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STANDARD

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Criteria for Flight and Flight Support Systems Lifecycle Reviews

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CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
-	02/19/2005	Baseline Release
A	10/01/2009	Modified to reflect changes to NPR 7120.5 Rev. D, and NPR 7123.1 Rev. A.
A	09/17/2015	Updated responsible office and extended for 18 months from original expiration date.
A	04/22/2016	Updated responsible office and extended for 12 months from expiration date.
A	4/1/2017	Updated responsible office, removed references to IPAO and IPAO Review Manager and extended for 12 months from expiration date
A	3/28/2018	Extended for 12 months from current expiration date
A	03/01/2019	Removed references to SRO. Removed references to NPR 7120.5D and NPR 7123.1A. (NPR 7120.5E and NPR 7123.1B are the current versions.) Replaced IIRT with GSRT.

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1.0 SCOPE

1.1 Purpose

The guidelines and criteria contained in this document are intended for use by the project team, the GSFC System Review Managers, the Chair of the Goddard System Review Team (GSRT) and the Chair of the NASA appointed Standing Review Board (SRB) in support of planning and implementing the reviews conducted under the authority of each organization. Such reviews range from subsystem and functional reviews to the mission-level reviews, many of which serve as Key Decision Point (KDP) gateways. The criteria defined in this document have been developed to encompass those specified by NPR 7123.1.

As a supplement to this document, the GSFC STD-1001- Appendix, “Lifecycle Review Success Criteria Key Evaluation Factors”, provides sample evaluation factors intended to be used in assessing the project’s achievements toward meeting the success criteria in the development of associated system. The sample lists are organized by review type (i.e., SRR, PDR, CDR, PER, etc.) and are a compilation of evaluation factors acquired from lesson's learned and NASA best practices. Key evaluation factors may be tailored to suit the needs of the individual project. They are typically provided as reference material to the project in support of review preparation and to the independent review panels to support the conduct of the review (agenda definition, line of questioning, etc.). The Key Evaluation Factors are not success criteria for the associated review.

1.2 Applicability

This document describes the mission and lower level element reviews (e.g., spacecraft, instrument, ground system, operations, etc.) conducted during the development and operations lifecycle for Goddard Space Flight Center (GSFC) managed projects, and incorporates the requirements for:

- (a) Agency-level mission reviews as prescribed by National Aeronautics and Space Administration (NASA) Procedural Requirement (NPR) 7120.5, “NASA Space Flight Program and Project Management Requirements” and NPR 7123.1, “NASA Systems Engineering Processes and Requirements”,
- (b) Center unique mission, flight, and flight support system reviews as prescribed by GSFC Procedural Requirement (GPR) 8700.4, “Integrated Independent Reviews”, the results of which are flowed up to the Agency level reviews that are conducted in support of the Agency level mission reviews at a lower level.

The Project/Product Manager should use this guide when preparing the Systems Review Plan (SRP) for conducting a comprehensive set of mission, spacecraft, instrument and ground system reviews as required by Agency and GSFC review process documents. In collaboration with the Systems Review Manager (SRM) and SRB Chair should use this document to assess compliance with unique Agency requirements and to prepare the Terms of Reference (ToR) that documents the charter of the SRB.

2.0 MISSION AND ELEMENT-LEVEL REVIEWS

The Safety and Mission Assurance Directorate (Code 300) is responsible for the implementation of the GSFC independent review requirements as approved by the Center Management Council (CMC) for all flight projects, including mission and element reviews. This document should be used by the Project Manager, and the Chairs of the GSRT and SRB, to determine the project's readiness to proceed with a review and to finalize the specific objectives, agenda, and success criteria prior to each review. It provides specific information for the reviews identified in GPR 8700.4 including descriptions of review objectives, typical timing, and success criteria.

The mission-level reviews described in this document include those conducted to meet the unique requirements of the Center in addition to the reviews required by the Agency to be conducted by the SRB at specific progress points along the development lifecycle for NASA missions. These reviews are supported by element reviews that are conducted by a GSFC-convened GSRT and include spacecraft, instrument, operational and ground systems. Furthering the continuity of the Center's review process, the mission and element reviews are supported by project implemented Engineering Peer Reviews (EPRs) with a principal focus on discipline or subsystem related technical considerations. These reviews are addressed in a project Engineering Peer Review Plan (EPRP) as required by GPR 8700.6, "Engineering Peer Reviews".

It is recognized that the full set of mission and element-level reviews described herein will not be appropriate for every project. Therefore, not all projects will conform to the complete lifecycle review process described in NPR 7120.5 and GPR 8700.4, and may require a waiver and/or tailoring of the requirements and criteria to match the specific needs of the project. To accommodate this, project-unique review requirements may be negotiated with the responsible review team chair and System Review Manager to tailor the review requirements and success criteria as appropriate. The details of the agreed upon tailoring are documented in the SRP and/or the ToR and shall be supported by a waiver to the requirements of GPR 8700.4 or NPR 7120.5 as may be required.

It is also recognized that the final complement of reviews, individual review content, review titles, and the timing for the conduct of the individual reviews may vary with each project. However, unless otherwise agreed upon and documented in the SRP, the complete set of success criteria provided herein relative to the product being developed (end-to-end mission, flight or ground element, etc.) shall be addressed within the total set of reviews being proposed by the project. The distribution of criteria amongst the specific reviews may vary from what is specified in this document to best meet the needs of the specific project.

2.1 Results of Review

Some projects may not fully satisfy all of the criteria at the time of the milestone/gateway review. In making a judgment as to whether the review has accomplished its objectives and has been successfully completed, each member of the review team will assess the degree to which the above success criteria have been met based on the key evaluation factors. Each member should also take into account (a) the criticality of the areas where there are shortfalls, (b) how straightforward the path forward is and the likelihood of success, as well as (c) any other relevant

factors. Individual findings from each review team member are conveyed to the convening authority in the panel's final report, including RFA's. An RFA is a formal written request sponsored by the review panel asking for additional information or action by the project team. They are generally developed as a result of insufficient safety, technical, or programmatic information being available at the time of the review.

2.2 General Criteria

The sections that follow provide the criteria to be used by the independent review panel members during their assessment of a flight or flight support system. The criteria have been divided into five categories: Review Process, Technical Management, System Design and Demonstration, Safety and Mission Assurance (SMA), and Project Management. In section 3.0, a table is provided within the description of each review defining the success criteria within each of these categories. The criteria evolve as the project progresses through its lifecycle to reflect expected changes in the maturity of the system. The following provides a general description of the criteria associated with each category.

Review Process: (a) the identification and reporting of peer reviews conducted since the last element/system review, (b) the status of all critical issues (e.g. critical Requests for Action) surfaced at prior reviews, and (c) Request for Action (RFA) disposition from all preceding reviews and associated risk status.

Technical Management: (a) trade-studies and alternative solutions, (b) system effectiveness, life cycle resources, risk, and customer requirements, (c) requirements traceability, (d) schedules for development and delivery are mutually supportive, (e) integration of technical disciplines, (f) validity, consistency, desirability, and attainability of functional and performance requirements, and (g) traceability of design requirements to the functional and performance requirements and vice-versa, (h) identification and control of critical interfaces, and (i) trending plans/analyses.

System Design and Demonstration: (a) baseline designs and documentation, (b) system level performance specifications, (c) fabrication of engineering demonstration models, (d) processes associated with system/product integration including end-item traceability and product quality, (e) verification of requirements grounded by sound engineering analysis and test practices, and (f) production and manufacturing.

Safety and Mission Assurance: (a) quality engineering, (b) quality assurance, (c) safety assurance processes associated with flight, ground, and operational systems/subsystems, and d) reliability engineering (including EEE parts program).

Project Management: (a) cost estimates, (b) control processes, and (c) schedules that indicate the mission will be ready to launch on time and within budget. Examples of control processes being evaluated include a Project Plan, Systems Engineering Management Plan, Configuration Management Plan, and a Risk Management Plan, etc.

Table 2-1 identifies the typical mission and element-level reviews recognized by the GSFC, in adherence to the Center's requirements and consistent with those specified by NPR 7120.5.

Table 2-1 Chairing Organizations of Key Mission and Element-Level Reviews

Review Title	Mission	Element				
	Observatory ¹	S/C	Grnd Sys	Payloads		
				Instr 1	Instr 2	Instr n
Mission Concept Review (MCR)	SRB ²	-	-	-	-	-
Systems Requirements Review / System Definition Review (SRR/SDR)	SRB ²	GSRT	GSRT	Project ³	Project ³	Project ³
Preliminary Design Review (PDR)	SRB	GSRT	GSRT	GSRT	GSRT	GSRT
Critical Design Review (CDR)	SRB	GSRT	GSRT	GSRT	GSRT	GSRT
Mission Operations Review (MOR)	GSRT	-	-	-	-	-
System Integration Review (SIR)	SRB	-	-	-	-	-
Pre-Environmental Review (PER), or Test Readiness Review (TRR)	GSRT	GSRT	GSRT	GSRT	GSRT	GSRT
Flight Operations Review (FOR)	GSRT	-	-	-	-	-
Pre-Shipment Review (PSR)	GSRT ⁴	GSRT	-	GSRT	GSRT	GSRT
Operational Readiness Review (ORR)	SRB	-	-	-	-	-
Mission Readiness Review ⁵	CMC	-	-	-	-	-
Flight Readiness Review (FRR) ⁶	KSC	-	-	-	-	-
Launch Readiness Review (LRR) ⁶	KSC	-	-	-	-	-
Post-Launch Assessment Review (PLAR)	Project ³	-	-	-	-	-
Critical Event Readiness Review (CERR) ⁷	Project	-	-	-	-	-
Decommissioning Review (DR)	Project ³	-	-	-	-	-

¹ Observatory is assessed at the Mission-level review which encompasses both the ground and flight segments.

² Conducted by the GSRT in instances where an SRB has not yet been established or an SRB is not required.

³ Chairing organization is negotiable with the project and can be GSRT.

⁴ Conducted concurrently with the ORR by the SRB as the operational status warrants.

⁵ Conducted by the GSFC CMC prior to KDP-E and supported by GSRT and SRB Chairs.

⁶ Chaired by Kennedy Space Center (KSC) and supported by GSRT and SRB Chairs as needed; requirements/criteria not included in this document.

⁷ Supported by GSRT as needed.

3.0 MISSION CONCEPT REVIEW (MCR)

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 is usually conducted by the system development organization. ROM budget and schedules are presented. At the MCR, the project demonstrates to the review panel that the:

- Proposed mission meets the science.
- Objectives proposed mission is feasible.
- Proposed mission and operations design concepts are viable.
- Preliminary plan for lifecycle activities suitably illustrates reasonable execution of the mission within resource budgets and other foreseen constraints.

3.1 Timing

The MCR is normally held upon completion of mission feasibility studies and represents the conclusion of project pre-formulation activities. In advance of the review, the project should highlight and discuss with the review chairperson any areas that may warrant consideration in establishing the composition of the review team (e.g., problematic mission requirements, critical technology dependencies, critical trade studies, or anticipated resource constraints). Depending upon the intended acquisition approach for the mission, GSFC management may decide that an MCR need not be conducted or that it will be replaced by a management review as permitted within the guidance of NPR 7120.5. Such determination shall be made early in the lifecycle and in conjunction with the development of the project Systems Review Plan (SRP) and consequently the Terms of Reference (ToR) for the Standing Review Board (SRB) as an applicable document incorporated by reference.

3.2 Success Criteria

The review agenda, success criteria, and charge to the independent review board shall be discussed for concurrence by the Principal Investigator (PI-mode only), Program Executive (SRB reviews only), Project Manager, Review Board Chairperson, Systems Review Manager, and distributed to all parties prior to the review. The Systems Review Manager is responsible for initiating this discussion. Excluding any required tailoring, projects must at a minimum meet the following criteria as part of the MCR or demonstrate an adequate path to completion. Table 3-2 depicts the criteria for a successful MCR.

Table 3-2: MCR Success Criteria

Category	MCR Criteria
Review Process	A preliminary Systems Review Plan (SRP) including an Engineering Peer Review Plan (EPRP) is available and deemed compliant with all applicable requirements.
Technical Management	<p>Mission objectives are clearly defined and unambiguous.</p> <p>Potential technology needs are identified and the gaps between such needs and the current and/or planned technology readiness levels have been assessed with acceptable results.</p> <p>The evaluation criteria and trade space for candidate systems that fulfill the conceptual design requirements have been identified and prioritized.</p> <p>Technical planning is sufficient to proceed to the next phase.</p>
System Design and Demonstration	<p>An operations concept and system architecture is provided that meets these requirements, demonstrating the feasibility of the mission and technical solution.</p> <p>A search was conducted to identify existing assets or products that have a potential to be implemented to satisfy the mission or parts of the mission.</p> <p>The preliminary set of requirements meeting the objectives is provided and is consistently stated within the project.</p>
Safety & Mission Assurance	Safety and mission assurance activities (i.e., safety, reliability, maintainability, quality, and Electrical, Electronic and Electromechanical [EEE] parts) related to the mission and conceptual design have been adequately addressed.
Project Management	<p>Initial risk identification and mitigation strategies have been provided and are acceptable.</p> <p>A rough order of magnitude cost estimate is provided and is both credible and within an acceptable cost range.</p> <p>The schedule estimates are credible.</p>

3.3 Key Evaluation Factors for the Assessment of Success Criteria

The MCR should contain a complete description of the conceptual mission design. The project team presents the design using block diagrams, flowcharts, schematics, etc., depicting system interfaces with external supporting systems, as well as interfaces between independent system elements. Preliminary modeling and analysis results should be presented in order to illustrate feasibility of achieving science objectives. Programmatic planning and resource estimates shall also be discussed in sufficient detail to permit assessment of relevant review objectives.

The GSFC STD-1001-Appendix provides sample key evaluation factors often applied by individual review team members when assessing the satisfactory achievement of the established criteria.

4.0 SYSTEM REQUIREMENTS AND SYSTEM DEFINITION REVIEWS (SRR/SDR)

The purpose of this review is to verify that the functional and performance requirements are defined for the system under review and to ensure the requirements are satisfied by the selected concept. To justify proceeding with detailed definition and the flow-down of requirements to the major elements of the system, the project must convey to the review panel that the:

Baseline mission requirements are clearly understood.

Top-level requirements for each system element have been determined.

Proposed mission design and operations concept satisfies baseline mission requirements plans for future activities justify expectations the mission design will accommodate imposed constraints and accomplish the mission within allocated resources.

4.1 Timing

An SRR can be conducted for selected elements (e.g., spacecraft, instruments, ground systems, operations, etc.) as well as the mission. An SRR is typically conducted once a feasible system definition is available and while changes to the particular element under review can be accommodated with minimal impact. The SRR for any particular element is typically conducted concurrently with the associated System Definition Review (SDR).

Similarly, as part of the GSFC process, the Mission-level SRR (MSRR) is conducted concurrently with the Mission Definition Review (MDR) toward the end of Phase A and provides the relevant data for the Key Decision Point “B” (KDP-B) gateway at which the decision to proceed with the preliminary design is made. When scheduling the review, the project should highlight and discuss with the review Chair any significant risk areas (e.g., problematic requirements, critical technology dependencies, outstanding trade studies, or significant resource constraints) that may warrant consideration in the timing of the review or the composition of the review team. The determination of the readiness of a project to proceed with the review will be based on these discussions and at the discretion of the Chair and in consultation with the Project, Systems Review Manager, Program Office and Convening Authority as applicable.

4.2 Success Criteria

The SRR/SDR and MSRR/MDR criteria provided below should be consulted early enough in the project schedule to select a suitable date for the review and to properly plan an agenda that fulfills the objectives of a System Requirements Review (SRR) simultaneously with those of a System Definition Review (SDR). The system under review may include elements such as ground systems, instruments, and spacecraft; or the observatory which includes the flight and ground segments. The review agenda, success criteria, and charge to the independent review board shall be discussed for concurrence with the Principal Investigator (PI-mode only), Program Executive (SRB reviews only), Project Manager, Review Board Chairperson, and Systems Review Manager; and distributed to all parties prior to the review. The Systems Review Manager is responsible for initiating this discussion. Excluding any required tailoring, projects must at a minimum meet the following criteria as part of the SRR/SDR or MSRR/MDR, or demonstrate an adequate path to completion. Table 4-2 depicts the criteria for a successful SRR/SDR or MSRR/MDR.