7120.5D – The Goddard "Reader's Digest" Version

1.0 Introduction

The new NPR 7120.5D documents the processes by which the Agency's space flight programs and projects are formulated and implemented. The focus is on the program and project lifecycles. To a large extent, the document reflects how Goddard already does business. Probably the biggest change is the introduction of Key Decision Points (KDPs) which serve to force a conscious decision on the part of Center and Headquarters management as to whether a particular program or project is ready to move on the next phase in their lifecycle. The introduction of the KDPs was in response to criticism from the General Accounting Office and other independent review organizations.

Another significant change is the introduction of a single Standing Review Board (SRB) which follows a project throughout its lifecycle. This eliminates the current practice of multiple, overlapping review boards which at times out-number the project being reviewed. In addition, some of the key gateway reviews have been combined into a single review (eg, the MDR and the Pre-NAR, the PDR and the NAR) which serves to eliminate the need to spend days preparing for and conducting separate reviews which to a large extent duplicate one which has already taken place.

The new NPR applies to all current and future NASA space flight programs and projects (including spacecraft, instruments, research and technology funded by programs or projects, facilities specifically developed/modified for space flight systems, and ground systems in support of space flight operations).

It also applies to reimbursable space flight programs/projects performed for non-NASA sponsors. If the sponsoring agency does not want NPR 7120.5D requirements to be followed, then the inter-agency agreement must explicitly identify those requirements that will not be followed. The Agency will not accept the work without a formal waiver from the NASA Chief Engineer for those requirements that are not to be followed.

Requests for waivers to NPR 7120.5D requirements are documented and submitted for approval using the NPR 7120.5D Waiver Form (see Section 3.6 of the NPR for more details). Be aware that nearly all waivers will have to be cleared up through the Agency Chief Engineer.

2.0 The NASA Management Process

NASA has a four-part process for managing programs and projects:

Formulation – The identification of how the program or project supports the Agency's strategic needs, goals, and objectives; the assessment of feasibility and risks; development of operations concepts and acquisition strategies; establishment of high-level requirements and success criteria; the preparation of plans, budgets, and schedules; and the establishment of control systems to ensure performance to those plans.

Approval (for Implementation) – The acknowledgment that the program/project has met formulation requirements and is ready to proceed to implementation. By doing so, the Decision Authority (see Section 4.3) commits the budget resources necessary to continue into implementation.

Implementation – The execution of approved plans for the development and operation of the program/project.

Evaluation – The ongoing independent (outside the advocacy chain of the program/project) evaluation of the performance of a program or project to ensure adequacy of planning and execution according to approved plans.

3.0 Program and Project Classification

3.1 Programs

Programs are generally assigned to Centers based on decisions made by Agency senior management. A program consists on one or more projects. Because the goals of programs vary significantly, different program implementation strategies are required.

3.1.1 Program Types

NASA identifies four basic types of programs that may be employed:

Single-project programs (e.g., James Webb Space Telescope) tend to have long development and/or operational lifetimes, represent a large investment of Agency resources in one program/project, and have contributions to that program/project from multiple organizations/agencies.

Uncoupled programs (e.g., Explorers) are implemented under a broad scientific theme and/or a common program implementation concept, such as providing frequent flight opportunities for cost-capped projects selected through Announcements of Opportunity or NASA Research Announcements. Each such project is independent of the other projects within the program.

Loosely coupled programs (e.g., Living With a Star and Earth Observing Systems) generally address scientific objectives across a broad science theme through multiple space flight projects of varied scope. While each individual project has specific mission objectives, architectural and technological synergies may be adopted that benefit the program as a whole.

Tightly coupled programs (e.g., Constellation) have multiple projects that execute portions of a mission or missions. No single project is capable of implementing a complete mission. Typically, multiple NASA Centers contribute to the program. Individual projects may be managed at different Centers. The program may also include other agency or international partner contributions.

> ***In reality:*** *One need not spend a lot of time worrying about program type. Single-project programs are self-evident and follow the project lifecycle rather than the program lifecycle. The distinction between Uncoupled and Loosely Coupled programs is largely academic. There is no difference in how they are executed or overseen. For now, we have no Tightly Coupled programs at Goddard in the sense described above.*

3.1.2 Program Documents

Program formulation and implementation require the preparation and approval of three key documents — a program Formulation Authorization Document (FAD), a Program Commitment Agreement (PCA), and a Program Plan.

FAD - To initiate planning for individual programs, a Mission Directorate prepares a program FAD. The program FAD authorizes a Program Manager to initiate the planning of a new program, and to perform the Analysis of Alternatives required to formulate a Program Plan. The FAD template may be found in Appendix C of NPR 7120.5D.

PCA - The Program Commitment Agreement is the agreement between the Mission Directorate Associate Administrator (MDAA) and the NASA Associate Administrator (AA) that authorizes transition from formulation to implementation. The PCA is prepared by the Mission Directorate with support from the Program Manager, as requested. The PCA documents Agency requirements, program objectives, management and technical approach and associated architecture, technical performance, schedule, cost, safety and risk factors, internal and external agreements, independent reviews, and all attendant top-level program requirements. The PCA is updated and re-baselined as the program matures. The PCA template may be found in Appendix D of NPR 7120.5D.

Program Plan - The Program Plan is an agreement between the MDAA, the Center Director, and the Program Manager that documents at a high level the program's objectives and requirements, scope, implementation approach, interfaces with other programs, budget by fiscal year, and the commitments of the program. The Program Plan is prepared by the Program Manager. Concurrence by the Center Director demonstrates a commitment to support the program in terms of Center resources needed by the program. The baseline Program Plan is required at the time of program approval and is used by the governing Program Management Council (PMC) (see Section 4.1) in the review process to determine if the program is fulfilling its agreements. The Program Plan is updated and approved during the program life cycle, as appropriate. The Program Plan template including required Control Plans may be found in Appendix E of NPR 7120.5D.

3.2 Projects

A project is a specific investment identified in a Program Plan having defined requirements, a life-cycle cost, a beginning, and an end. A project yields products that directly address NASA's strategic needs.

3.2.1 Project Categories

Projects also vary in scope and complexity and thus require varying levels of management attention and oversight. Projects are classified as either *Category 1, 2, or 3* and are assigned to a category based initially on (1) the project life-cycle cost (LCC) estimate, the use of nuclear power sources, its use for human space flight; and (2) priority level (importance of the activity to NASA, the extent of interagency or international participation, the use of new or untested technologies, and the risk classification - see NPR 8705.4, *Risk Classification for NASA Payloads)*.

Table 3-1 provides guidelines for determining project categorization. Final categorization may be based on recommendations by the MDAA. The NASA AA approves final project categorization. For purposes of categorization, the project life-cycle cost estimate includes Phases A through F, all WBS Level 2 elements, and is measured in real-year dollars. The threshold values in Table 3-1 will be updated annually as part of the Agency's strategic planning guidance.

When projects are initiated, they are either assigned directly to a Center by the MDAA, or are selected through a competitive process such as an Announcement of Opportunity (AO). For Category 1 projects, the assignment is with the concurrence of the NASA AA.

Priority Level	LCC < $250M	$250M ≤ LCC ≤ $1B	LCC > $1B, use of nuclear power source, or human space flight
High	Category 2	Category 2	Category 1
Medium	Category 3	Category 2	Category 1
Low	Category 3	Category 2	Category 1

Table 3-1 Project Categorization Guidelines

3.2.2 Project Documents

Project Plan - The Project Plan is an agreement between the Program Manager, Center Director, the Project Manager, and for AO-driven missions, the Principal Investigator. The MDAA may be added to the signature list for the plan at his/her discretion. The Project Plan is prepared by the Project Manager with the support of the project team. It defines, at a high level, the project's objectives, technical and management approach, the environment within which the project operates, and the commitments of the project to the program. The baseline Project Plan is required at the time of project approval and is used by the governing PMC in the review process to determine if the project is fulfilling its agreements. The Project Plan is updated and approved during the project life cycle if warranted by changes in the stated commitments or program requirements on the project. The Project Plan template may be found in Appendix F of NPR 7120.5D.

Control Plans - Larger and more complex projects may find it necessary or desirable to write separate *control plans* to convey project approaches and strategies. In these cases, the Project Plan summarizes the key elements of such separate plans. In smaller projects, separate and detailed control plans may not be needed to document project approaches, and the Project Plan itself serves as the single source for such information. Table 3-2 identifies the Project Control Plans and when they are due. Appendix F of NPR 7120.5D provides further descriptions of the Project Control Plans.

NPR 7120.5D Project Plan and Control Plans	Phase A	Phase B	Phase C
1.Technical, Schedule, and Cost Control Plan	Preliminary	Baseline	
2. Safety and Mission Assurance Plan	Preliminary	Baseline	
3. Risk Management Plan	Preliminary	Baseline	
4. Acquistion Plan	Preliminary	Baseline	
5. Technology Development Plan	Baseline		
6. Systems Engineering Management Plan	Baseline		
7. Software Management Plan	Preliminary	Baseline	
8. Review Plan	Preliminary	Baseline	
9. Missions Operations Plan		Preliminary	Baseline
10. Environmental Management Plan	Baseline		
11. Logistics Plan	Preliminary		Baseline
12. Science Data Management Plan		Preliminary	Baseline
13. Information & Configuration Management Plan	Preliminary	Baseline	
14. Security Plan	Preliminary	Baseline	
15. Export Control Plan	Preliminary	Baseline	

Table 3-2 Project Plan Control Plan Maturity Matrix

4.0 Program and Project Oversight

4.1 Program Management Councils

To provide management oversight, NASA has established two levels of Program Management Councils (PMCs)—the Agency PMC and Mission Directorate PMCs. The PMCs have the responsibility of periodically evaluating the cost, schedule, risk, technical performance, and content of a program or project under its purview. Each program and project has a governing PMC, which acts as the highest PMC for that program or project. For all programs, the governing PMC is the Agency PMC; for projects, the governing PMC is determined by the established project category. Table 4-1 shows the relationship between programs and projects and the PMCs.

	Agency PMC	Mission Directorate PMC
Programs	●	✓
Category 1 Projects	●	✓
Category 2 Projects		●
Category 3 Projects		●

● Indicates governing PMC ✓ Indicates PMC evaluation

Table 4-1 Relationship Between Programs/Projects and PMCs

The Agency PMC evaluates all programs and Category 1 projects immediately prior to KDPs and then recommends approval or disapproval to the Decision Authority (see Section 4.3) regarding entrance to the next life-cycle phase. The Agency PMC also performs program oversight during implementation by means of Quarterly Status Reports provided by the cognizant MDAA. The Agency PMC is chaired by the Associate Administrator.

A Mission Directorate PMC evaluates all programs and projects executed within that Directorate and provides input to the MDAA. For programs and Category 1 projects, the MDAA carries forward the findings and recommendations to the Agency PMC. For Category 2 and 3 projects, the Mission Directorate PMC is the governing PMC, and recommends approval or disapproval to the MDAA regarding entry to the next phase. For Category 3 projects, the MDAA may designate a division within the Mission Directorate or Program Office as the governing authority. Such delegations are described in the Program Plan. The Mission Directorate PMCs are usually chaired at the Deputy AA level.

4.2 Center Management Councils

Oversight of programs and projects is also performed by a Center Management Council (CMC), which evaluates all program and project work executed at that Center. At Goddard, this is done primarily through the Monthly Status Reviews. The CMC assesses program and project performance and provides technical and programmatic guidance to the affected programs and projects. The CMC provides its findings and recommendations to the Mission Directorate PMC regarding the technical and management viability of the program/project prior to KDPs. The CMC evaluation also determines whether Center engineering, SMA, and management best

practices (i.e., resources, procurement, institutional) are being followed, and whether Center resources can support program/project requirements.

4.3 Decision Authority

The Decision Authority is the individual who authorizes the transition of a program or project to the next life-cycle phase. For programs and Category 1 projects, the Decision Authority is the NASA AA. For Category 1 projects, this authority may be delegated to the MDAA. For Category 2 and 3 projects, the Decision Authority is the MDAA. This authority may also be delegated to a lower level. The delegation of authority for projects is documented in the Program Commitment Agreement.

4.4 Key Decision Points (KDPs)

A KDP is an event where the Decision Authority determines the readiness of a program/project to progress to the next phase of the standard life cycle (Section 5). As such, KDPs serve as gates through which programs and projects must pass. KDPs associated with programs are enumerated with roman numerals, starting with zero. KDPs associated with projects are labeled with capital letters, the letter corresponding to the phase that the project will be entering. Within each phase, the KDP is preceded by one or more reviews, including one by the governing PMC. The KDPs were created to ensure that a conscious decision is made by NASA management to approve the transition of a program or project to the next phase in its lifecycle.

To support the decision process at the various KDPs, a number of supporting materials (KDP Readiness Products) are submitted to the Decision Authority. These materials include (more or less in the order they become available):

- The Standing Review Board report (see Section 6.3);
- The Program and/or Project Manager recommendation;
- The CMC recommendation;
- The Mission Directorate PMC recommendation to the MDAA (for Category 2 and 3 projects);
- The MDAA and Agency PMC recommendation to the AA (for programs and Category 1 projects).

To complete formal actions at a KDP, the Decision Authority makes and documents his/her decision and its basis (including materials presented, major issues, options, and open action items).

5.0 Program and Project Lifecycles

5.1 Program Life Cycle

Although programs vary significantly in scope, complexity, cost, and criticality, they have a generic life-cycle management process that is divided into two distinct phases, Formulation and Implementation.

Program Formulation

The formulation phase for all program types is the same, involving one or more program reviews, followed by KDP I, where a decision is made regarding program implementation. At the discretion of the Decision Authority, an earlier KDP 0 may be required to ensure major issues are understood and resolved prior to formal program approval at KDP I

Program Implementation

During Implementation, constituent projects are initiated through direct assignment or a competitive process (e.g., RFP, AO). There are two different implementation paths, depending on program type:

- For uncoupled and loosely coupled programs, the implementation phase requires biennial "KDPs" preceded by Program Status Reviews (PSRs)/Program Implementation Reviews (PIRs) to assess the program's performance and authorize its continuation. See Table 6-2 for review definitions.

- For tightly coupled and single project programs, the implementation phase will coincide with the project life cycle. After launch, these programs also have biennial "KDPs" preceded by attendant PSRs/PIRs.

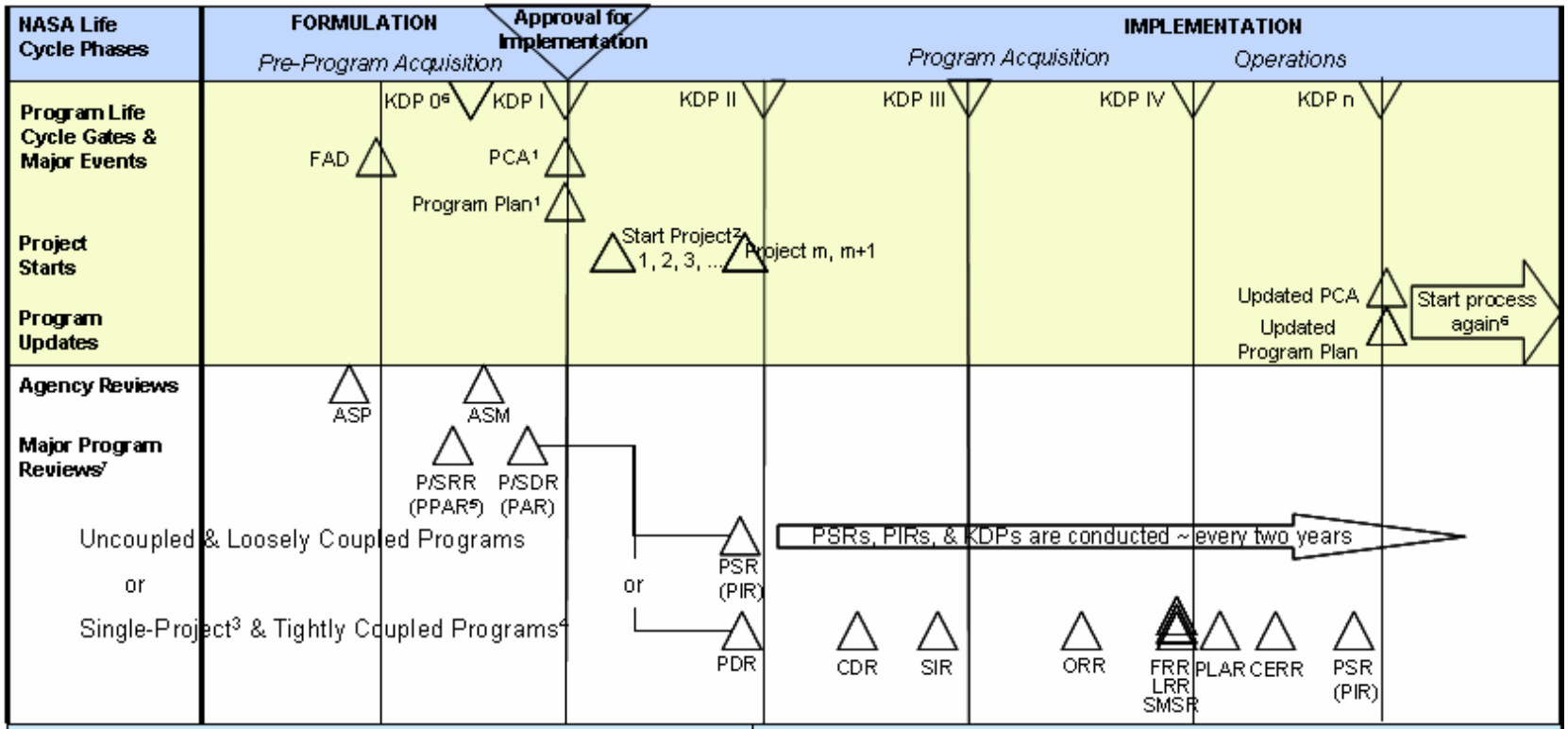
The program life cycle is depicted in Figure 5-1.

> ***In reality:*** *It is not clear what is being "decided" in the biennial KDPs other than whether or not to let the program continue.*

5.2 Project Life Cycle

The NASA Project Life Cycle is shown in Figure 5-2. The phases are separated by major reviews (see Section 6) and KDPs. In practice, the activities described for each phase are not always exclusively carried out in that phase; their timing will depend on the particular schedule requirements of the project. For example, some projects procure long-lead flight hardware in Phase B to enable them to achieve their launch dates.

> ***Note that:*** *Figure 5-2 has been simplified from the equivalent chart in the NPR. Reviews, footnotes, and acronyms peculiar to Human Spaceflight Projects have been deleted.*



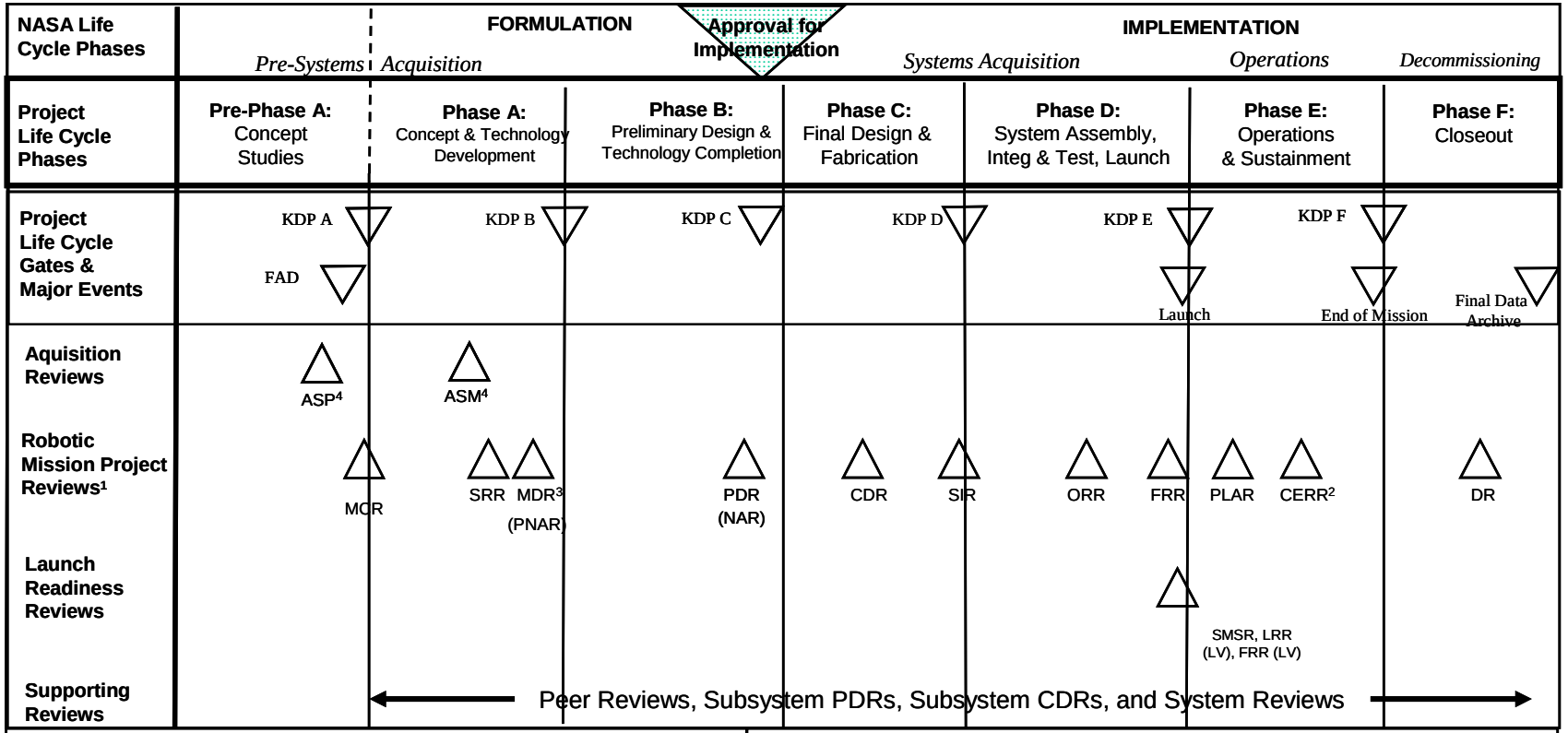
FOOTNOTES

1. PCA and Program Plans are baselined at KDP I and reviewed and updated, as required, to ensure program content, cost, and budget remain consistent.
2. Projects, in some instances, may be approved for formulation prior to KDP II. Initial project pre-formulation generally occurs during program formulation.
3. Single-project program reviews from PDR until operations are the same reviews as the project reviews (not duplicates). Single-project programs are approved at KDP II.
4. Tightly coupled program reviews generally differ from other program types because they are conducted to ensure the overall integration of all program elements (i.e., projects). Once in operations, PSRs/PIRs are conducted ~ every two years.
5. KDP 0 and the PPAR may be required by the Decision Authority to ensure major issues are understood and resolved prior to formal program approval at KDP I.
6. When programs require upgrades (e.g., new program capabilities), the life-cycle process will be restarted when directed by the AA, i.e., the program's upgrade will go through the same formulation and implementation steps as originally done.
7. These reviews are conducted by the program for the independent SRB (with the exception of the FRR and SMSR). See Section 2.5 and Table 2-5.

ACRONYMS

ASP—Acquisition Strategy Planning meeting
ASM—Acquisition Strategy Meeting
CDR—Critical Design Review
CERR—Critical Events Readiness Review
FAD—Formulation Authorization Document
FRR—Flight Readiness Review
KDP—Key Decision Point
LRR—Launch Readiness Review
ORR—Operational Readiness Review
PAR—Program Approval Review
PCA—Program Commitment Agreement
PDR—Preliminary Design Review
PIR—Program Implementation Review
PLAR—Post-Launch Assessment Review
PPAR—Preliminary Program Approval Review
P/SDR—Program/System Definition Review
P/SRR—Program/System Requirements Review
PSR—Program Status Review
SIR—System Integration Review
SRB—Standing Review Board
SMSR—Safety and Mission Success Review

Figure 5-1 The NASA Program Life Cycle



FOOTNOTES

1. Flexibility is allowed in the timing, number, and content of reviews as long as the equivalent information is provided at each KDP and the approach is fully documented in the Project Plan. These reviews are conducted by the project for the independent SRB.
2. CERRs are established at the discretion of Program Offices.
3. For robotic missions, the SRR and the MDR may be combined.
4. The ASP and ASM are Agency reviews, not life-cycle reviews.

ACRONYMS

ASP—Acquisition Strategy Planning Meeting
ASM—Acquisition Strategy Meeting
CDR—Critical Design Review
CERR—Critical Events Readiness Review
DR—Decommissioning Review
FAD—Formulation Authorization Document
FRR—Flight Readiness Review
KDP—Key Decision Point
LRR—Launch Readiness Review
MCR—Mission Concept Review
MDR - Mission Definition Review
NAR—Non-Advocate Review
ORR—Operational Readiness Review
PDR—Preliminary Design Review
PLAR—Post-Launch Assessment Review
PNAR—Preliminary Non-Advocate Review
SDR—System Definition Review
SIR—System Integration Review
SMSR—Safety and Mission Success Review
SRR—System Requirements Review

Figure 5-2 The NASA Project Life Cycle

Project formulation

Project formulation consists of two sequential phases denoted as Phases A (*Concept & Technology Development*) and B (*Preliminary Design & Technology Completion*). The primary activities in these phases are to develop and define the project requirements and cost/schedule basis and to design a plan for implementation (including an acquisition strategy, contractor selection, and long-lead procurement).

To initiate a new project, a Mission Directorate, working through a program office, usually provides a small amount of discretionary resources for concept studies (i.e., Pre-Phase A). These pre-formulation activities involve mission design analysis, feasibility studies, technology needs analyses, and analyses of alternatives. These trade studies are not considered part of formal project planning since there is no certainty that a specific project proposal will emerge.

To effect a project's official entry into formulation, the Program Manager prepares a draft project FAD or equivalent (such as an MDAA letter selecting a specific AO proposal). Once the MDAA signs the project FAD, the project formally enters formulation.

A one or two-step Announcement of Opportunity (AO) process may be used to initiate projects. In a one-step process, projects are competed and selected for implementation in a single step. In two-step competitions, several projects may be selected in Step 1 and given time to mature their concepts in a funded Phase A before the Step 2 down-selection of one or more projects for further formulation (Phase B). Program resources are used during Phase A to bring these projects to a state in which their overall approach can be better judged. These projects are referred to as "competed" or "AO-driven."

Project implementation

Project Implementation consists of Phases C, D, E, and F. "Approval" marks the transition from Phase B of formulation to Phase C of implementation. During Phases C (*Final Design and Fabrication*) and D (*System Assembly, Integration and Test, and Launch*), the primary activities are developmental in nature. Phase C includes the fabrication and testing of components, assemblies, and subsystems. All activities are executed as per the Project Plan developed during formulation. The transition from Phase C to Phase D is uniquely a "soft gate," in which the project may initiate Phase D work immediately upon completion of the Phase C products (rather than waiting for formal approval to begin Phase D). The start of Phase E (*Operations and Sustainment*) marks the transition from system development to systems operations. In Phase F (*Closeout*), project systems are taken out of service and safely disposed, although scientific and other analyses may still continue under project funding. Independent evaluation activities occur throughout all phases.

6.0 Program and Project Reviews

As was shown in Program and Project lifecycle charts (Figures 5-1 and 5-2), NPR 7120.5D establishes a set of reviews to be conducted during the lifecycle of a program or project. To a large extent, these reviews are nearly identical to the system level reviews that Goddard has always conducted. Some exceptions and uncertainties are as follows:

- NPR 7120.5D establishes a new System Integration Review (SIR) just preceding KDP-D. Just how the SIR will be implemented at Goddard is still to be determined.

- There are also reviews (eg, Pre-Environmental Reviews) that Goddard conducts that are not included in the NPR 7120.5D list. These reviews will continue to be conducted as they have been in the past.

- NPR 7120.5D establishes a single Operational Readiness Review (ORR), while Goddard currently conducts both a Mission Operations Review and a Flight Operations Review. How this will be resolved is also TBD.

- NPR 7120.5D establishes a Flight Readiness Review (FRR) which will somehow have to feed into our Mission Readiness Review. We are working to avoid having the FRR become a whole new review on its own. (The use of the term FRR is unfortunate since it will likely get confused with the KSC FRR.)

6.1 Acquisition Reviews

In establishing programs and projects, three discrete acquisition events are required:

(1) The Acquisition Strategy Planning (ASP) meeting provides the forum for senior Agency management to review major acquisitions before authorizing budget expenditures. The ASP meeting is used to approve programs and projects for formulation and to assign programs to Centers.

(2) The Acquisition Strategy Meeting (ASM) examines the Agency's acquisition approach (e.g., internal make-or-buy, Center assignments, etc.). The ASM is program- or project-specific and is more detailed than the ASP meeting.

(3) The Procurement Strategy Meeting (PSM) approves the approach for each procurement. The ASP and ASM occur during the formulation and approval processes. The PSM is project- or contract-specific and is developed by the Project Manager, supported by the Contracting Officer, and approved as prescribed in the NASA FAR Supplement.

6.2 Programmatic and Technical Reviews

A summary of the review process is shown in Figure 6-1. The top row of boxes shows the steps taken by the project to prepare for the lifecycle review, the second row shows the preparation steps for the SRB, and the bottom row shows the SRB report-out process following a review. Tables 6-1, 6-2, and 6-3 provide brief descriptions of acquisition, program, and project reviews, respectively. Note that not all reviews are applicable to every program and project.

In preparation for the life cycle reviews, programs and projects will conduct internal reviews as part of the normal systems engineering work processes as defined in NPR 7123.1, *NASA Systems*

Engineering Processes and Requirements. Programs and projects are required to document in their Program and Project Plans, their approach to conducting the internal reviews, and how they will support the independent lifecycle reviews.

Under certain circumstances such as the inability of a program or project to meet its commitments or a change in the NASA budget, the termination of a program or project may be called for. Typically, it is the MDAA that calls for such a review. The Decision Authority commissions an independent assessment, and following its completion, the governing PMC holds a Termination Review. At the Termination Review, the program/project teams present status, including any additional material requested by the Decision Authority. A Center assessment is also presented. The decision is documented and reviewed with the Associate Administrator prior to final implementation.

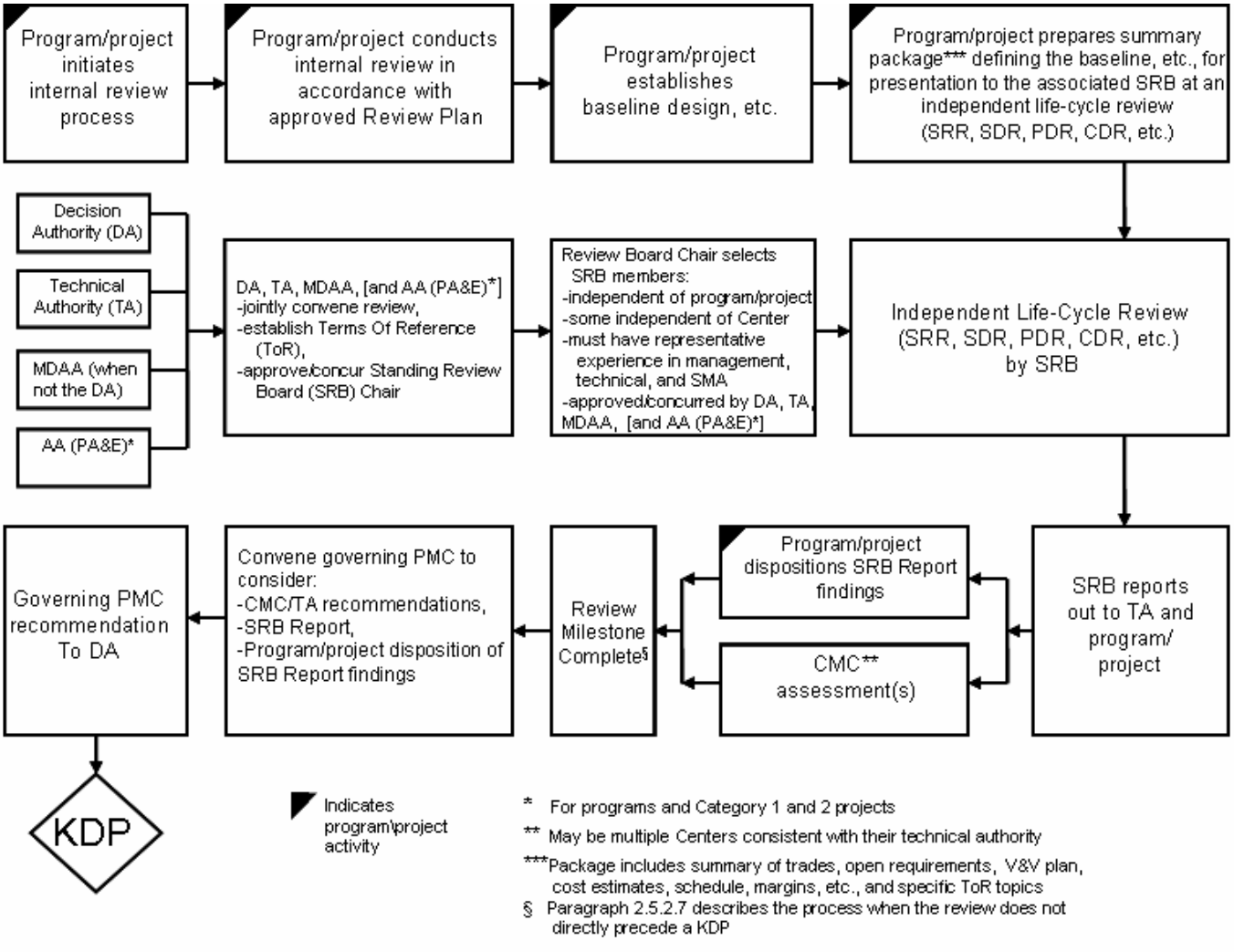


Figure 6-1 Program/Project Independent Life-Cycle Review Process

Review	Description
Acquisition Strategy Planning (ASP) Meeting*	The ASP meeting is integral to the annual budget submission process. The ASP meeting is structured to allow Agency senior management to review major acquisitions that evolve from Needs, Goals, and Objectives, as well as requirements introduced to the Agency from external sources (e.g., The President's Vision for Space Exploration) and internal sources (e.g., major acquisitions initiated by MDs/MSOs). The purpose of the ASP meeting is to identify and define roles and responsibilities of Mission Directorate(s), Centers, major partnerships, and associated infrastructure (workforce and facilities) with the focus on maintaining ten healthy Centers.
Acquisition Strategy Meeting (ASM)*	The ASM applies to both programs and projects. The ASM should be convened as early as practicable and prior to partnership commitments. The purpose of an ASM is to obtain senior management approval of acquisition strategy (e.g., make-or-buy, Center assignments, and targeted partners) for programs and projects. The ASM meeting also delineates if a Procurement Strategy Meeting (PSM) is required for each acquisition under consideration. The Program ASM may be held in conjunction with the Program/System Requirements Review (P/SRR) but must be held prior to KDP I. The Project ASM may be held in conjunction with the project SRR, but must be held prior to KDP B. The supporting materials for the ASM include appropriate program/project documentation that covers budget, schedule, requirements, and risk.

* This review is not subject to a SRB independent review.

Table 6-1 Space Flight Program and Project Acquisition Reviews

Review	Description
Program/System Requirements Review (P/SRR)/ Preliminary Program Approval Review (PPAR)	The P/SRR examines the functional and performance requirements defined for the program (and its constituent projects) and ensures that the requirements and the selected concept will satisfy the program and higher-level requirements. It is an internal review. ROM budgets and schedules are presented. The PPAR is conducted (when requested by the DA) as part of this review to ensure that major issues are understood and resolved early and to provide Agency management with an independent assessment of the readiness of the program to continue with formulation.
Program/System Definition Review (P/SDR)/Program Approval Review (PAR)	The P/SDR examines the proposed program architecture and the flow down to the functional elements of the system. The PAR is conducted as part of this review to provide Agency management with an independent assessment of the readiness of the program to proceed into implementation. The proposed program's objectives and the concept for meeting those objectives are assessed. Key technologies and other risks are identified and assessed. The baseline Program Plan, budgets, and schedules are presented.
Program Status Review (PSR)/ Program Implementation Review (PIR)	PSRs are conducted by the program to examine the program's continuing relevance to the Agency's Strategic Plan, the progress to date against the approved baseline, the implementation plans for current and upcoming work, budget, schedule, and all risks and their mitigation plans. PIRs are conducted as part of this review to provide Agency management with an independent assessment of the readiness of the program to continue with implementation.
Preliminary Design Review (PDR)	The PDR demonstrates that the overall program preliminary design meets all requirements with acceptable risk and within the cost and schedule constraints and establishes the basis for proceeding with detailed design. It shows 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 all risk assessment, management systems, and metrics are presented.
Critical Design Review (CDR)	The CDR demonstrates that the maturity of the program's design is appropriate to support proceeding full-scale fabrication, assembly, integration, and test and that the technical effort is on track to complete the flight and ground system development and mission operations in order to meet overall performance requirements within the identified cost and schedule constraints. Progress against management plans, budget, and schedule, as well as risk assessment, are presented.
System Integration Review (SIR)	The SIR evaluates the readiness of the overall system (all projects working together) to commence integration and test. 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.
Operations Readiness Review (ORR)	The ORR examines the actual overall system (all projects working together) characteristics and the procedures used in the system or product's operation and ensures that all project and support (flight and ground) hardware, software, personnel, and procedures are ready for operations and that user documentation accurately reflects the deployed state of the entire system.
Safety and Mission Success Review (SMSR)*	SMSRs are 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. The SMA lead and lead PCE are the focal points for planning, coordinating, and providing the program/project elements of these reviews.
Flight Readiness Review (FRR)	The FRR examines tests, demonstrations, analyses, and audits that determine the overall system (all projects working together) readiness for a safe and successful flight/launch and for subsequent flight operations. It also ensures that all flight and ground hardware, software, personnel, and procedures are operationally ready.
Launch Readiness Review (LRR)	Final review prior to actual launch in order to verify that Launch System and Spacecraft/Payloads are ready for launch.
Post-Launch Assessment Review (PLAR)	Assessment of system in-flight performance.
Critical Events Readiness Review (CERR)	Review to confirm readiness to execute a critical event during flight operations.

*This review is not subject to an SRB independent review.

Table 6-2 Space Flight Program Reviews

Review	Description
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 usually occurs at the cognizant system development organization. ROM budget and schedules are presented.
System Requirements Review (SRR)	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. It may be combined with the MDR for robotic missions.
Mission Definition Review (MDR) / Preliminary Non-Advocate Review (PNAR)	The MDR examines the proposed requirements, the mission/system architecture, and the flow down to all functional elements of the system. The 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.
Preliminary Design Review (PDR)/ Non-Advocate Review (NAR)	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 shows that the correct design option has 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. The 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.
Critical Design Review (CDR)	The CDR demonstrates that the maturity of the design is appropriate to support proceeding with full scale fabrication, assembly, integration, and test, and that the technical effort is on track to complete the flight and ground system development and mission operations in order to meet mission performance requirements within the identified cost and schedule constraints. Progress against management plans, budget, and schedule, as well as risk assessments are presented.
Production Readiness Review (PRR)	The PRR is held for projects developing or acquiring multiple (>3) similar or identical flight and/or ground support systems. The purpose of the PRR is to determine the readiness of the system developer(s) to efficiently produce (build, integrate, test, and launch) the required number of systems. The PRR also evaluates how well the production plans address the system's operational support requirements. This type of review would rarely be held at Goddard.
System Integration Review (SIR)	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. How this will be implemented at Goddard is TBD.
Operations Readiness Review (ORR)	The ORR examines the actual system characteristics and the procedures used in the system or product's operation and ensures that all system and support (flight and ground) hardware, software, personnel, and procedures are ready for operations and that user documentation accurately reflects the deployed state of the system. How this will be implemented at Goddard is TBD.
Safety and Mission Success Review (SMSR)*	SMSRs are 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. The SMA lead and lead PCE are the focal points for planning, coordinating, and providing the program/project elements of these reviews.
Flight Readiness Review (FRR)	The FRR examines tests, demonstrations, analyses, and audits that determine the system's readiness for a safe and successful flight/launch and for subsequent flight operations. It also ensures that all flight and ground hardware, software, personnel, and procedures are operationally ready. How this will be implemented at Goddard is TBD.
Launch Readiness Review (LRR) (Launch Vehicle)	Final review prior to actual launch in order to verify that Launch System and Spacecraft/Payloads are ready for launch.
Post-Launch Assessment Review (PLAR)	Assessment of system in-flight performance. This is the equivalent of the "Receiving Review" or "Commissioning Review" that Goddard conducts.
Critical Event Readiness Review (CERR)	Review to confirm readiness to execute a critical event during flight operations.
Decommissioning Review (DR)	The purpose of the DR is to confirm the decision to terminate or decommission the system and assess the readiness for the safe decommissioning and disposal of system assets.

* This review is not subject to an SRB independent review.

Table 6-3 Space Flight Project Reviews

6.3 Standing Review Boards (SRBs)

The independent life-cycle reviews are conducted by Standing Review Boards. The SRB's role is advisory to the program/project and does not have authority over any program/project content. Its review provides expert assessment of the technical and programmatic approach, risk posture, and progress against the program/project baseline. When appropriate, it may offer recommendations to improve performance and/or reduce risk.

The SRB has a single chairperson and a NASA Review Manager (RM). The chairperson for a program SRB is nominated by the MDAA. The chairperson for a project SRB is nominated by the Center Director. The chairperson, with support from the RM, organizes the review board, and submits the names of proposed board members. The individuals indicated in Table 6-4 develop and approve/concur in the Terms of Reference (ToR) and approve/concur in the assignment of the chairperson, the RM, and the board members. Note that the individuals along any row in this table are referred to in the NPR as the "Convening Authority" for that program or project category. More information as to how the SRB's are established and function is available in the SRB Handbook. Note that this handbook is a guidance document, not a requirements document.

		Decision Authority		Technical Authority		Associate Administrator, PA&E
		NASA AA	MDAA	NASA CE	Center Director	
Establish SRB, Develop ToR. Approve Chairperson, RM, and Other Board Members	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 6-4 Standing Review Board Protocols

To the extent possible, the SRB is to remain intact with the same core membership for the duration of the program or project, although it may be augmented with specialized reviewers as needed. The SRB Handbook recommends that program SRBs have 6 to 8 members and that project SRBs have approximately 12 members. Board members must be independent of the program and project, and some members (approximately half) must be independent of the program's or project's host Center.

> ***Note that:*** *Although Figure 5-2 and Table 6-3 suggest that the SRB will be conducting all of the indicated system-level reviews (except the SMSR), the SRB Handbook suggests that the involvement of the SRB will diminish in the later reviews. In particular, only the SRB Chair (or designee) will attend the LRR, PLAR, and the CERR (if any), and then only as non-voting observers. In addition, only a subset of the SRB (as determined*

by the Chair) will attend the PRR (if any), ORR, and DR. Actually, it is unlikely that there will be any SRB involvement in the HQ-led DR.

For programs, board members responsible for the Independent Cost Analysis (ICA) are provided by the Independent Program Assessment Office (IPAO). For Category 1 and 2 projects, board members responsible for the Independent Cost Estimate (ICE) are also provided by the IPAO. For Category 3 projects, board members responsible for the ICE may be provided by the IPAO or by Goddard's Resource Analysis Office (RAO). Required ICAs and ICEs will be reconciled internally within the SRB and with the program/project prior to the PMC review.

The RM supports each review by assisting 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 Requests for Action (RFAs) are tracked and closed; documenting and distributing SRB findings and recommendations; and preparing management briefings and reports.

Following each review, the SRB issues a report within 30 days or as specified in the ToR. Each report along with recommended actions is submitted to the relevant individuals (e.g., Project Manager, Program Manager, Center Director, MDAA, PA&E, and the Decision Authority). Dissenting opinions are documented in the board report.

The SRB findings are briefed to the program/project under review prior to being reported to higher levels of management. The program/project assesses and dispositions the findings and recommendations of the SRB. Referring to the bottom row of Figure 6-1, the SRB report-out to the Technical Authority (see Section 8) will occur at a Goddard CMC meeting. At that time, the program/project will present their response to the SRB findings. The SRB report, the program/project response, and the CMC assessment will then be presented to the Mission Directorate PMC. For Category 2 and 3 projects, the Mission Directorate PMC recommendation is provided to the MDAA for a final decision. For programs and Category 1 projects, there is one final review by the Agency PMC and a final decision by the NASA AA.

For independent life-cycle reviews that do not directly precede a KDP (e.g., an ORR), the SRB Report, CMC recommendations, and the Program/Project Manager recommendations are presented to the Mission Directorate PMC. For programs and Category 1 projects, these review results may be further reported to the Agency PMC at the discretion of the NASA AA.

In general, the SRB assessments will be based on the following success criteria:

- Alignment with Agency needs, goals, and objectives, and adequacy of requirements flow-down
- Adequacy of technical approach as defined by the NPR 7123.1 entrance and exit criteria
- Adequacy of schedule
- Adequacy of estimated costs, including Independent Cost Analyses (ICAs) and Independent Cost Estimates (ICEs), against approved budget resources
- Adequacy/availability of resources other than budget
- Adequacy of risk management approach and risk identification/mitigation
- Adequacy of management approach

The contribution of each of these criteria to the overall state of the program or project varies as the program/project proceeds through its lifecycle. For example, the first criteria, alignment with Agency needs, goals, and objectives, should be completely met early in the lifecycle. Although the SRB will continue to monitor this criteria, the likelihood of there being an issue will be significantly lower later in the lifecycle.

7.0 Roles and Responsibilities

The roles and responsibilities of senior NASA management, along with fundamental principles of governance, are defined in NPD 1000.0, the *NASA Strategic Management and Governance Handbook*. The key roles and responsibilities specific to program and projects can be summarized as follows:

- **NASA Administrator:** Approves assignment of programs and Category 1 projects to Centers.

- **NASA Associate Administrator:** Responsible for the technical and programmatic integration of programs at the Agency level, chairing the Agency PMC, serving as KDP Decision Authority for programs and Category 1 projects, and approving the PCA.

- **Associate Administrator, PA&E:** Responsible for independent assessment of programs, Category 1 and 2 projects, and other projects as assigned in the areas of cost and management systems; and conducting special studies as requested.

- **Chief Engineer:** Establishes policy, oversight, and assessment of the NASA engineering and program/project management process; implements the engineering technical authority process; serves as principal advisor to the Administrator and other senior officials on matters pertaining to the technical capability and readiness of NASA programs and projects to execute according to plans; and directs the NASA Engineering and Safety Center (NESC) which may conduct independent technical assessments of programs/projects.

- **Chief Safety and Mission Assurance Officer:** Performs independent program and project compliance verification audits and implements the SMA technical authority process.

- **Mission Directorate Associate Administrator:** Primarily responsible for managing programs within the Mission Directorate; recommends the assignment of programs and Category 1 projects to Centers; assigns Category 2 and 3 projects to Centers; serves as the KDP Decision Authority for Category 2 and 3 projects; and is responsible for all program requirements, and the high-level programmatic requirements levied on projects within the Mission Directorate.

- **Center Director:** Responsible for providing oversight of programs and projects at he Center; establishing, developing, and maintaining the institutional capabilities (processes and procedures, human capital, facilities, and infrastructure) required for the execution of programs and projects, including the system of checks and balances to ensure the technical integrity of programs and projects assigned to the Center.

- **Program Manager:** Responsible for the formulation and implementation of the program.

- **Project Manager:** Responsible for the formulation and implementation of the project.

8.0 Technical Authority

The NASA governance model prescribes a management structure that employs checks and balances between key organizations to ensure that decisions have the benefit of different points of view and are not made in isolation. The technical authority process provides for the selection of individuals at different levels of responsibility who provide an independent view of matters within their respective areas of expertise. A key aspect of the technical authority process is that the Technical Authorities (TAs) are funded independently of the program/project. Their responsibilities include approving changes to, and waivers of all TA-owned requirements, and serving as members of program/project control boards, change boards, and internal review boards.

In the event that a Technical Authority and Program/Project Manager disagree on a proposed programmatic or technical action, the following procedures apply:

- The Program/Project Manager has the authority to make a decision while resolution is attempted at the next higher level of Programmatic and Technical Authority.

- The Program/Project Manager may proceed at risk in parallel with pursuit of resolution if they deem it in the best interest of the program/project. In such circumstances, the next higher level of Programmatic and Technical Authority would be informed of the decision to proceed at risk.

- Resolution should be attempted at successively higher levels of Programmatic Authority and Technical Authority until resolved. Final appeals are made to the Office of the Administrator.

8.1 Engineering Technical Authority

The Engineering Technical Authority establishes and is responsible for the engineering design processes, specifications, rules, best practices, etc., necessary to fulfill mission requirements. Engineering technical authority responsibilities originate with the NASA Administrator and are delegated to the NASA Chief Engineer. Specific engineering technical authority responsibilities may then be delegated from the NASA Chief Engineer to Center, program, project, and system-level Engineering Technical Authorities.

The NASA Chief Engineer provides overall leadership of the engineering technical authority process for space flight programs/projects. The NASA Chief Engineer approves the appointment of the Center Engineering Directors and of Engineering Technical Authorities on programs and Category 1 projects, and is notified of the appointment of other Engineering Technical Authorities. The NASA Chief Engineer hears appeals of the Engineering Technical Authority's decisions when they cannot be resolved at lower levels.

The following individuals are responsible for implementing engineering technical authority at the Center:

- **Center Director (CD) –** The CD (or the Center Engineering Director, or other designee) is the Center Engineering Technical Authority for projects or major systems implemented by the Center. The Center Engineering Technical Authority approves waivers and changes in Center requirements. The CD appoints, with the approval of the NASA Chief Engineer, individuals for the position of Center Engineering Director and for the

Engineering Technical Authority positions down to and including Program Chief Engineers and Category 1 Project Chief Engineers. The CD appoints Category 2 and 3 Project Chief Engineers and Lead Discipline Engineers.

- **Program/Project Chief Engineer (PCE) –** The PCE is the Engineering Technical Authority for a given program/project. When there are disagreements, resolution is sought at the level of the Center Engineering Technical Authority. To ensure independence, the PCE is assigned to the program/project, but is organizationally in the Center Engineering Directorate. The PCE serves as a member of program/project change boards, and thereby concurs in the establishment of changes to, and waivers of, engineering requirements. The PCE also serves as a member of internal review boards.

- **Lead Discipline Engineer (LDE) –** The LDE is a senior technical engineer in a specific discipline who is designated as the Engineering Technical Authority for that discipline at the Center. To ensure independence, the LDE is organizationally separate from the program/project. The LDE assists the program/project through direct involvement with working-level engineers and the PCE to identify discipline-specific engineering requirements and develop solutions that comply with the requirements.

8.2 SMA Technical Authority

The SMA Technical Authority establishes and is responsible for the SMA design processes, specifications, rules, best practices, etc., necessary to fulfill programmatic mission performance. The SMA Technical Authority starts with the NASA Chief SMA Officer and flows down to the Center Director, Center SMA Director, and then to the Program and Project SMA Leads. To ensure independence, SMA Technical Authority personnel are organizationally separate from the program/project.

9.0 Program Requirements by Phase

The following sections focus on the program team activities and products during program formulation and implementation. It is understood that prior to the formal SRB life cycle reviews, the program will conduct their usual internal reviews in accordance with NPR 7123.1 (Systems Engineering) and Center practices.

9.1 Program Formulation Phase

Prior to KDP-I, the Program Manager and the program team shall:

- Plan, prepare for, and support the Acquisition Strategy Meeting.
- Support the MDAA in developing and obtaining approval of the FAD, PCA, and annual budget submissions.
- Prepare and obtain approval of the Program Plan and related Control Plans. The template for the Program Plan and related Control Plans may be found in Appendix E of NPR 7120.5D.
- Support the MDAA and the NASA HQ Office of External Relations in obtaining approved interagency and international agreements.
- Document the traceability of program requirements on individual projects to Agency needs, goals, and objectives as described in the NASA Strategic Plan.
- Initiate the development of required technologies.

At the discretion of the Agency AA, preliminary versions of these products may be required at a KDP 0 to ensure major issues are understood and resolved prior to KDP I.

9.2 Program Implementation Phase

During program implementation, the Program Manager and the program team shall:

- Support the MDAA in updating the PCA, Program Plan, and interagency and international agreements as required.
- Support the MDAA in the project selection process.
- Approve project FADs and Project Plans.
- Maintain programmatic and technical oversight of the projects within the program and report their status as required.
- Review and approve annual project budget submission inputs and prepare annual program budget submissions.
- Continue to develop technologies that cut across multiple projects within the program.

10.0 Project Requirements by Phase

Table 10-1 provides a summary of the technical and programmatic "products" that are required to be developed during the various stages of a project's life cycle. The following sections provide additional information on a phase by phase basis.

> ***Note that:*** *These sections are an abridged version of what is contained in the equivalent sections of the NPR. Many of the activities that would just naturally be done in the normal course of business (eg, implement the Project Plan in Phase C and beyond, conduct internal reviews prior to the life cycle reviews, support the life cycle reviews, support the KDP process, etc) have been removed from this listing.*

10.1 Project Pre-Phase A

During Pre-Phase A, a pre-project team studies a broad range of mission concepts that contribute to program and Mission Directorate goals and objectives. These activities are focused toward a Mission Concept Review (MCR) and KDP A.

During Pre-Phase A, the pre-project manager and team shall:

- Support the MDAA in developing and obtaining approval of the FAD
- Support the Program Manager and the MDAA in developing *draft* program requirements on the project
- Develop the KDP A technical and programmatic readiness products shown in Table 10-1

10.2 Project Phase A

During Phase A, a project team is formed to develop a baseline mission concept and begin the development of needed technologies. These activities include a System Requirements Review (SRR) and Mission Definition Review (MDR). For robotic missions, these two reviews may be combined. Note that the Pre Non-Advocate Review (PNAR) is conducted in concert with the MDR (or the combined SRR/MDR). This process culminates in the PNAR and KDP B.

For projects that are initiated through a competitive Announcement of Opportunity (AO) or similar instrument, Phase A includes project concept development, technology development, and independent assessment by PI-led teams leading to the preparation of detailed proposals and culminating in a final selection. As a result, the normal requirements for gate products and independent life-cycle reviews are waived during Phase A, and the emphasis shifts to the gate products and independent life-cycle reviews at the end of Phase B.

During Phase A, the Project Manager and project team shall:

- Support the Program Manager and the MDAA in developing *baseline* program requirements on the project
- Plan, prepare for, and support the Acquisition Strategy Meeting (ASM)
- Support the Program Manager, the MDAA, and the NASA HQ Office of External Relations in initiating interagency and international agreements.

- Develop the KDP B readiness products shown in Table 10-1

NPR 7120.5D Project Gate Products	Pre-Phase A	Phase A	Phase B	Phase C	Phase D	Phase E
Headquarters and Program Products						
1. FAD	Approved					
2. Program Requirements on the Project (from the Program Plan)	Draft	Baseline	Update			
3. ASM minutes		Baseline				
4. NEPA compliance documentation			Baseline			
5. Interagency & International Agreements			Baseline			
Project Technical Products						
1. Mission Concept Report (Note 1)	Preliminary	Baseline				
2. System Level Requirements		Preliminary	Baseline			
3. Preliminary Design Report (Note 2)			Baseline			
4. Missions Operations Concept		Preliminary	Baseline			
5. Technology Readiness Assessment Report			Baseline			
6. MSPSP (Note 3)			Preliminary	Baseline	Update	
7. Detailed Design Report (Note 4)				Baseline		
8. As-built H/W & S/W Documentation					Baseline	
9. Verification and Validation Report					Baseline	
10. Operations Handbook				Preliminary	Baseline	
11. Orbital Debris Assessment (Note 5)		Initial	Preliminary	Baseline		
12. Mission Report						Final
Project Planning, Cost, and Schedule Products						
1. Work Agreements for next phase		Baseline	Baseline	Baseline	Baseline	Baseline
2. Integrated Baseline (Note 6)	Draft	Preliminary	Baseline			
3. Project Plan		Preliminary	Baseline			
4. CADRe (Note 7)		Preliminary	Baseline	Update		Update
5. Planetary Protection Plan (as required)		Certification	Baseline			
6. Nuclear Safety Launch Approval Plan		Baseline (as reqd)				
7. Business Case Analysis for Infrastructure		Preliminary	Baseline			
8. Range Safety Risk Management Plan			Preliminary	Baseline		
9. Systems Decommissioning/Disposal Plan				Preliminary		Baseline

Table 10-1 Project Gate Products Maturity Matrix

Note 1: Essentially the contents of the MCR presentation material including risk drivers and mitigation options and descope options.
Note 2: Essentially the contents of the PDR presentation material including risk drivers and mitigation options and descope options.
Note 3: Updated Missile System Pre-launch Safety Package (MSPSP) in Phase D is due 45 days prior to delivery of the spacecraft to the launch site.
Note 4: Essentially the contents of the SIR (or equivalent) presentation material including risk drivers and mitigation options and descope options.
Note 5: These due times are one phase earlier than makes any sense, and are in conflict with the newly released NPR 8715.6 on orbital debris control. Hopefully this will be corrected so that every project doesn't have to get a waiver to this requirement.
Note 6: See Sections 4.3.to 4.4 of NPR 7120.5 for details on contents of Integrated Baseline by phase.

Note 7: For Category 1 and 2 projects, develop required CADRe 60 days prior to the KDP. For competed projects, this requirement is met by the submission of a copy of the winning proposal and concept study report (include times).

- Initiate technology developments, as required.

- For contracts requiring Earned Value Management (EVM), conduct required Integrated Baseline Reviews.

- Work with NASA Headquarters to initiate the development of MOUs/MOAs with external partners, as needed

- Prepare list of long-lead procurements that need to be procured in Phase B.

- Support NASA export control officials in identifying and assessing export-controlled technical data that will be provided to foreign partners and the approval requirements for release of that data, all as a part of developing the Export Control Plan.

10.3 Project Phase B

During Phase B, the project team completes its preliminary design and technology development. These activities are focused toward completing the Project Plan and Preliminary Design Review (PDR)/Non-Advocate Review (NAR). The PDR/NAR process culminates in KDP C.

During Phase B, the Project Manager and the project team shall:

- Update the program requirements on the project in coordination with the Program Manager and the MDAA

- Work with Code 250 to complete the environmental planning process as explained in NPR 8580.1, Implementing the National Environmental Policy Act

- Support the Program Manager, the MDAA, and the NASA HQ Office of External Relations in finalizing any interagency or international agreements.

- Coordinate with the Space Operations Mission Directorate (SOMD) if the project involves launch services.

- Develop the KDP C readiness products shown in Table 10-1.

- As part of baselining the interface control documents, verify compliance with NPD 8010.2, *Use of the SI (Metric) System of Measurement in NASA Programs*, and/or obtain any necessary waivers.

- Plan and execute long-lead procurements in accordance with the Acquisition Plan. (Note: Long-lead procurements can only be initiated in Phase B when specifically approved by the MDAA.)

- Identify any risk drivers and proposed mitigation plans for each risk.

- Develop a set of descope options.

- For contracts requiring Earned Value Management (EVM), conduct required Integrated Baseline Reviews.

- Reconcile the project's baseline life-cycle cost estimate with the PDR/NAR Independent Cost Estimate.

10.4 Project Phase C

During Phase C, the project completes the design that meets the detailed requirements and begins fabrication of test and flight article components, assemblies, and subsystems. These activities focus on preparing for the Critical Design Review (CDR) and the System Integration Review (SIR). This phase culminates in KDP D.

During Phase C, the Project Manager and the project team shall:

- Develop the KDP D readiness products shown in Table 10-1.

- Develop and test all requisite engineering models (brass boards, breadboards, full-up models) sufficiently prior to lower-level CDRs to enable test results to affect detailed designs.

- Develop requisite system and subsystem test beds needed for qualification and acceptance testing of flight articles.

- Following the appropriate lower-level CDR, initiate fabrication/procurement of flight article components, assemblies, and/or subsystems.

- Initiate the qualification and acceptance testing of flight article components, assemblies, and/or subsystems.

- Hold peer reviews, as appropriate, prior to major project reviews in accordance with the Project Review Plan.

- Following the SIR and/or PRR, initiate system assembly and integration and test activities even if KDP D has not occurred (unless otherwise directed by the Program Manager).

- Develop Project Control Plans as required by Table 3-2.

- Implement Earned Value Management (EVM) as documented in the Project Plan. For contracts requiring EVM, conduct required Integrated Baseline Reviews.

  Note that: *Generic EVM guidance is hidden in Appendix F (Project Plan Template) of NPR 7120.5D. See Section 3.1.(c) of that appendix.*

- Provide immediate written notice and a recovery plan to the Program Manager and the MDAA if the latest Phase C through D Estimate at Completion (EAC) of the project exceeds by 15% or more of the cost at KDP C. Update the Project Plan as required.

- Provide immediate written notice and a recovery plan to the Program Manager and the MDAA if a milestone listed for Phases C and D on the project life-cycle chart (Figure 5-2) is estimated to be delayed in excess of six months from the date scheduled at KDP C. Update the Project Plan as required.

10.5 Project Phase D

During Phase D, the project performs system assembly, integration, and test. These activities focus on preparing for the Flight Readiness Review (FRR). This phase culminates in KDP E.

During Phase D, the Project Manager and the project team shall:

- Develop the KDP E readiness products shown in Table 10-1
- Initiate system assembly, integration, and test
- Execute and document the results of the project's Verification and Validation Plan
- Resolve all test, analysis, and inspection discrepancies.
- Integrate payload/launch vehicle and test
- Conduct operational tests and training, including normal and anomalous scenarios
- Establish and maintain an integrated logistics support capability, including spares, ground support equipment, and system maintenance and operating procedures, in accordance with the project's Logistics Plan.
- Launch and perform system checkout
- For contracts requiring EVM, conduct required Integrated Baseline Reviews.
- Provide immediate written notice and a recovery plan to the Program Manager and the MDAA if the latest Phase C through D Estimate at Completion (EAC) of the project exceeds by 15% or more of the cost at KDP C. Update Project Plan as required.
- Provide immediate written notice and a recovery plan to the Program Manager and the MDAA if a milestone listed for Phases C and D on the project life-cycle chart (Figure 5-2) is estimated to be delayed in excess of six months from the date scheduled at KDP C. Update Project Plan as required.

10.6 Project Phase E

During Phase E, the project implements the Missions Operations Plan developed in previous phases. This phase culminates in KDP F.

During Phase E, the Project Manager and the project team shall:

- Develop the KDP F readiness products shown in Table 10-1.
- Monitor system incidents, problems, and anomalies, as well as system margins to ensure that deployed project systems function as intended, and investigate system behavior that is observed to exceed established operational boundaries or expected trends, and implement corrective actions, as necessary.
- Provide sustaining engineering, as appropriate, to the mission to enhance efficiency, safety, and accommodate obsolescence.

- Capture and archive mission results, including engineering data on system and subsystem performance, in an MDAA-approved data depository.

- As directed by the Program Manager, support the development of Project Plan revisions to continue the mission into extended operations beyond the primary mission phase or beyond any extension previously included in the plan.

10.7 Project Phase F

During Phase F, the project implements the Systems Decommissioning/Disposal Plan developed in Phase E, and performs analyses of the returned data.

During Phase F, the Project Manager and the project team shall:

- Complete analysis and archiving of mission and science data, as well as archiving of project engineering and technical management data and documentation, and lessons learned in accordance with agreements, the Project Plan and Program Plan, and Center and Agency policies.

- Implement the Systems Decommissioning/Disposal Plan and safely dispose of project systems.

- For Category 1 and 2 projects, prepare a final CADRe consistent with the NASA Cost Estimating Handbook.

APPENDIX A. Definitions

Analysis of Alternatives. A formal analysis method that compares alternative approaches by estimating their ability to satisfy mission requirements through an effectiveness analysis and by estimating their life-cycle costs (LCC) through a cost analysis. The results of these two analyses are used together to produce a cost-effectiveness comparison that allows decision-makers to assess the relative value or potential programmatic returns of the alternatives.

Baseline Document. Implies the expectation of a finished product, though updates may be needed as circumstances warrant. All approvals required by Center policies and procedures have been obtained.

Cost Analysis Data Requirement (CADRe). A formal document designed to help managers to understand the cost and cost risk of space flight projects. The CADRe consists of a Part A "Narrative," a Part B "Technical Data" in tabular form, both provided by the program/project to the ICE team. A "Project Life Cycle Cost Estimate," produced by the project team, is appended as Part C, but the ICE team does not see Part C until it has produced its own independent estimate.

Earned Value Management (EVM). A tool for measuring and assessing project performance through the integration of technical scope with schedule and cost objectives during the execution of the project. EVM provides quantification of technical progress, enabling management to gain insight into project status and project completion costs and schedules. Two essential characteristics of successful EVM are EVM system data integrity and carefully targeted monthly EVM data analyses (i.e., risky WBS elements). Refer to Section 3.1.(c) of Appendix F of NPR 7120.5D.

Independent Cost Analysis (ICA). An independent analysis of program resources (including budget) and financial management associated with the program content over the program's budget horizon, conducted by an impartial body independent from the management or advocacy chain of the program. ICA includes, but is not limited to, the assessment of cost estimates, budgets, and schedules in relation to the program and its constituent projects' technical content, performance, and risk. ICAs may include Independent Cost Estimates (ICE), assessment of resource management, distribution and planning, and verification of cost-estimating methodologies. (ICAs are not life-cycle cost estimates but are assessments of the adequacy of the budget and management practices to accomplish the work scope through the budget horizon; as such, ICAs can be performed for programs/projects when a life-cycle ICE is not warranted.)

Independent Cost Estimate (ICE). An independent project cost estimate prepared by an office or other entity that is not under the supervision, direction, advocacy, or control of the project (or its chain of command) that is responsible for carrying out the development or acquisition of the program/project. An ICE is bounded by the project scope (total life cycle through all phases),

schedule, technical content, risk, ground rules, and assumptions and is conducted with objectivity and the preservation of integrity of the cost estimate. ICEs are generally developed using parametric approaches that are tailored to reflect the design, development state, difficulty, and expertise of team members.

Integrated Baseline. The project's technical performance baseline/mission content, technology application, and schedule milestones. The integrated baseline also includes the WBS, WBS dictionary, integrated master schedule, life-cycle cost and workforce estimates that are consistent with the program requirements on the project, the project's CADRe (if applicable), and the technical performance baseline/mission content.

Integrated Baseline Review (IBR). A joint assessment by the offeror/contractor and the Government to verify the technical content and the realism of the related performance budgets, resources, and schedules. It should provide a mutual understanding of the inherent risks in offerors'/contractors' performance plans and the underlying management control systems, and it should formulate a plan to handle these risks.

Non-Advocate Review (NAR). The analysis of a proposed program or project by a (non-advocate) team composed of management, technical, and resources experts (personnel) from outside the advocacy chain of the proposed program or project. It provides Agency management with an independent assessment of the readiness of the program/project to proceed into implementation.

Procurement Strategy Meeting (PSM). A meeting in which the Program/Project Manager, supported by the contracting officer, seeks Agency approval of the procurement approach (e.g., competition approach, small business goals, and government furnished property). The PSM is normally contract-specific but may address all contracts within a project. PSMs can occur multiple times over the project life cycle, are held prior to release of a solicitation, and are conducted in accordance with the NASA FAR Supplement. (The initial PSM will typically be held between the SDR/MDR/PNAR and the PDR/NAR. The AO process embodies the activities included in a PSM; therefore, a separate PSM is not required for AO-driven projects.)

Standing Review Board (SRB). The entity responsible for conducting independent reviews of the program/project per the life-cycle requirements. The SRB is advisory and is chartered to objectively assess the material presented by the program/project at a specific review.

Technical Authority. The individual who specifically maintains technical responsibility over establishment of, changes to, and waivers of requirements in a designated area.

Termination Review. A review initiated by the Decision Authority for the purpose of securing a recommendation as to whether to continue or terminate a program or project. Failing to stay within the parameters or levels specified in controlling documents will result in consideration of a termination review.

Terms of Reference (ToR). A document specifying the nature, scope, schedule, and ground rules for an independent review or independent assessment.

Validation. Proof that the product accomplishes the intended purpose based on stakeholder expectations. May be determined by a combination of test, analysis, demonstration, and inspection.

Verification. Proof of compliance with design solution specifications and descriptive documents. May be determined by a combination of test, analysis, demonstration, and inspection.

Waiver. A documented authorization intentionally releasing a program or project from meeting a requirement.

Work Agreement. The Center form (or equivalent), prepared for each program/project cost account and used to document agreements and commitments for the work to be performed, including scope of work, receivables/deliverables, schedule, budget, and assumptions.