Mission Success Criteria

Mission/Project Overview & Status
- Mission/Project Organization

Implementation Concept Alternatives and Analyses
- Conceptual System Architectures
- Conceptual Operational Concept(s)

Requirements Management & Flowdown
- Mission/User Requirements
- System Requirements
- Element Requirements including software functionality
- Subsystem Resource Allocations

Descope Options

Design Solution
- Design Description
- Requirements Satisfaction / Traceability
- Trade-off studies
- Resource Margins

Development Approach
- Technology Assessment

Test and Evaluation Strategy
- Draft Photographic Documentation Plan
- Systems Engineering
- Systems Engineering Management Plan

Mission Analysis
- Orbits and Trajectories
- Launch Windows
- Guidance, Navigation, and Control
  - Station Acquisition and Keeping

Mission Assurance
- Safety Considerations
  - Safety Analyses

Conceptual Life-Cycle Support Strategies

Mission/Science

Programmatics / Project Plan
- Work Breakdown Structure (WBS)
- Schedule
- Budget / Life Cycle Cost
- Deliverables
- Resources
- Partnerships & Organizational Interfaces
- Management Processes and Control Plans

Information & Configuration Management
Preliminary Acquisition Plan
Security Considerations
Review Plan
RFA status

4.4.5 Success Criteria:

For formal NASA programs and projects, the Review Board shall evaluate the project using the success criteria indicated below. For subprojects, tailored success criteria may be used provided they are enumerated in the ToR for the review.

(1) The project utilizes a sound process for the allocation and control of requirements throughout all levels, and a plan has been defined to complete the definition activity within schedule constraints.
(2) Requirements definition is complete with respect to top-level mission and science requirements, and interfaces with external entities and between major internal elements have been defined.
(3) Requirements allocation and flow down of key driving requirements have been defined down to subsystems.
(4) Preliminary approaches have been determined for how requirements will be verified and validated down to the subsystem level.
(5) Major risks have been identified and technically assessed, and viable mitigation strategies have been defined.
(6) Evidence is presented that at least one proposed concept will meet the system requirements, satisfy the mission objectives, and address operational needs within the project constraints.
(7) The cost and schedule are valid in view of the system requirements and architectural concepts.
(8) Appropriate trade studies that support the mission concept(s) have been identified.

4.4.6 Lessons Learned:

Following the review, the project is expected to collect lessons learned on the project thus far. The project may define the method(s) for collecting the lessons. The lessons learned are expected to be presented at the project's next Engineering Project and Task Review and to be included as backup at the project's next CMC review. Particularly important lessons learned may be included in the main portion of the CMC presentation. The collected lessons learned are expected to become part of the project's concluding Lessons Learned Review.

4.5 Mission Definition Review

The MDR examines the proposed requirements, the mission architecture, and the flow down to all functional elements of the mission to ensure that the overall concept is complete, feasible, and consistent with available resources. The MDR is required for robotic, but not human space-flight missions. The MDR may be combined with either the SRR or the PDR if appropriate for the project. At the project level, a Preliminary Non-Advocate Review (PNAR) is conducted as part of this review to provide Agency management with an independent assessment of the readiness of the project to proceed to Phase B. The PNAR includes a Preliminary Independent Cost Estimate and a Preliminary Independent Schedule Assessment. If the MDR is combined with the PDR, then the PNAR activities occur as part of the SRR.

4.5.1 Timing

a. The project has refined the system concept studies and technology readiness assessment, and selected a system architecture and operational concept that will satisfy negotiated goals and objectives within project constraints.

b. The project has successfully completed the SRR and provided responses to all SRR RFAs and other findings.

c. An MDR ToR, with agenda and success criteria, has been agreed to by the appropriate parties.

4.5.2 Entrance Criteria

The following Entrance Criteria are specified in NPR 7123.1A and are required for all formal NASA projects. For subprojects, tailored Entrance Criteria may be used as long as they are enumerated in the ToR for the review.

1. Successful completion of the SRR and responses made to all SRR RFAs and RIDs.
2. A preliminary MDR agenda, success criteria, and charge to the board have been agreed to by the technical team, project manager, and review chair prior to the MDR.
3. The following technical products for hardware and software system elements are available to the cognizant participants prior to the review:
    a. system architecture;
    b. updated system requirements document, if applicable;
    c. system software functionality description;
    d. updated concept of operations, if applicable;
    e. updated mission requirements, if applicable;
    f. updated SEMP, if applicable;
    g. updated risk management plan, if applicable;
    h. Technology Development Maturity Assessment Plan;

i. preferred system solution definition, including major trades and options;
j. updated risk assessment and mitigations (including PRA, as applicable);
k. updated cost and schedule data;
l. logistics documentation (e.g., preliminary maintenance plan);
m. Software Development Plan (SDP);
n. system safety and mission assurance plan;
o. configuration management plan;
p. updated initial document tree, if applicable;
q. preliminary system safety analysis; and
r. other specialty disciplines as required.

4.5.3 Management and Technical Products

Table Note: Items in angle brackets are not required to be formal documents at this stage.

For formal NASA programs and projects, the project shall make available to the Review Board the following Management and Technical Products with the indicated maturity. For subprojects, tailored Management and Technical Products may be used as long as they are enumerated in the ToR for the review.

Product	**Maturity**	**Source**
Formulation Authorization Document	Approved	NPR-7120.5D, Table 4-3
Acquisition Strategy Meeting Minutes	Baseline	NPR-7120.5D, Table 4-3
Program Requirements on Project	Baseline	NPR-7120.5D, Table 4-3
CADRe	Preliminary	NPR-7120.5D, Table 4-3
Management Planning and Control		
ITA (or equivalent authorization)	Updated	LaRC
Project Implementation Plan, a.k.a. Project Plan	Preliminary (all sections)	NPR-7120.5D, Table 4-3
<Integrated Baseline>	Preliminary	NPR-7120.5D, Table 4-3
<Document Tree>	Preliminary	NPR-7123.1A, Table G-5
Systems Engineering Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5
Information & Configuration Management Plan	Preliminary	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5
Risk Management Plan	Preliminary	NPR-7120.5D, Table 4-4,

		NPR-7123.1A, Table G-5
Software Management Plan	Preliminary	NPR-7120.5D, Table 4-4
<Risk assessment and mitigations>	Updated	NPR-7123.1A, Table G-5
Review Plan	Updated	LPR-7130
Technology Development Plan, a.k.a., Technology Development Maturity Assessment Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5
<Business Case Analysis for Infrastructure>	Preliminary	NPR-7120.5D, Table 4-3
Regulatory Plans		
Nuclear Safety Launch Approval Plan, if applicable (updated)	Baseline	NPR-7120.5D, Table 4-3
Planetary Protection Plan	Certification	NPR-7120.5D, Table 4-3
Environmental Management Plan	Baseline	NPR-7120.5D, Table 4-4
Safety & Mission Assurance		
Safety & Mission Assurance Plan / Product Assurance Plan	Preliminary	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5, LPR-5300.1
EEE Parts Plan	Preliminary	LaRC
<System Safety Analysis>	Preliminary	NPR-7123.1A, Table G-5
<Orbital Debris Assessment>	Draft	NPR-7120.5D, Table 4.3
Requirements		
Mission Concept Report	Baseline	NPR-7120.5D, Table 4-3
Concept of Operations	Updated	NPR-7123.1A, Table G-5
System Requirements Document	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5
Subsystem Requirements Documents (including software)	Preliminary	NPR-7123.1A, Table G-4
Design		
Software Development Plan	Baseline	NPR-7123.1A, Table G-5
Design Report	Preliminary	NPR-7120.5D, Table 4.3
<Analyses>	Preliminary	NPR-7123.1A, Table G-5
<Trade Study Reports>	Preliminary	NPR-7123.1A, Table G-5

Build and Test		
Software Test Plan	Preliminary	NPR-7123.1A, Table G-6
<Contamination Control Plan>	Preliminary	NPR-7123.1A, Table G-7
Photographic Documentation Plan	Draft	LPR-7600.1
<Integration and Test Plan>	Preliminary	Preliminary to NPR-7123.1A, Table G-8
Verification, Validation, Certification		
<Verification Plan (may be combined with Validation Plan below)>	Preliminary	NPR-7123.1A, Table G-4
<Validation Plan (may be combined with Verification Plan above)>	Preliminary	NPR-7123.1A, Table G-4
Operations and Logistics		
Mission Operations Concept Document	Preliminary	NPR-7120.5D, Table 4-3
<Logistics Plan>	Preliminary	NPR-7120.5D, Table 4-4 NPR-7123.1A, Table G-5
Security Plan	Preliminary	NPR-7120.5D, Table 4-4
Export Control Plan	Preliminary	NPR-7120.5D, Table 4-4

4.5.4 Review Content:

The following content is typically expected at an MDR.

Science/Mission Goals and Objectives
- Minimum Mission Success Criteria

Mission/Project Overview & Status
- Mission/Project Organization

Implementation Concept
- Preliminary System Architecture
- Preliminary Operational Concept

Requirements Management & Flowdown
- Mission/User Requirements
- System Requirements
- Element Requirements incl. software functionality
- Subsystem Requirements

Descope Options
Design Solution
Design Description

- Requirements Satisfaction / Traceability
- Trade-off studies
- Resource Margins
- Changes from SRR Design Concept
- External Interfaces
- Technical Standards Used
- Preliminary Analyses
- Subsystem & Peer Review Reports

Development Approach
- Technology Development Plan
- Flight Systems Development
- Ground Systems Development
- Ground Support Equipment Development
- Fabrication/Procurement Plan
- Long-Lead Items

Software
- Development Plan
- Requirements
- Architecture
- Interfaces

Assembly, Integration and Test Plan
- Performance Verification Approach
- Integrated Test Plan
- Flight Certification Plan
    - Definition of Environments
- Calibration Plan
- Draft Photographic Documentation Plan

Systems Engineering
- Systems Engineering Management Plan
- Configuration Management
- Metrics & Technical Performance Measures
- Interface Control
- Planetary Protection

Mission Analysis
- Orbits and Trajectories
- Launch Windows
- Guidance, Navigation, and Control
    - Station Acquisition and Keeping

Mission Operations
- Organizational Roles and Responsibilities
- Ground Operations
- Ground Support Equipment
- Orbital Debris Plan

Launch Vehicle
- Launch Environments
- Launch Site Operations Plan

- Launch Vehicle Integration
- Mission Assurance
  - Quality Assurance
    - Contamination Control
  - Design Assurance
    - Reliability Analysis
    - FMEA / FTA
    - EEE Parts Program
- Safety Considerations
  - System Safety Analyses
  - Probabilistic Risk Assessment
- Logistics
  - Contamination Control
  - Packaging, Handling & Transportation
  - Facilities
- Mission/Science
  - Validation Approach
  - Mission/Science Data Management
- Programmatics / Project Plan
  - Work Breakdown Structure (WBS)
  - Schedule
  - Budget / Life Cycle Cost
  - Deliverables
  - Resources
  - Partnerships & Organizational Interfaces
  - Management Processes and Control Plans
  - Information & Configuration Management
  - Preliminary Acquisition Plan
    - Contracts
    - Components
  - Preliminary Security Plan
  - Preliminary Export Control Plan
  - Review Plan
    - RFA status
- Lessons Learned
  - Relevant Lessons from Prior Projects
  - Lessons Learned from Current Project
- Risk Management
  - Risk Assessment and Mitigation Plans
- Results of Document Review/Inspection
- PNAR Assessments
  - Preliminary Independent Cost Analyses / Estimates
  - Preliminary Independent Schedule Assessment

4.5.5 Success Criteria:

a. For formal NASA programs and projects, the Review Board shall evaluate the project using the success criteria indicated below. For subprojects, tailored success criteria may be used provided they are enumerated in the ToR for the review.

(1) Systems requirements, including mission success criteria, end product acceptance criteria, and any sponsor-imposed constraints, are defined and form the basis for the proposed conceptual design.
(2) All technical requirements are allocated and the flow down to subsystems is adequate. The requirements, design approaches, and conceptual design will fulfill the mission needs consistent with the available resources (cost, schedule, mass, and power).
(3) The requirements process is sound and can reasonably be expected to continue to identify and flow detailed requirements in a manner timely for development.
(4) The selected overall concept is reasonable, feasible, complete, responsive to the mission requirements, and is consistent with system requirements and available resources (cost, schedule, mass, and power).
(5) System and subsystem design approaches and operational concepts exist and are consistent with the requirements set.
(6) The requirements, design approaches, and conceptual design will fulfill the mission needs within the estimated costs.
(7) Technical plans have been updated, as necessary.
(8) The tradeoffs are completed, and those planned for Phase B adequately address the option space.
(9) Significant development, mission, and safety risks are identified and technically assessed, and a process and resources exist to manage the risks.
(10) Adequate planning exists for the development of any enabling new technology.
(11) The operations concept is consistent with proposed design concept(s) and is in alignment with the mission requirements.
(12) The project and development plans are at the appropriate level of maturity for the stage of the project.

b. The Review Board shall consider the following supplemental success criteria when the MDR serves as the PNAR.

(1) Alignment with and contributing to Agency needs, goals, and objectives, and the adequacy of requirements flow-down from those.
(2) Adequacy of schedule.
(3) Adequacy of estimated costs against budget resources.
(4) Adequacy / availability of resources other than budget.
(5) Adequacy of risk management approach and risk identification / mitigation.
(6) Adequacy of management approach.

4.5.6 Lessons Learned:

Following the review, the project is expected to collect lessons learned on the project thus far. The project may define the method(s) for collecting the lessons. The lessons learned are expected to be presented at the project's next Engineering Project and Task Review and to be included as backup at the project's next CMC review. Particularly important lessons learned may be included in the main portion of the CMC presentation. The collected lessons learned are expected to become part of the project's concluding Lessons Learned Review.

4.6 System Definition Review (SDR)

a. The SDR examines the proposed system architecture and design and the flow down to all functional elements of the system. The SDR is required for human, but not robotic space-flight missions. The SDR may be combined with either the SRR or the PDR if appropriate for the project. At the project level, a Preliminary Non Advocate Review (PNAR) is conducted as part of this review to provide Agency management with an independent assessment of the readiness of the project to proceed to Phase B. The PNAR includes a Preliminary Independent Cost Estimate and a Preliminary Independent Schedule Assessment.

b. If the SDR is combined with the PDR, then the PNAR activities occur as part of the SRR.

4.6.1 Timing

a. The project has refined the system concept studies and technology readiness assessment, and selected a system architecture and operational concept that will satisfy negotiated goals and objectives within project constraints.

b. The project has successfully completed the SRR and provided responses to all SRR RFAs and other findings.

c. An SDR ToR, with agenda and success criteria, has been agreed to by the appropriate parties.

4.6.2 Entrance Criteria

The following Entrance Criteria are specified in NPR 7123.1A and are required for all formal NASA projects. For subprojects, tailored Entrance Criteria may be used as long as they are enumerated in the ToR for the review.

1. Successful completion of the SRR and responses made to all SRR RFAs and RIDs.
2. A preliminary SDR agenda, success criteria, and charge to the board have been agreed to by the technical team, project manager, and review chair prior to the SDR.

3. SDR technical products listed below for both hardware and software system elements have been made available to the cognizant participants prior to the review:

a. system architecture;
b. preferred system solution definition including major tradeoffs and options;
c. updated baselined documentation, as required;
d. preliminary functional baseline (with supporting trade-off analyses and data);
e. preliminary system software functional requirements;
f. SEMP changes, if any;
g. updated risk management plan;
h. updated risk assessment and mitigations (including PRA, as applicable);
i. updated technology development, maturity, and assessment plan;
j. updated cost and schedule data;
k. updated logistics documentation;
l. based on system complexity, updated human rating plan;
m. software test plan;
n. software requirements document(s);
o. interface requirements documents (including software);
p. technical resource utilization estimates and margins;
q. updated safety and mission assurance (S&MA) plan; and updated preliminary safety analysis.

4.6.3 Management and Technical Products

Table Note: Items in angle brackets are not required to be formal documents at this stage.

For formal NASA programs and projects, the project shall make available to the Review Board the following Management and Technical Products with the indicated maturity. For subprojects, tailored Management and Technical Products may be used as long as they are enumerated in the ToR for the review.

Product	Maturity	Source
Formulation Authorization Document	Approved	NPR-7120.5D, Table 4-3
Acquisition Strategy Meeting Minutes	Baseline	NPR-7120.5D, Table 4-3
Program Requirements on Project	Baseline	NPR-7120.5D, Table 4-3
CADRe	Preliminary	NPR-7120.5D, Table 4-3
Management Planning and Control		
ITA (or equivalent	Updated	LaRC

authorization)		
Project Implementation Plan, a.k.a. Project Plan	Preliminary (all sections)	NPR-7120.5D, Table 4-3
<Integrated Baseline>	Preliminary	NPR-7120.5D, Table 4-3
<Document Tree>	Preliminary	NPR-7123.1A, Table G-5
Systems Engineering Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-6
Information & Configuration Management Plan	Preliminary	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5
Risk Management Plan	Preliminary	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-6
Software Management Plan	Preliminary	NPR-7120.5D, Table 4-4
<Risk assessment and mitigations>	Updated	NPR-7123.1A, Table G-6
Review Plan	Updated	LPR-7130
Technology Development Plan, a.k.a., Technology Development Maturity Assessment Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-6
<Business Case Analysis for Infrastructure>	Preliminary	NPR-7120.5D, Table 4-3
Regulatory Plans		
Nuclear Safety Launch Approval Plan, if applicable (updated)	Baseline	NPR-7120.5D, Table 4-3
Planetary Protection Plan	Certification	NPR-7120.5D, Table 4-3
Environmental Management Plan	Baseline	NPR-7120.5D, Table 4-4
Safety & Mission Assurance		
Safety & Mission Assurance Plan / Product Assurance Plan	Preliminary	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-6, LPR-5300.1
EEE Parts Plan	Preliminary	LaRC
<System Safety Analysis>	Preliminary	NPR-7123.1A, Table G-6
<Orbital Debris Assessment>	Draft	NPR-7120.5D, Table 4.3
Requirements		
Mission Concept Report	Baseline	NPR-7120.5D, Table 4-3
Concept of Operations	Updated	NPR-7123.1A, Table G-5
System Requirements	Updated	NPR-7120.5D, Table 4-4,

Document		NPR-7123.1A, Table G-5
Subsystem Requirements Documents (including software)	Preliminary	NPR-7123.1A, Table G-4
Design		
Software Development Plan	Baseline	NPR-7123.1A, Table G-5
Design Report	Preliminary	NPR-7120.5D, Table 4.3
<Analyses>	Preliminary	NPR-7123.1A, Table G-6
<Trade Study Reports>	Preliminary	NPR-7123.1A, Table G-6
Build and Test		
Software Test Plan	Preliminary	NPR-7123.1A, Table G-6
<Contamination Control Plan>	Preliminary	NPR-7123.1A, Table G-7
Photographic Documentation Plan	Draft	LPR-7600.1
<Integration and Test Plan>	Preliminary	Preliminary to NPR-7123.1A, Table G-8
Verification, Validation, Certification		
Human Rating Plan, if applicable	Preliminary	NPR-7123.1A, Table G-4
<Verification Plan (may be combined with Validation Plan below)>	Preliminary	NPR-7123.1A, Table G-4
<Validation Plan (may be combined with Verification Plan above)>	Preliminary	NPR-7123.1A, Table G-4
Operations and Logistics		
Mission Operations Concept Document	Preliminary	NPR-7120.5D, Table 4-3
<Logistics Plan>	Preliminary	NPR-7120.5D, Table 4-4 NPR-7123.1A, Table G-6
Security Plan	Preliminary	NPR-7120.5D, Table 4-4
Export Control Plan	Preliminary	NPR-7120.5D, Table 4-4

4.6.4 Review Content:

The following content is typically expected at an SDR.

Science/Mission Goals and Objectives
Minimum Mission Success Criteria
Mission/Project Overview & Status

- Mission/Project Organization
- Implementation Concept
  - Preliminary System Architecture
  - Preliminary Operational Concept
- Requirements Management & Flowdown
  - Mission/User Requirements
  - System Requirements
  - Element Requirements incl. software functionality
  - Subsystem Requirements
- Descope Plan
- Design Solution
  - Design Description
  - Requirements Satisfaction / Traceability
  - Trade-off studies
  - Resource Margins
  - Changes from SRR Design Concept
  - External Interfaces
  - Technical Standards Used
  - Preliminary Analyses
  - Subsystem & Peer Review Reports
- Development Plan
  - Technology Development Plan
  - Flight Systems Development
  - Ground Systems Development
  - Ground Support Equipment Development
  - Fabrication/Procurement Plan
  - Long-Lead Items
- Software
  - Development Plan
  - Requirements
  - Architecture
  - Interfaces
- Assembly, Integration and Test Plan
  - Performance Verification Approach
  - Integrated Test Plan
  - Flight Certification Plan
    - Definition of Environments
  - Calibration Plan
  - Draft Photographic Documentation Plan
- Systems Engineering
  - Systems Engineering Management Plan
  - Configuration Management
  - Metrics & Technical Performance Measures
  - Interface Control
  - Planetary Protection
- Mission Analysis

- Orbits and Trajectories
- Launch Windows
- Guidance, Navigation, and Control
    - Station Acquisition and Keeping

Mission Operations
- Organizational Roles and Responsibilities
- Ground Operations
- Ground Support Equipment
- Orbital Debris Plan

Launch Vehicle
- Launch Environments
- Launch Site Operations Plan
- Launch Vehicle Integration

Mission Assurance
- Quality Assurance
    - Contamination Control
- Design Assurance
    - Reliability Analysis
    - FMEA / FTA
    - EEE Parts Program

Safety Considerations
- System Safety Analyses
- Probabilistic Risk Assessment

Logistics
- Contamination Control
- Packaging, Handling & Transportation
- Facilities

Mission/Science
- Validation Approach
- Mission/Science Data Management

Programmatics / Project Plan
- Work Breakdown Structure (WBS)
- Schedule
- Budget / Life Cycle Cost
- Deliverables
- Resources
- Partnerships & Organizational Interfaces
- Management Processes and Control Plans
- Information & Configuration Management
- Preliminary Acquisition Plan
    - Contracts
    - Components
- Preliminary Security Plan
- Preliminary Export Control Plan
- Review Plan
    - RFA status

Lessons Learned
    Relevant Lessons from Prior Projects
    Lessons Learned from Current Project
Risk Management
    Risk Assessment and Mitigation Plans
Results of Document Review/Inspection
PNAR Assessments
    Preliminary Independent Cost Analyses / Estimates
    Preliminary Independent Schedule Assessment

4.6.5 Success Criteria:

a. For formal NASA programs and projects, the Review Board shall evaluate the project using the success criteria indicated below. For subprojects, tailored success criteria may be used provided they are enumerated in the ToR for the review.

(1) Systems requirements, including mission success criteria, end product acceptance criteria, and any sponsor-imposed constraints, are defined and form the basis for the proposed conceptual design.
(2) All technical requirements are allocated and the flow down to subsystems is adequate. The requirements, design approaches, and conceptual design will fulfill the mission needs consistent with the available resources (cost, schedule, mass, and power).
(3) The requirements process is sound and can reasonably be expected to continue to identify and flow detailed requirements in a manner timely for development.
(4) The selected overall concept is reasonable, feasible, complete, responsive to the mission requirements, and is consistent with system requirements and available resources (cost, schedule, mass, and power).
(5) System and subsystem design approaches and operational concepts exist and are consistent with the requirements set.
(6) The requirements, design approaches, and conceptual design will fulfill the mission needs within the estimated costs.
(7) Technical plans have been updated, as necessary.
(8) The tradeoffs are completed, and those planned for Phase B adequately address the option space.
(9) Significant development, mission, and safety risks are identified and technically assessed, and a process and resources exist to manage the risks.
(10) Adequate planning exists for the development of any enabling new technology.
(11) The operations concept is consistent with proposed design concept(s) and is in alignment with the mission requirements.
(12) The project and development plans are at the appropriate level of maturity for the stage of the project.

b. The Review Board shall consider the following supplemental success criteria when the SDR serves as the PNAR.

(1) Alignment with and contributing to Agency needs, goals, and objectives, and the adequacy of requirements flow-down from those.
(2) Adequacy of schedule.
(3) Adequacy of estimated costs against budget resources.
(4) Adequacy / availability of resources other than budget.
(5) Adequacy of risk management approach and risk identification / mitigation.
(6) Adequacy of management approach.

4.6.6 Lessons Learned:

Following the review, the project is expected to collect lessons learned on the project thus far. The project may define the method(s) for collecting the lessons. The lessons learned are expected to be presented at the project's next Engineering Project and Task Review and to be included as backup at the project's next CMC review. Particularly important lessons learned may be included in the main portion of the CMC presentation. The collected lessons learned are expected to become part of the project's concluding Lessons Learned Review.

4.7 Preliminary Design Review (PDR)

a. The PDR demonstrates that the preliminary design meets all system requirements with acceptable risk and within the cost and schedule constraints and establishes the basis for proceeding with detailed design. It will show that the correct design options have been selected, interfaces have been identified, and verification methods have been described. Full baseline cost and schedules, as well as risk assessments, management systems, and metrics are presented. At the project level a Non-Advocate Review (NAR) is conducted as part of this review to provide Agency management with an independent assessment of the readiness of the project to proceed to implementation. The NAR includes a Baseline Independent Cost Estimate and a Baseline Independent Schedule Assessment.

b. The PDR is held at the system and lower levels (as appropriate) to ensure the system requirements are complete and have been allocated. The PDR also demonstrates that preliminary designs meet functional and performance requirements with acceptable risk (technical performance, cost, and schedule) and are verifiable. PDRs at lower level are performed prior to or in concert with the system-level PDR.

c. Successful completion of the PDR will result in recommended approval of the performance allocations, the preliminary design, and the project plan to establish a "design-to" baseline. It will also serve as a prerequisite to proceeding with detailed design and fabrication.

4.7.1 Timing:

a. The project is ready to baseline the system performance and functional allocations, budget, and schedule. All segment, element, and subsystem preliminary designs are complete and meet system performance and subsystem functional requirements. All requirements traceability, verification and validation methodologies, and interfaces are identified. Some development build/test and detail design may have been done.

b. The project has successfully completed the MDR or SDR and provided responses to all RFAs and other findings.

c. A PDR ToR, with agenda and success criteria, has been agreed to by the appropriate parties.

4.7.2 Entrance Criteria

The following Entrance Criteria are specified in NPR 7123.1A and are required for all formal NASA projects. For subprojects, tailored Entrance Criteria may be used as long as they are enumerated in the ToR for the review.

1. Successful completion of the SDR or SRR and/or MDR and responses made to all SDR or SRR and/or MDR RFAs and RIDs, or a timely closure plan exists for those remaining open.
2. A preliminary PDR agenda, success criteria, and charge to the board have been agreed to by the technical team, project manager, and review chair prior to the PDR.
3. PDR technical products listed below for both hardware and software system elements have been made available to the cognizant participants prior to the review:
    a. Updated baselined documentation, as required.
    b. Preliminary subsystem design specifications for each configuration item (hardware and software), with supporting trade-off analyses and data, as required. The preliminary software design specification should include a completed definition of the software architecture and a preliminary database design description, as applicable.
    c. Updated technology development maturity assessment plan.
    d. Updated risk assessment and mitigation.
    e. Updated cost and schedule data.
    f. Updated logistics documentation, as required.
    g. Applicable technical plans (e.g., technical performance measurement plan, contamination control plan, parts management plan, environments control plan, EMI/EMC control plan, payload-to-carrier integration plan, producibility/manufacturability program plan, reliability program plan, quality assurance plan).
    h. Applicable standards.
    i. Safety analyses and plans.

j. Engineering drawing tree.
k. Interface control documents.
l. Verification/validation plan.
m. Plans to respond to regulatory requirements (e.g., Environmental Impact Statement), as required.
n. Disposal plan.
o. Technical resource utilization estimates and margins.
p. System-level safety analysis.
q. Preliminary limited life items list (LLIL).

4.7.3 Management and Technical Products

Table Note: Items in angle brackets are not required to be formal documents at this stage.

For formal NASA programs and projects, the project shall make available to the Review Board the following Management and Technical Products with the indicated maturity. For subprojects, tailored Management and Technical Products may be used as long as they are enumerated in the ToR for the review.

Product	Maturity	Source
Formulation Authorization Document	Approved	NPR-7120.5D, Table 4-3
Acquisition Strategy Meeting Minutes	Baseline	NPR-7120.5D, Table 4-3
Program Requirements on Project	Updated	NPR-7120.5D, Table 4-3
CADRe	Baseline	NPR-7120.5D, Table 4-3
Management Planning and Control		
ITA (or equivalent authorization)	Updated	LaRC
Project Implementation Plan, a.k.a. Project Plan	Baseline	NPR-7120.5D, Table 4-3
<Integrated Baseline>	Baseline	NPR-7120.5D, Table 4-3
<Document Tree>	Preliminary	NPR-7123.1A, Table G-4
Systems Engineering Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Information & Configuration Management Plan	Baseline	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Risk Management Plan	Baseline	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Software Management Plan	Baseline	NPR-7120.5D, Table 4-4

<Risk assessment and mitigations>	Updated	NPR-7123.1A, Table G-7
Review Plan	Updated	LPR-7130
Technology Development Plan, a.k.a., Technology Development Maturity Assessment Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-7
Science Data Management Plan	Preliminary	NPR-7120.5D, Table 4-4
<Business Case Analysis for Infrastructure>	Baseline	NPR-7120.5D, Table 4-3
Regulatory Plans		
Nuclear Safety Launch Approval Plan, if applicable (updated)	Updated	NPR-7120.5D, Table 4-3
Planetary Protection Plan	Baseline	NPR-7120.5D, Table 4-3
Environmental Management Plan	Updated	NPR-7120.5D, Table 4-4
Regulatory Agency Plans and Assessments (as needed)	Preliminary	NPR-7123.1A, Table G-7
Safety & Mission Assurance		
Safety & Mission Assurance Plan / Product Assurance Plan	Baseline	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-7, LPR-5300.1
EEE Parts Plan	Preliminary	LaRC
Software Assurance Plan	Baseline	LaRC
<System Safety Analysis>	Preliminary	NPR-7123.1A, Table G-7
<Reliability Analyses>	Preliminary	NPR-7123.1A, Table G-8
Orbital Debris Assessment	Preliminary	NPR-7120.5D, Table 4.3
Missile System Pre-Launch Safety Package	Preliminary	NPR-7120.5D, Table 4-3
Range Safety Risk Management Plan	Preliminary	NPR-7120.5D, Table 4-3
Requirements		
Mission Concept Report	Updated	NPR-7120.5D, Table 4-3
Concept of Operations	Updated	NPR-7123.1A, Table G-4
System Requirements Document	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5
Subsystem Requirements Documents (including software)	Baseline	NPR-7123.1A, Table G-4

Design		
Interface Control Documents	Preliminary	NPR-7123.1A, Table G-7
Software Development Plan	Updated	NPR-7123.1A, Table G-4
Software Design Documents	Preliminary	NPR-7123.1A, Table G-8
Technology Assessment Readiness Report	Baseline	NPR-7120.5D, Table 4-3
Design Report	Preliminary	NPR-7120.5D, Table 4.3
<Engineering Drawing Tree>	Preliminary	NPR-7123.1A, Table G-7
Drawings	Preliminary	NPR-7123.1A, Table G-7
Analyses	Preliminary	NPR-7123.1A, Table G-7
Trade Study Reports	Preliminary	NPR-7123.1A, Table G-7
Build and Test		
Configuration Item List	Preliminary	NPR-7123.1A, Table G-7
Limited Life Items List	Preliminary	NPR-7123.1A, Table G-7
Software Test Plan	Preliminary	NPR-7123.1A, Table G-6
Contamination Control Plan	Baseline	NPR-7123.1A, Table G-7
Photographic Documentation Plan	Preliminary	LPR-7600.1
<Integration and Test Plan>	Preliminary	Preliminary to NPR-7123.1A, Table G-8
Verification, Validation, Certification		
Human Rating Plan, if applicable	Baseline	NPR-7123.1A, Table G-4
Verification Plan (may be combined with Validation Plan below)	Preliminary	NPR-7123.1A, Table G-7
Validation Plan (may be combined with Verification Plan above)	Preliminary	NPR-7123.1A, Table G-7
Operations and Logistics		
Mission Operations Concept Document	Baseline	NPR-7120.5D, Table 4-3
Mission Operations Plan	Preliminary	NPR-7120.5D, Table 4-4
<Logistics Plan>	Preliminary	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-7
Security Plan	Baseline	NPR-7120.5D, Table 4-4

Export Control Plan	Baseline	NPR-7120.5D, Table 4-4
Decommissioning and Closeout		
<Decommissioning/Disposal Plan>	<initial concept>	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-7

4.7.4 Review Content:

The following content is typically expected at a PDR.

Science/Mission Goals and Objectives
- Minimum Mission Success Criteria

Mission/Project Overview & Status
- Mission/Project Organization

Implementation Concept
- System Architecture
- Operational Concept

Requirements Management & Flowdown
- Mission/User Requirements
- System Requirements
- Element Requirements incl. software functionality
- Subsystem Requirements

Descope Plan

Design Solution

Design Description
- Requirements Satisfaction / Traceability
- Trade-off studies
- Technical Resource Budgets & Margins
- Changes from MDR/SDR Design Approach
- External Interfaces
- Technical Standards Used
- Supporting Analyses and Tests
  - Thermal
  - Structural
- Subsystem & Peer Review Reports

Development Plan
- Technology Development Plan
- Flight Systems Development
- Ground Systems Development
- Ground Support Equipment Development
- Fabrication/Procurement Plan
- Long-Lead Items
- Limited Life Items

Software
- Management Plan

- Software Assurance Plan
- Requirements
- Architecture
- Interfaces

Assembly, Integration and Test Plan
- Performance Verification Plan
- Integrated Test Plan
- Flight Certification Plan
  - Definition of Environments
- Calibration Plan
- Preliminary Photographic Documentation Plan

Systems Engineering
- Systems Engineering Management Plan
- Configuration Management
- Metrics & Technical Performance Measures
- Interface Control
- Document Tree
- Drawing Tree
- Configuration Item List
- Planetary Protection
- System Acceptance Criteria

Mission Analysis
- Orbits and Trajectories
- Launch Windows
- Guidance, Navigation, and Control
  - Station Acquisition and Keeping

Mission Operations
- Organizational Roles and Responsibilities
- Ground Operations
- Ground Support Equipment
- Retirement/Disposal
- Orbital Debris Plan

Launch Vehicle
- Launch Environments
- Launch Site Operations Plan
- Launch Vehicle Integration

Mission Assurance
- Quality Assurance
  - Contamination Control
- Design Assurance
  - Reliability Analysis
  - FMEA / FTA
  - EEE Parts Program

Safety Assurance
- Safety Plans
- System Safety Analyses

- Probabilistic Risk Assessment
- Manufacturing, Assembly, and Integration
- Logistics
  - Contamination Control
  - Packaging, Handling & Transportation
  - Facilities
  - Test & Support Equipment
  - Servicing/Maintenance
  - Sparing
- Mission/Science
  - Validation Plan
  - Mission/Science Data Management
    - Data Retrieval and Analysis
- Programmatics / Project Plan
  - Work Breakdown Structure (WBS)
  - Schedule
  - Budget / Life Cycle Cost
  - Deliverables
  - Resources
  - Partnerships & Organizational Interfaces
  - Management Processes and Control Plans
  - Information & Configuration Management
  - Acquisition Plan
    - Contracts
    - Government Furnished Equipment
    - Components
  - Security Plan
  - Export Control Plan
  - Regulatory Agency Plans (as required)
  - Review Plan
    - RFA status
- Lessons Learned
  - Relevant Lessons from Prior Projects
  - Lessons Learned from Current Project
- Risk Management
  - Risk Assessment and Mitigation Plans
- Results of Document Review/Inspection
- NAR Assessments
  - Independent Cost Analyses / Estimates
  - Independent Schedule Assessment

4.7.5 Success Criteria:

a. For formal NASA programs and projects, the Review Board shall evaluate the project using the success criteria indicated below. For subprojects, tailored success criteria may be used provided they are enumerated in the ToR for the review.

(1) The top-level requirements—including mission success criteria, TPMs, and any sponsor-imposed constraints—are agreed upon, finalized, stated clearly, and consistent with the preliminary design.
(2) The flow down of verifiable requirements is complete and proper or, if not, an adequate plan exists for timely resolution of open items. Requirements are traceable to mission goals and objectives.
(3) The preliminary design is expected to meet the requirements at an acceptable level of risk.
(4) Definition of the technical interfaces is consistent with the overall technical maturity and provides an acceptable level of risk.
(5) Adequate technical interfaces are consistent with the overall technical maturity and provide an acceptable level of risk.
(6) Adequate technical margins exist with respect to TPMs.
(7) Any required new technology has been developed to an adequate state of readiness, or back-up options exist and are supported to make them a viable alternative.
(8) The project risks are understood and have been credibly assessed, and plans, a process, and resources exist to effectively manage them.
(9) Safety and mission assurance (e.g., safety, reliability, maintainability, quality, and EEE parts) have been adequately addressed in preliminary designs and any applicable S&MA products (e.g., PRA, system safety analysis, and failure modes and effects analysis) have been approved.
(10) The operational concept is technically sound, includes (where appropriate) human factors, and includes the flow down of requirements for its execution.
(11) Long-lead items that threaten schedule compliance have been fully justified, and contingency plans have been provided.
(12) Required resources (workforce and facilities) are available to proceed further.
(13) All assembly, integration, and verification test plans have been presented.
(14) The production, verification, operations, and other specialty engineering organizations have reviewed the design.
(15) The plans and design specifications provide sufficient guidance, constraints, and system requirements for the design engineers to execute the design.
(16) Overall system architecture has been established and all the external interfaces have been identified and defined.

b. The Review Board shall consider the following supplemental success criteria when the PDR serves as the NAR.

(1) Alignment with and contributing to Agency needs, goals, and objectives, and the adequacy of requirements flow-down from those.

(2) Adequacy of schedule.

(3) Adequacy of estimated costs against budget resources.

(4) Adequacy / availability of resources other than budget.

(5) Adequacy of risk management approach and risk identification / mitigation. Adequacy of management approach.

4.7.6 Lessons Learned:

Following the review, the project is expected to collect lessons learned on the project thus far. The project may define the method(s) for collecting the lessons. The lessons learned are expected to be presented at the project's next Engineering Project and Task Review and to be included as backup at the project's next CMC review. Particularly important lessons learned may be included in the main portion of the CMC presentation. The collected lessons learned are expected to become part of the project's concluding Lessons Learned Review.

4.8 Critical Design Review (CDR)

a. The CDR demonstrates that the maturity of the design is appropriate to support proceeding with full-scale fabrication, assembly, integration, and test. The CDR determines that the technical effort is on track to complete the flight and ground system development and mission operations, meeting mission performance requirements within the identified cost and schedule constraints. Progress against management plans, budget, and schedule, as well as risk assessments are presented. The review team is responsible for assessing cost reserves and funded slack and including their findings in their final report. [Ref. SRB Handbook]

b. The CDR is held at the component, subsystem, and system level to demonstrate detailed designs meet system functional and performance requirements and specifications established at PDR with acceptable risk (technical performance, cost, and schedule), to ensure the design has been satisfactorily reviewed by production, verification, operations, and other specialty engineering organizations, and to ensure production processes and controls are sufficient to proceed to fabrication. All performance specifications, verification and validation plans, and interfaces are identified.

c. Successful completion of the CDR will result in recommended approval for the detailed design and verification plans to establish a "build-to" baseline and serve as a prerequisite to proceeding with fabrication of the flight system.

4.8.1 Timing:

The detailed design phase has been completed. The project is ready for full-scale fabrication, and testing. As outlined in the fabrication plan at PDR, fabrication and/or procurement of some flight items may need to be started prior to this review.

4.8.2 Entrance Criteria

The following Entrance Criteria are specified in NPR 7123.1A and are required for all formal NASA projects. For subprojects, tailored Entrance Criteria may be used as long as they are enumerated in the ToR for the review.

1. Successful completion of the PDR and responses made to all PDR RFAs and RIDs, or a timely closure plan exists for those remaining open.
2. A preliminary CDR agenda, success criteria, and charge to the board have been agreed to by the technical team, project manager, and review chair prior to the CDR.
3. CDR technical work products listed below for both hardware and software system elements have been made available to the cognizant participants prior to the review:
    a. updated baselined documents, as required;
    b. product build-to specifications for each hardware and software configuration item, along with supporting trade-off analyses and data;
    c. fabrication, assembly, integration, and test plans and procedures;
    d. technical data package (e.g., integrated schematics, spares provisioning list, interface control documents, engineering analyses, and specifications);
    e. operational limits and constraints;
    f. technical resource utilization estimates and margins;
    g. acceptance criteria;
    h. command and telemetry list;
    i. verification plan (including requirements and specification);
    j. validation plan;
    k. launch site operations plan;
    l. checkout and activation plan;
    m. disposal plan (including decommissioning or termination);
    n. updated Technology Development Maturity Assessment Plan;
    o. updated risk assessment and mitigation;
    p. updated reliability analyses and assessments;
    q. updated cost and schedule data;
    r. updated logistics documentation;
    s. software design document(s) (including interface design documents);
    t. updated LLIL;
    u. subsystem-level and preliminary operations safety analyses;

v. systems and subsystem certification plans and requirements (as needed); and
w. system safety analysis with associated verifications.

4.8.3 Management and Technical Products

Table Note: Items in angle brackets are not required to be formal documents at this stage.

For formal NASA programs and projects, the project shall make available to the Review Board the following Management and Technical Products with the indicated maturity. For subprojects, tailored Management and Technical Products may be used as long as they are enumerated in the ToR for the review.

Product	Maturity	Source
Formulation Authorization Document	Approved	NPR-7120.5D, Table 4-3
Acquisition Strategy Meeting Minutes	Baseline	NPR-7120.5D, Table 4-3
Program Requirements on Project	Updated	NPR-7120.5D, Table 4-3
CADRe	Updated	NPR-7120.5D, Table 4-3
Management Planning and Control		
ITA (or equivalent authorization)	Updated	LaRC
Project Implementation Plan, a.k.a. Project Plan	Updated	NPR-7120.5D, Table 4-3
<Integrated Baseline>	Updated	NPR-7120.5D, Table 4-3
Document Tree	Baseline	NPR-7123.1A, Table G-4
Systems Engineering Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Information & Configuration Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Risk Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Software Management Plan	Updated	NPR-7120.5D, Table 4-4
<Risk assessment and mitigations>	Updated	NPR-7123.1A, Table G-8
Review Plan	Updated	LPR-7130
Technology Development Plan, a.k.a., Technology Development Maturity	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8

Assessment Plan		
Science Data Management Plan	Preliminary	NPR-7120.5D, Table 4-4
<Business Case Analysis for Infrastructure>	Updated	NPR-7120.5D, Table 4-3
Regulatory Plans		
Nuclear Safety Launch Approval Plan, if applicable (updated)	Updated	NPR-7120.5D, Table 4-3
Planetary Protection Plan	Updated	NPR-7120.5D, Table 4-3
Environmental Management Plan	Updated	NPR-7120.5D, Table 4-4
Regulatory Agency Plans and Assessments (as needed)	Baseline	NPR-7123.1A, Table G-7
Safety & Mission Assurance		
Safety & Mission Assurance Plan / Product Assurance Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-7, LPR-5300.1
EEE Parts Plan	Baseline	LaRC
Software Assurance Plan	Updated	LaRC
System Safety Analysis	Baseline (with Verifications)	NPR-7123.1A, Table G-8
Subsystem Safety Analyses	Baseline (with Verifications)	NPR-7123.1A, Table G-8
Reliability Analyses	Baseline	NPR-7123.1A, Table G-8
Orbital Debris Assessment	Preliminary	NPR-7120.5D, Table 4.3
Missile System Pre-Launch Safety Package	Baseline	NPR-7120.5D, Table 4-3
Range Safety Risk Management Plan	Baseline	NPR-7120.5D, Table 4-3
Requirements		
Mission Concept Report	Updated	NPR-7120.5D, Table 4-3
Concept of Operations	Updated	NPR-7123.1A, Table G-4
System Requirements Document	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5
Subsystem Requirements Documents (including software)	Updated	NPR-7123.1A, Table G-4
Design		
Interface Control Documents	Baseline	NPR-7123.1A, Table G-8

Software Development Plan	Updated	NPR-7123.1A, Table G-4
Software Design Document(s)	Preliminary	NPR-7123.1A, Table G-8
Technology Assessment Readiness Report	Updated	NPR-7120.5D, Table 4-3
Design Report	Detailed	NPR-7120.5D, Table 4.3
<Engineering Drawing Tree>	Baseline	NPR-7123.1A, Table G-7
Drawings	Baseline	NPR-7123.1A, Table G-7, G-8
Analyses	Baseline	NPR-7123.1A, Table G-7, G-8
Trade Study Reports	Baseline	NPR-7123.1A, Table G-7, G-8
Build and Test		
Configuration Item List	Baseline	NPR-7123.1A, Table G-7, G-8
Limited Life Items List	Baseline	NPR-7123.1A, Table G-8
Software Test Plan	Baseline	NPR-7123.1A, Table G-6
Contamination Control Plan	Updated	NPR-7123.1A, Table G-7
Photographic Documentation Plan	Baseline	LPR-7600.1
<Technical Product Data Package>	Preliminary	NPR-7123.1A, Table G-8
Integration and Test Plan	Baseline	NPR-7123.1A, Table G-8
Verification, Validation, Certification		
Human Rating Plan, if applicable	Updated	NPR-7123.1A, Table G-8
Verification Plan (may be combined with Validation Plan below)	Baseline	NPR-7123.1A, Table G-8
Validation Plan (may be combined with Verification Plan above)	Preliminary	NPR-7123.1A, Table G-8
System Acceptance Criteria	Preliminary	NPR-7123.1A, Table G-8
Operations and Logistics		
Mission Operations Concept Document	Updated	NPR-7120.5D, Table 4-3
Mission Operations Plan	Baseline	NPR-7120.5D, Table 4-4
<Operational Activation and Checkout Plan>	Draft	NPR-7123.1A, Table G-8
<Command and Telemetry List>	Preliminary	NPR-7123.1A, Table G-8

Logistics Plan	Baseline	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
<Launch Site Operations Plan>	Preliminary	NPR-7123.1A, Table G-8
Security Plan	Updated	NPR-7120.5D, Table 4-4
Export Control Plan	Updated	NPR-7120.5D, Table 4-4
Decommissioning and Closeout		
Decommissioning/Disposal Plan	Preliminary	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-8

4.8.4 Review Content:

The following content is typically expected at a CDR.

Science/Mission Goals and Objectives
- Minimum Mission Success Criteria

Mission/Project Overview & Status
- Mission/Project Organization

Implementation Concept
- System Architecture
- Operational Concept

Requirements Management & Flowdown
- Mission/User Requirements
- System Requirements
- Element Requirements incl. software functionality
- Subsystem Requirements

Descope Plan

Design Solution
- Baseline Design (Build-to Specifications)
- Requirements Satisfaction / Traceability
- Trade-off studies
- Resource Margins
- Changes from PDR Design
- External Interfaces
- Operational Limits and Constraints
- Technical Standards Used
- Supporting Analyses and Tests
  - Thermal
  - Structural
- Subsystem & Peer Review Reports
- Design for Manufacturing Considerations and Trades
- Design Certifications

Development Plan
- Technology Development Plan

- Flight Systems Development
- Ground Systems Development
- Ground Support Equipment Development
- Fabrication/Procurement Plan
- Testbeds, Models and Simulations
- Long-Lead Items
- Limited Life Items

Software
- Management Plan
- Software Assurance Plan
- Requirements
- Architecture
- Functional Allocations
- Interfaces
  - Command and Data Interfaces
  - Electrical Interfaces
- Flight Certification

Assembly, Integration and Test Plan
- Performance Verification Plan
- Integrated Test Plan
  - Test Objectives
  - Test Cases
  - Expected Results
- Flight Certification Plan
  - Definition of Environments
- Calibration Plan
- Trend Analysis Plan
- Photographic Documentation Plan

Systems Engineering
- Systems Engineering Management Plan
- Configuration Management
- Metrics & Technical Performance Measures
- Interface Control
- Document Tree
- Drawing Tree
- Drawing Certifications
- Configuration Item List
- Planetary Protection
- System Acceptance Criteria

Mission Analysis
- Orbits and Trajectories
- Launch Windows
- Guidance, Navigation, and Control
  - Station Acquisition and Keeping

Mission Operations
- Organizational Roles and Responsibilities

- Ground Operations
- Ground Support Equipment
- Operations Team / Training Plan
- On-Orbit Activation and Checkout Plan
- Retirement/Disposal
- Orbital Debris Plan

Launch Vehicle
- Launch Environments
- Launch Site Operations Plan
- Launch Vehicle Integration
- Launch and Deployment Activities

Mission Assurance
- Quality Assurance
  - Contamination Control
  - Failure Reporting
  - Materials & Process Control
  - Qualified Vendors
  - Organizational Readiness to support Production (if no PRR planned)
- Design Assurance
  - Reliability Analysis
  - FMEA / FTA
  - EEE Parts Program
- Software Assurance and IV&V

Safety Assurance
- Safety Plans
- Safety Analyses
- Probabilistic Risk Assessment

Manufacturing, Assembly, and Integration
- Parts and Materials
  - Alternate Suppliers
  - Subassembly Testing and Availability
- Facilities and Tooling
- Production and Support Staff Readiness

Logistics
- Contamination Control
- Packaging, Handling & Transportation
- Handling and Safety Requirements
- Training of support personnel
- Availability of qualified personnel
- Facilities
- Test & Support Equipment
- Servicing/Maintenance
- Sparing

Mission/Science
- Validation Plan
- Mission/Science Data Management

- Data Retrieval and Analysis
- Programmatics / Project Plan
  - Work Breakdown Structure (WBS)
  - Schedule
  - Budget / Life Cycle Cost
  - Deliverables
  - Resources
  - Partnerships & Organizational Interfaces
  - Management Processes and Control Plans
  - Information & Configuration Management
  - Acquisition Plan
    - Contracts
    - Government Furnished Equipment
    - Components
  - Security Plan
  - Review Plan
    - RFA status
- Lessons Learned
  - Relevant Lessons from Prior Projects
  - Lessons Learned from Current Project
- Risk Management
  - Risk Assessment and Mitigation Plans
- Results of Document Review/Inspection

4.8.5 Success Criteria:

For formal NASA programs and projects, the Review Board shall evaluate the project using the success criteria indicated below. For subprojects, tailored success criteria may be used provided they are enumerated in the ToR for the review.

(1) The detailed design is expected to meet the requirements with adequate margins at an acceptable level of risk.
(2) Interface control documents are sufficiently matured to proceed with fabrication, assembly, integration, and test, and plans are in place to manage any open items.
(3) High confidence exists in the product baseline, and adequate documentation exists or will exist in a timely manner to allow proceeding with fabrication, assembly, integration, and test.
(4) The product verification and product validation requirements and plans are complete.
(5) The testing approach is comprehensive, and the planning for system assembly, integration, test, and launch site and mission operations is sufficient to progress into the next phase.
(6) Adequate technical and programmatic margins and resources exist to complete the development within budget, schedule, and risk constraints.
(7) Risks to mission success are understood and credibly assessed, and plans and resources exist to effectively manage them.

(8) Safety and mission assurance (e.g., safety, reliability, maintainability, quality, and EEE parts) have been adequately addressed in system and operational designs, and any applicable S&MA products (e.g., PRA, system safety analysis and failure modes and effects analysis) have been approved.
(9) All appropriate engineering analyses are complete and accurate; the detailed design is based on these results.
(10) Integrated safety analysis shows that any outstanding hazards can be controlled and are within an acceptable risk level.

4.8.6 Lessons Learned:

Following the review, the project is expected to collect lessons learned on the project thus far. The project may define the method(s) for collecting the lessons. The lessons learned are expected to be presented at the project's next Engineering Project and Task Review and to be included as backup at the project's next CMC review. Particularly important lessons learned may be included in the main portion of the CMC presentation. The collected lessons learned are expected to become part of the project's concluding Lessons Learned Review.

4.9 Production Readiness Review (PRR)

A PRR is held for projects developing or acquiring greater than three similar systems. The PRR determines the readiness of the system developers to efficiently produce the required number of systems. It ensures that the production plans; fabrication, assembly, and integration enabling products; and personnel are in place and ready to begin production. The PRR also evaluates how well the production plans address the system's operational support requirements.

4.9.1 Timing

The project has successfully completed the CDR and provided responses to all CDR RFAs and other findings. A PRR ToR, with agenda and success criteria, has been agreed to by the appropriate parties.

4.9.2 Entrance Criteria

The following Entrance Criteria are specified in NPR 7123.1A and are required for all formal NASA projects. For subprojects, tailored Entrance Criteria may be used as long as they are enumerated in the ToR for the review.

1. The significant production engineering problems encountered during development are resolved.
2. The design documentation is adequate to support production.
3. The production plans and preparation are adequate to begin fabrication.

4. The production-enabling products and adequate resources are available, have been allocated, and are ready to support end product production.

4.9.3 Management and Technical Products Products

Table Note: Items in angle brackets are not required to be formal documents at this stage.

For formal NASA programs and projects, the project shall make available to the Review Board the following Management and Technical Products with the indicated maturity. For subprojects, tailored Management and Technical Products may be used as long as they are enumerated in the ToR for the review.

Product	Maturity	Source
Formulation Authorization Document	Approved	NPR-7120.5D, Table 4-3
Acquisition Strategy Meeting Minutes	Baseline	NPR-7120.5D, Table 4-3
Program Requirements on Project	Update	NPR-7120.5D, Table 4-3
CADRe	Update	NPR-7120.5D, Table 4-3
Management Planning and Control		
ITA (or equivalent authorization)	Updated	LaRC
Project Implementation Plan, a.k.a. Project Plan	Updated	NPR-7120.5D, Table 4-3
<Integrated Baseline>	Updated	NPR-7120.5D, Table 4-3
Document Tree	Updated	NPR-7123.1A, Table G-4
Systems Engineering Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Information & Configuration Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Risk Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Software Management Plan	Updated	NPR-7120.5D, Table 4-4
<Risk assessment and mitigations>	Updated	NPR-7123.1A, Table G-8
Review Plan	Updated	LPR-7130
Technology Development Plan, a.k.a., Technology Development Maturity Assessment Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8

Science Data Management Plan	Preliminary	NPR-7120.5D, Table 4-4
<Business Case Analysis for Infrastructure>	Updated	NPR-7120.5D, Table 4-3
Regulatory Plans		
Nuclear Safety Launch Approval Plan, if applicable (updated)	Updated	NPR-7120.5D, Table 4-3
Planetary Protection Plan	Updated	NPR-7120.5D, Table 4-3
Environmental Management Plan	Updated	NPR-7120.5D, Table 4-4
Regulatory Agency Plans and Assessments (as needed)	Updated	NPR-7123.1A, Table G-7
Safety & Mission Assurance		
Safety & Mission Assurance Plan / Product Assurance Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-7, LPR-5300.1
EEE Parts Plan	Updated	LaRC
Software Assurance Plan	Updated	LaRC
System Safety Analysis	Updated	NPR-7123.1A, Table G-8
Subsystem Safety Analyses	Updated	NPR-7123.1A, Table G-8
Reliability Analyses	Updated	NPR-7123.1A, Table G-8
Orbital Debris Assessment	Preliminary	NPR-7120.5D, Table 4.3
Missile System Pre-Launch Safety Package	Updated	NPR-7120.5D, Table 4-3
Range Safety Risk Management Plan	Updated	NPR-7120.5D, Table 4-3
Requirements		
Mission Concept Report	Updated	NPR-7120.5D, Table 4-3
Concept of Operations	Updated	NPR-7123.1A, Table G-4
System Requirements Document	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5
Subsystem Requirements Documents (including software)	Updated	NPR-7123.1A, Table G-4
Design		
Interface Control Documents	Updated	NPR-7123.1A, Table G-8
Software Development Plan	Updated	NPR-7123.1A, Table G-4
Software Design Document(s)	Preliminary	NPR-7123.1A, Table G-8

Technology Assessment Readiness Report	Updated	NPR-7120.5D, Table 4-3
Design Report	Detailed	NPR-7120.5D, Table 4.3
<Engineering Drawing Tree>	Updated	NPR-7123.1A, Table G-7
Drawings	Updated / Certified	NPR-7123.1A, Table G-7, G-8, G-9
Analyses	Updated	NPR-7123.1A, Table G-7, G-8
Trade Study Reports	Updated	NPR-7123.1A, Table G-7, G-8
Build and Test		
Configuration Item List	Updated	NPR-7123.1A, Table G-7, G-8
Limited Life Items List	Updated	NPR-7123.1A, Table G-8
Software Test Plan	Updated	NPR-7123.1A, Table G-6
Contamination Control Plan	Updated	NPR-7123.1A, Table G-7
Photographic Documentation Plan	Updated	LPR-7600.1
<Technical Product Data Package>	Preliminary	NPR-7123.1A, Table G-8
Integration and Test Plan	Updated	NPR-7123.1A, Table G-8
Verification, Validation, Certification		
Human Rating Plan, if applicable	Updated	NPR-7123.1A, Table G-8
Verification Plan (may be combined with Validation Plan below)	Updated	NPR-7123.1A, Table G-8
Validation Plan (may be combined with Verification Plan above)	Preliminary	NPR-7123.1A, Table G-8
System Acceptance Criteria	Preliminary	NPR-7123.1A, Table G-8
Operations and Logistics		
Mission Operations Concept Document	Updated	NPR-7120.5D, Table 4-3
Mission Operations Plan	Updated	NPR-7120.5D, Table 4-4
<Operational Activation and Checkout Plan>	Draft	NPR-7123.1A, Table G-8
<Command and Telemetry List>	Preliminary	NPR-7123.1A, Table G-8
Logistics Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8

<Launch Site Operations Plan>	Preliminary	NPR-7123.1A, Table G-8
Security Plan	Updated	NPR-7120.5D, Table 4-4
Export Control Plan	Updated	NPR-7120.5D, Table 4-4
Decommissioning and Closeout		
Decommissioning/Disposal Plan	Preliminary	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-8

4.9.4 Review Content:

The following content is typically expected at a PRR.

Science/Mission Goals and Objectives
- Minimum Mission Success Criteria

Requirements Management & Flowdown
- System Requirements

Design Solution
- Baseline Design (Build-to Specifications)
- Requirements Satisfaction / Traceability
- Changes from CDR Design
- External Interfaces
- Operational Limits and Constraints
- Technical Standards Used
- Design for Manufacturing Considerations and Trades
- Design Certifications

Development Plan
- Fabrication/Procurement Plan
- Transition to Production/Manufacturing Plan
- Limited Life Items

Software
- Interfaces
  - Command and Data Interfaces
  - Electrical Interfaces

Assembly, Integration and Test Plan
- Integration Procedures and Work Flow
- Training and Readiness of Integration Personnel
- Flight Certification
- Photographic Documentation Plan

Systems Engineering
- Configuration Management
- Interface Control
- Drawing Tree
- Drawing Certifications
- Configuration Item List

- System Acceptance Criteria
- Mission Assurance
  - Quality Assurance
    - Contamination Control
    - Failure Reporting
    - Materials & Process Control
    - Qualified Vendors
    - Organizational Readiness to support Production
    - Reliability Analysis
    - FMEA / FTA
    - EEE Parts Program
  - Software Assurance and IV&V
- Safety Assurance
  - Development Phase
  - Probabilistic Risk Assessment (if appropriate)
- Manufacturing, Assembly, and Integration
  - Parts and Materials
    - Alternate Suppliers
    - Subassembly Testing and Availability
  - Facilities and Tooling
  - Production and Support Staff Readiness
- Logistics
  - Contamination Control
  - Packaging, Handling & Transportation
  - Handling and Safety Requirements
  - Training of support personnel
  - Availability of qualified personnel
  - Facilities ready and available for production
  - Test & Support Equipment
  - Servicing/Maintenance
  - Sparing
- Programmatics / Project Plan
  - Work Breakdown Structure (WBS)
  - Schedule
  - Budget / Life Cycle Cost
  - Deliverables
  - Resources
  - Partnerships & Organizational Interfaces
  - Management Processes and Control Plans
  - Information & Configuration Management
  - Acquisition Plan
    - Contracts
    - Government Furnished Equipment
    - Components
  - Security Plan
- Lessons Learned

Relevant Lessons from Prior Projects
Lessons Learned from Current Project
Risk Management
Risk Assessment and Mitigation Plans
Results of Document Review/Inspection

4.9.5 Success Criteria:

For formal NASA programs and projects, the Review Board shall evaluate the project using the success criteria indicated below. For subprojects, tailored success criteria may be used provided they are enumerated in the ToR for the review.

(1) The design is appropriately certified.
(2) The system requirements are fully met in the final production configuration.
(3) Adequate measures are in place to support production.
(4) Design-for-manufacturing considerations ensure ease and efficiency of production and assembly.
(5) Risks have been identified, credibly assessed, and characterized, and mitigation efforts have been defined.
(6) The bill of materials has been reviewed and critical parts identified.
(7) Delivery schedules have been verified.
(8) Alternate sources for resources have been identified, as appropriate.
(9) Adequate spares have been planned and budgeted.
(10) Required facilities and tools are sufficient for end product production.
(11) Specified special tools and test equipment are available in proper quantities.
(12) Production and support staff are qualified.
(13) Drawings are certified.
(14) Production engineering and planning are sufficiently mature for cost-effective production.
(15) Production processes and methods are consistent with quality requirements and compliant with occupational safety, environmental, and energy conservation regulations.
(16) Qualified suppliers are available for materials that are to be procured.

4.9.6 Lessons Learned:

Following the review, the project is expected to collect lessons learned on the project thus far. The project may define the method(s) for collecting the lessons. The lessons learned are expected to be presented at the project's next Engineering Project and Task Review and to be included as backup at the project's next CMC review. Particularly important lessons learned may be included in the main portion of the CMC presentation. The collected lessons learned are expected to become part of the project's concluding Lessons Learned Review.

4.10 System Integration Review (SIR)

a. An SIR ensures that the system is ready to be integrated. Segments, components, and subsystems are available and ready to be integrated into the system. Integration facilities, support personnel, and integration plans and procedures are ready for integration. [Ref. NPR 7123.1A]

b. The SIR evaluates the readiness of the project to start flight system assembly, test, and launch operations. V&V plans, integration plans and test plans are reviewed. Test articles (hardware/software), test facilities, support personnel, and test procedures are ready for testing and data acquisition, reduction, and control. [Ref. NPR 7120.5D] The review team is also responsible for assessing cost reserves and funded slack and including their findings in their final report. [Ref. SRB Handbook]

4.10.1 Timing

a. The project has successfully completed the CDR and provided responses to all CDR RFAs and other findings.

b. If a PRR is required, the project has successfully completed the PRR and provided responses to all PRR RFAs and other findings.

c. An SIR ToR, with agenda and success criteria, has been agreed to by the appropriate parties.

4.10.2 Entrance Criteria

The following Entrance Criteria are specified in NPR 7123.1A and are required for all formal NASA projects. For subprojects, tailored Entrance Criteria may be used as long as they are enumerated in the ToR for the review.

1. Integration plans and procedures have been completed and approved.
2. Segments and/or components are available for integration.
3. Mechanical and electrical interfaces have been verified against the interface control documentation.
4. All applicable functional, unit-level, subsystem, and qualification testing has been conducted successfully.
5. Integration facilities, including clean rooms, ground support equipment, handling fixtures, overhead cranes, and electrical test equipment, are ready and available.
6. Support personnel have been adequately trained.
7. Handling and safety requirements have been documented.
8. All known system discrepancies have been identified and disposed in accordance with an agreed-upon plan.
9. All previous design review success criteria and key issues have been satisfied in accordance with an agreed-upon plan.
10. The quality control organization is ready to support the integration effort.

4.10.3 Management and Technical Products

Table Note: Items in angle brackets are not required to be formal documents at this stage.

For formal NASA programs and projects, the project shall make available to the Review Board the following Management and Technical Products with the indicated maturity. For subprojects, tailored Management and Technical Products may be used as long as they are enumerated in the ToR for the review.

Product	Maturity	Source
Formulation Authorization Document	Approved	NPR-7120.5D, Table 4-3
Acquisition Strategy Meeting Minutes	Baseline	NPR-7120.5D, Table 4-3
Program Requirements on Project	Update	NPR-7120.5D, Table 4-3
CADRe	Update	NPR-7120.5D, Table 4-3
Management Planning and Control		
ITA (or equivalent authorization)	Updated	LaRC
Project Implementation Plan, a.k.a. Project Plan	Updated	NPR-7120.5D, Table 4-3
<Integrated Baseline>	Updated	NPR-7120.5D, Table 4-3
Document Tree	Updated	NPR-7123.1A, Table G-4
Systems Engineering Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Information & Configuration Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Risk Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Software Management Plan	Updated	NPR-7120.5D, Table 4-4
<Risk assessment and mitigations>	Updated	NPR-7123.1A, Table G-8
Review Plan	Updated	LPR-7130
Technology Development Plan, a.k.a. Technology Development Maturity Assessment Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
Science Data Management Plan	Preliminary	NPR-7120.5D, Table 4-4
<Business Case Analysis for	Updated	NPR-7120.5D, Table 4-3

Infrastructure>		
Regulatory Plans		
Nuclear Safety Launch Approval Plan, if applicable (updated)	Updated	NPR-7120.5D, Table 4-3
Planetary Protection Plan	Updated	NPR-7120.5D, Table 4-3
Environmental Management Plan	Updated	NPR-7120.5D, Table 4-3
Regulatory Agency Plans and Assessments (as needed)	Updated	NPR-7120.5D, Table 4-3
Safety & Mission Assurance		
Safety & Mission Assurance Plan / Product Assurance Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-7, LPR-5300.1
EEE Parts Plan	Updated	LaRC
Software Assurance Plan	Updated	LaRC
System Safety Analysis	Updated	NPR-7123.1A, Table G-8
Subsystem Safety Analyses	Updated	NPR-7123.1A, Table G-8
Reliability Analyses	Updated	NPR-7123.1A, Table G-8
Orbital Debris Assessment	Baseline	NPR-7120.5D, Table 4.3
Missile System Pre-Launch Safety Package	Updated	NPR-7120.5D, Table 4-3
Range Safety Risk Management Plan	Updated	NPR-7120.5D, Table 4-3
Requirements		
Mission Concept Report	Updated	NPR-7120.5D, Table 4-3
System Requirements Document	Updated	NPR-7123.1A, Table G-4
Element Requirements Documents (including IRDs)	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5
Subsystem Requirements Documents (including software)	Updated	NPR-7123.1A, Table G-4
Design		
Interface Control Documents	Updated	NPR-7123.1A, Table G-8
Software Development Plan	Updated	NPR-7123.1A, Table G-4
Software Design Document(s)	Baseline	NPR-7123.1A, Table G-8
Technology Assessment Readiness Report	Updated	NPR-7120.5D, Table 4-3

Design Report	Updated	NPR-7120.5D, Table 4.3
<Engineering Drawing Tree>	Updated	NPR-7123.1A, Table G-7
Drawings	Updated	NPR-7123.1A, Table G-7, G-8, G-9
Analyses	Updated	NPR-7123.1A, Table G-7, G-8
Trade Study Reports	Updated	NPR-7123.1A, Table G-7, G-8
Build and Test		
Configuration Item List	Updated	NPR-7123.1A, Table G-7, G-8
Limited Life Items List	Updated	NPR-7123.1A, Table G-8
Software Test Plan	Updated	NPR-7123.1A, Table G-6
Contamination Control Plan	Updated	NPR-7123.1A, Table G-7
Photographic Documentation Plan	Updated	LPR-7600.1
Technical Product Package	Preliminary	NPR-7123.1A, Table G-8
Integration and Test Plan	Updated	NPR-7123.1A, Table G-10
Verification, Validation, Certification		
Human Rating Plan, if applicable	Updated	NPR-7123.1A, Table G-8
Verification Plan (may be combined with Validation Plan below)	Updated	NPR-7123.1A, Table G-8
Validation Plan (may be combined with Verification Plan above)	Preliminary	NPR-7123.1A, Table G-8
System Acceptance Criteria	Preliminary	NPR-7123.1A, Table G-8
Operations and Logistics		
Mission Operations Concept Document	Updated	NPR-7120.5D, Table 4-3
Mission Operations Plan	Updated	NPR-7120.5D, Table 4-4
<Operational Activation and Checkout Plan>	Draft	NPR-7123.1A, Table G-8
Operations Handbook (including software users manuals)	Preliminary	NPR-7120.5D, Table 4-3
<Command and Telemetry List>	Preliminary	NPR-7123.1A, Table G-8
Logistics Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8

Launch Site Operations Plan	Preliminary	NPR-7123.1A, Table G-8
Security Plan	Updated	NPR-7120.5D, Table 4-4
Export Control Plan	Updated	NPR-7120.5D, Table 4-4
Decommissioning and Closeout		
Decommissioning/Disposal Plan	Preliminary	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-8

4.10.4 Review Content:

The following content is typically expected at an SIR.

Science/Mission Goals and Objectives
- Minimum Mission Success Criteria

Implementation Concept
- System Architecture
- Operational Concept

Requirements Management & Flowdown
- Mission/User Requirements
- System Requirements

Design Solution
- Baseline Design (Build-to Specifications)
- Requirements Satisfaction / Traceability
- Resource Margins
- Changes from CDR Design
- External Interfaces
- Operational Limits and Constraints
- Technical Standards Used
- Supporting Analyses and Tests
  - Thermal
  - Structural
- Subsystem & Peer Review Reports
- Design for Manufacturing Considerations and Trades
- Design Certifications

Development Plan
- Fabrication/Procurement Plan
- Testbeds, Models and Simulations
- Transition to Production/Manufacturing Plan
- Limited Life Items

Software
- Software Assurance Plan
- Requirements
- Architecture
- Interfaces

- Command and Data Interfaces
- Electrical Interfaces
- Flight Certification

Assembly, Integration and Test Plan
- Integration Procedures and Work Flow
- Training and Readiness of Integration Personnel
- Flight Certification
- Functional, Unit-level, Subsystem Qualification Test Results
- Calibration Plan
- Trend Analysis Plan
- Photographic Documentation Plan

Systems Engineering
- Configuration Management
- Metrics & Technical Performance Measures
- Interface Control
- Document Tree
- Drawing Tree
- Drawing Certifications
- Configuration Item List
- System Acceptance Criteria

Mission Operations
- Organizational Roles and Responsibilities
- Ground Operations (if appropriate for integration)
- Ground Support Equipment (if appropriate for integration)

Launch Vehicle
- Launch Vehicle Integration

Mission Assurance
- Quality Assurance
  - Contamination Control
  - Failure Reporting
  - Materials & Process Control
  - Qualified Vendors
  - Quality Control Organizational Readiness to support Integration
- Design Assurance
  - Reliability Analysis
  - FMEA / FTA
  - EEE Parts Program
  - Software Assurance and IV&V

Safety Assurance
- Development Phase
- Range Phase
- Probabilistic Risk Assessment (if appropriate)

Manufacturing, Assembly, and Integration
- Parts and Materials
  - Alternate Suppliers
  - Subassembly Testing and Availability

- Facilities and Tooling
- Integration and Support Staff Readiness

Logistics
- Contamination Control
- Packaging, Handling & Transportation
- Handling and Safety Requirements
- Training of support personnel
- Availability of qualified personnel
- Facilities ready and available for integration
- Test & Support Equipment
- Servicing/Maintenance
- Sparing

Programmatics / Project Plan
- Work Breakdown Structure (WBS)
- Schedule
- Budget / Life Cycle Cost
- Deliverables
- Resources
- Partnerships & Organizational Interfaces
- Management Processes and Control Plans
- Information & Configuration Management
- Acquisition Plan
  - Contracts
  - Government Furnished Equipment
  - Components
- Security Plan
- Review Plan
  - RFA status
  - Known System Discrepancies Disposed According to Agreed-upon Plan

Lessons Learned
- Relevant Lessons from Prior Projects
- Lessons Learned from Current Project

Risk Management
- Risk Assessment and Mitigation Plans

Results of Document Review/Inspection

4.10.5 Success Criteria:

For formal NASA programs and projects, the Review Board shall evaluate the project using the success criteria indicated below. For subprojects, tailored success criteria may be used provided they are enumerated in the ToR for the review.

(1) There is substantial evidence that the detailed design is complete, i.e., traceable to and covers and requirements, and will meet performance, cost, and schedule as planned.

(2) All fabrication drawings and software specifications have been completed with a complete inventory of bill of materials.
(3) Adequate integration plans and procedures are completed and approved for the system to be integrated.
(4) All development testing successfully concluded; solutions are identified or in hand.
(5) Previous component, subsystem, and system test results form a satisfactory basis for proceeding to integration.
(6) Risk level is identified and accepted by program/project leadership, as required.
(7) The integration procedures and work flow have been clearly defined and documented.
(8) The review of the integration plans, as well as the procedures, environment, and configuration of the items to be integrated, provides a reasonable expectation that the integration will proceed successfully.
(9) Integration personnel have received appropriate training in the integration and safety procedures.
(10) The integrated logistics analysis shows complete spares provisioning for the life of a program.
(11) A comprehensive system verification and validation approach (that minimizes on-orbit checkout risks for space-flight systems) has been established.

4.10.6 Lessons Learned:

Following the review, the project is expected to collect lessons learned on the project thus far. The project may define the method(s) for collecting the lessons. The lessons learned are expected to be presented at the project's next Engineering Project and Task Review and to be included as backup at the project's next CMC review. Particularly important lessons learned may be included in the main portion of the CMC presentation. The collected lessons learned are expected to become part of the project's concluding Lessons Learned Review.

4.11 Test Readiness Review (TRR)

A TRR ensures that the test article (hardware/software), test facility, support personnel, and test procedures are ready for testing and data acquisition, reduction, and control. This is not a prerequisite for KDP E. [Ref. NPR 7123.1A]

4.11.1 Timing

a. The objectives of the testing have been clearly defined and documented, and all of the test plans, procedures, environment, and configuration of the test item(s) support those objectives. [Ref. NPR 7123.1A]

b. All TRR-specific materials, such as test plans, test cases, and procedures, have been available to all participants prior to conducting the review. [Ref. NPR 7123.1A]

c. A TRR ToR, with agenda and success criteria, has been agreed to by the appropriate parties.

4.11.2 Entrance Criteria

The following Entrance Criteria are specified in NPR 7123.1A and are required for all formal NASA projects. For subprojects, tailored Entrance Criteria may be used as long as they are enumerated in the ToR for the review.

1. The objectives of the testing have been clearly defined and documented, and all of the test plans, procedures, environment, and configuration of the test item(s) support those objectives.
2. Configuration of the system under test has been defined and agreed to. All interfaces have been placed under configuration management or have been defined in accordance with an agreed to plan, and a version description document has been made available to TRR participants prior to the review.
3. All applicable functional, unit-level, subsystem, system, and qualification testing has been conducted successfully.
4. All TRR-specific materials, such as test plans, test cases, and procedures, have been available to all participants prior to conducting the review.
5. All known system discrepancies have been identified and disposed in accordance with an agreed-upon plan.
6. All previous design review success criteria and key issues have been satisfied in accordance with an agreed-upon plan.
7. All required test resources—people (including a designated test director), facilities, test articles, test instrumentation, and other test enabling products—have been identified and are available to support required tests.
8. Roles and responsibilities of all test participants are defined and agreed to.
9. Test contingency planning has been accomplished, and all personnel have been trained.

4.11.3 Management and Technical Products

Table Note: Items in angle brackets are not required to be formal documents at this stage.

For formal NASA programs and projects, the project shall make available to the Review Board the following Management and Technical Products with the indicated maturity. For subprojects, tailored Management and Technical Products may be used as long as they are enumerated in the ToR for the review.

Product	Maturity	Source
Formulation Authorization Document	Approved	NPR-7120.5D, Table 4-3
Acquisition Strategy Meeting	Baseline	NPR-7120.5D, Table 4-3

Minutes		
Program Requirements on Project	Update	NPR-7120.5D, Table 4-3
CADRe	Update	NPR-7120.5D, Table 4-3
Management Planning and Control		
ITA (or equivalent authorization)	Updated	LaRC
Project Implementation Plan, a.k.a. Project Plan	Updated	NPR-7120.5D, Table 4-3
<Integrated Baseline>	Updated	NPR-7120.5D, Table 4-3
Document Tree	Updated	NPR-7123.1A, Table G-4
Systems Engineering Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Information & Configuration Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Risk Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Software Management Plan	Updated	NPR-7120.5D, Table 4-4
<Risk assessment and mitigations>	Updated	NPR-7123.1A, Table G-8
Review Plan	Updated	LPR-7130
Technology Development Plan, a.k.a. Technology Development Maturity Assessment Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
Science Data Management Plan	Preliminary	NPR-7120.5D, Table 4-4
<Business Case Analysis for Infrastructure>	Updated	NPR-7120.5D, Table 4-3
Regulatory Plans		
Nuclear Safety Launch Approval Plan, if applicable (updated)	Updated	NPR-7120.5D, Table 4-3
Planetary Protection Plan	Updated	NPR-7120.5D, Table 4-3
Environmental Management Plan	Updated	NPR-7120.5D, Table 4-3
Regulatory Agency Plans and Assessments (as needed)	Updated	NPR-7120.5D, Table 4-3
Safety & Mission Assurance		
Safety & Mission Assurance	Updated	NPR-7120.5D, Table 4-4,

Plan / Product Assurance Plan		NPR-7123.1A, Table G-7, LPR-5300.1
EEE Parts Plan	Updated	LaRC
Software Assurance Plan	Updated	LaRC
System Safety Analysis	Updated	NPR-7123.1A, Table G-8
Subsystem Safety Analyses	Updated	NPR-7123.1A, Table G-8
Reliability Analyses	Updated	NPR-7123.1A, Table G-8
Orbital Debris Assessment	Updated	NPR-7120.5D, Table 4.3
Missile System Pre-Launch Safety Package	Updated	NPR-7120.5D, Table 4-3
Range Safety Risk Management Plan	Updated	NPR-7120.5D, Table 4-3
Requirements		
Mission Concept Report	Updated	NPR-7120.5D, Table 4-3
System Requirements Document	Updated	NPR-7123.1A, Table G-4
Element Requirements Documents (including IRDs)	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5
Subsystem Requirements Documents (including software)	Updated	NPR-7123.1A, Table G-4
Design		
Interface Control Documents	Updated	NPR-7123.1A, Table G-8
Software Development Plan	Updated	NPR-7123.1A, Table G-4
Software Design Document(s)	Updated	NPR-7123.1A, Table G-8
Technology Assessment Readiness Report	Updated	NPR-7120.5D, Table 4-3
Design Report	Updated	NPR-7120.5D, Table 4.3
<Engineering Drawing Tree>	Updated	NPR-7123.1A, Table G-7
Drawings	Updated	NPR-7123.1A, Table G-7, G-8, G-9
Analyses	Updated	NPR-7123.1A, Table G-7, G-8
Trade Study Reports	Updated	NPR-7123.1A, Table G-7, G-8
Build and Test		
Configuration Item List	Updated	NPR-7123.1A, Table G-7, G-8
Limited Life Items List	Updated	NPR-7123.1A, Table G-8
Software Test Plan	Updated	NPR-7123.1A, Table G-6

Contamination Control Plan	Updated	NPR-7123.1A, Table G-7
Photographic Documentation Plan	Updated	LPR-7600.1
Technical Product Package	Preliminary	NPR-7123.1A, Table G-8
<As-built hardware and software documentation>	Preliminary	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-12
<Test Results>	Preliminary	NPR-7123.1A, Table G-12
Integration and Test Plan	Updated	NPR-7123.1A, Table G-10
Baseline Test Procedures (including software)	Baseline	LaRC
Verification, Validation, Certification		
Human Rating Plan, if applicable	Updated	NPR-7123.1A, Table G-8
Verification Plan (may be combined with Validation Plan below)	Updated	NPR-7123.1A, Table G-8
Validation Plan (may be combined with Verification Plan above)	Preliminary	NPR-7123.1A, Table G-8
System Acceptance Criteria	Baseline	NPR-7123.1A, Table G-8
Operations and Logistics		
Mission Operations Concept Document	Updated	NPR-7120.5D, Table 4-3
Mission Operations Plan	Updated	NPR-7120.5D, Table 4-4
<Operational Activation and Checkout Plan>	Draft	NPR-7123.1A, Table G-8
Operations Handbook (including software users manuals)	Preliminary	NPR-7120.5D, Table 4-3
<Command and Telemetry List>	Preliminary	NPR-7123.1A, Table G-8
Logistics Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
Launch Site Operations Plan	Preliminary	NPR-7123.1A, Table G-8
Security Plan	Updated	NPR-7120.5D, Table 4-4
Export Control Plan	Updated	NPR-7120.5D, Table 4-4
Decommissioning and Closeout		
Decommissioning/Disposal Plan	Preliminary	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-8

4.11.4 Review Content:

The following content is typically expected at a TRR.

Science/Mission Goals and Objectives
- Minimum Mission Success Criteria

Development Plan
- Testbeds, Models and Simulations

Test Plan
- Performance Verification
- Anomalies Documented and Assessed
- Integrated Test Plan
  - Test Objectives
  - Test Cases
  - Test Contingency Plans
  - Expected Results

Mission Assurance
- Quality Assurance

Safety Assurance

Logistics for Testing
- Contamination Control, if applicable
- Packaging, Handling & Transportation, if applicable
- Handling and Safety Requirements
- Training of test personnel, if applicable
- Availability of qualified personnel
- Facilities ready and available for testing
- Test & Support Equipment

Programmatics / Project Plan
- Information & Configuration Management
- Review Plan
- RFA status
- Known System Discrepancies Disposed According to Agreed-upon Plan

Lessons Learned
- Plans to capture Lessons Learned

Risk Management
- Risk Assessment and Mitigation Plans

4.11.5 Success Criteria:

For formal NASA programs and projects, the Review Board shall evaluate the project using the success criteria indicated below. For subprojects, tailored success criteria may be used provided they are enumerated in the ToR for the review.

(1) Adequate test plans are completed and approved for the system under test.

(2) Adequate identification and coordination of required test resources are completed.
(3) Previous component, subsystem, and system test results form a satisfactory basis for proceeding into planned tests.
(4) Risk level is identified and accepted by program/competency leadership as required.
(5) Plans to capture any lessons learned from the test program are documented.
(6) The objectives of the testing have been clearly defined and documented, and the review of all the test plans, as well as the procedures, environment, and configuration of the test item, provides a reasonable expectation that the objectives will be met.
(7) The test cases have been reviewed and analyzed for expected results, and the results are consistent with the test plans and objectives.
(8) Test personnel have received appropriate training in test operation and safety procedures.

4.11.6 Lessons Learned:

Following the review, the project is expected to collect lessons learned on the project thus far. The project may define the method(s) for collecting the lessons. The lessons learned are expected to be presented at the project's next Engineering Project and Task Review and to be included as backup at the project's next CMC review. Particularly important lessons learned may be included in the main portion of the CMC presentation. The collected lessons learned are expected to become part of the project's concluding Lessons Learned Review.

4.12 System Acceptance Review (SAR)

a. The purpose of the SAR is to examine the system, its end items and documentation, and test data and analysis that support verification and qualification and to ensure the system meets acceptance criteria and that there is a high level of confidence that the flight item has complied with mission requirements and specifications, that the documentation delivered with the system is complete and current, that it and its ground support equipment will be transported safely to their destination, and that they will operate as designed upon arrival.

b. The SAR verifies the completeness of the specific end products in relation to their expected maturity level and assesses compliance to stakeholder expectations. The SAR examines the system, its end products and documentation, and test data and analyses that support verification. It also ensures that the system has sufficient technical maturity to authorize its shipment to the designated operational facility or launch site. [Ref. NPR 7123.1A, NPR 7120.5D]

c. Successful completion of the SAR results in recommendation that the system be accepted and authorization given to ship the system end items to the launch/deployment site or operational facility and to install software and hardware for operational use. It also establishes an understanding of the capabilities and operational constraints of the “as-built” system.

4.12.1 Timing

a. The flight system is ready for acceptance. The fabrication, assembly, and testing have been completed, and all anomalies have been addressed and corrected.

b. The project has successfully completed the SIR and provided responses to all SIR RFAs and other findings.

c. A SAR ToR, with agenda and success criteria, has been agreed to by the appropriate parties.

4.12.2 Entrance Criteria

The following Entrance Criteria are specified in NPR 7123.1A and are required for all formal NASA projects. For subprojects, tailored Entrance Criteria may be used as long as they are enumerated in the ToR for the review.

1. A preliminary agenda has been coordinated (nominally) prior to the SAR.
2. The following SAR technical products have been made available to the cognizant participants prior to the review:
    a. results of the SARs conducted at the major suppliers;
    b. transition to production and/or manufacturing plan;
    c. product verification results;
    d. product validation results;
    e. documentation that the delivered system complies with the established acceptance criteria;
    f. documentation that the system will perform properly in the expected operational environment;
    g. technical data package updated to include all test results;
    h. certification package;
    i. updated risk assessment and mitigation;
    j. successfully completed previous milestone reviews; and
    k. remaining liens or unclosed actions and plans for closure.

4.12.3 Management and Technical Products

Table Note: Items in angle brackets are not required to be formal documents at this stage.

For formal NASA programs and projects, the project shall make available to the Review Board the following Management and Technical Products with the indicated

maturity. For subprojects, tailored Management and Technical Products may be used as long as they are enumerated in the ToR for the review.

Product	Maturity	Source
Formulation Authorization Document	Approved	NPR-7120.5D, Table 4-3
Acquisition Strategy Meeting Minutes	Baseline	NPR-7120.5D, Table 4-3
Program Requirements on Project	Updated	NPR-7120.5D, Table 4-3
CADRe	Updated	NPR-7120.5D, Table 4-3
Management Planning and Control		
ITA (or equivalent authorization)	Updated	LaRC
Project Implementation Plan, a.k.a. Project Plan	Updated	NPR-7120.5D, Table 4-3
<Integrated Baseline>	Updated	NPR-7120.5D, Table 4-3
Document Tree	Updated	NPR-7123.1A, Table G-4
Systems Engineering Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Information & Configuration Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Risk Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Software Management Plan	Updated	NPR-7120.5D, Table 4-4
<Risk assessment and mitigations>	Updated	NPR-7123.1A, Table G-8
Review Plan	Updated	LPR-7130
Technology Development Plan, a.k.a. Technology Development Maturity Assessment Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
Science Data Management Plan	Preliminary	NPR-7120.5D, Table 4-4
<Business Case Analysis for Infrastructure>	Updated	NPR-7120.5D, Table 4-3
Regulatory Plans		
Nuclear Safety Launch Approval Plan, if applicable (updated)	Updated	NPR-7120.5D, Table 4-3

Planetary Protection Plan	Updated	NPR-7120.5D, Table 4-3
Environmental Management Plan	Updated	NPR-7120.5D, Table 4-3
Regulatory Agency Plans and Assessments (as needed)	Updated	NPR-7120.5D, Table 4-3
Safety & Mission Assurance		
Safety & Mission Assurance Plan / Product Assurance Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-7, LPR-5300.1
EEE Parts Plan	Updated	LaRC
Software Assurance Plan	Updated	LaRC
System Safety Analysis	Updated	NPR-7123.1A, Table G-8
Subsystem Safety Analyses	Updated	NPR-7123.1A, Table G-8
Reliability Analyses	Updated	NPR-7123.1A, Table G-8
Orbital Debris Assessment	Updated	NPR-7120.5D, Table 4.3
Missile System Pre-Launch Safety Package	Updated	NPR-7120.5D, Table 4-3
Range Safety Risk Management Plan	Updated	NPR-7120.5D, Table 4-3
Requirements		
Mission Concept Report	Updated	NPR-7120.5D, Table 4-3
System Requirements Document	Updated	NPR-7123.1A, Table G-4
Element Requirements Documents (including IRDs)	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5
Subsystem Requirements Documents (including software)	Updated	NPR-7123.1A, Table G-4
Design		
Interface Control Documents	Updated	NPR-7123.1A, Table G-8
Software Development Plan	Updated	NPR-7123.1A, Table G-4
Software Design Document(s)	Updated	NPR-7123.1A, Table G-8
Technology Assessment Readiness Report	Updated	NPR-7120.5D, Table 4-3
Design Report	Updated	NPR-7120.5D, Table 4.3
<Engineering Drawing Tree>	Updated	NPR-7123.1A, Table G-7
Drawings	Updated	NPR-7123.1A, Table G-7, G-8, G-9
Analyses	Updated	NPR-7123.1A, Table G-7, G-8

Trade Study Reports	Updated	NPR-7123.1A, Table G-7, G-8
Build and Test		
Configuration Item List	Updated	NPR-7123.1A, Table G-7, G-8
Limited Life Items List	Updated	NPR-7123.1A, Table G-8
Software Test Plan	Updated	NPR-7123.1A, Table G-6
Contamination Control Plan	Updated	NPR-7123.1A, Table G-7
Photographic Documentation Plan	Updated	LPR-7600.1
Technical Product Package	Baseline	NPR-7123.1A, Table G-12
<As-built hardware and software documentation>	Baseline	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-12
<Test Results>	Baseline	NPR-7123.1A, Table G-12
Integration and Test Plan	Updated	NPR-7123.1A, Table G-10
Baseline Test Procedures (including software)	Updated	LaRC
Verification, Validation, Certification		
Human Rating Plan, if applicable	Updated	NPR-7123.1A, Table G-8
Certification Package	Baseline	NPR-7123.1A, Table G-12, G14
Verification Plan (may be combined with Validation Plan below)	Updated	NPR-7123.1A, Table G-8
Validation Plan (may be combined with Verification Plan above)	Preliminary	NPR-7123.1A, Table G-8
Verification and Validation Report	Baseline	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-12
System Acceptance Criteria	Baseline	NPR-7123.1A, Table G-8
Documentation that system satisfies acceptance criteria	Baseline	NPR-7123.1A, Table G-12
Operations and Logistics		
Mission Operations Concept Document	Updated	NPR-7120.5D, Table 4-3
Mission Operations Plan	Updated	NPR-7120.5D, Table 4-4
<Operational Activation and Checkout Plan>	Draft	NPR-7123.1A, Table G-8
Operations Handbook (including software users	Preliminary	NPR-7120.5D, Table 4-3

manuals)		
<Command and Telemetry List>	Preliminary	NPR-7123.1A, Table G-8
Logistics Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
Launch Site Operations Plan	Preliminary	NPR-7123.1A, Table G-8
Security Plan	Updated	NPR-7120.5D, Table 4-4
Export Control Plan	Updated	NPR-7120.5D, Table 4-4
Decommissioning and Closeout Decommissioning/Disposal Plan	Preliminary	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-8

4.12.4 Review Content:

The following content is typically expected at an SAR.

Science/Mission Goals and Objectives
- Minimum Mission Success Criteria

Requirements Management & Flowdown
- Mission/User Requirements
- System Requirements

Descope Plan

Design Solution
- Baseline Design (Build-to Specifications)
- Requirements Satisfaction / Traceability
- Resource Margins
- Changes from SIR Design
- External Interfaces
- Operational Limits and Constraints
- Technical Standards Used
- Supporting Analyses and Tests
  - Thermal
  - Structural
- Subsystem & Peer Review Reports

Development Plan
- Transition to Production/Manufacturing Plan

Software
- Software Assurance Plan
- Interfaces
  - Command and Data Interfaces
  - Electrical Interfaces
- Flight Certification

- Assembly, Integration and Test
  - Performance Verification w/ Documentation
  - Anomalies Documented and Assessed
  - Integrated Test Plan
    - Test Objectives
    - Test Cases
    - Expected Results
    - Results
  - Flight Certification
    - Definition of Environments
    - Flight Certification Test Results
  - Trend Analysis
  - Photographic Documentation Plan and Status
- Systems Engineering
  - Configuration Management
  - Metrics & Technical Performance Measures
  - Interface Control
    - Electrical and Mechanical Interfaces verified against ICDs
  - System Acceptance Criteria w/ Product Documentation
- Launch Vehicle
  - Launch Site Operations Plan
  - Launch Vehicle Integration
- Mission Assurance
  - Quality Assurance
    - Contamination Control
    - Failure Reporting
    - Materials & Process Control
  - Design Assurance
    - Reliability Analysis
    - FMEA / FTA
    - EEE Parts Program
    - Software Assurance and IV&V
- Safety Assurance
  - Safety Plans
  - Safety Analyses
- Logistics
  - Contamination Control
  - Packaging, Handling & Transportation
  - Handling and Safety Requirements
  - Training of support personnel, if applicable
  - Availability of qualified personnel
  - Facilities ready and available for shipping and handling
  - Support Equipment
- Mission/Science
  - Product Validation Results
- Programmatics / Project Plan

Work Breakdown Structure (WBS)
Schedule
Budget / Life Cycle Cost
Deliverables
Resources
Information & Configuration Management
Security Plan
Review Plan and Status
RFA status
Remaining Leins and Agreed-upon Closure Plan(s)
Lessons Learned
Relevant Lessons from Prior Projects
Lessons Learned from Current Project
Risk Management
Risk Assessment and Mitigation Plans
Results of Document and Product Review/Inspection

4.12.5 Success Criteria:

For formal NASA programs and projects, the Review Board shall evaluate the project using the success criteria indicated below. For subprojects, tailored success criteria may be used provided they are enumerated in the ToR for the review.

(1) The project has demonstrated compliance with mission requirements and specifications. There are no open items remaining before acceptance.
(2) Required tests and analyses are complete and indicate that the system will perform properly in the expected operational environment.
(3) Risks are known and manageable.
(4) System meets the established acceptance criteria.
(5) Required safe shipping, handling, checkout, and operational plans and procedures are complete and ready for use. The system is ready to be delivered (flight items to the launch/deployment site and non-flight items to the intended operational facility) for integration/installation.
(6) Technical data package is complete and reflects the delivered system.
(7) All applicable lessons learned for organizational improvement and system operations are captured.

4.12.6 Lessons Learned:

Following the review, the project is expected to collect lessons learned on the project thus far. The project may define the method(s) for collecting the lessons. The lessons learned are expected to be presented at the project's next Engineering Project and Task Review and to be included as backup at the project's next CMC review. Particularly important lessons learned may be included in the main portion of the CMC presentation. The collected lessons learned are expected to become part of the project's concluding Lessons Learned Review.

4.13 Operational Readiness Review (ORR)

The ORR examines the actual system characteristics and the procedures used in the system or end product's operation, and ensures that all system and support (flight and ground) hardware, software, personnel, procedures, and user documentation accurately reflect the deployed state of the system and are ready for operations. (NPR 7123.1A, NPR 7120.5D)

4.13.1 Timing

a. All validation testing has been completed. [Ref. NPR 7123.1A]

b. All operational supporting and enabling products (e.g., facilities, equipment, documents, and updated databases) that are necessary for the nominal and contingency operations have been tested and delivered/installed at the site(s) necessary to support operations. [Ref. NPR 7123.1A]

c. An ORR ToR, with agenda and success criteria, has been agreed to by the appropriate parties.

4.13.2 Entrance Criteria

The following Entrance Criteria are specified in NPR 7123.1A and are required for all formal NASA projects. For subprojects, tailored Entrance Criteria may be used as long as they are enumerated in the ToR for the review.

1. All validation testing has been completed.
2. Test failures and anomalies from validation testing have been resolved and the results incorporated into all supporting and enabling operational products.
3. All operational supporting and enabling products (e.g., facilities, equipment, documents, updated databases) that are necessary for the nominal and contingency operations have been tested and delivered/installed at the site(s) necessary to support operations.
4. Operations handbook has been approved.
5. Training has been provided to the users and operators on the correct operational procedures for the system.
6. Operational contingency planning has been accomplished, and all personnel have been trained.

4.13.3 Management and Technical Products

Table Note: Items in angle brackets are not required to be formal documents at this stage.

For formal NASA programs and projects, the project shall make available to the Review Board the following Management and Technical Products with the indicated

maturity. For subprojects, tailored Management and Technical Products may be used as long as they are enumerated in the ToR for the review.

Product	Maturity	Source
Formulation Authorization Document	Approved	NPR-7120.5D, Table 4-3
Acquisition Strategy Meeting Minutes	Baseline	NPR-7120.5D, Table 4-3
Program Requirements on Project	Updated	NPR-7120.5D, Table 4-3
CADRe	Updated	NPR-7120.5D, Table 4-3
Management Planning and Control		
ITA (or equivalent authorization)	Updated	LaRC
Project Implementation Plan, a.k.a. Project Plan	Updated	NPR-7120.5D, Table 4-3
<Integrated Baseline>	Updated	NPR-7120.5D, Table 4-3
Document Tree	Updated	NPR-7123.1A, Table G-4
Systems Engineering Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Information & Configuration Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Risk Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Software Management Plan	Updated	NPR-7120.5D, Table 4-4
<Risk assessment and mitigations>	Updated	NPR-7123.1A, Table G-8
Review Plan	Updated	LPR-7130
Technology Development Plan, a.k.a. Technology Development Maturity Assessment Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
Science Data Management Plan	Baseline	NPR-7120.5D, Table 4-4
<Business Case Analysis for Infrastructure>	Updated	NPR-7120.5D, Table 4-3
Regulatory Plans		
Nuclear Safety Launch Approval Plan, if applicable (updated)	Updated	NPR-7120.5D, Table 4-3

Planetary Protection Plan	Updated	NPR-7120.5D, Table 4-3
Environmental Management Plan	Updated	NPR-7120.5D, Table 4-3
Regulatory Agency Plans and Assessments (as needed)	Updated	NPR-7120.5D, Table 4-3
Safety & Mission Assurance		
Safety & Mission Assurance Plan / Product Assurance Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-7, LPR-5300.1
EEE Parts Plan	Updated	LaRC
Software Assurance Plan	Updated	LaRC
System Safety Analysis	Updated	NPR-7123.1A, Table G-8
Subsystem Safety Analyses	Updated	NPR-7123.1A, Table G-8
Reliability Analyses	Updated	NPR-7123.1A, Table G-8
Orbital Debris Assessment	Baseline	NPR-7120.5D, Table 4.3
Missile System Pre-Launch Safety Package	Updated	NPR-7120.5D, Table 4-3
Range Safety Risk Management Plan	Updated	NPR-7120.5D, Table 4-3
Requirements		
Mission Concept Report	Updated	NPR-7120.5D, Table 4-3
System Requirements Document	Updated	NPR-7123.1A, Table G-4
Element Requirements Documents (including IRDs)	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5
Subsystem Requirements Documents (including software)	Updated	NPR-7123.1A, Table G-4
Design		
Interface Control Documents	Updated	NPR-7123.1A, Table G-8
Software Development Plan	Updated	NPR-7123.1A, Table G-4
Software Design Document(s)	Baseline	NPR-7123.1A, Table G-8
Technology Assessment Readiness Report	Updated	NPR-7120.5D, Table 4-3
Design Report	Updated	NPR-7120.5D, Table 4.3
<Engineering Drawing Tree>	Updated	NPR-7123.1A, Table G-7
Drawings	Updated	NPR-7123.1A, Table G-7, G-8, G-9
Analyses	Updated	NPR-7123.1A, Table G-7, G-8

Trade Study Reports	Updated	NPR-7123.1A, Table G-7, G-8
Build and Test		
Configuration Item List	Updated	NPR-7123.1A, Table G-7, G-8
Limited Life Items List	Updated	NPR-7123.1A, Table G-8
Software Test Plan	Updated	NPR-7123.1A, Table G-6
Contamination Control Plan	Updated	NPR-7123.1A, Table G-7
Photographic Documentation Plan	Updated	LPR-7600.1
Technical Product Package	Updated	NPR-7123.1A, Table G-12
<As-built hardware and software documentation>	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-12
<Test Results>	Updated	NPR-7123.1A, Table G-12
Integration and Test Plan	Updated	NPR-7123.1A, Table G-10
Baseline Test Procedures (including software)	Updated	LaRC
Verification, Validation, Certification		
Human Rating Plan, if applicable	Updated	NPR-7123.1A, Table G-8
Certification Package	Updated	NPR-7123.1A, Table G-12, G14
Verification Plan (may be combined with Validation Plan below)	Updated	NPR-7123.1A, Table G-8
Validation Plan (may be combined with Verification Plan above)	Baseline	NPR-7123.1A, Table G-8
Verification and Validation Report	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-12
System Acceptance Criteria	Updated	NPR-7123.1A, Table G-8
Documentation that system satisfies acceptance criteria	Updated	NPR-7123.1A, Table G-12
Operations and Logistics		
Mission Operations Concept Document	Updated	NPR-7120.5D, Table 4-3
Mission Operations Plan	Updated	NPR-7120.5D, Table 4-4
Operational Activation and Checkout Plan	Baseline	NPR-7123.1A, Table G-8
Operations Handbook (including software users	Baseline	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-13

manuals)		
Command and Telemetry List	Baseline	NPR-7123.1A, Table G-8
Logistics Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
Launch Site Operations Plan	Baseline	NPR-7123.1A, Table G-8
Security Plan	Updated	NPR-7120.5D, Table 4-4
Export Control Plan	Updated	NPR-7120.5D, Table 4-4
Decommissioning and Closeout Decommissioning/Disposal Plan	Preliminary	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-8

4.13.4 Review Content:

The following content is typically expected at an ORR.

Science/Mission Goals and Objectives
- Minimum Mission Success Criteria

Mission/Project Overview & Status
- Mission/Project Organization

Requirements Management & Flowdown
- Mission/User Requirements

Design Solution
- Changes from SAR Design and Implications
- Operational Limits and Constraints

Software
- Interfaces
  - Command and Data Interfaces
- Flight Certification
- Operation

Assembly, Integration and Test Results
- Anomalies Documented and Assessed
- Integrated Test Results
- Flight Certification
  - Definition of Environments
  - Flight Certification Test Results
- Calibration
- Trend Analysis
- Photographic Documentation Status

Peer Review Reports

Systems Engineering
- Configuration Management
- Metrics & Technical Performance Measures

- Interface Control
- Planetary Protection
- System Acceptance Criteria

Mission Analysis
- Orbits and Trajectories
- Launch Windows
- Guidance, Navigation, and Control
  - Station Acquisition and Keeping

Mission Operations
- Organizational Roles and Responsibilities
- Ground Operations
- Supporting and Enabling Operations Products
  - Ground Support Equipment
  - Facilities
  - Equipment
  - Documents and Databases
- Operations Team / Training Plan
- On-Orbit Activation and Checkout Plan
- Contingency Plans
- Retirement/Disposal
- Orbital Debris Plan
- Go-NoGo Criteria

Launch Vehicle
- Launch Environments
- Launch Site Operations Plan
- Launch Vehicle Integration
- Launch and Deployment Activities

Mission Assurance
- Quality Assurance
  - Contamination Control, if applicable
  - Failure Reporting
  - Test Failure and Anomaly Resolution

Safety Assurance
- Safety Plans
- Safety Analyses
- Probabilistic Risk Assessment, where appropriate

Logistics
- Contamination Control
- Training of all operations personnel
- Facilities
- Support Equipment
- Servicing/Maintenance
- Sparing

Mission/Science
- Product Validation Results
- Mission/Science Data Management

Data Retrieval and Analysis
Programmatics / Project Plan
Security Plan
Review Plan
Known System Discrepancies Disposed According to Agreed-upon Plan
Lessons Learned
Relevant Lessons from Prior Projects
Lessons Learned from Current Project
Risk Management
Risk Assessment and Mitigation Plans
Results of Document and Product Review/Inspection

4.13.5 Success Criteria:

For formal NASA programs and projects, the Review Board shall evaluate the project using the success criteria indicated below. For subprojects, tailored success criteria may be used provided they are enumerated in the ToR for the review.

(1) The system, including any enabling products, is determined to be ready to be placed in an operational status.
(2) All applicable lessons learned for organizational improvement and systems operations have been captured.
(3) All waivers and anomalies have been closed.
(4) Systems hardware, software, personnel, and procedures are in place to support operations.

4.13.6 Lessons Learned:

Following the review, the project is expected to collect lessons learned on the project thus far. The project may define the method(s) for collecting the lessons. The lessons learned are expected to be presented at the project's next Engineering Project and Task Review and to be included as backup at the project's next CMC review. Particularly important lessons learned may be included in the main portion of the CMC presentation. The collected lessons learned are expected to become part of the project's concluding Lessons Learned Review.

4.14 Flight Readiness Review (FRR)

a. The FRR examines tests, demonstrations, analyses, and audits that determine the system's readiness for a safe and successful flight or launch and for subsequent flight operations. It also ensures that all flight and ground hardware, software, personnel, and procedures are operationally ready. [Ref. NPR 7123.1A]

b. Successful completion of the FRR will result in acknowledgement that system technical and procedural maturity exists for launch and flight authorization and initiation of system operations.

4.14.1 Timing

a. The flight system is ready for its mission. The system has been configured for flight. This review is held as close as possible to the flight date. It may be held in conjunction with reviews required by other Centers and thus may not require participation by the LaRC review panel.

b. An FRR ToR, with agenda and success criteria, has been agreed to by the appropriate parties.

4.14.2 Entrance Criteria

The following Entrance Criteria are specified in NPR 7123.1A and are required for all formal NASA projects. For subprojects, tailored Entrance Criteria may be used as long as they are enumerated in the ToR for the review.

1. Certification has been received that flight operations can safely proceed with acceptable risk.
2. The system and support elements have been confirmed as properly configured and ready for flight.
3. Interfaces are compatible and function as expected.
4. The system state supports a launch “go” decision based on go/no-go criteria.
5. Flight failures and anomalies from previously completed flights and reviews have been resolved and the results incorporated into all supporting and enabling operational products.
6. The system has been configured for flight.

4.14.3 Management and Technical Products

Table Note: Items in angle brackets are not required to be formal documents at this stage.

For formal NASA programs and projects, the project shall make available to the Review Board the following Management and Technical Products with the indicated maturity. For subprojects, tailored Management and Technical Products may be used as long as they are enumerated in the ToR for the review.

Product	Maturity	Source
Formulation Authorization Document	Approved	NPR-7120.5D, Table 4-3
Acquisition Strategy Meeting Minutes	Baseline	NPR-7120.5D, Table 4-3

Program Requirements on Project	Updated	NPR-7120.5D, Table 4-3
CADRe	Updated	NPR-7120.5D, Table 4-3
Management Planning and Control		
ITA (or equivalent authorization)	Updated	LaRC
Project Implementation Plan, a.k.a. Project Plan	Updated	NPR-7120.5D, Table 4-3
<Integrated Baseline>	Updated	NPR-7120.5D, Table 4-3
Document Tree	Updated	NPR-7123.1A, Table G-4
Systems Engineering Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Information & Configuration Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Risk Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Software Management Plan	Updated	NPR-7120.5D, Table 4-4
<Risk assessment and mitigations>	Updated	NPR-7123.1A, Table G-8
Review Plan	Updated	LPR-7130
Technology Development Plan, a.k.a. Technology Development Maturity Assessment Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
Science Data Management Plan	Updated	NPR-7120.5D, Table 4-4
<Business Case Analysis for Infrastructure>	Updated	NPR-7120.5D, Table 4-3
Regulatory Plans		
Nuclear Safety Launch Approval Plan, if applicable (updated)	Updated	NPR-7120.5D, Table 4-3
Planetary Protection Plan	Updated	NPR-7120.5D, Table 4-3
Environmental Management Plan	Updated	NPR-7120.5D, Table 4-3
Regulatory Agency Plans and Assessments (as needed)	Updated	NPR-7120.5D, Table 4-3
Safety & Mission Assurance		
Safety & Mission Assurance Plan / Product Assurance Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-7, LPR-5300.1

EEE Parts Plan	Updated	LaRC
Software Assurance Plan	Updated	LaRC
System Safety Analysis	Updated	NPR-7123.1A, Table G-8
Subsystem Safety Analyses	Updated	NPR-7123.1A, Table G-8
Reliability Analyses	Updated	NPR-7123.1A, Table G-8
Orbital Debris Assessment	Updated	NPR-7120.5D, Table 4.3
Missile System Pre-Launch Safety Package	Updated	NPR-7120.5D, Table 4-3
Range Safety Risk Management Plan	Updated	NPR-7120.5D, Table 4-3
Requirements		
Mission Concept Report	Updated	NPR-7120.5D, Table 4-3
System Requirements Document	Updated	NPR-7123.1A, Table G-4
Element Requirements Documents (including IRDs)	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5
Subsystem Requirements Documents (including software)	Updated	NPR-7123.1A, Table G-4
Design		
Interface Control Documents	Updated	NPR-7123.1A, Table G-8
Software Development Plan	Updated	NPR-7123.1A, Table G-4
Software Design Document(s)	Updated	NPR-7123.1A, Table G-8
Technology Assessment Readiness Report	Updated	NPR-7120.5D, Table 4-3
Design Report	Updated	NPR-7120.5D, Table 4.3
<Engineering Drawing Tree>	Updated	NPR-7123.1A, Table G-7
Drawings	Updated	NPR-7123.1A, Table G-7, G-8, G-9
Analyses	Updated	NPR-7123.1A, Table G-7, G-8
Trade Study Reports	Updated	NPR-7123.1A, Table G-7, G-8
Build and Test		
Configuration Item List	Updated	NPR-7123.1A, Table G-7, G-8
Limited Life Items List	Updated	NPR-7123.1A, Table G-8
Software Test Plan	Updated	NPR-7123.1A, Table G-6
Contamination Control Plan	Updated	NPR-7123.1A, Table G-7

Photographic Documentation Plan	Updated	LPR-7600.1
Technical Product Package	Updated	NPR-7123.1A, Table G-12
<As-built hardware and software documentation>	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-12
<Test Results>	Updated	NPR-7123.1A, Table G-12
Integration and Test Plan	Updated	NPR-7123.1A, Table G-10
Baseline Test Procedures (including software)	Updated	LaRC
Verification, Validation, Certification		
Human Rating Plan, if applicable	Updated	NPR-7123.1A, Table G-8
Certification Package	Updated	NPR-7123.1A, Table G-12, G14
Verification Plan (may be combined with Validation Plan below)	Updated	NPR-7123.1A, Table G-8
Validation Plan (may be combined with Verification Plan above)	Updated	NPR-7123.1A, Table G-8
Verification and Validation Report	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-12
System Acceptance Criteria	Updated	NPR-7123.1A, Table G-8
Documentation that system satisfies acceptance criteria	Updated	NPR-7123.1A, Table G-12
Operations and Logistics		
Mission Operations Concept Document	Updated	NPR-7120.5D, Table 4-3
Mission Operations Plan	Updated	NPR-7120.5D, Table 4-4
Operational Activation and Checkout Plan	Updated	NPR-7123.1A, Table G-8
Operations Handbook (including software users manuals)	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-13
Command and Telemetry List	Updated	NPR-7123.1A, Table G-8
Logistics Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
Launch Site Operations Plan	Updated	NPR-7123.1A, Table G-8
Security Plan	Updated	NPR-7120.5D, Table 4-4
Export Control Plan	Updated	NPR-7120.5D, Table 4-4

Decommissioning and Closeout		
Decommissioning/Disposal Plan	Preliminary	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-8

4.14.4 Review Content:

The following content is typically expected at an FRR.

Science/Mission Goals and Objectives
- Minimum Mission Success Criteria

Mission/Project Overview & Status
- Mission/Project Organization

Design Solution
- Changes from ORR Design and Implications
- Operational Limits and Constraints

Software
- Flight Certification
- Operation

Test Results
- Anomalies Documented and Assessed
- Flight Certification
  - Flight Certification Test Results
- Trend Analysis
- Photographic Documentation Status

Peer Review Reports

Systems Engineering
- Interface Control

Mission Analysis
- Orbits and Trajectories
- Launch Windows
- Guidance, Navigation, and Control
  - Station Acquisition and Keeping

Mission Operations
- Organizational Roles and Responsibilities
- Ground Operations
- Ground Support Equipment Status
- Contingency Plans
- Go-NoGo Criteria
- System Checkout Status
- Significant Changes to Procedures
- Public Relations Plans (including contingencies)

Launch Vehicle
- Launch Site Operations
- Launch Vehicle Status

Launch and Deployment Activities
Mission Assurance
Quality Assurance
Test Failure and Anomaly Resolution
Safety Assurance
Safety Plans
Safety Analyses
Probabilistic Risk Assessment, where appropriate
Programmatics / Project Plan
Security Plan
Review Plan
RFA status
Known System Discrepancies Disposed According to Agreed-upon Plan
Lessons Learned
Relevant Lessons from Prior Projects
Lessons Learned from Current Project
Risk Management
Risk Assessment and Mitigation Plans
Results of Document and Product Review/Inspection

4.14.5 Success Criteria:

For formal NASA programs and projects, the Review Board shall evaluate the project using the success criteria indicated below. For subprojects, tailored success criteria may be used provided they are enumerated in the ToR for the review.

(1) The flight vehicle is ready for flight.
(2) The hardware is deemed acceptably safe for flight (i.e., meeting the established acceptable risk criteria or documented as being accepted by the PM and DGA).
(3) Flight and ground software elements are ready to support flight and flight operations.
(4) Interfaces are checked and found to be functional.
(5) Open items and waivers have been examined and found to be acceptable.
(6) The flight and recovery environmental factors are within constraints.
(7) All open safety and mission risk items have been addressed.
(8) The mission operations plan has been completely developed.
(9) The data retrieval and analysis plan has been completely developed and all interfaces are compatible and function as expected.
(10) Plans for public information services have been developed.

4.14.6 Lessons Learned:

Following the review, the project is expected to collect lessons learned on the project thus far. The project may define the method(s) for collecting the lessons. The lessons learned are expected to be presented at the project's next Engineering Project

and Task Review and to be included as backup at the project's next CMC review. Particularly important lessons learned may be included in the main portion of the CMC presentation. The collected lessons learned are expected to become part of the project's concluding Lessons Learned Review.

4.15 Launch Readiness Review (LRR)

a. The LRR is the final review prior to actual launch in order to verify that the launch system and spacecraft/payloads are ready for launch.

b. The Review Board shall use the content and success criteria of the launch facility for the LRR.

4.16 Post-Launch Assessment Review (PLAR)

A PLAR is a post-deployment evaluation of the readiness of the spacecraft systems to proceed with full, routine operations. The review evaluates the status, performance, and capabilities of the project evident from the flight operations experience since launch. This can also mean assessing readiness to transfer responsibility from the development organization to the operations organization. The review also evaluates the status of the project plans and the capability to conduct the mission with emphasis on near-term operations and mission-critical events. [Ref. NPR 7123.1A] For human space flight, the PLAR is performed by the Mission Management Team (MMT). [Ref. NPR 7120.5D]

4.16.1 Timing

a. This review is typically held after the early flight operations and initial checkout. [Ref. NPR 7123.1A]

b. A PLAR ToR, with agenda and success criteria, has been agreed to by the appropriate parties.

4.16.2 Entrance Criteria

The following Entrance Criteria are specified in NPR 7123.1A and are required for all formal NASA projects. For subprojects, tailored Entrance Criteria may be used as long as they are enumerated in the ToR for the review.

1. The launch and early operations performance, including (when appropriate) the early propulsive maneuver results, are available.
2. The observed spacecraft and science instrument performance, including instrument calibration plans and status, are available.

3. The launch vehicle performance assessment and mission implications, including launch sequence assessment, launch operations experience with lessons learned, are completed.
4. The mission operations and ground data system experience, including tracking and data acquisition support and spacecraft telemetry data analysis, is available.
5. The mission operations organization, including status of staffing, facilities, tools, and mission software (e.g., spacecraft analysis, and sequencing), is available.
6. In-flight anomalies and the responsive actions taken, including any autonomous fault protection actions taken by the spacecraft or any unexplained spacecraft telemetry, including alarms, are documented.
7. The need for significant changes to procedures, interface agreements, software, and staffing has been documented.
8. Documentation is updated, including any updates originating from the early operations experience.
9. Future development/test plans are developed.

4.16.3 Management and Technical Products

Table Note: Items in angle brackets are not required to be formal documents at this stage.

For formal NASA programs and projects, the project shall make available to the Review Board the following Management and Technical Products with the indicated maturity. For subprojects, tailored Management and Technical Products may be used as long as they are enumerated in the ToR for the review.

Product	Maturity	Source
Formulation Authorization Document	Approved	NPR-7120.5D, Table 4-3
Acquisition Strategy Meeting Minutes	Baseline	NPR-7120.5D, Table 4-3
Program Requirements on Project	Updated	NPR-7120.5D, Table 4-3
CADRe	Updated	NPR-7120.5D, Table 4-3
Management Planning and Control		
ITA (or equivalent authorization)	Updated	LaRC
Project Implementation Plan, a.k.a. Project Plan	Updated	NPR-7120.5D, Table 4-3
<Integrated Baseline>	Updated	NPR-7120.5D, Table 4-3
Document Tree	Updated	NPR-7123.1A, Table G-4
Systems Engineering Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4

Information & Configuration Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Risk Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Software Management Plan	Updated	NPR-7120.5D, Table 4-4
<Risk assessment and mitigations>	Updated	NPR-7123.1A, Table G-8
Review Plan	Updated	LPR-7130
Technology Development Plan, a.k.a. Technology Development Maturity Assessment Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
Science Data Management Plan	Updated	NPR-7120.5D, Table 4-4
<Business Case Analysis for Infrastructure>	Updated	NPR-7120.5D, Table 4-3
Regulatory Plans		
Nuclear Safety Launch Approval Plan, if applicable (updated)	Updated	NPR-7120.5D, Table 4-3
Planetary Protection Plan	Updated	NPR-7120.5D, Table 4-3
Environmental Management Plan	Updated	NPR-7120.5D, Table 4-3
Regulatory Agency Plans and Assessments (as needed)	Updated	NPR-7120.5D, Table 4-3
Safety & Mission Assurance		
Safety & Mission Assurance Plan / Product Assurance Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-7, LPR-5300.1
EEE Parts Plan	Updated	LaRC
Software Assurance Plan	Updated	LaRC
System Safety Analysis	Updated	NPR-7123.1A, Table G-8
Subsystem Safety Analyses	Updated	NPR-7123.1A, Table G-8
Reliability Analyses	Updated	NPR-7123.1A, Table G-8
Orbital Debris Assessment	Updated	NPR-7120.5D, Table 4.3
Missile System Pre-Launch Safety Package	Updated	NPR-7120.5D, Table 4-3
Range Safety Risk Management Plan	Updated	NPR-7120.5D, Table 4-3
Requirements		

Mission Concept Report	Updated	NPR-7120.5D, Table 4-3
System Requirements Document	Updated	NPR-7123.1A, Table G-4
Element Requirements Documents (including IRDs)	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5
Subsystem Requirements Documents (including software)	Updated	NPR-7123.1A, Table G-4
Design		
Interface Control Documents	Updated	NPR-7123.1A, Table G-8
Software Development Plan	Updated	NPR-7123.1A, Table G-4
Software Design Document(s)	Updated	NPR-7123.1A, Table G-8
Technology Assessment Readiness Report	Updated	NPR-7120.5D, Table 4-3
Design Report	Updated	NPR-7120.5D, Table 4.3
<Engineering Drawing Tree>	Updated	NPR-7123.1A, Table G-7
Drawings	Updated	NPR-7123.1A, Table G-7, G-8, G-9
Analyses	Updated	NPR-7123.1A, Table G-7, G-8
Trade Study Reports	Updated	NPR-7123.1A, Table G-7, G-8
Build and Test		
Configuration Item List	Updated	NPR-7123.1A, Table G-7, G-8
Limited Life Items List	Updated	NPR-7123.1A, Table G-8
Software Test Plan	Updated	NPR-7123.1A, Table G-6
Contamination Control Plan	Updated	NPR-7123.1A, Table G-7
Photographic Documentation Plan	Updated	LPR-7600.1
Technical Product Package	Updated	NPR-7123.1A, Table G-12
<As-built hardware and software documentation>	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-12
<Test Results>	Updated	NPR-7123.1A, Table G-12
Integration and Test Plan	Updated	NPR-7123.1A, Table G-10
Baseline Test Procedures (including software)	Updated	LaRC
Verification, Validation, Certification		
Human Rating Plan, if applicable	Updated	NPR-7123.1A, Table G-8

Certification Package	Updated	NPR-7123.1A, Table G-12, G14
Verification Plan (may be combined with Validation Plan below)	Updated	NPR-7123.1A, Table G-8
Validation Plan (may be combined with Verification Plan above)	Updated	NPR-7123.1A, Table G-8
Verification and Validation Report	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-12
System Acceptance Criteria	Updated	NPR-7123.1A, Table G-8
Documentation that system satisfies acceptance criteria	Updated	NPR-7123.1A, Table G-12
Operations and Logistics		
Mission Operations Concept Document	Updated	NPR-7120.5D, Table 4-3
Mission Operations Plan	Updated	NPR-7120.5D, Table 4-4
Operational Activation and Checkout Plan	Updated	NPR-7123.1A, Table G-8
Operations Handbook (including software users manuals)	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-13
Command and Telemetry List	Updated	NPR-7123.1A, Table G-8
Logistics Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
Launch Site Operations Plan	Updated	NPR-7123.1A, Table G-8
Security Plan	Updated	NPR-7120.5D, Table 4-4
Export Control Plan	Updated	NPR-7120.5D, Table 4-4
Decommissioning and Closeout Decommissioning/Disposal Plan	Preliminary	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-8

4.16.4 Review Content:

The following content is typically expected at a PLAR.

Science/Mission Goals and Objectives
Minimum Mission Success Criteria
Mission/Project Overview & Status
Peer Review Reports
Mission Operations

Organizational Roles and Responsibilities
Ground Operations
Ground Support Equipment
Operations Team / Training Plan
On-Orbit Activation and Checkout Plan
Contingency Plans
System Checkout Status
Significant Changes to Procedures, interfaces agreements, software, and staffing
In Flight Anomalies and Responsive Action

Launch Vehicle
Launch Vehicle Performance Assessment and Implications

Mission Assurance
Quality Assurance

Safety Assurance
Safety Plans
Safety Analyses
Probabilistic Risk Assessment, where appropriate

Mission/Science
Spacecraft / Instrument Performance
Mission/Science Data Management
Data Retrieval and Analysis

Programmatics / Project Plan
Security Plan
Review Plan
Known System Discrepancies Disposed According to Agreed-upon Plan

Lessons Learned
Relevant Lessons from Prior Projects
Lessons Learned from Current Project

Risk Management
Risk Assessment and Mitigation Plans

4.16.5 Success Criteria:

For formal NASA programs and projects, the Review Board shall evaluate the project using the success criteria indicated below. For subprojects, tailored success criteria may be used provided they are enumerated in the ToR for the review.

(1) The observed spacecraft and science payload performance agrees with prediction, or if not, is adequately understood so that future behavior can be predicted with confidence.
(2) All anomalies have been adequately documented, and their impact on operations assessed. Further, anomalies impacting spacecraft health and safety or critical flight operations have been properly disposed.
(3) The mission operations capabilities, including staffing and plans, are adequate to accommodate the actual flight performance.

(4) Liens, if any, on operations, identified as part of the ORR, have been satisfactorily disposed.

4.16.6 Lessons Learned:

Following the review, the project is expected to collect lessons learned on the project thus far. The project may define the method(s) for collecting the lessons. The lessons learned are expected to be presented at the project's next Engineering Project and Task Review and to be included as backup at the project's next CMC review. Particularly important lessons learned may be included in the main portion of the CMC presentation. The collected lessons learned are expected to become part of the project's concluding Lessons Learned Review.

4.17 Critical Events Readiness Review (CERR)

A CERR confirms the project's readiness to execute the mission's critical activities during flight operation. [Ref. NPR 7123.1A] The Review confirms the readiness to execute a critical event during flight operations. For human space flight, the CERR is performed by the Mission Management Team (MMT). [Ref. NPR 7120.5D]

4.17.1 Timing

a. The review is held prior to execution of a critical event during flight operations. When multiple critical events are planned in close sequence, a single CERR may be used to address all of those critical events.

b. A CERR ToR, with agenda and success criteria, has been agreed to by the appropriate parties.

4.17.2 Entrance Criteria

The following Entrance Criteria are specified in NPR 7123.1A and are required for all formal NASA projects. For subprojects, tailored Entrance Criteria may be used as long as they are enumerated in the ToR for the review.

1. Mission overview and context for the critical event(s).
2. Activity requirements and constraints.
3. Critical activity sequence design description including key tradeoffs and rationale for selected approach.
4. Fault protection strategy.
5. Critical activity operations plan including planned uplinks and criticality.
6. Sequence verification (testing, walk-throughs, peer review) and critical activity validation.
7. Operations team training plan and readiness report.

8. Risk areas and mitigations.
9. Spacecraft readiness report.
10. Open items and plans.

4.17.3 Management and Technical Products

Table Note: Items in angle brackets are not required to be formal documents at this stage.

For formal NASA programs and projects, the project shall make available to the Review Board the following Management and Technical Products with the indicated maturity. For subprojects, tailored Management and Technical Products may be used as long as they are enumerated in the ToR for the review.

Product	Maturity	Source
Formulation Authorization Document	Approved	NPR-7120.5D, Table 4-3
Acquisition Strategy Meeting Minutes	Baseline	NPR-7120.5D, Table 4-3
Program Requirements on Project	Updated	NPR-7120.5D, Table 4-3
CADRe	Updated	NPR-7120.5D, Table 4-3
Management Planning and Control		
ITA (or equivalent authorization)	Updated	LaRC
Project Implementation Plan, a.k.a. Project Plan	Updated	NPR-7120.5D, Table 4-3
<Integrated Baseline>	Updated	NPR-7120.5D, Table 4-3
Document Tree	Updated	NPR-7123.1A, Table G-4
Systems Engineering Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Information & Configuration Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Risk Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Software Management Plan	Updated	NPR-7120.5D, Table 4-4
<Risk assessment and mitigations>	Updated	NPR-7123.1A, Table G-8
Review Plan	Updated	LPR-7130
Technology Development Plan, a.k.a. Technology Development Maturity	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8

Assessment Plan		
Science Data Management Plan	Updated	NPR-7120.5D, Table 4-4
<Business Case Analysis for Infrastructure>	Updated	NPR-7120.5D, Table 4-3
Regulatory Plans		
Nuclear Safety Launch Approval Plan, if applicable (updated)	Updated	NPR-7120.5D, Table 4-3
Planetary Protection Plan	Updated	NPR-7120.5D, Table 4-3
Environmental Management Plan	Updated	NPR-7120.5D, Table 4-3
Regulatory Agency Plans and Assessments (as needed)	Updated	NPR-7120.5D, Table 4-3
Safety & Mission Assurance		
Safety & Mission Assurance Plan / Product Assurance Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-7, LPR-5300.1
EEE Parts Plan	Updated	LaRC
Software Assurance Plan	Updated	LaRC
System Safety Analysis	Updated	NPR-7123.1A, Table G-8
Subsystem Safety Analyses	Updated	NPR-7123.1A, Table G-8
Reliability Analyses	Updated	NPR-7123.1A, Table G-8
Orbital Debris Assessment	Updated	NPR-7120.5D, Table 4.3
Missile System Pre-Launch Safety Package	Updated	NPR-7120.5D, Table 4-3
Range Safety Risk Management Plan	Updated	NPR-7120.5D, Table 4-3
Requirements		
Mission Concept Report	Updated	NPR-7120.5D, Table 4-3
System Requirements Document	Updated	NPR-7123.1A, Table G-4
Element Requirements Documents (including IRDs)	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5
Subsystem Requirements Documents (including software)	Updated	NPR-7123.1A, Table G-4
Design		
Interface Control Documents	Updated	NPR-7123.1A, Table G-8
Software Development Plan	Updated	NPR-7123.1A, Table G-4

Software Design Document(s)	Updated	NPR-7123.1A, Table G-8
Technology Assessment Readiness Report	Updated	NPR-7120.5D, Table 4-3
Design Report	Updated	NPR-7120.5D, Table 4.3
<Engineering Drawing Tree>	Updated	NPR-7123.1A, Table G-7
Drawings	Updated	NPR-7123.1A, Table G-7, G-8, G-9
Analyses	Updated	NPR-7123.1A, Table G-7, G-8
Trade Study Reports	Updated	NPR-7123.1A, Table G-7, G-8
Build and Test		
Configuration Item List	Updated	NPR-7123.1A, Table G-7, G-8
Limited Life Items List	Updated	NPR-7123.1A, Table G-8
Software Test Plan	Updated	NPR-7123.1A, Table G-6
Contamination Control Plan	Updated	NPR-7123.1A, Table G-7
Photographic Documentation Plan	Updated	LPR-7600.1
Technical Product Package	Updated	NPR-7123.1A, Table G-12
<As-built hardware and software documentation>	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-12
<Test Results>	Updated	NPR-7123.1A, Table G-12
Integration and Test Plan	Updated	NPR-7123.1A, Table G-10
Baseline Test Procedures (including software)	Updated	LaRC
Verification, Validation, Certification		
Human Rating Plan, if applicable	Updated	NPR-7123.1A, Table G-8
Certification Package	Updated	NPR-7123.1A, Table G-12, G14
Verification Plan (may be combined with Validation Plan below)	Updated	NPR-7123.1A, Table G-8
Validation Plan (may be combined with Verification Plan above)	Updated	NPR-7123.1A, Table G-8
Verification and Validation Report	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-12
System Acceptance Criteria	Updated	NPR-7123.1A, Table G-8
Documentation that system satisfies acceptance criteria	Updated	NPR-7123.1A, Table G-12

Operations and Logistics		
Mission Operations Concept Document	Updated	NPR-7120.5D, Table 4-3
Mission Operations Plan	Updated	NPR-7120.5D, Table 4-4
Operational Activation and Checkout Plan	Updated	NPR-7123.1A, Table G-8
Operations Handbook (including software users manuals)	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-13
Command and Telemetry List	Updated	NPR-7123.1A, Table G-8
Logistics Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
Launch Site Operations Plan	Updated	NPR-7123.1A, Table G-8
Security Plan	Updated	NPR-7120.5D, Table 4-4
Export Control Plan	Updated	NPR-7120.5D, Table 4-4
Critical Events Readiness Report	Baseline	NPR-7123.1A, Table G-16
Decommissioning and Closeout Decommissioning/Disposal Plan	Preliminary	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-8

4.17.4 Review Content:

The following content is typically expected at a CERR.

Science/Mission Goals and Objectives
- Minimum Mission Success Criteria

Mission/Project Overview & Context for Critical Event
Design Solution
- Changes from FRR Design and Implications
- Operational Limits and Constraints

Peer Review Reports
Mission Operations
- Organizational Roles and Responsibilities
- Ground Operations
- Ground Support Equipment, if applicable
- Operations Team / Training Plan
- Contingency Plans
- System Checkout Status
- Significant Changes to Procedures, Interfaces, Software, and Staffing

Public Relations Plans (including contingencies)
In Flight Critical Events
Activity Requirements and Constraints
Critical Event Sequence Design
Trade-off studies
Fault Protection Strategy
Critical Activity Operations Plan
Sequence Verification
Team Readiness Report
Spacecraft Readiness Report
Programmatics / Project Plan
Security Plan
Lessons Learned
Relevant Lessons from Prior Projects
Lessons Learned from Current Project
Risk Management
Risk Assessment and Mitigation Plans

4.17.5 Success Criteria:

For formal NASA programs and projects, the Review Board shall evaluate the project using the success criteria indicated below. For subprojects, tailored success criteria may be used provided they are enumerated in the ToR for the review.

(1) The critical activity design complies with requirements.
(2) The preparation for the critical activity, including the verification and validation, is thorough.
(3) The project (including all the systems, supporting services, and documentation) is ready to support the activity.
(4) The requirements for the successful execution of the critical event(s) are complete and understood and have flowed down to the appropriate levels for implementation.

4.17.6 Lessons Learned:

Following the review, the project is expected to collect lessons learned on the project thus far. The project may define the method(s) for collecting the lessons. The lessons learned are expected to be presented at the project's next Engineering Project and Task Review and to be included as backup at the project's next CMC review. Particularly important lessons learned may be included in the main portion of the CMC presentation. The collected lessons learned are expected to become part of the project's concluding Lessons Learned Review.

4.18 Post-Flight Assessment Review (PFAR)

The PFAR is a human space flight review that occurs after a flight mission in order to assess whether mission objectives were met and the status of the returned vehicle. [Ref. NPR 7120.5D] The PFAR evaluates the activities from the flight after recovery. The review identifies all anomalies that occurred during the flight and mission and determines the actions necessary to mitigate or resolve the anomalies for future flights. [Ref. NPR 7123.1A]

4.18.1 Timing:

a. The review is held after a human space-flight mission but prior to the next similar human space-flight mission.

b. A PFAR ToR, with agenda and success criteria, has been agreed to by the appropriate parties.

4.18.2 Entrance Criteria

The following Entrance Criteria are specified in NPR 7123.1A and are required for all formal NASA projects. For subprojects, tailored Entrance Criteria may be used as long as they are enumerated in the ToR for the review.

1. All anomalies that occurred during the mission, as well as during preflight testing, countdown, and ascent, identified.
2. Report on overall post-recovery condition.
3. Report any evidence of ascent debris.
4. All photo and video documentation available.
5. Retention plans for scrapped hardware completed.
6. Post-Flight Assessment Team Operating Plan completed.
7. Disassembly activities planned and scheduled.
8. Processes and controls to coordinate in-flight anomaly trouble shooting and post-flight data preservation developed.
9. Problem reports, corrective action requests, Post Flight Anomaly Records (PFARs), and final post-flight documentation completed.
10. All post-flight hardware and flight data evaluation reports completed.

4.18.3 Management and Technical Products

Table Note: Items in angle brackets are not required to be formal documents at this stage.

For formal NASA programs and projects, the project shall make available to the Review Board the following Management and Technical Products with the indicated

maturity. For subprojects, tailored Management and Technical Products may be used as long as they are enumerated in the ToR for the review.

Product	Maturity	Source
Formulation Authorization Document	Approved	NPR-7120.5D, Table 4-3
Acquisition Strategy Meeting Minutes	Baseline	NPR-7120.5D, Table 4-3
Program Requirements on Project	Updated	NPR-7120.5D, Table 4-3
CADRe	Updated	NPR-7120.5D, Table 4-3
Management Planning and Control		
ITA (or equivalent authorization)	Updated	LaRC
Project Implementation Plan, a.k.a. Project Plan	Updated	NPR-7120.5D, Table 4-3
<Integrated Baseline>	Updated	NPR-7120.5D, Table 4-3
Document Tree	Updated	NPR-7123.1A, Table G-4
Systems Engineering Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Information & Configuration Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Risk Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Software Management Plan	Updated	NPR-7120.5D, Table 4-4
<Risk assessment and mitigations>	Updated	NPR-7123.1A, Table G-8
Review Plan	Updated	LPR-7130
Technology Development Plan, a.k.a. Technology Development Maturity Assessment Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
Science Data Management Plan	Updated	NPR-7120.5D, Table 4-4
<Business Case Analysis for Infrastructure>	Updated	NPR-7120.5D, Table 4-3
Regulatory Plans		
Nuclear Safety Launch Approval Plan, if applicable (updated)	Updated	NPR-7120.5D, Table 4-3

Planetary Protection Plan	Updated	NPR-7120.5D, Table 4-3
Environmental Management Plan	Updated	NPR-7120.5D, Table 4-3
Regulatory Agency Plans and Assessments (as needed)	Updated	NPR-7120.5D, Table 4-3
Safety & Mission Assurance		
Safety & Mission Assurance Plan / Product Assurance Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-7, LPR-5300.1
EEE Parts Plan	Updated	LaRC
Software Assurance Plan	Updated	LaRC
System Safety Analysis	Updated	NPR-7123.1A, Table G-8
Subsystem Safety Analyses	Updated	NPR-7123.1A, Table G-8
Reliability Analyses	Updated	NPR-7123.1A, Table G-8
Orbital Debris Assessment	Updated	NPR-7120.5D, Table 4.3
Missile System Pre-Launch Safety Package	Updated	NPR-7120.5D, Table 4-3
Range Safety Risk Management Plan	Updated	NPR-7120.5D, Table 4-3
Requirements		
Mission Concept Report	Updated	NPR-7120.5D, Table 4-3
System Requirements Document	Updated	NPR-7123.1A, Table G-4
Element Requirements Documents (including IRDs)	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5
Subsystem Requirements Documents (including software)	Updated	NPR-7123.1A, Table G-4
Design		
Interface Control Documents	Updated	NPR-7123.1A, Table G-8
Software Development Plan	Updated	NPR-7123.1A, Table G-4
Software Design Document(s)	Updated	NPR-7123.1A, Table G-8
Technology Assessment Readiness Report	Updated	NPR-7120.5D, Table 4-3
Design Report	Updated	NPR-7120.5D, Table 4.3
<Engineering Drawing Tree>	Updated	NPR-7123.1A, Table G-7
Drawings	Updated	NPR-7123.1A, Table G-7, G-8, G-9
Analyses	Updated	NPR-7123.1A, Table G-7, G-8

Trade Study Reports	Updated	NPR-7123.1A, Table G-7, G-8
Build and Test		
Configuration Item List	Updated	NPR-7123.1A, Table G-7, G-8
Limited Life Items List	Updated	NPR-7123.1A, Table G-8
Software Test Plan	Updated	NPR-7123.1A, Table G-6
Contamination Control Plan	Updated	NPR-7123.1A, Table G-7
Photographic Documentation Plan	Updated	LPR-7600.1
Technical Product Package	Updated	NPR-7123.1A, Table G-12
<As-built hardware and software documentation>	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-12
<Test Results>	Updated	NPR-7123.1A, Table G-12
Integration and Test Plan	Updated	NPR-7123.1A, Table G-10
Baseline Test Procedures (including software)	Updated	LaRC
Verification, Validation, Certification		
Human Rating Plan, if applicable	Updated	NPR-7123.1A, Table G-8
Certification Package	Updated	NPR-7123.1A, Table G-12, G14
Verification Plan (may be combined with Validation Plan below)	Updated	NPR-7123.1A, Table G-8
Validation Plan (may be combined with Verification Plan above)	Updated	NPR-7123.1A, Table G-8
Verification and Validation Report	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-12
System Acceptance Criteria	Updated	NPR-7123.1A, Table G-8
Documentation that system satisfies acceptance criteria	Updated	NPR-7123.1A, Table G-12
Operations and Logistics		
Mission Operations Concept Document	Updated	NPR-7120.5D, Table 4-3
Mission Operations Plan	Updated	NPR-7120.5D, Table 4-4
Operational Activation and Checkout Plan	Updated	NPR-7123.1A, Table G-8
Operations Handbook (including software users	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-13

manuals)		
Command and Telemetry List	Updated	NPR-7123.1A, Table G-8
Logistics Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
Launch Site Operations Plan	Updated	NPR-7123.1A, Table G-8
Security Plan	Updated	NPR-7120.5D, Table 4-4
Export Control Plan	Updated	NPR-7120.5D, Table 4-4
Critical Events Readiness Report	Updated	NPR-7123.1A, Table G-16
Decommissioning and Closeout		
Decommissioning/Disposal Plan	Preliminary	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-8
Mission Report	Preliminary	NPR-7120.5C, Table 4-3
Postflight Assessment Team Operating Plan	Baseline	NPR-7123.1A, Table G-17

4.18.4 Review Content:

The following content is typically expected at a PFAR.

Science/Mission Goals and Objectives
- Minimum Mission Success Criteria

Mission/Project Overview & Status

Mission Operations
- Organizational Roles and Responsibilities
- Retirement/Disposal

Mission/Science
- Mission/Science Data Management
  - Data Retrieval and Analysis

Programmatics / Project Plan
- Schedule
- Budget / Life Cycle Cost
- Deliverables
- Resources
- Information & Configuration Management
- Security Plan

Post-Flight Assessments
- Post-Flight Assessment Team Operating Plan
- Anomalies (including ascent debris)
- Overall Post-Recovery Condition, if applicable
- Photographic and Video Documentation

Corrective Actions and Impact on Future Flight Operations
Plans for Assessment Documentation and Imaging Retention
Disposition of reports and other documentation for future performance comparison and trending
Processes and Controls for Coordination of In-Flight Anomaly Trouble-shooting and Post-Flight Data Preservation
Hardware Retention, Disassembly and/or Scrapping Plans
Lessons Learned
Relevant Lessons from Prior Projects
Lessons Learned from Current Project

4.18.5 Success Criteria:

For formal NASA programs and projects, the Review Board shall evaluate the project using the success criteria indicated below. For subprojects, tailored success criteria may be used provided they are enumerated in the ToR for the review.

(1) A formal final report documents flight performance and recommendations for future missions.
(2) All anomalies have been adequately documented and dispositioned.
(3) The impact of anomalies on future flight operations has been assessed.
(4) Plans for retaining assessment documentation and imaging have been made. Reports and other documentation have been added to a database for performance comparison and trending.

4.18.6 Lessons Learned:

Following the review, the project is expected to collect lessons learned on the project thus far. The project may define the method(s) for collecting the lessons. The lessons learned are expected to be presented at the project's next Engineering Project and Task Review and to be included as backup at the project's next CMC review. Particularly important lessons learned may be included in the main portion of the CMC presentation. The collected lessons learned are expected to become part of the project's concluding Lessons Learned Review.

4.19 Decommissioning Review (DR)

A DR confirms the decision to terminate or decommission the system and assesses the readiness of the system for the safe decommissioning and disposal of system assets. [Ref. NPR 7123.1A, NPR 7120.5D]

4.19.1 Timing:

a. The review is prior to decommissioning or intentionally disposing of a space-flight system.

b. A DR ToR, with agenda and success criteria, has been agreed to by the appropriate parties.

4.19.2 Entrance Criteria

The following Entrance Criteria are specified in NPR 7123.1A and are required for all formal NASA projects. For subprojects, tailored Entrance Criteria may be used as long as they are enumerated in the ToR for the review.

1. Requirements associated with decommissioning and disposal are defined.
2. Plans are in place for decommissioning, disposal, and any other removal from service activities.
3. Resources are in place to support decommissioning and disposal activities, plans for disposition of project assets, and archival of essential mission and project data.
4. Safety, environmental, and any other constraints are described.
5. Current system capabilities are described.
6. For off-nominal operations, all contributing events, conditions, and changes to the originally expected baseline are described.

4.19.3 Management and Technical Products

Table Note: Items in angle brackets are not required to be formal documents at this stage.

For formal NASA programs and projects, the project shall make available to the Review Board the following Management and Technical Products with the indicated maturity. For subprojects, tailored Management and Technical Products may be used as long as they are enumerated in the ToR for the review.

Product	Maturity	Source
Formulation Authorization Document	Approved	NPR-7120.5D, Table 4-3
Acquisition Strategy Meeting Minutes	Baseline	NPR-7120.5D, Table 4-3
Program Requirements on Project	Updated	NPR-7120.5D, Table 4-3
CADRe	Updated	NPR-7120.5D, Table 4-3
Management Planning and Control		
ITA (or equivalent authorization)	Updated	LaRC
Project Implementation Plan, a.k.a. Project Plan	Updated	NPR-7120.5D, Table 4-3

<Integrated Baseline>	Updated	NPR-7120.5D, Table 4-3
Document Tree	Updated	NPR-7123.1A, Table G-4
Systems Engineering Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Information & Configuration Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Risk Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Software Management Plan	Updated	NPR-7120.5D, Table 4-4
<Risk assessment and mitigations>	Updated	NPR-7123.1A, Table G-8
Review Plan	Updated	LPR-7130
Technology Development Plan, a.k.a. Technology Development Maturity Assessment Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
Science Data Management Plan	Updated	NPR-7120.5D, Table 4-4
<Business Case Analysis for Infrastructure>	Updated	NPR-7120.5D, Table 4-3
Regulatory Plans		
Nuclear Safety Launch Approval Plan, if applicable (updated)	Updated	NPR-7120.5D, Table 4-3
Planetary Protection Plan	Updated	NPR-7120.5D, Table 4-3
Environmental Management Plan	Updated	NPR-7120.5D, Table 4-3
Regulatory Agency Plans and Assessments (as needed)	Updated	NPR-7120.5D, Table 4-3
Safety & Mission Assurance		
Safety & Mission Assurance Plan / Product Assurance Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-7, LPR-5300.1
EEE Parts Plan	Updated	LaRC
Software Assurance Plan	Updated	LaRC
System Safety Analysis	Updated	NPR-7123.1A, Table G-8
Subsystem Safety Analyses	Updated	NPR-7123.1A, Table G-8
Reliability Analyses	Updated	NPR-7123.1A, Table G-8
Orbital Debris Assessment	Updated	NPR-7120.5D, Table 4.3

Missile System Pre-Launch Safety Package	Updated	NPR-7120.5D, Table 4-3
Range Safety Risk Management Plan	Updated	NPR-7120.5D, Table 4-3
Requirements		
Mission Concept Report	Updated	NPR-7120.5D, Table 4-3
System Requirements Document	Updated	NPR-7123.1A, Table G-4
Element Requirements Documents (including IRDs)	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5
Subsystem Requirements Documents (including software)	Updated	NPR-7123.1A, Table G-4
Design		
Interface Control Documents	Updated	NPR-7123.1A, Table G-8
Software Development Plan	Updated	NPR-7123.1A, Table G-4
Software Design Document(s)	Updated	NPR-7123.1A, Table G-8
Technology Assessment Readiness Report	Updated	NPR-7120.5D, Table 4-3
Design Report	Updated	NPR-7120.5D, Table 4.3
<Engineering Drawing Tree>	Updated	NPR-7123.1A, Table G-7
Drawings	Updated	NPR-7123.1A, Table G-7, G-8, G-9
Analyses	Updated	NPR-7123.1A, Table G-7, G-8
Trade Study Reports	Updated	NPR-7123.1A, Table G-7, G-8
Build and Test		
Configuration Item List	Updated	NPR-7123.1A, Table G-7, G-8
Limited Life Items List	Updated	NPR-7123.1A, Table G-8
Software Test Plan	Updated	NPR-7123.1A, Table G-6
Contamination Control Plan	Updated	NPR-7123.1A, Table G-7
Photographic Documentation Plan	Updated	LPR-7600.1
Technical Product Package	Updated	NPR-7123.1A, Table G-12
<As-built hardware and software documentation>	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-12
<Test Results>	Updated	NPR-7123.1A, Table G-12
Integration and Test Plan	Updated	NPR-7123.1A, Table G-10
Baseline Test Procedures	Updated	LaRC

(including software)		
Verification, Validation, Certification		
Human Rating Plan, if applicable	Updated	NPR-7123.1A, Table G-8
Certification Package	Updated	NPR-7123.1A, Table G-12, G14
Verification Plan (may be combined with Validation Plan below)	Updated	NPR-7123.1A, Table G-8
Validation Plan (may be combined with Verification Plan above)	Updated	NPR-7123.1A, Table G-8
Verification and Validation Report	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-12
System Acceptance Criteria	Updated	NPR-7123.1A, Table G-8
Documentation that system satisfies acceptance criteria	Updated	NPR-7123.1A, Table G-12
Operations and Logistics		
Mission Operations Concept Document	Updated	NPR-7120.5D, Table 4-3
Mission Operations Plan	Updated	NPR-7120.5D, Table 4-4
Operational Activation and Checkout Plan	Updated	NPR-7123.1A, Table G-8
Operations Handbook (including software users manuals)	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-13
Command and Telemetry List	Updated	NPR-7123.1A, Table G-8
Logistics Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
Launch Site Operations Plan	Updated	NPR-7123.1A, Table G-8
Security Plan	Updated	NPR-7120.5D, Table 4-4
Export Control Plan	Updated	NPR-7120.5D, Table 4-4
Critical Events Readiness Report	Updated	NPR-7123.1A, Table G-16
Decommissioning and Closeout		
Decommissioning/Disposal Plan	Baseline	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-8
Mission Report	Baseline	NPR-7120.5C, Table 4-3
Postflight Assessment Team Operating Plan	Updated	NPR-7123.1A, Table G-17

4.19.4 Review Content:

The following content is typically expected at a DR.

- Science/Mission Goals and Objectives
  - Minimum Mission Success Criteria
- Mission/Project Overview & Status
  - Mission/Project Organization
- Systems Engineering
  - Configuration Item List of Recovered Hardware
- Mission Analysis
  - Orbits and Trajectories
  - De-orbit Windows
  - Guidance, Navigation, and Control
- Mission Operations for Decommissioning
  - Organizational Roles and Responsibilities
  - Ground Operations
  - Ground Support Equipment, if applicable
  - Retirement/Disposal – Disposition of Assets
    - Disposal Requirements
    - Decommissioning/Disposal Plan
    - Safety, Environmental, and Other Constraints
    - Current Capabilities
    - Off-Nominal Operations
    - Contingency Plans
    - Operations Team / Training Plan
    - Disposition of Assets
    - Data Archiving
    - Necessary Approvals
    - Recovery Plans and Logistics, if applicable
  - Public Relations Plans (including contingencies)
- Mission/Science
  - Mission/Science Data Management
    - Data Analysis and Archival Plans
- Programmatics / Project Plan
  - Work Breakdown Structure (WBS)
  - Schedule
  - Budget / Life Cycle Cost
  - Resources
  - Security Plan
  - Export Control Plan
- Lessons Learned
  - Relevant Lessons from Prior Projects
  - Lessons Learned from Current Project

4.19.5 Success Criteria:

For formal NASA programs and projects, the Review Board shall evaluate the project using the success criteria indicated below. For subprojects, tailored success criteria may be used provided they are enumerated in the ToR for the review.

(1) The reasons for decommissioning disposal are documented.
(2) The decommissioning and disposal plan is complete, approved by appropriate management, and compliant with applicable Agency safety, environmental, and health regulations. Operations plans for all potential scenarios, including contingencies, are complete and approved. All required support systems are available.
(3) All personnel have been properly trained for the nominal and contingency procedures.
(4) Safety, health, and environmental hazards have been identified. Controls have been verified.
(5) Risks associated with the disposal have been identified and adequately mitigated. Residual risks have been accepted by the required management.
(6) If hardware is to be recovered from orbit:
   a. Return site activity plans have been defined and approved.
   b. Required facilities are available and meet requirements, including those for contamination control, if needed.
   c. Transportation plans are defined and approved. Shipping containers and handling equipment, as well as contamination and environmental control and monitoring devices, are available.
(7) Plans for disposition of mission-owned assets (i.e., hardware, software, and facilities) have been defined and approved.
(8) Plans for archival and subsequent analysis of mission data have been defined and approved. Arrangements have been finalized for the execution of such plans. Plans for the capture and dissemination of appropriate lessons learned during the project life cycle have been defined and approved. Adequate resources (schedule, budget, and staffing) have been identified and are available to successfully complete all decommissioning, disposal, and disposition activities.

4.19.6 Lessons Learned:

Following the review, the project is expected to collect lessons learned on the project thus far. The project may define the method(s) for collecting the lessons. The lessons learned are expected to be presented at the project's next Engineering Project and Task Review and to be included as backup at the project's next CMC review. Particularly important lessons learned may be included in the main portion of the CMC

presentation. The collected lessons learned are expected to become part of the project's concluding Lessons Learned Review.

4.20 Lessons Learned Review (LLR)

The purpose of this review is to collect and disseminate information on experiences gained during the project lifetime. It provides the review panel with an overview of the lessons learned.

4.20.1 Timing:

The project team is ready to do an evaluation of project activities. This is normally soon after launch and initialization. A concluding LLR is done at the end of the project. If lessons learned are reported incrementally, then separate lessons learned reviews are not required.

4.20.2 Management and Technical Products

For formal NASA programs and projects, the project shall make available to the Review Board the following Management and Technical Products with the indicated maturity. For subprojects, tailored Management and Technical Products may be used as long as they are enumerated in the ToR for the review.

Product	Maturity	Source
Formulation Authorization Document	Approved	NPR-7120.5D, Table 4-3
Acquisition Strategy Meeting Minutes	Baseline	NPR-7120.5D, Table 4-3
Program Requirements on Project	Updated	NPR-7120.5D, Table 4-3
CADRe	Updated	NPR-7120.5D, Table 4-3
Management Planning and Control		
ITA (or equivalent authorization)	Updated	LaRC
Project Implementation Plan, a.k.a. Project Plan	Updated	NPR-7120.5D, Table 4-3
<Integrated Baseline>	Updated	NPR-7120.5D, Table 4-3
Document Tree	Updated	NPR-7123.1A, Table G-4
Systems Engineering Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Information & Configuration	Updated	NPR-7120.5D, Table 4-4,

Management Plan		NPR-7123.1A, Table G-4
Risk Management Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-4
Software Management Plan	Updated	NPR-7120.5D, Table 4-4
<Risk assessment and mitigations>	Updated	NPR-7123.1A, Table G-8
Review Plan	Updated	LPR-7130
Technology Development Plan, a.k.a. Technology Development Maturity Assessment Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
Science Data Management Plan	Updated	NPR-7120.5D, Table 4-4
<Business Case Analysis for Infrastructure>	Updated	NPR-7120.5D, Table 4-3
Regulatory Plans		
Nuclear Safety Launch Approval Plan, if applicable (updated)	Updated	NPR-7120.5D, Table 4-3
Planetary Protection Plan	Updated	NPR-7120.5D, Table 4-3
Environmental Management Plan	Updated	NPR-7120.5D, Table 4-3
Regulatory Agency Plans and Assessments (as needed)	Updated	NPR-7120.5D, Table 4-3
Safety & Mission Assurance		
Safety & Mission Assurance Plan / Product Assurance Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-7, LPR-5300.1
EEE Parts Plan	Updated	LaRC
Software Assurance Plan	Updated	LaRC
System Safety Analysis	Updated	NPR-7123.1A, Table G-8
Subsystem Safety Analyses	Updated	NPR-7123.1A, Table G-8
Reliability Analyses	Updated	NPR-7123.1A, Table G-8
Orbital Debris Assessment	Updated	NPR-7120.5D, Table 4.3
Missile System Pre-Launch Safety Package	Updated	NPR-7120.5D, Table 4-3
Range Safety Risk Management Plan	Updated	NPR-7120.5D, Table 4-3
Requirements		

Mission Concept Report	Updated	NPR-7120.5D, Table 4-3
System Requirements Document	Updated	NPR-7123.1A, Table G-4
Element Requirements Documents (including IRDs)	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-5
Subsystem Requirements Documents (including software)	Updated	NPR-7123.1A, Table G-4
Design		
Interface Control Documents	Updated	NPR-7123.1A, Table G-8
Software Development Plan	Updated	NPR-7123.1A, Table G-4
Software Design Document(s)	Updated	NPR-7123.1A, Table G-8
Technology Assessment Readiness Report	Updated	NPR-7120.5D, Table 4-3
Design Report	Updated	NPR-7120.5D, Table 4.3
<Engineering Drawing Tree>	Updated	NPR-7123.1A, Table G-7
Drawings	Updated	NPR-7123.1A, Table G-7, G-8, G-9
Analyses	Updated	NPR-7123.1A, Table G-7, G-8
Trade Study Reports	Updated	NPR-7123.1A, Table G-7, G-8
Build and Test		
Configuration Item List	Updated	NPR-7123.1A, Table G-7, G-8
Limited Life Items List	Updated	NPR-7123.1A, Table G-8
Software Test Plan	Updated	NPR-7123.1A, Table G-6
Contamination Control Plan	Updated	NPR-7123.1A, Table G-7
Photographic Documentation Plan	Updated	LPR-7600.1
Technical Product Package	Updated	NPR-7123.1A, Table G-12
<As-built hardware and software documentation>	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-12
<Test Results>	Updated	NPR-7123.1A, Table G-12
Integration and Test Plan	Updated	NPR-7123.1A, Table G-10
Baseline Test Procedures (including software)	Updated	LaRC
Verification, Validation, Certification		
Human Rating Plan, if applicable	Updated	NPR-7123.1A, Table G-8

Certification Package	Updated	NPR-7123.1A, Table G-12, G14
Verification Plan (may be combined with Validation Plan below)	Updated	NPR-7123.1A, Table G-8
Validation Plan (may be combined with Verification Plan above)	Updated	NPR-7123.1A, Table G-8
Verification and Validation Report	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-12
System Acceptance Criteria	Updated	NPR-7123.1A, Table G-8
Documentation that system satisfies acceptance criteria	Updated	NPR-7123.1A, Table G-12
Operations and Logistics		
Mission Operations Concept Document	Updated	NPR-7120.5D, Table 4-3
Mission Operations Plan	Updated	NPR-7120.5D, Table 4-4
Operational Activation and Checkout Plan	Updated	NPR-7123.1A, Table G-8
Operations Handbook (including software users manuals)	Updated	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-13
Command and Telemetry List	Updated	NPR-7123.1A, Table G-8
Logistics Plan	Updated	NPR-7120.5D, Table 4-4, NPR-7123.1A, Table G-8
Launch Site Operations Plan	Updated	NPR-7123.1A, Table G-8
Security Plan	Updated	NPR-7120.5D, Table 4-4
Export Control Plan	Updated	NPR-7120.5D, Table 4-4
Critical Events Readiness Report	Updated	NPR-7123.1A, Table G-16
Decommissioning and Closeout		
Decommissioning/Disposal Plan	Baseline	NPR-7120.5D, Table 4-3, NPR-7123.1A, Table G-8
Mission Report	Baseline	NPR-7120.5C, Table 4-3
Postflight Assessment Team Operating Plan	Updated	NPR-7123.1A, Table G-17
<Lessons Learned Summary>	Baseline	LaRC

4.20.3 Review Content:

The following content is typically expected at an LLR.

Science/Mission Goals and Objectives
- Minimum Mission Success Criteria

Mission/Project Overview & Status
- Mission/Project Organization

Lessons Learned
- Relevant Lessons from Prior Projects
- Lessons Learned from Current Project

5. Waivers

5.1 Waivers to requirements that appear only in this LPR can be granted by the individual with approval authority for the project review plan (see section 3 of LPR 7130). Prior to requesting a waiver, the Project Manager should discuss the matter with the project sponsor (the Principal Investigator or other appropriate individual). Waiver requests shall be in writing from the Project Manager and specify what requirement(s) is (are) to be waived, why the waiver is desired, what mitigation(s) will be put in place to address any increased risk, and what residual risk remains as a consequence of the waiver. Any requests for waivers are to be accompanied by evidence of concurrence by the project Chief Engineer. In cases where the identity of the project Chief Engineer is unclear, the LaRC Chief Engineer or his/her designee may assign an individual to act in that role, or may waive the requirement for concurrence.

5.2 All waiver documentation shall be maintained by the Project. Upon approval, the Project Manager shall notify the project sponsor of the approved waiver.

5.3 The LaRC SMO Director should be consulted on whether specific requirements appear only in this LPR. Requirements that flow down agency requirements and other regulations follow the procedure described in LMS-CP-7151, “Obtaining Waivers from Langley Management System (LMS) Requirements,” supplemented by any requirements in the source documents. In particular, for formal NASA programs and projects, the Director of the LaRC SMO shall determine what signatories are necessary to be in conformance with Table 3-2 of NPR 7120.5D and NPR 7123.1A.

Appendix A -- Acronyms and Definitions

APMC – Agency Program Management Council
CADRe – Cost Analysis Data Requirement
CDR – Critical Design Review
CERR – Critical Event Readiness Review
CID – Center Interim Directive
CMC – Center Management Council: The group of senior LaRC personnel that performs oversight of programs and projects by evaluating all program and project work executed at LaRC (LAPD 1150.2, “Councils, Boards, Panels, Committees, Teams, and Groups,” defines CMC’s charter).
CP – Center Procedure: A center-level document that provides information on how to accomplish a task at LaRC
DA – Decision Authority: The Agency’s responsible individual who authorizes the transition of a program/project to the next life-cycle phase. [NPR 7120.5D]
Formal NASA project: A project that is identified in the Agency MdM database and therefore has its own 6-digit WBS and must comply with NPR 7120.5D.
DGA – Designated Governing Authority
DR – Decommissioning Review
EEE – Electrical, Electronic, and Electromechanical
FMEA – Failure Modes and Effects Analysis
FRR – Flight Readiness Review
FTA – Fault Tree Analysis
ICD – Interface Control Document
ICE – Independent Cost Estimate
IRD – Interface Requirements Document
ISA – Independent Schedule Assessment
IT – Information Technology: Any equipment, or interconnected system(s) of subsystem(s) of equipment, that is used in the automatic acquisition, storage, analysis, evaluation, manipulation, management, movement, control, switching, interchange, transmission, or reception of data or information by the Agency. [Ref. NPR 7120.5D]
ITA – Internal Task Agreement
IV&V – Independent Verification and Validation
JPL – Jet Propulsion Laboratory
KDP – 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 KDP). [Ref NPR 7120.5D]
LaRC – Langley Research Center
LPR – LaRC Procedural Requirements: A center-level directive that describes procedures to be followed for work managed by LaRC
MCR – Mission Concept Review
MDR – Mission Definition Review
MDAA – Mission Directorate Associated Administrator
MdM – Metadata Manager, the home for NASA's standard program/project structure and accounting codes used for program management, budget and accounting. See https://budget.nasa.gov/
MDPMC – Mission Directorate Program Management Council

MMT – Mission Management Team
MOE – Measure of Effectiveness
MOP – Measure of Performance
NASA AA – NASA Associate Administrator
NPR – NASA Procedural Requirements: An agency-level directive that describes NASA procedures
ORR – Operational Readiness Review
OUM – Organizational Unit Manager
PA&E – Program Analysis and Evaluation
PDR – Preliminary Design Review
PFAR – Post-Flight Assessment Review
PLAR – Post-Launch Assessment Review
PM – Program (or Project) Manager
PNAR – Preliminary Non-Advocate Review
PRA – Probabilistic Risk Assessment
PRR – Production Readiness Review
RFA – Request for Action: A formal request submitted as part of a review for the project to perform one or more actions to address an issue within the scope of the review.
RM – Review Manager: Individual who works with the Review Chair and the Project Manager to organize the logistics of the review.
ROM – Rough Order of Magnitude
SAR – System Acceptance Review
SIR – System Integration Review
SMA – Safety and Mission Assurance
S&MA – Safety and Mission Assurance
SMAO – Safety and Mission Assurance Organization
SMO – Systems Management Office: LaRC office responsible for managing life cycle reviews.
SRB – Standing Review Board: The entity responsible for conducting the continuum of independent life cycle reviews [Ref. NPR 7120.5D]
SDR – System Definition Review
SRR – System Requirements Review
TA – Technical Authority: The individual who specifically maintains technical responsibility over establishment of, changes to, and waivers of requirements in a designated area. [Ref. NPR 7120.5D] The term may also refer to the process by which technical concerns are elevated.
ToR – Terms of Reference: A document specifying the nature, scope, schedule, and ground rules for a review. [Ref. NPR 7120.5D]
TPM – Technical Performance Measure
TRR – Test Readiness Review
V&V – Verification and Validation