NASA Procedural Requirements

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COMPLIANCE IS MANDATORY FOR NASA EMPLOYEES

NASA Research and Technology Program and Project Management Requirements (Updated w/Chage 2)

Responsible Office: Office of the Chief Engineer

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Chg#	Date	Description/Comments
1	05/26/2020	In para. 4.2.3.3, corrected section reference for PM roles and responsibilities; in para. 4.2.5.4, added statement that R&T projects operated in space has to develop a Project Protection Plan; in Appendix A, removed definitions not used in body of document and in Appendix K, corrected definition of Flight Unit.
2	09/13/2021	In para 5.3 change name of process from Dissenting Opinion Process to Formal Dissent Process; In Appendix A, update definitions in alignment with definitions in NPR 7120.5F; in Appendix G para 4.2, update example control plan list to include the Human System Integration Plan; in Appendix K, replace section with pointer to newly published Technology Readiness Assessment Guide; and throughout document, change IT Security Plan to System Security Plan

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Preface

P.1 Purpose

This document establishes the program and project management requirements by which the National Aeronautics and Space Administration (NASA) will formulate and execute research and technology (R&T) programs and projects, consistent with the governance model contained in NASA Policy Directive (NPD) 1000.0.

P.2 Applicability

a. This NASA Procedural Requirements (NPR) is applicable to NASA Headquarters and NASA Centers, including Component Facilities and Technical and Service Support Centers. This directive applies to the Jet Propulsion Laboratory (a Federally-funded Research and Development Center) and other contractors only to the extent specified or referenced in the applicable contracts.

b. This document establishes the management requirements for formulating, approving, implementing, and evaluating NASA R&T programs and projects consistent with the governance model contained in NPD 1000.0 and applies to R&T managed or funded by NASA (excluding all NASA-funded programs, projects, and activities managed under NPR 7120.5 and NPR 7120.7). R&T programs and projects that are directly funded by a space flight program/project should decide whether they are subject to NPR 7120.5, NPR 7120.8, or a hybrid per Mission Directorate policy and Decision Authority (DA) approval. R&T projects that directly tie to the space flight mission's success and schedule are normally managed under NPR 7120.5. For existing R&T programs and projects, the requirements of this NPR apply to their current and future phases as of the effective date of this NPR as determined by the responsible Mission Directorate and concurred with by the DA.

c. Programs and projects governed by NPR 7120.8 that have systems under development with information technology (IT) components follow relevant IT management processes and requirements contained in NPR 7150.2 and NPD 2800.1.

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

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

P.3 Authority

a. The National Aeronautics and Space Act, as amended, 51 U.S.C. § 20113(a).

b. NPD 7120.4, NASA Engineering and Program/Project Management Policy.

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P.4 Applicable Documents and Forms

a. Declaration of Policy, 15 U.S.C. § 205b.

b. Metric Usage in Federal Government Programs, Executive Order (EO) 12770, 56 Federal Register (FR) 35801 (July 29, 1991).

c. Procurement Strategy Meeting (PSM), NASA FAR Supplement (NFS), Part 1807.170.

d. NPD 1000.0, NASA Governance and Strategic Management Handbook.

e. NPD 1000.3, The NASA Organization.

f. NPD 1000.5, Policy for NASA Acquisition.

g. NPD 1001.0, NASA Strategic Plan.

h. NPD 1200.1, NASA Internal Control.

i. NPD 1382.17, NASA Privacy Policy.

j. NPD 1440.6, NASA Records Management.

k. NPD 1920.1, Scientific Integrity.

l. NPD 2800.1, Managing Information Technology.

m. NPD 2810.1, NASA Information Security Policy.

n. NPD 7120.6, Knowledge Policy for Programs and Projects.

o. NPR 1080.1, Requirements for the Conduct of NASA Research and Technology (R&T).

p. NPR 1441.1, NASA Records Management Program Requirements.

q. NPR 2210.1, Release of NASA Software.

r. NPR 2800.1, Managing Information Technology.

s. NPR 2810.1, Security of Information Technology.

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

u. NPR 7120.11, NASA Health and Medical Technical Authority (HMTA) Implementation.

v. NPR 7123.1, NASA Systems Engineering Processes and Requirements.

w. NPR 7150.2, NASA Software Engineering Requirements.

x. NPR 7500.2, NASA Technology Transfer Requirements.

y. NPR 7900.3, Aircraft Operations Management.

z. NPR 8000.4, Agency Risk Management Procedural Requirements.

aa. NPR 8580.1, Implementing the National Environmental Policy Act and Executive Order 12114.

bb. NPR 8705.6, Safety and Mission Assurance (SMA) Audits, Reviews, and Assessments.

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cc. NPR 8715.3, NASA General Safety Program Requirements.

dd. NPR 8715.6, NASA Procedural Requirements for Limiting Orbital Debris and Evaluating the Meteoroid and Orbital Debris Environments.

ee. NPR 8715.7, Payload Safety Program.

ff. NASA-STD-8709.20, Management of Safety and Mission Assurance Technical Authority (SMA TA) Requirements.

gg. NASA/SP-2014-3705, NASA Space Flight Program and Project Management Handbook.

hh. NASA/SP-2016-3706, NASA Standing Review Board Handbook.

ii. NASA/SP-2016-6105, NASA Systems Engineering Handbook.

jj. Guidebook for Proposers Responding to a NASA Funding Announcement, https://www.hq.nasa.gov/office/procurement/nraguidebook/proposer2017.pdf.

kk. NASA Agency Program Management Council (APMC), Independent Assessment Principles and Approach Decision Memorandum, December 13, 2016, https://nodis3.gsfc.nasa.gov/OCE_docs/OCE_31.pdf.

ll. Guide for Successful Headquarters Procurement Strategy Meetings (PSMs), https://nasa.sharepoint.com/sites/procurement/Shared%20Documents/NASA%20PSM%20Guide.pdf

P.5 Measurement/Verification

Compliance with this document is verified through oversight by the governing Program Management Council (PMC) and NASA internal controls described in NPD 1200.1, NASA Internal Control. Special audits are performed per NPD 1000.0.

P.6 Cancellation

NPR 7120.8, NASA Research and Technology Program and Project Management Requirements, dated February 5, 2008.

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Chapter 1. Introduction

1.1 Background

1.1.1 This document establishes the process by which NASA will formulate and implement Research and Technology (R&T) managed or funded by NASA consistent with the governance model contained in NPD 1000.0. NASA manages a wide variety of R&T, including but not limited to, scientific research, aeronautics research, and technology developed for space activities. Due to the wide range of activities, this NPR does not standardize their development into a single process, but rather provides a minimum management requirement set for R&T programs and projects that is tailorable to suit their type and complexity. This NPR then establishes the management processes and practices available for NASA R&T activities and identifies the Decision Authority (DA) responsible to select the appropriate process. The requirements of this NPR may be tailored in accordance with Section 5.6.

1.1.2 Central to building this cohesive management process is the introduction of NASA R&T program and project life cycles and identification of the Key Decision Points (KDPs) within these life cycles. Along with program and project life cycles and KDPs, this document also describes the roles and responsibilities of key personnel for NASA R&T program and project management.

1.1.3 This document distinguishes between programmatic requirements and institutional requirements. Both categories of requirements ultimately need to be satisfied in program and project formulation and implementation.

1.1.3.1 Programmatic requirements are the responsibility of the Programmatic Authorities. Programmatic requirements focus on the products to be developed and delivered and specifically relate to the goals and objectives of a particular NASA program or project. See Table 1-1 in NPR 7120.5 for further details on this flow down from Agency strategic planning through Agency, directorate, program, and project requirement levels to the systems that will be implemented to achieve the Agency goals.

1.1.3.2 Institutional requirements are the responsibility of the Institutional Authorities. They focus on how NASA performs program and project management activities and are independent of any particular program or project. These requirements are issued by NASA Headquarters (including the Office of the Administrator and Mission Support Offices) and by Center organizations. Institutional requirements may respond to Federal statute, regulation, treaty, or Executive Order. They are normally documented in NPDs, NPRs, NASA Standards, Center Policy Directives (CPDs), Center Procedural Requirements (CPRs), and Mission Directorate requirements.

1.2 Overview of Management Process

1.2.1 Program and project management is based on life cycles, KDPs, and evolving products that are embedded in NASA's four-part process for managing programs and projects consisting of:

1.2.1.1 Formulation—the assessment of feasibility, technology, and concepts; risk assessment; team-building; development of concepts and acquisition strategies; establishment of high-level requirements and success criteria; the preparation of plans, budgets, and schedules essential to the

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success of a program or project; and identification of how the program or project supports the Agency's strategic needs, goals, and objectives.

1.2.1.2 Approval—the ongoing effort by responsible officials above the program and project management level to review plans and performance at KDPs and authorize continuation of the effort and progression to the next phase.

1.2.1.3 Implementation—the execution of approved plans for the development and operation of programs and projects and use of control systems to ensure performance to approved plans and requirements and continued alignment with current Agency strategies.

1.2.1.4 Evaluation—the self-review and independent assessment of the performance of a program or project and incorporation of accepted findings to ensure adequacy of planning and execution according to approved plans and requirements.

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Chapter 2. NASA Life Cycles for Managing Research and Technology

2.1 Governance

2.1.1 The fundamental principles of NASA governance are defined in NPD 1000.0. The governance model prescribes a management structure that employs checks and balances among key organizations to ensure that decisions have the benefit of different points of view and are not made in isolation. This structure is made up of two authorities: Programmatic and Institutional. Programmatic Authority consists of the Mission Directorates and their respective programs and projects. The Institutional Authority consists of those organizations not in the Programmatic Authority and includes the Technical Authorities (refer to section 5.4). For further description of Programmatic and Institutional Authority, please see the NASA Space Flight Program and Project Management Handbook (NASA/SP-2014-3705), which can be found on the "Other Policy Documents" tab in NODIS under the Office of the Chief Engineer (OCE) menu item.

2.1.2 R&T management policy follows a different philosophy than NPR 7120.5, which compiles a comprehensive set of requirements for space flight that may need to be tailored down for smaller efforts that are not crewed. This directive applies the principle of a minimum set of essential requirements and maximum flexibility for research and technology development programs and projects. Rather than tailoring down from the directive's requirements, R&T projects may need to pull in additional requirements from NPR 7120.5 for more robust or structured project management, particularly on larger projects or projects that may transition to flight. Further details can be found in Section 5.6, Principles Related to Tailoring Requirements.

2.2 Research and Technology (R&T) Programs

2.2.1 A program is a strategic investment by a Mission Directorate that has a technical approach, requirements, funding level, and management structure that initiates and directs one or more projects.[1] A program defines a strategic direction that the Agency has identified as needed to accomplish Agency goals and objectives. An R&T program accomplishes Agency goals and objectives by managing projects that directly address NASA's R&T investment strategy and portfolio goals. Programs are usually long-term commitments by the Agency with a common focus. Programs follow a specific life cycle with periodic program reviews and the cyclical starts and stops of projects. Agency-level organizations such as the Office of the Administrator, the OCE, the Office of the Chief Financial Officer (OCFO), and the Office of Safety and Mission Assurance (OSMA) track, monitor, and assess the health and success of Agency programs.

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[1] The Office of the Chief Engineer (OCE) is responsible for the official listing of NASA programs and projects. This data is maintained by the Office of Chief Financial Officer (OCFO) in a database called the Meta-Data Manager (MdM). This database is the basis for the Agency's work breakdown and forms the structure for program and project status reporting across all Mission Directorates and Mission Support Offices.

2.2.2 This NPR applies only to R&T programs and projects. R&T programs comprise Technology Development (TD) projects and/or Research projects. (See Section 2.3 for details on TD projects and Research projects.) R&T program management requirements are defined in Chapter 3 of this document.

2.3 Research and Technology Projects

2.3.1 A project is a specific investment identified in a Program Plan, that has defined goals and/or requirements, a life-cycle cost, a beginning, and an end. Projects may consist of single or multiple related

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technology or research efforts. A project yields new or revised products that directly address NASA's strategic needs. This NPR is applicable only to R&T programs and projects, which can be either technology development or research projects as described below.

2.3.1.1 **Technology Development (TD) projects.** TD projects characterize or enhance performance and mature a technology or set of related technologies. These projects attempt to solve a specific problem or address a practical need. They advance investigations, experiments, and prototyping to higher level of maturity. This should typically be a point at which a decision to continue into a new project task or cease investment can be made based on performance. The most mature R&T projects advance to the point where the technology is at its final pre-production version, and where the prototype design has been fully developed, tested, and verified. TD projects typically focus their activities on fully establishing their approach and techniques, answering all pertinent questions on the theory or hypothesis, developing the simulations, prototypes, and models that demonstrate the capability, and testing, verifying and validating the capability with the intended customer or beneficiary. These activities reduce the risk associated with the new technology to the point where it is ready for use by a customer or beneficiary. Usually, TD projects have an identified or targeted beneficiary who is the intended user of the technology being developed and who is involved throughout the development process.

2.3.1.2 **Research projects.** Research projects perform either basic research or applied research. Basic research addresses the need for knowledge through investigation of fundamental principles and interactions. In the early stages, it may take the form of theory development, or scientific and/or technical investigations as to the feasibility of an idea. The activity at this stage is generally driven by a principal investigator. As the basic research evolves, hypotheses may be formed, or scientific testing may proceed to evaluate the theories. Research papers, presentations or articles are the typical outcomes of this phase. For applied research, once an idea is defined enough to start thinking about practical application, single prototypes can be designed and tested, or a simulation or model developed to demonstrate the potential of the research. Basic and applied research is directly tied to the Agency's vision and mission, as defined by NPD 1001.0. The results of this basic or applied research may provide fundamental discoveries, expand the knowledge base, provide scientific and technological breakthroughs that are immediately applicable, or evolve into more advanced technology development. Research projects are characterized by unpredictability of outcome. Funding may be at a fixed level on a yearly basis.

2.4 Strategic Acquisition Planning

2.4.1 NASA's program and project support of its overall mission is long term in nature, but the environments in which these programs and projects are conducted are dynamic. In recognition of this, NPD 1000.0 and NPD 1000.5 put in place a framework for ensuring that NASA's programs, projects, and resources align with NASA's long-term strategic vision. At NASA, the annual strategic resource planning forms a continuous process all the way through to acquisition and procurement to ensure this alignment. NPD 1000.5 details this process. At the program and project level, the Acquisition Strategy Meeting (ASM) and the Procurement Strategy Meeting (PSM) support the Agency's acquisition process, which includes strategic planning, as well as procurement. Links to the ASM guide and pre-ASM guide are found at the top of the first page of NPD 1000.5 in NODIS. The ASM is in NASA FAR Supplement (NFS), Part 1807.170. The PSM guide is found at https://nasa.sharepoint.com/sites/procurement/Shared%20Documents/NASA%20PSM%20Guide.pdf.

2.4.1.1 When determined applicable, these strategic acquisition events are part of the normal program and project formulation and implementation activities described in sections 2.5 and 2.6 and the remaining chapters of this NPR.

2.5 R&T Program and Project Oversight

2.5.1 Each program and project has a governing Program Management Council (PMC) that provides

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management oversight. To ensure the appropriate level of management oversight, NASA has established a hierarchy of PMCs—the Agency PMC (APMC) and Directorate PMC (DPMC). Each council has the responsibility of periodically evaluating the cost, schedule, risk, and performance of programs or projects under its purview. The evaluation focuses on whether the program or project is meeting its commitments to the Agency and is following appropriate management processes.

2.5.2 Oversight of programs and projects is also performed by a Center Management Council (CMC), which may evaluate all R&T work executed at that Center per the governance model in NPD 1000.0. The CMC evaluation is an additional assessment that focuses on whether Center engineering, research, and management practices (e.g., resources, contracting, institutional, and technical authority) are being followed by the R&T work under review and whether Center resources can support R&T work requirements. The evaluation should also focus on the technical authority role (see Section 5.4) of the Center to ensure technical and scientific integrity of work conducted at that Center. A CMC provides its findings and recommendations to the governing PMC.

2.5.3 In addition to the management councils, each program and project has a DA, the individual authorized by the Agency to make important decisions on programs and projects to which they are assigned authority. For more detail on authorities, see Chapter 3 for programs and Chapter 4 for projects.

2.6 R&T Program and Project Reviews

2.6.1 Program and project maturity and performance are periodically reviewed by upper management. Three basic types of reviews are applicable to programs and projects: internal reviews, KDPs, and independent assessments (IAs). These reviews also apply to competed projects. (See Section 4.2.6.5 to 4.2.6.9 for more detail.) Programs and projects document their approach to conducting all program/project reviews in their Program and Project Plans. In addition, special reviews may be needed on an ad hoc basis internally or by external entities such as termination reviews or special independent reviews for specific purposes. Reviews should be scaled as appropriate for the size and complexity of the program/project, including delegations of responsibility. Programs and projects should continuously capture and document lessons learned throughout the life cycle in accordance with NPD 7120.4 and as described in NPD 7120.6 and other appropriate requirements and standards documentation.

2.6.1.1 **Internal Reviews.** Program and project managers conduct internal program and project reviews as essential elements of conducting, managing, evaluating, and approving programs and projects. These reviews help to establish and manage the progress against plans. These internal reviews are called Program Status Reviews (PSRs) for programs and Periodic Project Reviews (PPRs) for projects. More detail on PSRs and PPRs can be found in Sections 3.2.7 and 4.2.10, respectively.

2.6.1.2 **Key Decision Points.** KDPs are decisional reviews that serve as gates through which programs and projects need to pass to continue through their life cycle. The program or project DA conducts the KDPs. The DA may delegate, as appropriate, based on the size and complexity of the program or project. For more detail on KDPs see Chapter 3 for programs and Chapter 4 for projects. To support the decision process, a KDP is typically preceded by one or more internal reviews and may include inputs from independent assessments. As appropriate for the size and complexity of the program or project, KDP membership may vary from a single DA to a more formal KDP board that includes other stakeholders and NASA Headquarters personnel. The DA shall approve decisions made at KDPs which are summarized and recorded in the decision documentation (e.g., memorandum or other appropriate format) that will become part of the retrievable program or project documentation. The decision documentation should include the decision made, rationale, effective date, and any actions associated with the decision (including responsible parties and due dates). Materials required to support KDPs are designated by the DA. Dissenting opinions are resolved through the Formal Dissent Process in accordance with the process described in Section 5.3. These decisional reviews are called Program Assessment Reviews (PARs) for programs and Continuation Assessments (CAs) for projects. More detail on PARs and CAs can be found in Sections 3.2.7.2 and 4.2.10.3,

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respectively

2.6.1.3 The potential outcomes at a KDP include:

a. Approval to continue through the life cycle.

b. Approval to continue through the life cycle, pending resolution of actions.

c. Disapproval to continue through the life cycle, with followup actions required (including descope actions). In such cases, followup actions are documented and the KDP is redone after the followup actions are completed.

d. Disapproval to continue the life cycle, with a decision to terminate.

2.6.1.4 **Independent Assessments.** The appointed Independent Assessment (IA) team shall conduct Independent Assessments during the program and project life cycles. The timing and frequency of the assessments are planned by the program or project manager with the approval of the Mission Directorate Associate Administrator (MDAA) and documented in retrievable program or project documents. The MDAA ensures the IAs are conducted in accordance with documented review expectations, e.g., charter or Terms of Reference (ToR). They are conducted periodically, typically prior to or concurrent with KDPs, particularly at the Program and Project Approval and Closeout KDPs. Findings and recommendations from the IA team and any responses from the program or project manager are provided to the DA to inform the KDP decision. The MDAA may utilize Center support to help manage and conduct IAs or may delegate this to the Center Director. The plan for the IA reviews is documented in the program or project Formulation Authorization Document (FAD) and Program or Project Plan. The plan should ensure the relevance, quality, and performance of the program or project.[2]

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[2] See NPR 1080.1 for additional guidance on assessments.

2.6.1.5 **IA Expectations Document.** The MDAA (or designee) is responsible for the development and approval of the IA expectations document. The document may be in the form of a charter, ToR, or other document that describes the IA review expectations. For each program and project IA, the IA expectations document describes the process and team membership, how the program or project will support the IA, and the nature, scope, schedule, and ground rules. The IA expectations document is developed in coordination with the program/project management.

2.6.1.6 **Independent Assessment Team.** The MDAA (or designee) is the management official for independent assessment teams. The MDAA identifies the chair of the IA team who then selects any team members. Approvals/concurrences are obtained from the Mission Directorate, implementing Centers and OCE for the (1) IA Chair, (2) IA team members, and (3) IA expectations document. The IA team membership and formality varies greatly depending upon the size and complexity of the program or project. Small projects may only need to appoint a single member to provide an independent assessment, whereas a large program or project may require a larger team, such as a Standing Review Board (SRB) with more formal processes.[3] The MDAA will ensure that the IA team membership and process are independent and objective in accordance with the SRB Handbook (Section 3.2 in NASA/SP-2016-3706) and the "NASA Independent Assessment Principles and Approach" white paper.[4]

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[3] For additional information on SRBs, refer to NASA/SP-2016-3706.
[4] Approved at the APMC held on May 18, 2016, and documented in a Decision Memorandum signed on December 13, 2016. It can be found on the OCE menu under the "Other Policy Documents" tab in NODIS.

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Chapter 3. Program Requirements

3.1 Overview

3.1.1 **R&T Programs**

3.1.1.1 The requirements in this section cover R&T programs. R&T programs comprise only R&T projects (technology development and/or research projects).

3.1.2 **Program Life Cycle**

3.1.2.1 The program life cycle is shown in Figure 3-1. As shown in the figure, the program life-cycle phases consist of Pre-Formulation, Formulation, and Implementation (including Closeout). The figure also depicts program reviews (key decision points, internal reviews, and independent assessments) and key products.

3.1.2.2 The program reviews consist of KDP reviews, including the Authority to Proceed (ATP), Program Approval, Program Assessment Reviews (PARs), and Closeout; internal reviews, called PSRs; and IAs (see Section 3.2.7.2 for more detail on PARs). As depicted in the life cycle, three specific KDP reviews are required: ATP (to transition from Pre-Formulation to Formulation), Program Approval (to transition from Formulation to Implementation), and Closeout. In addition to these KDPs, at least one PAR is to be conducted during the Implementation phase. If IAs are required at any KDP, they are performed immediately preceding or concurrent with the KDP.

3.1.2.3 The DA is the individual authorized by the Agency to make important decisions on programs, including determining the readiness of a program to progress to the next life cycle phase. The DA conducts the KDP reviews. The plans for conducting reviews, including the schedule for the ATP, Program Approval and Closeout KDPs and the periodicity of PSRs and PARs is approved by the DA in coordination with the program manager. While this NPR describes all potential phases of the program life cycle, which phases a specific program will execute and where the program enters the life cycle will be at the discretion of the DA in coordination with the program manager. The FAD, Program Commitment Agreement (PCA), and Program Plan or equivalent and the ATP, Program Approval, at least one PAR, and Closeout KDPs are required. Unless delegated and documented in the FAD, the DA for the Formulation Phase is the MDAA. Unless delegated and documented in the PCA, the DA for the Implementation Phase is the NASA Associate Administrator (AA). (See Table 3-1.)

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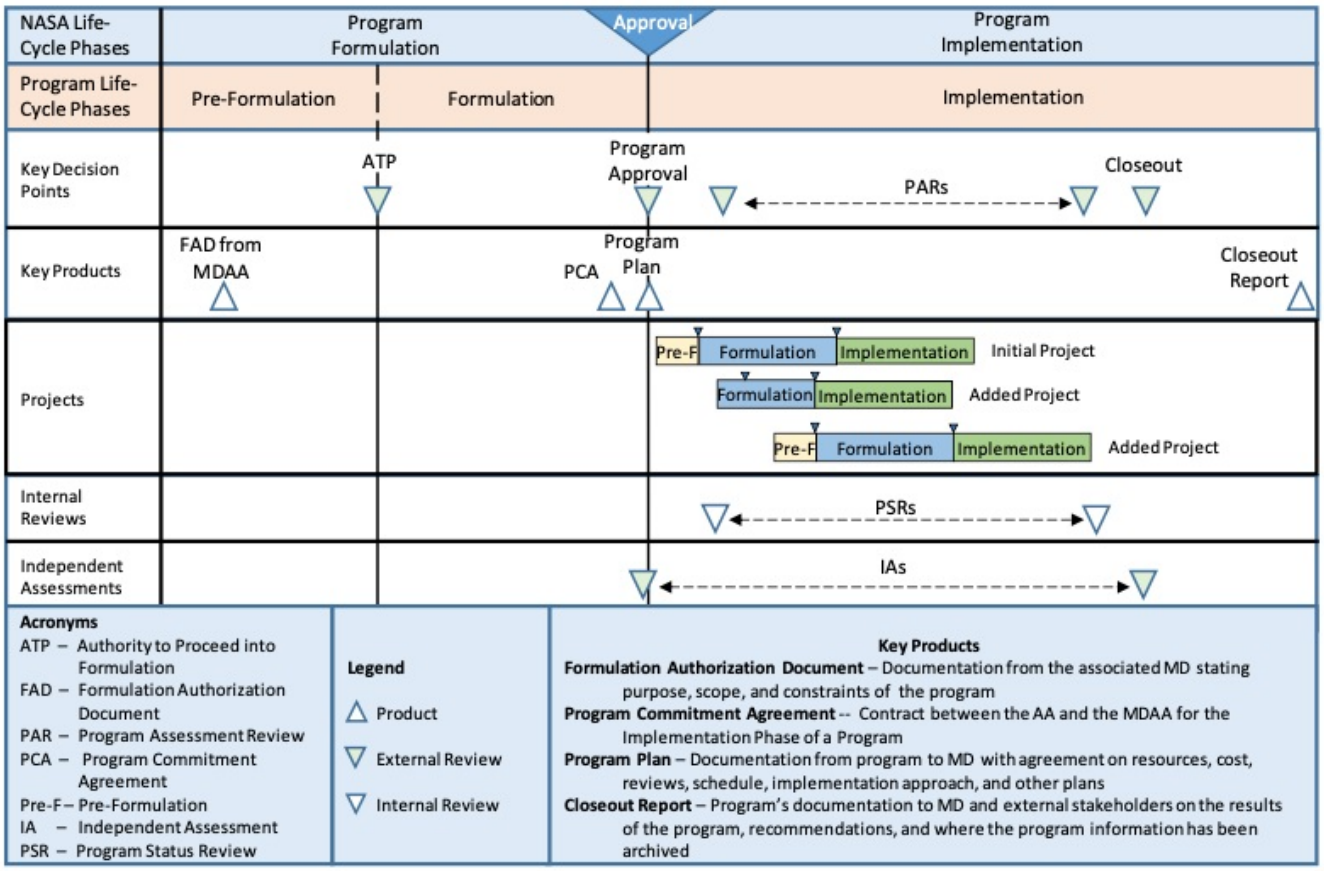

Figure 3-1 - Program Life Cycle

3.1.2.4 For R&T programs, the DA for KDPs, the Management Official for IA teams, the governing PMC, and the governing document are defined in Table 3-1.

Table 3-1 Summary of Governance Authorities for R&T Programs

Authority Role	Authority	Comments
Program DA for Authority to Proceed KDP and Formulation Phase	MDAA	
Program DA for Program Approval KDP, Closeout KDP, and Implementation Phase	NASA AA	The NASA AA can delegate responsibility to the MDAA. The DA may request additional KDPs (PARs) during Implementation.

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Management Official for Establishing Independent Assessment Team(s)	MDAA	The MDAA identifies the chair of the independent assessment team. The chair selects any team members. Approvals/concurrences are obtained from the Mission Directorate, implementing Centers, and OCE for the (1) IA Chair, (2) IA team members, and (3) IA expectations document. The MDAA will ensure that the team(s) and process are independent and objective.
Governing PMC for Formulation	DPMC	
Governing PMC for Implementation	APMC	The NASA AA can delegate oversight responsibility to the DPMC.
Governing Document	R&T Program Plan	The R&T Program Plan is approved by the MDAA.

Note: R&T Program Plans will reflect delegations, define reviews, and document the attendant rationale for delegations.

3.2 R&T Program Requirements

3.2.1 **Select Program Manager**

3.2.1.1 For an R&T program, the MDAA or their delegated representative shall assign a program manager to manage the effort. When a program manager will reside at a field Center, the Center Director will provide a recommendation for filling that role. The title of the position with responsibility for managing a program may be program manager, program lead, program executive, research director, program officer, or other. For the purposes of this NPR, the title “program manager” will be used.

3.2.1.2 If the program manager resides at a Center, the MDAA or their delegated representative coordinates the assignment of the program manager with the Center Director.

3.2.2 **R&T Program Pre-Formulation**

3.2.2.1 The MDAA has the authority to initiate Pre-Formulation of a potential R&T program. The MDAA is responsible for ensuring the start of new R&T programs are in line with the Agency’s vision and mission, as defined by NPD 1001.0.

3.2.2.2 The MDAA or their delegated representative shall provide the purpose, scope, and constraints of the potential R&T program to the program manager. The scope of the program may be provided in many forms, including in a formal FAD (see Appendix C for guidance), charter, task agreement, memorandum, or from a Request for Proposal (RFP), Announcement of Opportunity (AO), or other documentation, as appropriate for the type, size, and complexity of the program and as agreed-to by the MDAA.

3.2.2.3 During Pre-Formulation, the R&T program gains an understanding of the Agency strategic goals that need to be addressed. A literature search may be performed on existing and related

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research and technology development activities in other NASA programs, other Government agencies, and the commercial sector. Preliminary estimates for the program cost and schedule are developed. Planning is conducted to identify the tasks and activities needed to accomplish the Formulation Phase, including any Formulation key milestones and/or reviews. The program key deliverables are defined.

a. The program manager is responsible for developing a preliminary breakdown of the program's scope into scope assignments for potential projects starting in Pre-Formulation.

b. To minimize duplication of effort and identify opportunities to augment R&T developed elsewhere, the program manager or designee should conduct a gap analysis, an assessment of related research and technology development activities in other NASA programs, other Government agencies, and the commercial sector, prior to investment in a proposed R&T area.

3.2.2.4 The Pre-Formulation Phase culminates with the R&T program ATP KDP, which officially determines approval for the start of the program and entry into the Formulation Phase.

3.2.3 **R&T Program Authority to Proceed (ATP)**

3.2.3.1 The DA shall conduct the Authority to Proceed KDP to determine approval for a proposed program to enter the Formulation Phase. This decision is based on review of information provided by the program manager. (See Table 3-2.) The DA may decide to gather the DPMC, peers, stakeholders, or line managers to review the information provided by the program manager or may make the decision on his or her own depending on the size and complexity of the program. If the information is not sufficient to make that determination, the DA may direct the program manager to continue the pre-formulation effort or to modify the formulation plans based on identified weaknesses. If the DA determines that concepts for the potential program do not meet minimum requirements, a decision to discontinue work on the potential program may be made. If the information is deemed sufficient to conduct the Formulation Phase, the DA authorizes the program to enter Formulation. The DA is responsible for ensuring the R&T program is formulated and continues to be in line with the Agency's vision and mission, as defined by NPD 1001.0.

3.2.3.2 The ATP decision is documented in retrievable program documentation, which can be a Decision Memorandum or other appropriate format. This decision authorizes the R&T program to transition from the Pre-Formulation Phase to the Formulation Phase.

3.2.3.3 The decision documentation should include the formulation approach, cost, and schedule, with major formulation objectives identified, and any other decisions made or actions assigned.

3.2.3.4 Table 3-2 provides guidance on input and output expectations for the ATP KDP. The actual input and output content and format requirements are determined by the DA in coordination with the program manager and other key stakeholders and depends on the size and complexity of the program. The agreed-to information is provided by the program manager to the DA to determine if the potential program is in alignment with the previously defined purpose, scope, and constraints.

Table 3-2 ATP Expected Inputs and Outputs

Authority to Proceed	
Input Expectations	**Output Expectations**

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• Understanding of Agency strategic goals being addressed by this research and/or technology program • Formulation approach • Preliminary program cost estimate, including detailed cost for the formulation phase • Preliminary program schedule, including any formulation key milestones and/or reviews • Preliminary System Security Plan • Expected formulation and program key deliverables, including final end-state deliverables	• A documented decision on the Authority to Proceed by the DA.

3.2.4 R&T Program Formulation

3.2.4.1 During Formulation, R&T programs perform the detailed planning for how the program will be accomplished during the Implementation Phase. These planning activities include developing goals and objectives; identifying key stakeholders/beneficiaries; developing the cost plan/phasing and the master schedule; identifying the metrics to be used to ensure the program stays on track; identifying the initial projects to be encompassed by the program; defining the organizational structure, roles, and responsibilities; defining the management approach, including the approach and plans for PSRs, PARs, and IAs; and determining and developing what program control plans and other documentation will be needed (such as risk management, configuration management, safety, cyber security). Key products developed during the Formulation Phase are the PCA and the Program Plan.

3.2.4.2 **Program Commitment Agreement (PCA)**

a. The PCA is an agreement between the MDAA and the NASA AA and is necessary for the program to transition from Formulation to Implementation. The content of the initial PCA reflects the maturity of the R&T program at the beginning of Implementation. Prior to approval of the PCA, the MDAA coordinates with the NASA AA and any Center Directors contributing to the R&T program (not including competitively selected activities) to ensure their commitment to support the R&T program in terms of resources.

b. The MDAA, or designee, shall develop an R&T PCA during program Formulation. The content of the PCA includes program objectives; the organizational structure for managing the program and constituent projects; technical, schedule, and cost commitments; an overview of the acquisition strategy; and identification of high risk areas, internal and external agreements, PARs and IAs required by the DA during Implementation, and expected outcomes. A PCA template is provided as guidance in Appendix D. The PCA may take the form shown in the template or another form, as appropriate, for the size and complexity of the program. The R&T PCA is signed by the MDAA and approved by the NASA AA.

c. Key products such as the PCA and Program Plan (see Section 3.2.4.3) are updated as needed during the Implementation Phase. The updated documents are reviewed and approved using the same processes as the original.

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3.2.4.3 **Program Plan**

a. The Program Plan is an agreement between the MDAA, the program manager, and Center Director(s) that provide contributions to the program. The Program Plan details how the R&T program will be managed and executed and may contain a list of specific projects (updated as needed) that are official program elements. The initial Program Plan content is reviewed, approved, and baselined as part of the Program Approval KDP to transition to Implementation. The content of the initial Program Plan reflects the maturity of the program at the beginning of Implementation and may be updated during the program's life cycle.

b. The program manager shall develop a Program Plan that provides the goals and objectives, management approach, program requirements, schedule/key milestones and cost estimate, the budget and acquisition strategy or the project selection approach, and the approach for reviewing and assessing projects. The Program Plan identifies all planned reviews, including PSRs, PARs, and IAs, other reviews required by this NPR, and any additional reviews deemed necessary by the program manager, DA, MDAA, or governing PMC. A template is provided in Appendix E as guidance on the expected content of the Program Plan. The Program Plan is signed by the program manager and Center Director(s), if applicable, and approved by the MDAA.

c. As part of monitoring and controlling the program, the program manager ensures adequate risk management in accordance with NPR 8000.4, planning is conducted in conjunction with the designated SMA Technical Authority. (See NPR 8715.3, section 1.5 and NPR 8705.6.) In many cases, plans are already established by Center and/or facility procedures. Any applicable Center and/or facility institutional plans that the program will use should be referenced in the Program Plan.

3.2.5 **R&T Program Approval**

3.2.5.1 The DA shall conduct the Program Approval KDP to determine the program's readiness to proceed to Implementation.

3.2.5.2 As part of the Program Approval KDP, the DA reviews the Program Plan and any other relevant data requested to ensure that the program objectives are aligned with the research goals and/or stakeholder needs and that the program is well planned to meet the objectives.

3.2.5.3 The Program Approval decision is documented in retrievable program documentation, which can be a Decision Memorandum or other appropriate format depending on the size and complexity of the program and authorizes the R&T program to transition from the Formulation Phase to the Implementation Phase.

3.2.5.4 The decision documentation should include the decision made, the effective date, and any caveats for follow-up actions associated with the decision (including responsible parties and due dates). As part of the decision documentation the costs, schedules, and key deliverables are captured. Other information may also be captured such as the program roles and responsibilities, and other key parameters. Upon a successful Program Approval KDP, the program may proceed into the Implementation Phase. The decision documentation also documents any additional resources beyond those explicitly estimated or requested by the program/project (e.g., additional schedule margin) when the DA determines that this is appropriate. This includes Unallocated Future Expenses (UFE), which are costs that are expected to be incurred but cannot yet be allocated to a specific Work Breakdown Structure (WBS) sub-element of the program's or project's plan. Management control of some UFE may be retained above the level of the project (i.e., Agency, Mission Directorate, or program).

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3.2.5.5 Table 3-3 provides guidance on input and output expectations for the Program Approval KDP.

Table 3-3 Program Approval Expected Inputs and Outputs

Program Approval	
Input Expectations	**Output Expectations**
• Program Plan, including: • Purpose addressing Agency needs • Goals, objectives, metrics • Organizational structure • Requirements: e.g., Mission Directorate requirements levied on program, performance requirements, success criteria, end state/final product • Schedule/key milestones and cost estimate • Program review approach • R&T management approach • R&T project selection approach • R&T project execution, review, and CA approach • Program resource management approach • Control Plans and other documentation as appropriate: e.g., Acquisition Strategy; and Safety and Mission Assurance, Risk Management, Configuration Management, Data Management, Systems Engineering Management, Software Development, Environmental Protection, System Security Plan and associated security plans and assessments, Education and Public Outreach, Technology Transition Plans, etc. • Any expected tailoring of the NPR 7120.8 requirements	• A documented decision on Program Approval by the DA. • Documentation of the final Program Plan approval by the MDAA, including any actions or next steps as required.

3.2.6 **R&T Program Implementation**

3.2.6.1 During the Implementation Phase, the program is executed as described in the Program Plan. Constituent projects are initiated and executed according to the planned cost (phasing) and schedule commitments. Program and project end products are developed, analyzed, verified to meet requirements, validated against stakeholder expectations, and delivered/transitioned per applicable plans. Program Status Reviews, Program Assessment Reviews, and Independent Assessments are conducted as defined in the Program Plan. The Implementation Phase culminates in the closeout activities, including data/information archiving, as needed to end the program.

3.2.6.2 The performance of the program is assessed during reviews. The Program Plan, associated program control plans, accepted IA findings, project performance results, and other metrics are used by the program manager, DA, governing CMC, and governing PMC during PSRs and PARs to determine if the program is meeting objectives and requirements. The program manager shall

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provide to the project managers, in writing, the purpose, scope and constraints for each specific R&T project that is an official element of the program. This information may be in the form of a formal project FAD (see the template in Appendix F for guidance), project charter, memorandum, or other document as appropriate for the size and complexity of the project. The program manager also concurs on the Project Plan for each constituent project.

3.2.6.3 Program managers shall report new technologies arising from technology programs to the appropriate Center Technology Transfer Offices in a timely manner in accordance with NPR 7500.2 to be considered for intellectual property protection and transfer for secondary applications.

3.2.7 **Conduct Reviews**

As the program proceeds through the Implementation Phase, progress toward the program's technical goals, cost, and schedule are evaluated in periodic reviews. There are two types of reviews during the Implementation Phase: PSRs and Program Assessment Reviews (PARs).[5]

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[5] IAs may also be conducted during the Implementation Phase. PSRs, IAs, and PARs may be conducted consecutively or concurrently, in accordance with the approach documented in the PCA, Program Plan, and/or IA ToR.

3.2.7.1 **Program Status Reviews**

a. The program manager shall conduct PSRs to evaluate the status of the program. The frequency, timing, and format of the PSRs are determined by the program manager and documented in the Program Plan.

b. These reviews are typically considered internal reviews of the program cost, schedule, and technical performance. Any issues or concerns are discussed, risks reviewed, recommendations made and/or actions assigned. As documented in the Program Plan, these PSRs may take the form of informal discussions or as more formal life-cycle reviews (such as System Requirements Reviews or Preliminary Design Reviews (PDRs)). For small programs, a gathering of the program team and key stakeholders may suffice to discuss the program's progress and to refine forward planning. Larger programs may need a more formal review with a wider audience and a more formal process for gathering comments, dispositioning them, and refining plans.

c. Table 3-4 provides guidance on input and output expectations for PSRs. As program internal reviews, PSRs are considered non-decisional in that no formal decision on program continuance/cancellation occurs as a result of the review, but the information from PSRs may feed into PARs. PSRs may lead to program improvements and adjustments that are within the authority of the program manager to make.

Table 3-4 PSR Expected Inputs and Outputs

Program Status Review	
Input Expectations	**Output Expectations**

• Program cost and schedule performance
• Current projects (in aggregate)
  • Technical performance
	• PSR summary, including:
	  • Technical progress
	  • Cost/schedule status

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highlights • Issues/Risks • Status of plans and assessments (e.g., System Security Plans, Safety) • Summary of program issues concerns • Changes to scope/Level 1 requirements , if applicable	• Reviewer recommendations and/or actions • Observations, threats, issues, and/or concerns • Issues that need to be raised with upper management for help/resources • Actions/Recommendations

3.2.7.2 Program Assessment Reviews

a. The DA shall conduct decisional PARs during the Implementation Phase. The program DA, i.e., the NASA AA or their delegated representative, chairs the PARs. The frequency, timing, and format of the PARs are planned by the program manager and approved by the DA and documented in the Program Plan.

b. Additional PARs can also be called by the NASA AA or MDAA at any time.

c. The PARs are key decision points. During these reviews, the technical progress, cost/schedule, and top risks and threats are assessed. A discussion of the status of constituent projects, lessons learned, any advancements in the state of the art achieved, progression of the program towards its goals, any achievements that have reduced the level of uncertainty in the field, and any results from IAs should also be discussed. Cybersecurity risks and threats should be integrated into the risk and threat list and assessed during the review. As documented in the Program Plan, PARs may take the form of informal discussions or as more formal reviews. For small programs, a gathering of key stakeholders may suffice to discuss the program's progress and to refine forward planning. Larger programs may need a more formal review with a wider audience and a more formal process for gathering comments, dispositioning them, and refining plans. A decision to redirect, continue, or terminate the program is made at this time. A decision to terminate a program triggers the program closeout activity.

d. The result of a PAR is documented in a Decision Memorandum or other appropriate format that is part of retrievable program records. The decision documentation should include the decision made and rationale, the effective date, any caveats for follow-up actions associated with the decision (including responsible parties and due dates). As part of the decision documentation, the costs, schedules, and key deliverables are captured. Other information may be captured such as key parameters or constraints. If the program is redirected in a significant way, the Program Plan should be updated to reflect the change.

e. Table 3-5 provides guidance on input and output expectations for PARs.

Table 3-5 PAR Expected Inputs and Outputs

Program Assessment Review	
Input Expectations	Output Expectations

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• Summary of program metrics as evidence of meeting program goals (e.g., mission infusions/transitions, TRL advancement, dissemination, partnership performance) • Technical Progress Summary • o Identification of any systemic issues • Program Cost/Schedule Summary, including: portfolio to date, margins, and any newly anticipated needs • Program top risks and threats • Status of plans and assessments (e.g., System Security Plans, Safety) • Findings and recommendations from the most recent PSR and most recent IA, if applicable. • Continued Agency strategic alignment and relevance (e.g., National Academy of Sciences (NAS) Decadal, Federal Aviation Administration (FAA), National Oceanic and Atmospheric Administration (NOAA)) • Proposed Program Plan updates, if needed	• Documented decision by the DA to continue, redirect, or terminate the program • Summary of assessment findings and recommendations/actions • If required, approval of any Program Plan updates by the DA
It is recommended that a PAR be preceded by a PSR. PARs can be combined with PSRs with approval of the DA.	

3.2.8 **Program Closeout**

3.2.8.1 When the program achieves its goals and objectives and completes the planned mission, the DA shall conduct the Closeout KDP. A Closeout KDP may also be performed after a decision is made to terminate a program.

3.2.8.2 Once the DA authorizes a program to end, closeout activities can proceed. The decision of the DA to close out or terminate the program and the rationale is documented in a Decision Memorandum or other appropriate format, including any recommendations relevant to existing contractual relationships, disposal of assets, manpower support, and timeframe of closure process.

3.2.8.3 Table 3-6 provides guidance on input and output expectations for the Closeout KDP.

Table 3-6 Closeout Expected Inputs and Outputs

Closeout	
Input Expectations	Output Expectations

• Final program summary, including:
  • Program accomplishments
  • Program metrics summary
  • Rationale for Program closure
  • Lessons learned
	• Documentation of final program Closeout approval by DA, including any actions or next steps.

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• Archival, storage, disposal, and security approach for program information and artifacts • Technologies developed	
Closeout KDP should include stakeholder/customer participation.	

3.2.8.4 The program manager, in coordination with the MDAA, conducts program closeout activities at the end of the program. The program manager also conducts program closeout activities for each project and oversees closeout activities for the projects.

3.2.8.5 The program manager ensures sufficient data is archived to enable access to any research results and incorporation of the program's research or technology products into future system designs and investigations. This information is complementary to any information archived by constituent projects.

3.2.8.6 The program manager shall develop a final program report at the conclusion of the program, capturing recommendations/actions and results from the closeout activity, including any issues. The final report is captured as part of the program's retrievable records.

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Chapter 4. R&T Project Requirements

4.1 Overview

4.1.1 R&T Project Types

4.1.1.1 The requirements in this section cover R&T projects. As described in Section 2.3, there are two types of R&T projects: Technology Development and Research Projects. The requirements in this section apply equally to both types of projects. R&T projects may comprise a portfolio or series of scientific and/or technical investigations, experiments, or prototyping. As mentioned in Section 2.1.2 of this document, how they are implemented will vary between projects depending on their type, size, and complexity. Some guidance is provided with each requirement as to how the implementation may vary for different types and sizes of projects.

4.1.1.2 New technologies often emerge from R&T activities where fundamental scientific principles are investigated and concepts for their application are formulated. The early stages of technology development and research are often performed in the laboratory but may involve model development or simulations; later stages may involve field tests or flight demonstration experiments to validate the technology or research in relevant environments.

4.1.2 **Project Life Cycle**

4.1.2.1 The project life cycle is shown in Figure 4-1. As shown in the figure, the project life-cycle phases consist of Pre-Formulation, Formulation, and Implementation (including Closeout). The figure also depicts project reviews (including key decision points, internal reviews, and independent assessments) and key products.

4.1.2.2 The project reviews consist of KDP reviews that include ATP, Project Approval, CAs, and Closeout; internal reviews (PPRs); and IAs. As depicted in the life cycle, three specific KDPs are required: ATP (to transition from Pre-Formulation to Formulation), Project Approval (to transition from Formulation to Implementation), and Closeout. In addition to these KDPs, at least one CA is conducted during the Implementation Phase. Depending on the duration, investment-level, complexity, and/or project scope, periodic CAs may be added as additional KDPs. If IAs are required at any KDP, they are performed immediately preceding or concurrent with the KDP. The schedule of reviews, including CAs and PPRs is approved by the DA in coordination with the program manager and project manager and documented in the Project Plan.

4.1.2.3 The DA is the individual authorized by the Agency that determines the readiness of a project to progress to the next phase of the life cycle. The DA conducts the project key decision point reviews. The project may not have all the phases identified in Figure 4-1 depending on its type, size, and complexity. A large project may need all phases, whereas a smaller project may proceed directly into Implementation after attaining approval. The decision of where a project may enter the life cycle is made by the DA in coordination with the program manager and documented in the Project Plan. For the purposes of this document, all phases will be described. Which phases a specific project will execute will be at the discretion of the DA.

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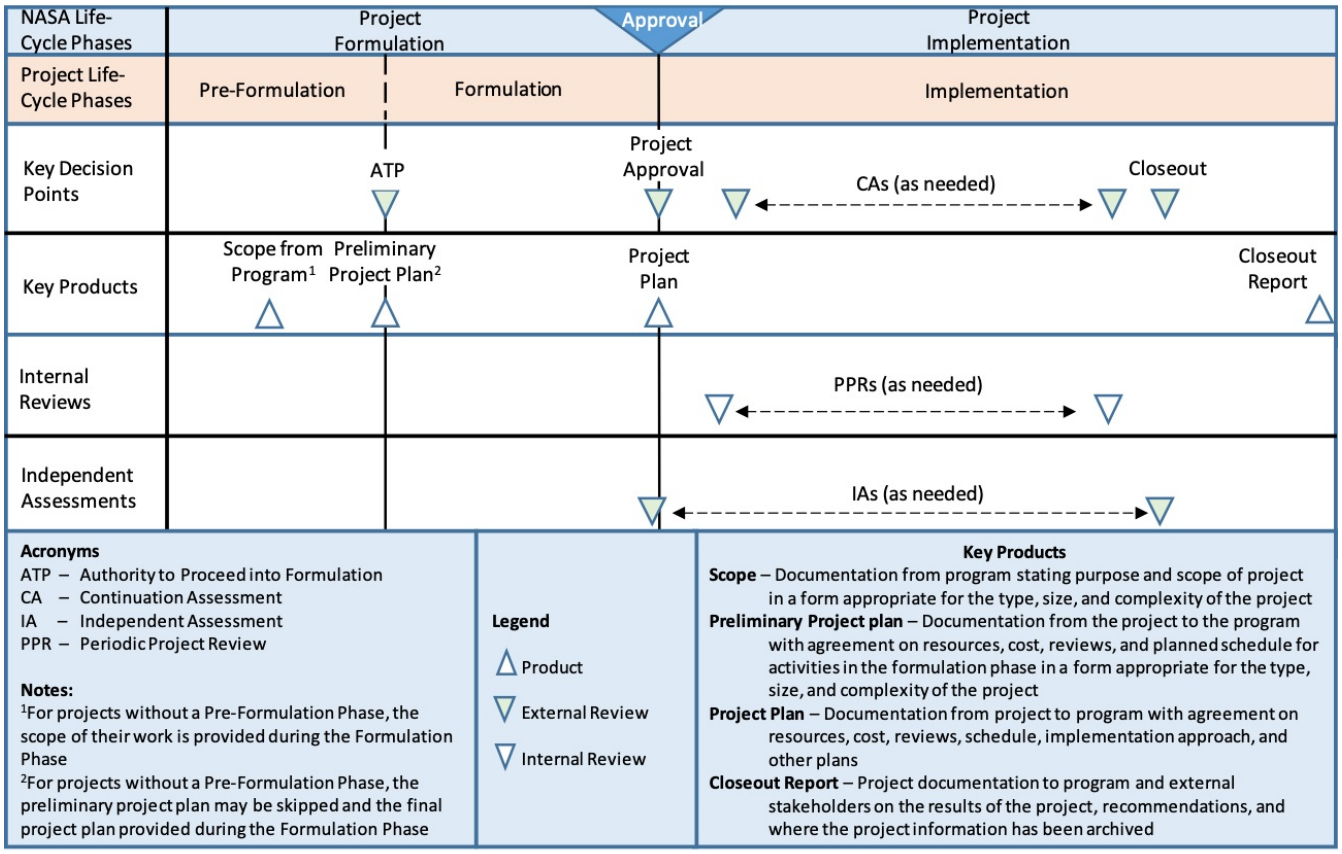

Figure 4-1 R&T Project Life Cycle

4.1.2.4 For R&T projects, the DA, Management Official, governing PMC, and governing document are defined in Table 4-1.

Table 4-1 Summary of Governance Authorities for R&T Projects

Authority Role	Authority	Comments
Project DA for KDPs (ATP), Project Approval, CAs, and Closeout)	MDAA	The MDAA can delegate responsibility to the program manager.
Management Official for Establishing Independent Assessment Team(s)	MDAA	The MDAA identifies the chair of the independent assessment team. The chair selects any team members. Approvals/concurrences are obtained from the Mission Directorate, implementing Centers, and OCE for the 1) IA Chair, 2) IA team members, and 3) IA expectations document. The MDAA may delegate responsibility for independent reviews per their discretion. The MDAA will ensure that the team(s) and process are independent and objective.

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Governing PMC	DPMC	If decision authority is delegated to the program manager, the governing PMC can be delegated to a lower level board or council.
Governing Document	Project Plan	The Project Plans are approved by the project DA with concurrence by the program manager/Research Director and applicable Center Director(s).

Note: Project Plans will reflect delegations, define reviews, and document the attendant rationale for the changes.

4.2 Project Requirements

4.2.1 Figure 4-2 depicts the generic flow of activities for R&T projects. Details of how each activity is accomplished may vary depending on the type of project and its size and complexity. Each activity will be described in the following sections and their associated requirements. For competed projects, see Sections 4.2.6.5 to 4.2.6.9.

4.2.2 The MDAA and Center Director roles (other than as described in Table 4-1) may be delegated, as appropriate, to the size and scope of the project. In this NPR, when the role of these authorities is described, "or designee" is implied.

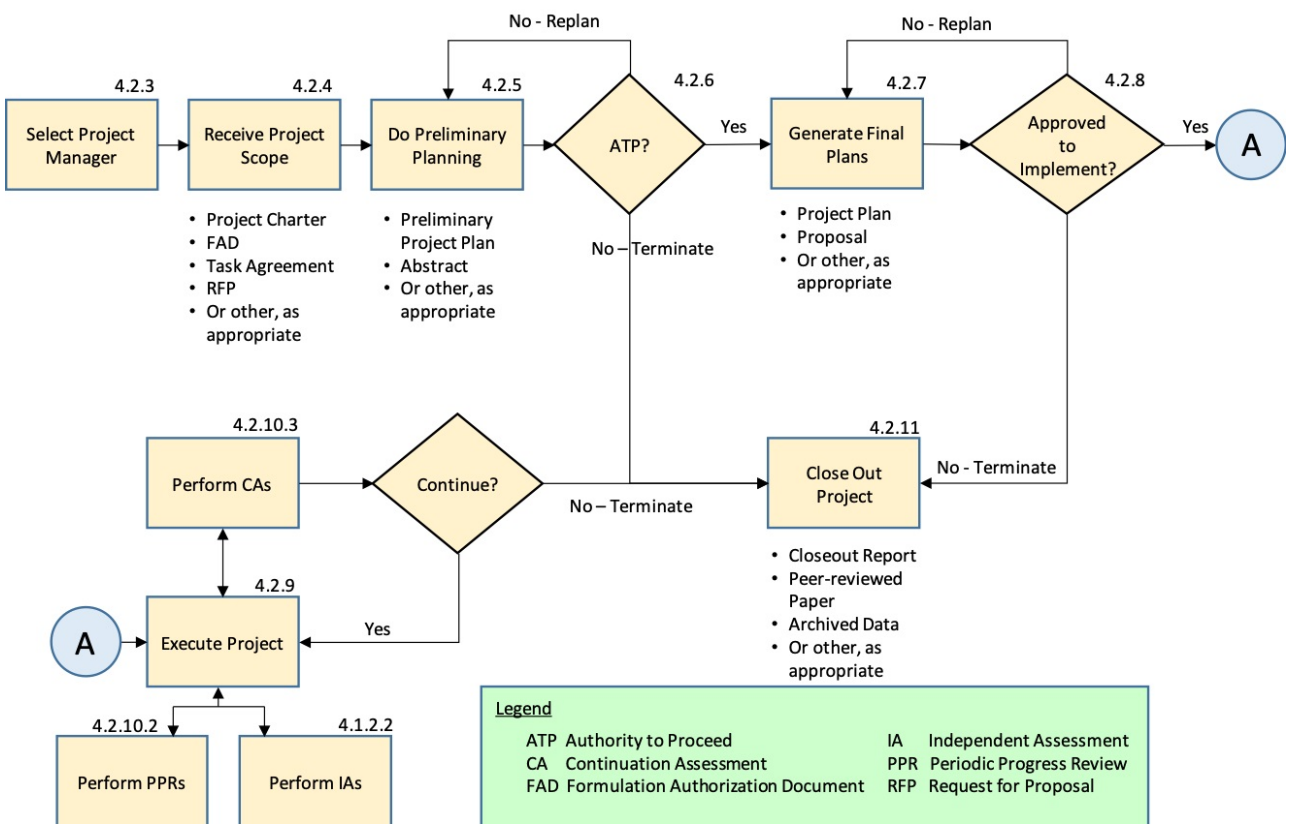

Figure 4-2 Generic Flow for R&T Projects

4.2.3 **Select Project Manager**

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4.2.3.1 The R&T program manager, in coordination with the DA, shall assign a project manager to lead the project effort.

4.2.3.2 For projects that reside in a Center, the program manager coordinates the assignment of the project manager with the providing Center Director or designee.

4.2.3.3 The selection and assignment of a project manager is made as early in the project life cycle as possible. The project manager provides the overall leadership for the project, managing all aspects of the project, including technical, cost, schedule, safety, and business aspects. The project manager will also be responsible for the coordination and direction of the project team. For details of the role and responsibilities of a project manager, refer to section 5.2.2.10

4.2.4 **Receive Project Scope**

4.2.4.1 As early in the life cycle as possible, the program manager provides the project manager with a documented statement for the project's purpose, scope (e.g., FAD), constraints, and any requirements that may be placed on the project or its product.

4.2.4.2 The scope of the project may be provided from the program in many forms, including in a formal FAD (see Appendix F for guidance), project charter, task agreement, memorandum, or from a Request for Proposal (RFP), Announcement of Opportunity (AO), or other documentation, as appropriate, for the type, size, and complexity of the project and as agreed-to by the MDAA and the program manager.

4.2.5 **Preliminary Planning**

4.2.5.1 The project manager shall provide to the DA documentation that establishes the technical and acquisition work that needs to be performed during the life cycle or at least during the Formulation Phase, including the management process, deliverables, preliminary schedule and funding requirements. This information is documented as a preliminary Project Plan, preliminary proposal response, development of an abstract for a paper, or other form depending on the type and size of the project.

4.2.5.2 Members of the project team are usually provided by line management in coordination with the project manager. The number and makeup of this initial project team will vary depending on the type and size of the project.

4.2.5.3 Planning starts with understanding the needs of the stakeholders and any high-level threshold requirements. The expected end-state of the project and its deliverables are identified. If not provided as part of the project scope, a preliminary schedule and estimate of life-cycle cost is developed. If the research is more exploratory in nature, this initial cost and schedule estimate may be just for the next phase of the project and then the information is updated as the forward progress becomes clearer. Note that in some cases, the length of the Formulation Phase may be very short—just enough to gather the information that will be provided to the DA for the ATP decision.

4.2.5.4 If the project is developing a technology for a space flight project, further technology development or integration may be governed by NPR 7120.5. The decision of when and how a technology is transitioned from this directive to 7120.5 is planned and identified in the Project Plan. This decision will affect the type of documentation, verification, and processes used during the technology development project and should be addressed early in the life cycle to ensure project planning is aligned to accommodate compliance with applicable requirements (e.g., space flight

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vehicle safety and interface requirement and integration reviews, and other applicable requirements to support preparation and certification for space flight). Note that R&T projects flying on expendable launch vehicles will also need to comply with NPR 8715.7. NASA-sponsored R&T projects launched into space will comply with NPR 8715.6. R&T projects operating in space must comply with the requirement to develop a Project Protection Plan in accordance with NASA-STD-1006 per NPR 7120.5.

4.2.6 **R&T Project Authority to Proceed (ATP)**

4.2.6.1 The DA shall conduct the ATP KDP to determine approval for a proposed project to enter the Formulation Phase and begin developing more detailed plans. The approach for the Formulation Phase (both technical and management), including preliminary costs and schedules, is reviewed at the ATP. The Formulation key milestones and reviews are identified. The associated Program Plan can be referenced for the details of the new project initiation process.

4.2.6.2 Table 4-2 provides guidance on input and output expectations for the ATP KDP. The actual input and output content and format requirements are determined by the DA in coordination with the program manager, project manager, and other key stakeholders and depends on the type and size of the project.

Table 4-2 ATP Expected Inputs and Outputs

Authority to Proceed	
Input Expectations	**Output Expectations**
• Identification of Agency strategic goal being addressed by this research/technology project • Identification of stakeholder needs and high-level threshold requirements • Definition of expected end state • Relative advantage over state-of-the-art • Identification of customer, beneficiary, or potential infusion path • Identification of why the research or technology investment is needed at this point • Formulation approach (technical and management) • Preliminary cost estimate • Preliminary schedule, including any formulation key milestones and/or reviews • Preliminary System Security Plan	• A documented decision on the Authority to Proceed by the DA. • Documentation should include formulation approach, cost, and schedule with major objectives and deliverables identified.

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• Expected formulation and project deliverables, including final end-state deliverables	

4.2.6.3 The agreed-to information is provided to the DA so that they can determine whether the potential project is within the cost, schedule, and technical needs of the project scope (FAD, Task Agreement, RFP, or other). The DA may gather peers, stakeholders, or line management to review the information or make the decision on their own depending on the type and size of the project. If the information is not sufficient to make that determination, the DA may ask the project team to continue their planning effort or modify their plans based on identified weaknesses. If the DA determines that the concepts for the potential project do not meet minimum requirements or are not relevant to the associated AO, NASA Research Announcement (NRA), or other solicitation, the DA may decide to discontinue work on the potential project. If the information is deemed sufficient to continue into more detailed planning, the DA will approve the project's transition to Formulation.

4.2.6.4 The ATP authorization decision documentation can come in the form of a Decision Memorandum, a signature on a task agreement, or other form depending on the type and size of the project. The decision is captured in some form and stored with the project's retrievable records (e.g., appended to Project Plan).

4.2.6.5 Competed projects may enter the life cycle as early as Formulation, with the selection process review being the equivalent of the ATP KDP. Competed projects are awarded through a solicitation process such as an AO, Broad Agency Announcement (BAA), and/or NRA. NPR 1080.1 governs the selection process for competed R&T activities.

4.2.6.6 It is the responsibility of the DA for any competed projects to ensure the requirements of this directive are met. As with all projects for which this directive applies, competed projects are afforded great flexibility in meeting the intent of the requirements. For competed projects, the equivalent of Pre-Formulation is NASA's solicitation development effort, which outlines the scope of project activities and initial resource estimates. Any tailoring of requirements and contractual obligations on the project are written into the solicitation.

4.2.6.7 Competed projects can be selected in either a single step or in multiple steps where several projects may be selected and program resources are invested to mature the concept, associated research, and/or technologies of the project. Depending on the selection process, the maturity of the project, and the products developed for the competition, the selection may meet the expectation criteria of an ATP KDP or the criteria satisfying the Project Approval KDP. Where the competed project enters the conventional life cycle should be determined by the DA before award.

4.2.6.8 The Formulation Phase for competed projects is performed by the proposer either after selection (for a one-step selection process) or in their response to the solicitation (for a multiple-step selection process). Multiple-step proposals typically include a WBS, schedule, cost estimate, science content, technology requirements, and implementation strategy that serve as the equivalent of a preliminary Project Plan for the project. Proposals are reviewed and if one or more proposals are selected, this decision serves as the Project Approval KDP for those projects to proceed to the Implementation Phase at which point their life cycle becomes conventional. At this time, the project's DA should have a detailed understanding of the resources and work plans to execute the selected project(s). As part of the Project Approval KDP, any clarifications or changes to the project's proposal should be negotiated as part of the project's Statement of Work (SOW). As determined by the DA, the SOW may serve as the Project Plan for competed projects or the project

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may be asked to develop a Project Plan in accordance with the template in this NPR that references the SOW and addresses other aspects of project management as well. The Project Plan or equivalent SOW should include project reviews required by the DA, including CAs and IA(s). The Project Plan or SOW should also document the Closeout plan and criteria for the required Closeout KDP.

4.2.6.9 There are various management structures that can be utilized when multiple awards are given. For example, they can be managed as a single project with multiple technologies or as separate projects. The approach is at the discretion of the DA but should be determined prior to award and documented as part of the final Project Approval decision.

4.2.7 **R&T Project Formulation**

4.2.7.1 The project manager shall develop a Project Plan that contains, as a minimum:

a. A description of the project and its objectives.

b. How the project will be managed.

c. How the project will be monitored and controlled, including reviews.

d. The expected cost and schedule.

e. Deliverables.

4.2.7.2 The Project Plan should be of sufficient detail for the project to manage its work through the Implementation Phase and to measure its progress and performance. In addition to the required information, the plan may also include the research or technical approach, technology needs derived from mission concept studies, metrics for tracking progress, WBS, planned reviews, resource requirements (cost and institutional), a schedule showing key milestones/deliverables and the approach for transition/infusion, the risk management approach or dissemination of the project results. The customers, stakeholders, or other beneficiaries that will benefit from the project's product as well as any specific points of contacts (e.g., working groups, advisory committees) may be included in the Project Plan. The customers/beneficiaries may include projects managed under NPR 7120.5, another R&T program, another Government agency, the aeronautics and aerospace communities, or the U.S. aerospace industry. The plan may also include identification of relationships with other entities such as working groups, advisory committees, integrated product teams, technology infusion liaisons, etc. Projects should also identify and manage the test, prototype, demonstration hardware/software, firmware, and instrumentation systems and product configuration as part of all R&D Projects in a form appropriate for the size and complexity of the project.

4.2.7.3 The Project Plan may be a separate document or contained within the Program Plan as appropriate for the type and size of the projects. For projects with a stand-alone Project Plan, a template is provided in Appendix G as guidance on the expected content. Templates may also be prescribed by the governing organization.

4.2.7.4 The Project Plan is an agreement between the project DA, the program manager, and the project manager that details how the project will be managed. The Project Plan is signed by the project manager and approved by the project DA with concurrence by the program manager. If the project manager resides at a Center, the Center Director (or designee) responsible for committing workforce and facilities is added as a concurrence signatory to the Project Plan. The plan is updated as needed when major project goals or activities change or when warranted by major program

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changes that affect the project.

4.2.7.5 Monitoring and controlling progress includes the planned reviews (e.g., PPRs, CAs, Independent Assessments, and Peer Reviews) and the use of metrics to allow the tracking of the projects cost, schedule, and technical performance.

4.2.7.6 **Cost and Schedule Metrics.** The form of these metrics will vary depending on the type of project. For example, costs may be tracked using Earned Value Management (EVM) for very large projects or may be a comparison of planned costs versus actual costs. Schedule tracking may be performed using an integrated master schedule or through tracking key milestones. The metrics should be periodically reviewed to ensure the cost and schedule are progressing according to plan and is under control.

4.2.7.7 **Key Performance Parameters.** Technical metrics may take the form of Key Performance Parameters (KPPs) for projects that have a measurable outcome or may be tracking towards a given goal or objective for outcomes that are not directly measurable. KPPs consist of measurable parameters that would be readily understood and used by engineers concerned with the ultimate application of the technology. For each KPP, both a goal and a threshold are specified. The goal is a performance level that the project team is striving for, and the threshold is the minimum performance level that users agree is acceptable for the end item deliverable. Typically, the threshold KPP values are set beyond the current state of the art to warrant investment in the project. KPPs include information that enables assessment of the advancement of the maturity of the technology throughout the development process. The definition of a KPP includes identifying the appropriate environment and the component, subsystem, or system within which the KPP measurements are to be made.

4.2.7.8 Technology Readiness Assessment

a. As part of monitoring and controlling, the accurate assessment of technology maturity is critical to technology advancement and its subsequent incorporation into operational products. Refer to the Technology Readiness Assessment process in Appendix K and NASA-SP 6105 for additional information on technology readiness assessments.

b. When a TD Project uses a measure of maturity other than Technical Readiness Level (TRLs), the measurement system should map back to TRLs. TRLs are defined in NPR 7123.1.

c. An independent validation should be made of the current state of maturity. The maturity assessment should involve or be reviewed by the customer(s)/beneficiary(ies) or their representatives. The initial maturity assessment is performed in the Formulation Phase and updated at the project status reviews.

d. TRLs establish the baseline maturity of a technology at a given time. Moving to a higher level of maturity (higher TRL) requires the assessment of an entire range of capabilities for design, analysis, manufacture, and test. These additional assessments may be embodied in other measures of technology maturity such as a Technology Maturity Index (TMI) or an Advancement Degree of Difficulty (AD2), which are described in NASA/SP-2016-6105 (https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20170001761.pdf).

4.2.7.9 As part of monitoring and controlling, any critical analyses, control plans, and applicable policies needed by the project are also documented in the Project Plan. These may include:

a. A plan for acquisition of new aircraft in accordance with NPR 7900.3.

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b. A document of environmental compliance considerations for the National Environmental Policy Act (NEPA) per NPR 8580.1.

c. If a project contains elements or systems that could result in harm to personnel or property:

(1) An SMA plan in accordance with NPRs 8715.3 and 8705.6.

(2) A risk management plan in accordance with NPR 8000.4.

d. In some cases, these plans are already established by Center and/or facility procedures for operations such as wind tunnel tests and flight testing and do not need to be developed by the project.

e. IT controls per NPD 2810.1, NASA Information Security Policy, and NPD 1382.17, NASA Privacy Policy.

4.2.8 **R&T Project Approval**

4.2.8.1 Before the project can enter the Implementation Phase, the DA shall conduct the Project Approval KDP to determine the project's readiness to proceed to Implementation and document the decision.

4.2.8.2 The DA reviews the Project Plan (or equivalent documentation) and any other relevant data requested to ensure that the project objectives are aligned with the research goals and/or stakeholder needs and that the project is well planned to meet the objectives.

a. The decision resulting from the Project Approval KDP review is documented and can be in the form of a Decision Memorandum or other documentation (depending on the type and size of the project) and becomes part of retrievable project records.

b. The decision documentation should include the decision made, rationale, effective date, and any caveats for follow-up actions associated with the decision (including responsible parties and due dates). As part of the decision documentation, the costs, schedules, and key deliverables are captured. Other information may be captured such as the project roles and responsibilities, and other key parameters can be captured along with the decision. Upon approval, the project may proceed into the Implementation Phase. This phase may be the entry point for small projects that do not need to go through the Pre-Formulation or Formulation phases.

4.2.8.3 Table 4-3 provides guidance on input and output expectations for the review to obtain approval for a project to proceed to Implementation.

Table 4-3 Project Approval Expected Inputs and Outputs

Project Approval	
Input Expectations	**Output Expectations**
• Project Plan or alternate documentation, including: • o Goals, Objectives, and Performance Requirements • o Research or technical approach, including systems engineering	• A decision by the DA to approve Project Plan or other equivalent documentation (e.g., SOW)

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• o Management approach
  • WBS, Team/partnerships, Milestone Reviews, including PPRs, CAs, Acquisition strategy
• o Resource Requirements
  • Cost, institutional
• o Schedule
  • Key milestones/deliverables
• o TRL assessment
• o Transition/Infusion/Dissemination Approach
• o Applicable control plans (e.g., Configuration Management, System Security Plan and associated security plans assessments, Safety, Security, NEPA, HSIP)
  • Customized, as appropriate, for the scope of the project	

4.2.9 **R&T Project Implementation**

4.2.9.1 During the Implementation Phase, the project is implemented as described in the Project Plan and executed according to the planned cost (phasing) and schedule commitments. Project end products are developed, analyzed, verified to meet requirements, validated against stakeholder expectations, and delivered/transitioned per applicable plans. Project Status Reviews, CA Reviews, and Independent Assessments are conducted as defined in the Project Plan. The Implementation Phase culminates in the closeout activities, including data/information archiving, as needed to end the program.

4.2.9.2 For projects with a life-cycle cost (LCC) of $250 million or greater, if the project exceeds the LCC costs by 30 percent or more, the project manager [7] shall notify the DA and program manager. At that point, the project is considered terminated. The project will need to respond to Agency direction for re-baseline consideration and potential reauthorization by Congress.

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[7] Per NASA Authorization Act of 2005; 42 U.S.C. Subchapter 1 §16613 section 103 (P.L. 109-155) and as required per OCFO project cost and schedule data reporting process.

4.2.10 **Conduct Reviews**

4.2.10.1 As the project proceeds to mature the technology or conducts the research in the Implementation Phase, progress toward the project's technical goals, cost, and schedule are evaluated in periodic reviews. There are two types of reviews during the Implementation Phase: PPRs and CAs.

4.2.10.2 **Periodic Project Reviews**

a. The project manager shall conduct PPRs to evaluate the status of the project.

b. These reviews are typically considered internal reviews, conducted by the project, to review the project cost, schedule, and technical performance. Any issues or concerns are discussed, risks reviewed, recommendations made and/or actions assigned. The frequency and timing of the PPRs are

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determined by the project manager in coordination with the DA and documented in the Project Plan. As desired by the project and DA, these PPRs may take the form of informal discussions or as more formal life-cycle reviews such as PDR or CDR, as described in NPR 7123.1. For small projects, a gathering of the project team and key stakeholders may suffice to discuss the project's progress and to refine forward planning. Larger projects may need a more formal review with a wider audience and a more formal process for gathering comments, dispositioning them, and refining plans. In either case, it is important to describe the planned approach in the Project Plan (or its equivalent).

c. The PPRs for a project are documented in the Project Plan. The project manager should consider the number, frequency, and timing of these reviews (e.g., annually or at key milestones). Table 4-4 provides guidance on input and output expectations for PPRs. As project internal reviews, PPRs are not KDPs but can be combined with or the information from a PPR may feed into CAs.

Table 4-4 PPR Expected Inputs and Outputs

Periodic Project Reviews	
Input Expectations	**Output Expectations**

• Technical status appropriate for its current stage of research or development, including:
  • Technical objectives
  • Technical performance relative to threshold requirements/goals, key performance parameters, and/or research expectations
  • Experimental and/or design progress and results
  • Issues and concerns (including progress on prior actions)
  • Project risks
• Cost and schedule performance
• Project plan updates as required, including changes to technical approach, key milestones, CAs, waivers, etc.
• Status of plans and assessments (e.g., System Security Plan, Safety)
	• PPR summary, including:
	  • Technical progress
	  • Cost/schedule status
	  • Reviewer recommendations and/or actions
	  • Observations, threats, issues, and/or concerns
	  • Issues that need to be raised with upper management or help/resources
	  • Documentation of any strong technical differences of opinion and resolution approach
	• If required by DA, recommendation for a CA
	• If applicable, approval of Project Plan updates by DA

4.2.10.3 **Continuation Assessments**

a. The DA shall conduct decisional CAs. The DA is responsible for conducting the CA with projects presenting as needed.

b. CAs are KDP reviews. The number, frequency, and timing of the CAs (e.g., annually or before key events) are determined by the DA and the program manager and documented in the Project Plan. During this assessment, the technical progress summary, cost/schedule summary, top risks, relevancy to stakeholder, and continued suitability of the project end-state is determined. A discussion of what was learned, any advancements in the state of the art that was achieved,

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progression of the project towards its goals, any achievements that have reduced the level of uncertainty in the field, and any results from independent assessments should also be discussed. A decision to redirect, continue, or terminate the project is made then.

c. The result of a CA is documented in a Decision Memorandum or other appropriate format and is part of retrievable project records. The decision documentation should include the decision made and rationale, the effective date, any caveats for follow-up actions associated with the decision (including responsible parties and due dates). As part of the decision documentation, the costs, schedules, and key deliverables discussed are captured. Other information may be captured such as the project roles and responsibilities and other key parameters along with the decision. If the project is redirected in a significant way, the Project Plan should be updated to reflect the change. A decision to terminate a project should trigger a project closeout activity per Section 4.2.11.

d. Table 4-5 provides guidance on input and output expectations for CAs. CAs are key decision points that may be combined with or fed by information from PPRs.

Table 4-5 CA Expected Inputs and Outputs

Continuation Assessment	
Input Expectations	**Output Expectations**
• Technical progress summary, including any independent assessments • Cost/Schedule Summary, including project performance to date, margins, and any newly anticipated needs • Project top risks and threats • Status of plans and assessments (e.g., System Security Plan, Safety, HSIP) • Continued Agency strategic alignment and relevance	• Formally documented continuation decision from DA with project redirection if required

4.2.11 **Project Closeout**

4.2.11.1 When a project achieves its goals and objectives and completes the planned mission, or if a project is terminated early, the DA shall conduct the Closeout KDP. The decision of the project DA to closeout or terminate a project and the rationale is documented in a Decision Memorandum or other appropriate retrievable project documentation, including any recommendations relevant to existing contractual relationships, disposal of assets, manpower support, and timeframe of closure process.

4.2.11.2 Table 4-6 provides guidance on input and output expectations for a Closeout KDP. A final project summary, transition and/or infusion plan is provided documenting the results of the project work. The project summary may include a description of the research and/or technology advancement, performance relative to goals and threshold requirements, technologies transferred, and TRL advancement that was accomplished, the life-cycle cost summary, dissemination/ storage/archival of project information and any lessons learned.

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Table 4-6 Closeout Expected Inputs and Outputs

Closeout	
Input Expectations	**Output Expectations**

• Final project summary, report, transition, and/or infusion plan, including:
  • Description of research and/or technology advancement
  • Performance relative to goals and threshold requirements
  • Technology Readiness Level advancement
  • Life-cycle cost summary
  • Lessons learned
  • If applicable, description of infusion and/or transition activities after project closure
  • Archival, storage, disposal, and security approach for program information and artifacts
  • Results of any independent assessments
	• Documentation of final project Closeout approval by DA, including any actions or next steps for infusion/transition.
	• • Location(s) where retrievable documentation is stored

Closeout KDP should include stakeholder/customer participation.	

4.2.11.3 Upon review of this information, the DA can declare the project completed and assess whether the project achieved its stated goals and objectives. The DA may also want to engage the R&T community in an assessment of the science accomplishments. The failure of an R&T project can occur for the same reason as other projects: poor management, including cost overruns; no credible or measurable data results; not meeting expectations; or is not demonstrated. Through no fault of the project, a technology may lose relevancy if Agency needs change, but the achievements and knowledge gained may be useful for other projects. Note that the concept of “success” or “failure” is dependent on the nature of the project and its goals. For example, if a research project is investigating the feasibility of a possible new concept or discovery, showing that the line of work is not feasible may still be considered a success. Table 4-7 provides examples of what “success” might mean for R&T projects.

Table 4-7 Examples of Success

Research Projects	Technology Development Projects

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• Level of understanding/relevant knowledge has been advanced, level of uncertainty has been reduced, results have been documented/published	• Technology matured/TRL has been advanced

• Data has been brought forward to make relevant decisions such as:
  • Research spawns new research and/or continues to be worth pursuing (new/continued funding)
  • Expected application is not viable or continued research is not warranted, negative outcome
	• Technology was transferred to stakeholder/industry partner or infused into a NASA mission application

• Meeting or exceeding expectations/research objectives	• Achievement against Agency technology roadmaps

4.2.11.4 Once the DA authorizes a project to end, closeout activities can proceed. The project manager shall provide a closeout report at the conclusion of each project. The report includes a summary of the project's accomplishments, including an assessment of the end state and other maturity measures. If there is a decision to terminate the project during a CA, the details of what is required for closeout activities is documented in the CA decision documentation.

4.2.11.5 Project managers shall report new technologies derived from NASA R&T projects to the appropriate Center Technology Transfer Office in a timely manner in accordance with NPR 7500.2 to be considered for intellectual property protection and transfer for secondary applications.

4.2.11.6 At the conclusion of the project, the project manager shall archive data so that future users can assess the research results and technology maturity (e.g., TRL) and incorporate the research or technology into system designs or perform further investigations.

a. Archival data may include, but are not limited to, the final report from the Closeout KDP, results from independent assessments, engineering drawings, specifications, test reports, problem reports, anomalies, cost, schedule, risk mitigations, and any other documentation of project activities and results necessary for future researchers to understand the work performed resources needed, and the results that were achieved. Lessons learned are documented in accordance with NPD 7120.6.

b. For projects with products transferring to a flight project that will be performed under NPR 7120.5, careful documentation of the product configuration, pedigree, analyses performed, tests conducted, discrepancies that were noted, engineering drawings, and other information will need to be captured.

c. Documentary information produced while conducting NASA R&T projects that is suitable for preservation, as evidence of NASA organization and activities or because of the value of the information contained, regardless of format, is a Federal record and is maintained, safeguarded, and dispositioned in accordance with the guidelines of NPR 1441.1.

d. Except when the information is classified or subject to export control restrictions, as delineated in the Export Administration Regulations (EAR) and the International Traffic in Arms Regulations (ITAR) restrictions, the project manager should encourage peer-reviewed publication of research

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results or the posting of a final report external to NASA to ensure wide dissemination of publicly funded research or technology information. For some R&T projects, peer-review of published results may serve as a form of IA.

e. The project manager should encourage dissemination of new software technologies developed by the project per NPR 2210.1.

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Chapter 5. General Management Principles

5.1 Overview

This chapter contains general management principles that are applicable to programs and projects: roles and responsibilities, how to handle dissenting opinions, how the technical authorities interact with the program/projects, research practices, how to handle waivers, and the use of the metric system.

5.2 Roles and Responsibilities

5.2.1 **Overview of Roles and Responsibilities**

5.2.1.1 The roles and responsibilities of senior management are defined in NPD 1000.0 and NPD 1000.3. This section delineates the roles and responsibilities specific to carrying out the requirements of this NPR.

5.2.1.2 It is important for the program manager and project manager to coordinate early and throughout the program and project life cycles with mission support organizations at NASA HQ and the implementing Centers. These mission support organizations include legal, procurement, safety, security, finance, export control, human resources, public affairs, international affairs, property, facilities, environmental, aircraft operations, cybersecurity, and others. They provide essential expertise and ensure compliance with relevant laws, treaties, Executive Orders, and regulations. Refer to Appendix M as a guide to relevant documents.

5.2.2 **Specific Roles and Responsibilities**

5.2.2.1 The NASA Associate Administrator (AA) is responsible for oversight of all Agency programs at the Agency level, chairing the Agency PMC, and serving as the program DA for the Program Approval KDP and program Implementation Phase in accordance with Table 3-1. The NASA AA approves the program PCA.

a. The NASA AA may delegate responsibilities to the MDAA as documented in the PCA and Program Plan or other retrievable program documentation.

b. The NASA AA or MDAA may direct the use of NPR 7120.5 in lieu of this NPR for any R&T investment.

5.2.2.2 MDAAs are responsible for overseeing program and project performance within their directorate, chairing the DPMC, and reporting status periodically to Agency-level management. They establish directorate policies applicable to programs, projects, and supporting elements; appoint and delegate functions within their directorate; and establish program and project budgets. In accordance with tables 3-1 and 4-1, MDAAs serve as the DA for the program Authority to Proceed KDP and during the program Formulation Phase and as the DA for projects. MDAAs are responsible for approving the program-level requirements, program FAD, project scope, and the Program and Project Plans and for concurring on the program PCA. MDAAs are responsible for planning and managing independent assessments for programs and projects in their portfolio, organizing and staffing independent assessment review teams, and monitoring execution of the assessments with

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support as needed from Centers, the Office of the Chief Financial Officer, and OCE. [8] If delegated decision authority for directorate programs, the MDAA determines the need to modify or end the program and, in the case of termination, makes a recommendation to the NASA AA. If MDAAs elect to delegate their authority, the delegation should be documented and retained in retrievable program or project documentation.

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[8] Reference the "NASA Independent Assessment Principles and Approach" white paper approved at the APMC held on May 18, 2016, which can be found on the OCE menu under the "Other Policy Documents" tab in NODIS.

5.2.2.3 Center Directors are responsible for establishing, developing, and maintaining the institutional capabilities (processes and procedures, human capital, facilities, aircraft, and infrastructure) required for the execution of programs and projects, including the system of checks and balances to ensure technical and scientific accuracy of the portion of the programs and projects that are conducted at their Center or specifically assigned to their Center by NASA HQ. (See Section 5.4 for technical authority role.) Center Director responsibilities include:

a. Ensuring compliance with Center scientific processes, specifications, rules, practices, and other activities necessary to ensure the quality of results from R&T programs and projects;

b. Establishing and maintaining ongoing processes and forums, including the CMC, to monitor the status and progress of programs and projects and assess their progress to ensure performance in accordance with their Center's and the Agency's requirements, procedures, and processes;

c. Working with the Mission Directorate and the programs and project managers, once assigned, to assemble the program/project team(s) and to provide needed Center resources;

d. Providing support and guidance to programs and projects in resolving technical and programmatic issues and risks; and

e. Supporting Mission Directorates to plan and manage independent assessments.

5.2.2.4 The NASA Chief Engineer is responsible for the establishment of policy, oversight, and assessment of the NASA engineering and program/project management processes; 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; directs the NASA Engineering and Safety Center (NESC); and directs programs/projects to respond to requests from the NESC for data and information needed to make independent technical assessments and to respond to these assessments.

5.2.2.5 The NASA Chief Financial Officer oversees all financial management, budget, strategic planning, and performance activities relating to the programs, projects, and operations of the Agency. The Office of the Chief Financial Officer provides Agency programmatic (cost and schedule) analysis capability leadership; establishes cost policies, analyzes and monitors the methods, standards, and processes used to record cost as well as the project life-cycle schedule. The OCFO also assists in identifying personnel with analytical expertise to support in-line programmatic activities of NASA programs, projects, and independent assessments.

5.2.2.6 The Chief Safety and Mission Assurance Officer is responsible to ensure the existence of robust Safety and Mission Assurance (SMA) processes and activities through the development, implementation, assessment, and functional oversight of Agency-wide safety, reliability, maintainability, and quality assurance policies and procedures; serves as principal advisor to the

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Administrator and other senior officials on Agency-wide safety, reliability, maintainability, and quality assurance matters; performs independent program and project compliance verification audits; and implements the SMA technical authority process.

5.2.2.7 The Chief Health and Medical Officer (CHMO) is responsible for policy formulation, oversight, coordination, and assessment on all NASA health and medical matters in all environments; implements the Health and Medical Technical Authority (HMTA) process; and serves as principal advisor to both the Administrator and the Deputy Administrator on health and medical requirements, matters of astronaut health, research subject protection, and matters to ensure the mental and physical health and well-being of the NASA workforce in all environments.

5.2.2.8 The Agency Chief Information Officer directs, manages, and provides policy guidance and oversight of the Agency's Center CIOs' activities and operations, including, in concurrence with Center Directors, approving assignment, promotion, discipline, and relief of the principal CIO at each Center and assessment of their performance. The ACIO also leads and implements NASA's Cybersecurity Program, ensuring appropriate confidentiality, integrity, and availability of all NASA's information assets throughout the system life cycle. The Agency CIO exercises Mission Support Authority for IT and signs the Authority to Operate (ATO) IT systems (e.g., corporate, mission, ground, air, and space). This authorization is the official management decision given by a senior organizational official to authorize operation of an information system and to explicitly accept the risk to organizational operations (including mission, functions, image, or reputation), organizational assets, individuals, other organizations, and the Nation based on implementing an agreed-upon set of security controls. Because most system security requirements originate from law and are necessary for the protection of the program/project, the Agency, and in some cases the Nation, only the Agency CIO or designee has the authority to approve waivers or tailoring to OCIO requirements. See NPR 2800.1 for additional aspects of IT authority.

5.2.2.9 The program manager oversees program level planning and integration, as appropriate, to support the MDAA in the project selection process, either assigned or through a competitive process. (The MDAA may delegate the authority for project selection. This delegation is documented in the PCA or Program Plan.) The program manager is responsible for the formulation and implementation of the program in accordance with the FAD, PCA, and the Program Plan (or equivalent). The program manager conducts internal reviews and supports key decision points and independent assessments and other required reviews. The program manager conducts the following activities:

a. Updates the Program Plan.

b. Executes the Program Plan.

c. Conducts planning, program-level systems engineering and integration, as appropriate, to support the project selection process, either assigned or through a competitive process.

d. Concurs on project scope (or equivalent) and Project Plans.

e. Plans, prepares for, and supports ATP, Program Approval, Closeout, PARs, PSRs, and IAs as identified in the Program Plan,

f. Provides oversight of the projects within the program and reports their status periodically.

g. Reviews and approves annual project budget submission inputs and prepares annual program budget submissions.

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h. Performs any DA functions delegated by the DA.

5.2.2.10 The project manager is responsible for the formulation and implementation of the project in accordance with the project scope and the Project Plan. The project manager conducts internal reviews and supports key decision points and independent assessments and other required reviews. The project manager conducts the following activities:

a. Develops, submits, updates, and executes the Project Plan.

b. Conducts planning, project-level systems engineering and integration to support the project selection process, either assigned or through a competitive process.

c. Plans, prepares for, and supports ATP, Project Approval, Closeout, CAs, PPRs, and IAs as identified in the Project Plan,

d. Ensures publication of results of NASA research investments whenever possible.

5.2.2.11 The project Safety & Mission Assurance (S&MA) Lead is responsible for the implementation of safety, reliability, maintainability, and quality assurance policies and procedures and serves as advisor to the project manager and implements the SM&A technical authority process.

5.3 Process for Handling Dissenting Opinions

5.3.1 MDAAs and program and project managers shall ensure dissenting opinions are elevated through the Formal Dissent Process described in this section in accordance with principles that NASA teams have full and open discussions with all facts made available, understand and assess issues, and foster and respect diverse views in an environment of integrity and trust with no suppression or retribution.

5.3.2 Unresolved issues of any nature (e.g., programmatic, safety, engineering, health and medical, acquisition, or accounting) within a team should be quickly elevated to achieve resolution at the appropriate level. In the team environment in which NASA operates, team members often have to determine where they stand on a decision. In assessing a decision or action, a team member has three choices: agree, disagree but be willing to fully support the decision, or disagree and raise a Dissenting Opinion. At the discretion of the dissenting person(s), a decision may be appealed to the next higher level of management for resolution.

5.3.3 When time permits, the disagreeing parties jointly document the issue, including agreed-to facts, discussion of the differing positions with rationale and impacts and the parties' recommendations. The joint documentation is approved by the representative of each view, concurred with by affected parties, and provided to the next higher level of the involved authorities with notification to the second higher level of management. This may involve a single authority (e.g., the Programmatic Authority) or multiple authorities (e.g., Programmatic and Technical Authority), program/project management and the appropriate Technical Authority (TA) with notification to the second-higher level of management. In cases of urgency, the disagreeing parties may jointly present the information stated above orally with all affected organizations represented, advance notification to the second-higher level of management, and documentation followup.

5.3.4 Management's decision/action on the dissent memorandum (or oral presentation) is documented and provided to the dissenter and to the notified managers and becomes part of the program or project record. If the dissenter is not satisfied with the process or outcome, the dissenter

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may appeal to the next-higher level of management. The dissenter has the right to take the issue upward in the organization, even to the NASA Administrator, if necessary.

5.4 Technical Authority

5.4.1 The NASA governance model prescribes a management structure that employs checks and balances among key organizations to ensure that decisions have the benefit of different points of view and are not made in isolation. This structure is made up of two authorities: Programmatic Authority and Institutional Authority. Programmatic Authority consists of the Mission Directorates and their respective programs and projects. The Institutional Authority consists of those organizations not in the Programmatic Authority. As part of Institutional Authority, NASA established the TA process as a system of checks and balances to provide independent oversight of programs and projects in support of safety and mission success through the selection of specific individuals with delegated levels of authority. The technical authority process is another means by which NASA maintains the technical integrity of its R&T programs and projects.

5.4.2 TA originates with the Administrator and is formally delegated to the NASA AA and then to the NASA Chief Engineer for Engineering Technical Authority (ETA); the Chief, Safety and Mission Assurance for SMA Technical Authority; and then to the Center Directors. The Administrator delegates HMTA to the NASA CHMO. Subsequent TA delegations are made to selected individuals who are funded independent of the Programmatic Authority.

5.4.3 The technical authority process provides for the selection of individuals at different levels of responsibility who maintain independent authority to ensure that proper technical standards are utilized in the performance of any R&T program or project tasks at the Center. In this document, the term TA is used to refer to such an individual but also is used (without capitalization) to refer to all the elements of the technical authority process taken together. There are three distinct types of TAs: Engineering TAs, SMA TAs, and HMTAs, each of whom is discussed in this section. A key aspect of the technical authority process is that the TAs are funded independently of the program/project.

5.4.3.1 The ETA establishes and is responsible for the engineering design processes, specifications, rules, best practices, etc., necessary to fulfill programmatic mission performance requirements. The NASA Chief Engineer provides overall leadership of the engineering technical authority process for NASA R&T programs and projects. This includes technical policy direction, requirements, and verification of technical authority process implementation. It may also include concurrence with the technical management oversight approach in the Project Plan. The ETA may also provide guidance on which control plans for the program/project are needed and whether they should be a stand-alone document or incorporated into other documents such as the Project Plan. The NASA Chief Engineer hears appeals of the Engineering Technical Authority's decisions when they cannot be resolved at lower levels.

5.4.3.2 The SMA TA establishes and is responsible for the SMA design processes, specifications, rules, best practices, etc., necessary to fulfill programmatic mission performance requirements. To ensure independence, SMA Technical Authority personnel are organizationally separate from the program/project. The Center SMA Director is responsible for establishing and maintaining institutional SMA policies and practices consistent with Agency policies and standards. The Center SMA Director also is responsible for ensuring that the program/project complies with both the program/project and Center SMA requirements.

5.4.3.3 The HMTA establishes and is responsible for ensuring Agency health and medical policy,

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procedural requirements, and technical standards are addressed in program/project management. The HMTA provides independent oversight of all health, medical, and space crew/personnel performance matters that either arise in association with the execution of NASA programs and projects or are embedded in NASA programs and projects as specified in NPR 7120.11.

5.4.4 Each Center Director is responsible for the technical integrity of R&T activities and investigations that are assigned or awarded to that Center. The Center Director is the overarching Center Technical Authority responsible for Center engineering verification/validation processes, specifications, rules, practices, and other activities necessary to ensure the technical integrity of R&T programs and projects accomplished by the Center. The Center Engineering TA approves waivers and changes in Center technical requirements. The Center Director may delegate Center engineering technical authority implementation responsibility to an individual in the Center's engineering leadership. Due to the nature of R&T, the technical authority requirements for R&T programs and projects are not as specific as for programs and projects managed under NPR 7120.5. The Center Director appoints personnel, as needed, to fill the Engineering TA roles at the Center. These roles are not predefined in this document because they may vary greatly depending on the nature and level of effort of the R&T programs and projects.

5.4.5 Depending on the scope of R&T work being performed at the Center, the TA may establish periodic reviews. However, the scope of these reviews should reflect the R&T work being accomplished at the Center. Whenever possible, the TA independent reviews should be coordinated with planned program/project reviews for efficiency. There may be cases when it is advantageous for several Centers to work together to come up with a means of maintaining technical integrity for efforts that are not Center specific. Therefore, it is possible for several Centers to work together to conduct one TA independent review of a piece of work.

5.4.6 The day-to-day involvement of the TA in program/project activities should ensure that any significant views from the TA will be available to the program/project in a timely manner and should be handled during the normal program/project processes. The ultimate responsibility for program/project success in conformance with governing requirements remains the responsibility of the program/project manager.

5.4.7 Infrequent circumstances may arise when the Technical Authority or the program/project manager may disagree on a proposed programmatic or technical action and judge that the issue rises to a level of significance that the next-higher level of management should be involved. In such circumstances:

5.4.7.1 If considered to be in the best interest of the program/project, the program/project manager has the authority to proceed at risk in parallel with the pursuit of a resolution.

5.4.7.2 Resolution should occur prior to implementation, whenever possible. However, the program/project manager may proceed at risk in parallel with pursuit of resolution if deemed 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.

5.4.7.3 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.

5.4.7.4 Additional details establishing the technical authority process are contained in NPR 7120.5 and NASA/SP-2014-3705 at https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20150000400.pdf.

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5.5 Research Practices

5.5.1 All R&T projects, activities, and investigations are conducted in accordance with established research practices and NASA's standards to ensure the quality, integrity, and acceptability in the community of the research results. Such standards and related requirements regarding NASA sponsored research are provided in NPR 1080.1 and NPD 1920.1.

5.5.2 Each Center Director is responsible for ensuring the conduct of R&T activities and investigations that are assigned or awarded to that Center follows appropriate practices. The Center Director is responsible for Center scientific processes, specifications, rules, practices, and other activities, necessary to ensure the quality of results from R&T programs and projects. The Center Director may delegate Center responsibility to an individual in the Center's leadership.

5.6 Principles Related to Tailoring Requirements

5.6.1 It is NASA policy that all prescribed requirements (requirements levied on a lower organizational level by a higher organizational level) are complied with unless relief is formally granted. Policy also recognizes that each program or project has unique aspects that need to be accommodated to achieve mission success in an efficient and economical manner. Tailoring is the process used to adjust or seek relief from a prescribed requirement to meet the needs of a specific program or project. Tailoring is both an expected and accepted part of establishing proper requirements. For requests for relief from requirements that are the responsibility of the Chief, SMA, see NASA-STD-8709.20 for the SMA-specific process.

5.6.2 The evaluation and disposition of requests for tailoring comply with the following:

5.6.2.1 The request for requirement relief is referred to as a "deviation" or "waiver" depending on the timing of the request. Deviations apply before a requirement is put under configuration control at the level the requirement will be implemented, and waivers apply after.

5.6.2.2 The organization submitting the tailoring request informs the next higher level of involved management in a timely manner of the tailoring request.

5.6.2.3 The organization at the level that established the requirement dispositions the request for tailoring of that requirement unless this authority has been formally delegated elsewhere. Such delegations will maintain the separation of Programmatic and Institutional Authorities required by governance.

5.6.2.4 The dispositioning organization consults with any other organizations that were involved in the establishment of the specific requirement and obtains the concurrence of those organizations having a substantive interest.

5.6.2.5 Approved tailoring requests become part of the retrievable program or project records.

5.6.3 A prescribed requirement that is not relevant and/or not capable of being applied to a specific program, project, system, or component can be approved to be designated Non-Applicable by the individual who has been delegated oversight authority by the organization that established the requirement. This approval can be granted at the level where the requirement was specified for implementation (e.g., the project-level ETA could approve a non-applicable designation for an engineering requirement). The request and approval documentation become part of the retrievable

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program or project records. No other formal deviation or waiver process is required.

5.6.4 The person requesting a permanent change to a prescribed requirement in an Agency or Center document that is applicable to all programs and projects shall submit a "change request" to the office responsible for the requirement policy document unless formally delegated elsewhere.

5.6.5 **Tailoring of NPR 7120.8 Requirements**

5.6.5.1 The requirements in this NPR follow the philosophy of minimizing down to the essential requirements for R&T projects and maximizing the flexibility of R&T projects to meet those requirements. Larger R&T project managers or the MDAA or program manager might find it advantageous to pull in more structured requirements from NPR 7120.5, for example, for some of the specific life-cycle reviews like the CDR. The addition of requirements from other directives and the addition of program/project technical requirements does not require a waiver.

5.6.5.2 Additionally, how a program or project complies with a requirement is not specified and depends on the size and complexity of the program or project and does not require a waiver. For example, this NPR requires the project manager develop a Project Plan that contains, as a minimum:

a. A description of the project and its objectives.

b. How the project will be managed.

c. How the project will be monitored and controlled, including reviews.

d. The expected cost and schedule.

e. The deliverables.

5.6.5.3 As long as the Project Plan contains these elements, the format that it takes can be scaled as appropriate for the size and complexity of the project. The format could follow the outline in Appendix G, a memorandum, or another format. The plan could be a hard copy document, an electronic file, power point file, e-mail, or other electronic media, as long as the DA agrees to it, the appropriate signatories sign off on it, and the plan is stored in official retrievable project documentation.

5.6.6 **Waiver Approval Authority**

5.6.6.1 The person requesting a waiver to a requirement in this directive shall document the request, obtain the required signature from the OCE or the organization responsible for the requirement, and submit a copy to the Office of the Chief Engineer. The request should include the rationale, a risk evaluation, and reference to all material that provides the justification supporting acceptance. Appendix L provides an example acceptable template for a waiver request.

5.6.6.2 Waivers to requirements in this directive are adjudicated by the officials shown in Table 5-1.

Table 5-1 Waiver Approval for R&T Programs and Projects

	Project Manager	Program Manager	Center Director*	MDAA	NASA Chief Engineer**	NASA AA	Approval Authority for Waivers with Dissent

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Programs		R	C	R	A	I	NASA AA
Projects	R	R	C	R	A	I	NASA AA

R = Recommends; C = Concurs; A = Approves; I = Informed
* Unless otherwise delegated.
**Or those delegated by the Chief Engineer or held by a different owner of the requirement.

5.7 Use of Metric System

The International System of Units (commonly known as the Système Internationale (SI) or metric system of measurement) is to be used for all new projects and programs, especially in cooperative efforts with international partners. 15 U.S.C. §205b and Executive Order 12770 provide relief from this preferential use of SI when the use is impractical or is likely to cause significant inefficiencies, such as a substantial increase in cost or unacceptable delays in schedule. Each program and project will perform and document an assessment to determine an approach that maximizes the use of SI. This assessment will document an integration strategy if both SI and U.S. customary units are used in a project or program. The assessment is to be completed and documented in the Program Plan or Project Plan.

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Appendix A. Definition of Terms

Acquisition.

The process for obtaining the systems, research, services, construction, and supplies that NASA needs to fulfill its missions. Acquisition—which may include procurement (contracting for products and services)—begins with an idea or proposal that aligns with the NASA Strategic Plan and fulfills an identified need and ends with the completion of the program or project or the final disposition of the product or service.

Acquisition Strategy Meeting. Acquisition Strategy Meeting. A decision-making forum where senior Agency management reviews and approves program and project acquisition strategies. The ASM focuses on considerations such as impacting the Agency workforce, maintaining core capabilities, make-or-buy supporting Center assignments, potential partners and risk. (See NPD 1000.5 for more information on ASMs.)

Agency Program Management Council. The senior management group, chaired by the NASA Associate Administrator or designee, that is responsible for reviewing Formulation performance, recommending approval, and overseeing implementation of programs and specified projects according to Agency commitments, priorities, and policies.

Approval. Authorization by a required management official to proceed with a proposed course of action. (When multiple approvals are required, all need to be obtained to proceed.) Approvals are documented in retrievable program and project records.

Center Management Council. The council at a Center that performs oversight of programs and projects by evaluating all program and project work executed at that Center.

Component Facilities. Complexes that are geographically separated from the NASA Center or institution to which they are assigned but are still part of the Agency.

Configuration Management.A technical and management process applying appropriate processes, resources, and controls to establish and maintain consistency between product configuration information and the product throughout the product life cycle.

Continuation Assessment. A key decision point for a project. During CAs, the technical progress, cost/schedule, top risks and threats, and continued suitability of the project's product end state are determined. A discussion of the status of project progress, lessons learned, any advancements in the state of the art achieved, progression of the project towards its goals, any achievements that have reduced the level of uncertainty in the field, and any results from IAs should also be discussed. CAs are formal reviews but the decision process can be scaled to fit the project size/scope. For small projects, a gathering of key stakeholders may suffice to discuss the project's progress and to refine forward planning. Larger projects may need a more formal review with a wider audience and a more formal process for gathering comments, dispositioning them, and refining plans. A decision to redirect, continue, or terminate a program is made at a CA.

Critical Technology Elements. Elements of a project that are essential in meeting overall technology requirements.

Customer/Beneficiary. The intended beneficiary or user of the R&T results (i.e., knowledge, technology). The organization or individual that has requested a product and will receive the product to be delivered. The customer may be an end user of the product, the acquiring agent for the end user, or the requestor of the work products from a technical effort. Typically, a customer is a space flight project or the aeronautics community. Customers may also be other NASA-focused R&T projects where further development occurs to meet a specific mission requirement or industrial partners that NASA supplies with the results of the R&T to maintain a national aerospace capability.

Decision Authority. The individual authorized by the Agency to make important decisions on programs and projects under their authority.

Decision Memorandum. Documentation that captures the results of a significant decision such as from a KDP review. The decision documentation should include the decision made, rationale, effective date, and any actions associated with the decision (including responsible parties and due dates).

Deviation. A documented authorization releasing a program or project from meeting a requirement before the requirement is put under configuration control at the level the requirement will be implemented.

Directorate Program Management Council. The senior management group, chaired by an MDAA or designee, responsible for evaluating programs and projects executed within that Mission Directorate and overseeing implementation according to Agency commitments, priorities, and policies. For some programs, the MDAA may carry forward the DPMC findings and recommendations to the APMC.

Earned Value Management. A project management approach 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

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of technical progress with objective performance measurement techniques, 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., identification of risky WBS elements).

Evaluation. The continual, self- and independent (i.e., outside the advocacy chain of the program/project) assessment of the performance of a program or project and incorporation of the evaluation findings to ensure adequacy of planning and execution according to plan. Flight Unit. The flight unit is the actual end item that is intended for deployment and operations. It is subjected to formal functional and acceptance testing.

Form. The physical characteristics of the product such as dimensions, weight, size, and visual parameters.

Formulation. The identification of how the program or project supports the Agency's strategic needs, goals, and objectives; the assessment of feasibility, technology, and concepts; risk assessment, team-building, development of concepts of operation, and acquisition strategies; establishment of high-level requirements and success criteria; the preparation of plans, budgets, and schedules essential to the success of a program or project; and the establishment of control systems to ensure performance to plan and alignment with current Agency strategies.

Formulation Authorization Document. The document issued by the MDAA to authorize the formulation of a program whose goals will fulfill part of the Agency's Strategic Plan and Mission Directorate strategies and establish the expectations and constraints for activity in the Formulation Phase. In addition, a FAD or equivalent is used to authorize the formulation of a project. (See appendices C and F.)

Function. The action or actions that a part is designed to perform.

Gap Analysis. An assessment of related technology development activities in other NASA programs, other Government agencies, and the commercial sector to evaluate the state of existing technology efforts and areas where additional work might be worthwhile to eliminate unnecessary duplication of effort.

Gate Products. Appropriate supporting materials submitted to the DA at a KDP. These materials may include: the governing PMC review recommendation; the Independent Assessment (IA) report; the program manager's recommendation, project manager's recommendation; Cost Estimation reports; the CMC's recommendation; and any agreement(s) ready for signature (i.e., FAD, Program or Project Plan, PCA, Selection Document, or updates).

Governing Program Management Council. The senior management group responsible for providing management oversight of specific programs and projects. Each council has the responsibility of periodically evaluating the cost, schedule, risk, and performance of programs or projects under its purview. The evaluation focuses on whether the program or project is meeting its commitments to the Agency and is following appropriate management processes. The governing PMC is either the APMC or the DPMC.

Implementation. The execution of approved plans for the development and operation of the program/project and the use of control systems to ensure performance to approved plans and continued alignment with the Agency's strategic goals.

Independent Assessment. IAs are conducted periodically as part of the program and project life cycle to ensure the relevance, quality, and performance of the program or project. Assessments include reviews, evaluations, audits, analysis oversight, and investigations and are independent to the extent the involved personnel apply their expertise impartially and without any conflict of interest or inappropriate interference or influence, particularly from the organization(s) being assessed.

Information Technology. IT, as defined in U.S. Federal Code 40 U.S.C. 11101, is any equipment or interconnected system or subsystem of equipment that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by an executive agency. It also includes computers, ancillary equipment (including imaging peripherals, input, output, and storage devices necessary for security and surveillance), peripheral equipment designed to be controlled by the central processing unit of a computer, software, firmware and similar procedures, services (including support services), and related resources. This includes: It does not include any equipment acquired by a Federal contractor incidental to a Federal contract.

Infrastructure Requirements. The facilities real property (buildings and/or other structures) and environmental, aircraft, personal property, equipment, and IT resources that are needed to support programs and projects.

Institutional Authority. Institutional Authority encompasses all those organizations and authorities not in the Programmatic Authority. This includes engineering, safety and mission assurance, and health and medical organizations; mission support organizations; and Center Directors.

Institutional Requirements. Requirements that focus on how NASA does business that are independent of the Particular program or project. There are five types: engineering, program/project management, safety and mission assurance, health and medical, and mission support requirements.

Investment. A resource and financial commitment by the Agency, Mission Directorate, or Center.

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Key Decision Point. A decisional review that serves as a gate through which programs and projects need to pass to continue through their life cycle. KDPs entail a determination by the DA on the readiness of the program or project to progress through its life cycle. KDPs enable a disciplined approach to assessing program and project performance.

Key Performance Parameter. Measurable engineering parameters that would be readily understood and used by engineers concerned with the ultimate application of the results from the Technology Development project. For each KPP, both a goal and a threshold will be specified. The goal is a performance level that the Technology Development project is striving for, and the threshold is the minimum performance level that users agree is acceptable for the end item deliverable. Typically, the threshold KPP values are set beyond the current state of the art to warrant investment in the Technology Development project. KPPs include information that enables an assessment of the advancement of the maturity of the technology throughout the development process. The definition of a KPP includes defining the appropriate environment and the component, subsystem, or system within which the KPP measurements are to be made.

Laboratory Environment. An environment that does not address in any manner the environment to be encountered by the system, subsystem, or component (hardware or software) during its intended operation tests in a laboratory environment are solely for demonstrating the underlying principles of technical performance (functions) without respect to the impact of environment.

Life-Cycle Cost. The total of the direct, indirect, recurring, nonrecurring, and other related expenses both incurred and estimated to be incurred in the design, development, verification, production, deployment, prime mission operation, maintenance, support, and disposal of a project, including closeout. The LCC of a project or system can also be defined as the total cost of ownership over the project or system's life cycle from Formulation through Implementation. It includes all design, development, deployment, operation and maintenance, and disposal costs.

Non-Applicable Requirement. Any requirement not relevant; not capable of being applied.

Operational Environment. The environment in which the final product will be operated. In the case of space flight hardware/software, it is space. In the case of ground-based or airborne systems that are not directed toward space flight, it will be the environments defined by the scope of operations. For software, the environment will be defined by the operational platform.

Periodic Project Review. An internal review of a project's cost, schedule, and technical performance. Any issues or concerns are discussed, risks reviewed, recommendations made, and/or actions assigned. PPRs may take the form of informal discussions or more formal life-cycle reviews. For small projects, a gathering of the project team and key stakeholders may suffice to discuss the project's progress and to refine forward planning. Larger projects may need a more formal review with a wider audience and a more formal process for gathering comments, dispositioning them, and refining plans.

Principal Investigator. A person who conceives an investigation and is responsible for carrying it out and reporting its results. In some cases, Principal Investigators (PIs) from industry and academia act as project managers for smaller development efforts with NASA personnel providing oversight. Not all projects will have a designated PI.

Program. A strategic investment by Mission Directorates or mission support offices that has a defined architecture and/or technical approach, requirements, funding level, and a management structure that initiates and directs one or more projects. A program implements a strategic direction that the Agency has identified as needed to accomplish Agency goals and objectives.

Program Assessment Review. A key decision point for a program. During PARs, the technical progress, cost/schedule, top risks and threats and continued suitability of a program end-state are determined. PARs may take the form of informal discussions or more formal reviews. For small programs, a gathering of key stakeholders may suffice to discuss the program's progress and to refine forward planning. Larger programs may need a more formal review with a wider audience and a more formal process for gathering comments, dispositioning them, and refining plans. A decision to redirect, continue, or terminate a program is made at a PAR.

Program Commitment Agreement. The contract between the AA and the responsible MDAA that authorizes transition from Formulation to Implementation of a program.

Program Manager. A generic term for the person who is formally assigned to be in charge of the program. A program manager could be designated as a program lead, program director, or some other term, as defined in the program's governing document. A program manager is responsible for the formulation and implementation of the R&T program, per the governing document with the sponsoring MDAA.

Program Plan. The document that establishes the program's baseline for implementation, signed by the MDAA or Center Director(s) and program manager.

Program Status Review. An internal review of a program's cost, schedule, and technical performance. For small programs, a gathering of the program team and key stakeholders may suffice to discuss the program's progress and to refine forward planning. Larger programs may need a more formal review with a wider audience and a more formal process for gathering comments, dispositioning them, and refining plans.

Program (Project) Team. All participants in program (project) Formulation and Implementation. This includes all direct reports

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and others that support meeting program (project) responsibilities.

Programmatic Authority. Programmatic Authority includes the Mission Directorates and their respective program and project managers. Individuals in these organizations are the official voices for their respective areas. Programmatic Authority sets, oversees, and ensures conformance to applicable programmatic requirements.

Programmatic Requirements. Requirements set by the Mission Directorate, program, project, and PI, if applicable. These include strategic scientific and exploration requirements, system performance requirements, safety requirements, and schedule, cost, and similar nontechnical constraints.

Project. A specific investment identified in a Program Plan having defined requirements, a life-cycle cost, a beginning, and an end. A project also has a management structure and may have interfaces to other projects, agencies, and international partners. A project yields new or revised products that directly address NASA's strategic goals.

Project Manager. A generic term that represents the position in charge of the project. A project manager could be designated as a project lead, project principal investigator, project scientist, research director, project executive, or some other term, as defined in the project's governing document. A project manager is responsible for the formulation and implementation of the R&T project, per the governing document in coordination with the program manager.

Project Plan. The document that establishes the project's baseline for Implementation, signed by the responsible program manager, Center Director, project manager, and the MDAA. if required.

Protoflight Unit. Protoflight units are developed for cases when a qualification unit is not developed (due to cost or schedule constraints). The protoflight unit is intended for flight or deployment and operations. A limited set of qualification and tests are performed on the prototype to preserve its ability to function and life expectancy. Full acceptance testing is performed.

Qualification Unit. Hardware that is generated with the same components and processes intended for the actual flight units. These units are tested to the levels that demonstrate the desired qualification level margins of key parameters such as thermal extremes, vibration, and radiation levels. Sometimes this means testing the unit to failure. This unit is not used operationally, but if still functioning, may be kept as a ground spare or test unit for mission anomalies.

R&T Program. An Agency program that comprises strictly R&T projects. R&T Project. An Agency project managed as either a Technology Development project or a Research project.

Relevant Environment. Not all systems, subsystems, and/or components need to be operated in the operational environment to satisfactorily address performance margin requirements. Consequently, the relevant environment is the specific subset of the operational environment that is required to demonstrate critical "at risk" aspects of the final product performance in an operational environment. It is an environment that focuses specifically on "stressing" the technology advance in question.

Research and Technology. Basic research, applied research, and technology development.

Risk. In the context of mission execution, risk is the potential for performance shortfalls, which may be realized in the future, with respect to achieving explicitly established and stated performance requirements. The performance shortfalls may be related to any one or more of the following mission execution domains: (1) safety, (2) technical, (3) cost, and (4) schedule. (See NPR 8000.4.)

Risk Assessment. An evaluation of a risk item that determines: (1) what can go wrong, (2) how likely is it to occur, (3) what the consequences are, (4) what the uncertainties are that are associated with the likelihood and consequences, and (5) what the mitigation plans are.

Risk Management. Risk management includes risk-informed decision making (RIDM) and continuous risk management (CRM) in an integrated framework. RIDM informs systems engineering decisions through better use of risk and uncertainty information in selecting alternatives and establishing baseline requirements. CRM manages risks over the course of the Formulation and Implementation Phase of the life cycle to ensure that safety, technical, cost, and schedule requirements are met. This is done to foster proactive risk management, to better inform decision making through better use of risk information, and then to more effectively manage Implementation risks by focusing the CRM process on the baseline performance requirements emerging from the RIDM process. (See NPR 8000.4.) These processes are applied at a level of rigor commensurate with the complexity, cost, and criticality of the program.

Risk-Informed Decision Making. A risk-informed decision-making process uses a diverse set of performance measures (some of which are model-based risk metrics), along with other considerations within a deliberative process to inform decision making.

Safety. Freedom from those conditions that can cause death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment.

Security. Protection of people, property, and information assets owned by NASA that covers physical assets, personnel, IT, communications, and operations.

Stakeholder. Any party that has an interest in the outcome or deliverable of a program or project. Stakeholders include customers,

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beneficiaries, and organizations that will work on or provide support to the program or project.

System. The combination of elements that function together to produce the capability required to meet a need. The elements include all hardware, software, equipment, facilities, personnel, processes, and procedures needed for this purpose.

Systems Engineering. Per NPR 7123.1, NASA Systems Engineering is a logical systems approach performed by multidisciplinary teams to engineer and integrate NASA's systems to ensure NASA products meet the customer's needs. Implementation of this systems approach will enhance NASA's core engineering capabilities while improving safety, mission success, and affordability. This systems approach is applied to all elements of a system (i.e., hardware, software, and human) and all hierarchical levels of a system over the complete program/project life cycle.

Tailoring. The process used to adjust or seek relief from a prescribed requirement to accommodate the needs of a specific task or activity (e.g., program or project). The tailoring process results in the generation of deviations and waivers depending on the timing of the request.

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

Technology Readiness Level. Provides a scale against which to measure the maturity of a technology. TRLs range from 1, Basic Technology Research, to 9, Systems Test, Launch, and Operations. Typically, a TRL of 6 (i.e., technology demonstrated in a relevant environment) is required for a technology to be integrated into a flight system. For detailed guidance on technology assessment refer to the Technology Readiness Assessment Best Practices Guide, SP-20205003605, which can be found on the NODIS OCE page at
https://ntrs.nasa.gov/api/citations/20205003605/downloads/TRA%20BP%20Guide%20manuscript%20for%20SP-XXXX.docx.pdf.

Termination Review. A review initiated by the DA 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. A document specifying the nature, scope, schedule, and ground rules for an independent review or independent assessment.

Technology Development Project. A specific R&T project identified in an Agency Program Plan that has defined technical requirements, a life-cycle cost that incorporates a specific beginning and ending, and a management structure. A Technology Development project yields new or revised technology that addresses NASA's strategic needs.

Unallocated Future Expenses. The portion of estimated cost required to meet specified confidence level that has not been allocated to the specific project WBS sub-elements because the probabilistic estimate includes risks and uncertainties.

Waiver. A documented authorization releasing a program or project from meeting a requirement after the requirement is put under configuration control at the level the requirement will be implemented.

Work Breakdown Structure. A product-oriented hierarchical division of the hardware, software, services, and data required to produce the program's or project's end product(s), structured according to the way the work will be performed, and reflecting the way in which program/project costs, schedule, technical, and risk data are to be accumulated, summarized, and reported.

https://ntrs.nasa.gov/api/citations/20205003605/downloads/TRA%20BP%20Guide%20manuscript%20for%20SP-XXXX.docx.pdf

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Appendix B. Acronyms

AA	Associate Administrator
AD2	Advancement Degree of Difficulty
AO	Announcement of Opportunity
APA	Allowance for Program Adjustment
APMC	Agency Program Management Council
ASM	Acquisition Strategy Meeting
ATP	Authority to Proceed
CA	Continuation Assessment
CDF	Capitalization Determination Form
CDR	Critical Design Review
CFR	Code of Federal Regulations
CHMO	Chief Health and Medical Officer
CIO	Chief Information Officer
CM	Configuration Management
CMC	Center Management Council
DA	Decision Authority
DPMC	Directorate Program Management Council
EMO	Environmental Management Office
EPO	Education and Public Outreach
EVM	Earned Value Management
FAA	Federal Aviation Administration
FAD	Formulation Authorization Document
FAR	Federal Acquisition Regulation
FPR	Facility Project Requirements
FY	Fiscal Year
HMA	Health and Medical Authority
HQ	Headquarters
IA	Independent Assessment
IBPD	Integrated Budget and Performance Document
IT	Information Technology

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ITAR	International Traffic in Arms Regulations
KDP	Key Decision Point
KPP	Key Performance Parameter
LCC	Life-Cycle Cost
MDAA	Mission Directorate Associate Administrator
MdM	Meta-Data Manager
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NESC	NASA Engineering and Safety Center
NF	NASA Form
NFS	NASA Federal Acquisition Regulation (FAR) Supplement
NOA	New Obligational Authority
NOAA	National Oceanic and Atmospheric Administration
NODIS	NASA Online Directives Information System
NPD	NASA Policy Directive
NPR	NASA Procedural Requirements
NRA	NASA Research Announcement
OCE	Office of the Chief Engineer
OCFO	Office of the Chief Financial Officer
OSMA	Office of Safety and Mission Assurance
PAR	Program Assessment Review
PCA	Program Commitment Agreement
PDR	Preliminary Design Review
PI	Principal Investigator
PMC	Program Management Council
PPR	Periodic Project Review
PSM	Procurement Strategy Meeting
PSR	Program Status Review
R&T	Research and Technology
RFP	Request for Proposal
SEHB	Systems Engineering Handbook
SI	Systeme Internationale (commonly known as Metric System)

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SMA	Safety and Mission Assurance
SOW	Statement of Work
SRB	Standing Review Board
TA	Technical Authority
TD	Technology Development
TMI	Technology Maturity Index
ToR	Terms of Reference
TRL	Technical Readiness Level
UFE	Unallocated Future Expenses
WBS	Work Breakdown Structure

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Appendix C. R&T Program Formulation Authorization Document (FAD) Template

C.1 R&T Program FAD Title Page

Research and Technology

Program

Formulation Authorization Document

(Provide a title for the candidate program and designate a short title or proposed acronym in parenthesis, if appropriate.)

_____ _____

Program Manager Date

_____ _____

Mission Directorate Associate Administrator Date

Figure C-1 R&T Program Formulation Authorization Document Title Page

C.2 R&T Program FAD Template

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RESEARCH AND TECHNOLOGY PROGRAM

FORMULATION AUTHORIZATION DOCUMENT
(PROGRAM TITLE)

1.0 PURPOSE (Required)

- Briefly describe the purpose of the program and define its relationship to the Agency's vision and mission, as defined by NPD 1001.0, NASA Strategic Plan.
- Establish the scope of work to be accomplished.
- Define the approach and resources required to conduct program formulation.

2.0 AUTHORITY

- Identify the program manager to manage the Formulation effort.
- Describe any Center involvement, including lines of authority, coordination, and reporting.
- Identify the governing program management policy document (e.g., NPR 7120.8).

3.0 FUNDING

- Identify, by fiscal year, the funding that will be committed for program Formulation.

4.0 CONSTRAINTS (Required)

- Provide initial constraints, including resources, schedule, and program participants within and external to NASA, including international partnerships.

5.0 REVIEWS

- Describe any reviews, including independent assessments required during the formulation phase.

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Appendix D. R&T Program Commitment Agreement (PCA) Template

D.1 R&T PCA Title Page

Research and Technology

Program Commitment Agreement

(Provide a title for the candidate program and designate a short title or proposed acronym in parenthesis, if appropriate.)

It is the responsibility of each of the signing parties to notify the other if a commitment cannot be met and to initiate the timely renegotiations of the terms of this agreement.

_____ _____

Mission Directorate Associate Administrator Date

_____ _____

NASA Associate Administrator Date

Figure D-1 R&T Program Commitment Agreement Title Page

D.2 R&T PCA Template

RESEARCH AND TECHNOLOGY

PROGRAM COMMITMENT AGREEMENT

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(PROGRAM TITLE)

1.0 R&T PROGRAM OBJECTIVES

Identify the broad program objectives. Describe the program's relationship to the Agency's vision and mission, as defined by NPD 1001.0, NASA Strategic Plan. Convey the public good of the program to the taxpayer, stated in a way that can be understood by the average citizen.

2.0 R&T PROGRAM OVERVIEW

Describe the strategy to achieve the above-mentioned objectives. Relationships with external organizations, other Government agencies, or international partners should be addressed if achievement of the program objectives is dependent on their performance. Identify the associated projects governed by the program.

3.0 R&T PROGRAM AUTHORITY

Describe the NASA organizational structure for managing the program and projects from the MDAA to the project managers. Include any NASA Center involvement. Include lines of authority and reporting, Center(s) responsibilities, the governing PMC for the oversight of the program and its projects, and the management responsibilities for approving new projects. Identify the program manager in charge of the program.

4.0 TECHNICAL PERFORMANCE COMMITMENT

Summarize the performance metrics with goals and minimum thresholds needed to achieve the program objectives. If the objectives include a technical performance target (goal) in addition to a threshold requirement, the commitment could be stated as a range.

5.0 SCHEDULE COMMITMENT

Identify the key target schedule milestones for the program and for each project in the program. Identify key target milestones such as:

a. Start of Formulation.

b. Target date or time frame for the Program Approval for approval to transition from Formulation to Implementation.

c. Start of Implementation.

d. Start of operations, if applicable.

e. End of prime operations and/or disposal requirements, if applicable.

f. Other milestones or time periods, as appropriate for a specific program/project.

6.0 COST COMMITMENT

Provide the estimated cost range for the program for the five-year period beginning in the current fiscal year at a level of detail that identifies the approved individual projects. Identify the constraints and assumptions used to develop this estimated cost range and specifically identify those assumptions that drive the range. This cost range should contain all costs necessary to perform the program, including, but not limited to, standard project activities, required technology developments, facilities costs, infrastructure costs, operations and sustainment, data analysis, and

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disposal. Reference the annual budget contained in the Integrated Budget and Performance Document (IBPD) for cost phasing. The cost range (and this PCA) should be updated when program content changes, such as the addition of new projects entering implementation.

7.0 ACQUISITION STRATEGY

Provide a brief statement of the proposed acquisition strategy for major program elements.

8.0 HIGH-RISK AREAS

Identify the areas of highest risk for the program (covering safety, technical, institutional, cost, or schedule issues) in which failure may result in changes to the program/project baseline cost, schedule, or technical performance requirements. This section should identify, where possible, the specific risk drivers, such as high-risk technologies upon which the program is dependent.

9.0 INTERNAL AGREEMENTS

If the program is dependent on other NASA activities outside of the MDAA's control to meet program objectives, identify the required support and list any formal agreements required.

10.0 EXTERNAL AGREEMENTS

Explain the involvement of external organizations, other Government agencies, or international support necessary to meet the program objectives. Include a brief overview of the program/project relationships with such external organizations. Include an identification of the commitments being made by the external organizations, other Government agencies, or international partners and a listing of the specific agreements to be concluded. Any unique considerations affecting implementation of required NASA policies and processes necessitated by the external involvement should be clearly identified.

11.0 REVIEWS

Key Decision Points are required at Authority to Proceed, Program Approval, and Closeout. IAs are required, but timing and frequency are determined by the MDAA with approval of the DA. PARs are required, but timing, frequency, and format are planned by the program manager and approved by the DA. PSRs are required, but timing and frequency are determined by the program manager in coordination with the DA. Include reviews required by this NPR and any additional reviews required by the program manager, DA, MDAA or governing PMC. Identify gate products required prior to the PARs and the type of IAs that will be performed.

12.0 OUTCOMES

Identify the discrete set of expected deliverables (outcomes) that flow from the Agency's goals and objectives, as defined in the Agency's strategic roadmaps, architecture, and plan.

13.0 WAIVERS

Identify known waivers that will be sought for the program. Provide rationale consistent with program characteristics such as scope, complexity, visibility, cost, safety, and acceptable risk.

14.0 R&T PCA CHANGE LOG

Document changes to the PCA.

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Appendix F. R&T Project Formulation Authorization Document (FAD) Template

F.1 R&T Project FAD Title Page

Research and Technology

Project

Formulation Authorization Document

(Provide a title for the candidate project and designate a short title or proposed acronym in parenthesis, if appropriate.)

_____ _____

Program Manager Date

_____ _____

Mission Directorate Associate Administrator Date

Figure F-1 R&T Project Formulation Authorization Document Title Page

F.2 R&T Project FAD Template

RESEARCH AND TECHNOLOGY PROJECT

FORMULATION AUTHORIZATION DOCUMENT
(PROJECT TITLE)

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1.0 PURPOSE

- Briefly describe the purpose of the project and define its relationship to the program's strategic goals and objectives.
- Establish the scope of work to be accomplished.
- Define the approach and resources required to conduct project formulation.

2.0 AUTHORITY

- Identify the project manager.
- Describe any Center involvement, including lines of authority, coordination, and reporting.
- Identify the governing project management policy document (e.g., NPR 7120.8).

3.0 FUNDING

- Identify, by fiscal year, the funding that will be committed for project Formulation.

4.0 CONSTRAINTS

- Provide initial constraints, including resources, schedule, and project participants within and external to NASA, including international partnerships.
- Include any constraints placed on the project by the Program Plan.

5.0 REVIEWS

- Describe any reviews, including IAs required during the Formulation Phase.
- Identify decisional reviews (CAs) if required by the DA during Formulation, including any decisional review at ATP. This should include determination of gate products.

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Appendix G. R&T Project Plan Template

The MDAA may authorize use of an alternative format with compatible content. For information within the Project Plan that changes frequently (i.e., requirements and schedules) or a body of information too extensive to include in the Project Plan, the information within the document could simply be a pointer to where the authoritative current information resides.

G.1 Project Plan Title Page

Project Plan

(Provide a title for the candidate project and designate a short title or proposed acronym in parenthesis, if appropriate.)

It is the responsibility of each of the signing parties to notify the other if a plan cannot be met and to initiate the timely renegotiations of the terms of this agreement.

_____	_____
Project Manager	Date
_____	_____
Center Director(s) or designee (if applicable)	Date
_____	_____
Program Manager	Date
_____	_____
Mission Directorate Associate Administrator (or designee)	Date

Figure G-1 Project Plan Title Page

G.2 Project Plan Template

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RESEARCH AND TECHNOLOGY PROJECT PLAN
(PROJECT TITLE)

Note: Required content is annotated by "Required." Optional content is annotated by "Optional." Optional content is recommended, if applicable. For information in the Project Plan that changes frequently (e.g., schedules), the Project Plan could point to where the authoritative current information resides.

Change Log

Document changes to the R&T Project Plan.

1.0 PROJECT OVERVIEW

1.1 Introduction (Optional)

Optional: Briefly state the background of the R&T project and the current status, including the results of Formulation activities, decisions, and documentation.

1.2 Goals, Objectives, and Metrics (Required)

Required: State the project's specific goals and objectives and their relationship to the program's goals and objectives. Describe the desired end-state of the project products. State the project's relevance to the Agency's vision and mission, as defined by NPD 1001.0, NASA Strategic Plan.

Required: State the minimum success criteria associated with the high-level project requirements that, if not met, trigger a possible Termination Review.

Optional: Performance goals and metrics and their relationship to the Agency's vision and mission, as defined by NPD 1001.0, NASA Strategic Plan, should be expressed in an objective, quantifiable, and measurable form.

1.3 Customer or Beneficiary, Stakeholder, and External Partner Definition and Advocacy (Required)

Required: Identify the main customers or beneficiaries, stakeholders, and external partners for the project's products or for the project (e.g., PI, science community, technology community, public, education community, CIO, Mission Directorate, OCE, OSMA, OCFO, and NASA Centers).

Optional: Describe the process to be used to ensure customer or beneficiary, stakeholder, and external partner advocacy.

Optional: Describe the way the project will relate to other institutions within and outside of NASA.

Optional: Identify opportunities for establishing partnerships with private industry, academia, or other governmental organizations to conduct dual-use research, develop mutually beneficial technologies, and/or transfer results into NASA missions and into the private sector for commercial application (if applicable).

2.0 MANAGEMENT APPROACH (Required)

2.1 Overview (Required)

Required: Identify the project manager.

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Required: Describe the project management structure consistent with the project WBS, including organization and responsibilities, its integration into the program management structure, and NASA Center participation.

Required: Identify the DA and governing Program Management Committee for oversight of the project, including delegations of authority, if any. Provide the rationale for any delegations.

Optional: Identify specific management tools to support management in planning and controlling the project. Describe any use of special boards and committees. Identify any metrics that will be used to determine the project's technical, cost, and schedule progress. Describe any periodic reporting requirements that have been placed on the project.

2.2 Project WBS (Required)

Required: A project WBS (see Appendix I in this NPR) is described in this section and can be accompanied by a WBS dictionary. The WBS level should be defined down to the level needed for effective tracking of key milestones and, if applicable, earned value management reporting.

2.3 Project Schedule/Key Project-Level Milestones (Required)

Required: Document the project's schedule for all major events, technology development or product milestones, major reviews, independent assessment(s), and other activities throughout the life cycle of the project.

Optional: Include approval dates for principal project documentation and significant contract key milestones. Identify lower-level schedules to be developed and maintained. Project managers are encouraged to identify alternative development paths to maximize the probability of success.

2.4 Project Resources/Annual Cost Estimate (Required)

Required: Document the initial estimated LCC, the annual cost breakdown, or other appropriate cost description for the project, including costs for each participating Center, if applicable, that is consistent with the project WBS, schedule, and performance parameters to form the project estimate baseline.

Required: Define the funding requirements. The funding requirements should cover major elements of cost reflecting the second level or below of the WBS or its equivalent.

Optional: Identify yearly NOA estimates for system development and operations, facility construction, institutional support (including safety and mission assurance), and management (if applicable), and address civil service workforce levels.

Optional: Document the integrated budget (three or five years) in accordance with defined WBS elements.

2.5 Budget and Acquisition Approach (Required)

Required: Briefly describe the budget and acquisition approach.

Optional: Address the respective roles, responsibilities, and relationships between the Government and its contractors, vendors, and/or partners, including a description of integration and surveillance responsibilities.

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Optional: If applicable, the use of cost caps or other cost control strategies should be addressed, as well as the financial strategy for initiation of new project elements. The amount of UFE and at what level the UFE will be held should be stated, if applicable.

3.0 TECHNICAL APPROACH

3.1 Overview (Required)

Required: Present a technical description of the project. This includes R&T, facilities, flight plans, operations and logistics concepts, and planned results analysis and reporting.

Required: Define any technical key milestones.

Optional: Define a process for the solicitation, evaluation, and selection of proposals (including identifying Selection Official(s)). Establish evaluation criteria, including considerations of technical merit, relevance to the Agency's vision and mission, as defined by NPD 1001.0, NASA Strategic Plan, and cost realism.

Optional: Document an assessment (Gap Analysis) of related activities in other NASA programs, other Government agencies, and the commercial sector to eliminate unnecessary duplication of effort.

3.2 Project Requirements (Required)

Required: Define the high-level project requirements.

Optional: Present the infrastructure requirements (use or development of real property/facilities, aircraft, personal property, IT) for the entire project throughout its life. Identify any necessary upgrades or new developments, including those needed for environmental compliance. If use of NASA aircraft is planned, address here or address in a separate aircraft utilization plan the projected ground and flight utilization, modification requirements, planned deployments, aerobatics requirements, estimated costs, and other applicable requirements.

3.3 Strategy for Technology Transition or Research Dissemination (Required)

Required: For projects developing technologies, describe how products will be transitioned to the customer or other beneficiary. If a definite customer/beneficiary has not been identified, outline a potential technology infusion path into NASA missions. For research projects, describe how the research results will be disseminated to the scientific community.

Optional: Document strategy for archival of data and disposition of residual property associated with the project when the project ends.

3.4 Project Reviews (Required)

Required: Provide details for the PPRs, CAs, and IAs that will be used to evaluate progress. Define the schedule of reviews and who leads and who participates in the review. This includes defining the role of the stakeholders in the review process. Define the factors (including TRLs) that will be used to perform the technology or research assessment. Define the technical, scientific, schedule, cost, and other criteria that will be used as criteria for determination of a successful review.

Optional: Describe any additional reviews that have been placed on the project.

4.0 CONTROLS AND COMPLIANCE (Required)

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4.1 SMA and Risk Management Strategy (Required)

Required: Summarize the risk management approach to be used for the project, including appropriate actions to mitigate risk and project descope plans. Risk mitigation should be balanced with the need to conduct challenging research and technology development that will realize significant gains.

Optional: List any project elements that will develop their own stand-alone risk and safety plans. Summarize any safety and mission assurance approach flowed down from the program and/or needed to complete the project.

4.2 Project Control Plans (Required)

Required: Identify any additional project control plans that are appropriate for the project, including any plans from the Program Plan that apply to the project. These may include, but are not limited to, a Systems Engineering Management Plan, Software Development Plan, Configuration Management Plan, Data Management Plan, Environmental Protection Plan, Human Systems Integration Plan, Safety Plan, System Security Plan and associated security plans and assessments in accordance with NPR 2810.1, or other plans as agreed-to by the project and the DA.

Required: State the approach for using English or metric system units within the project. Optional: Describe any activities specific to the project to be conducted with support from the cognizant EMO to comply with NPR 8580.1. Also, describe any activities in support of Education and Public Outreach.

4.3 Tailoring Approach (Required)

Required: If there is tailoring, describe any requirements identified in this NPR that will be tailored. For example, this may include incorporating elements from NPR 7120.5 for R&T projects that involve flight experiments and technology demonstrations.

Optional: List policy requirements that have been waived.

4.4 Data and Knowledge Management and Distribution (Optional)

Optional: Address the data or knowledge being developed or captured by the R&T project and define plans for data rights and services.

Optional: Explain how the project will ensure identification, control, and disposition of project records in accordance with NPD 1440.6 and NPR 1441.1.

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Appendix E. Program Plan Template

The MDAA may authorize use of an alternative format with required content.

E.1 Program Plan Title Page

Program Plan

(Provide a title for the Research and Technology Program Plan and designate a short title or proposed acronym in parenthesis, if appropriate.)

It is the responsibility of each of the signing parties to notify the other if a plan cannot be met and to initiate the timely renegotiations of the terms of this agreement.

_____	_____
Program Manager	Date
_____	_____
Center Director(s) (if applicable)	Date
_____	_____
Mission Directorate Associate Administrator	Date

Figure E-1 Program Plan Title Page

E.2 Program Plan Template

RESEARCH AND TECHNOLOGY
PROGRAM PLAN

Note: Required content is annotated by "Required." Optional content is annotated by "Optional." Optional content is recommended, if applicable. For information within the Program Plan that changes frequently (e.g., schedules), the information within the document could simply be a pointer to where the authoritative current information resides.

1.0 PROGRAM OVERVIEW

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1.1 Introduction (Optional)

Optional: Briefly state the background of the R&T program and the current status, including the results of formulation activities, decisions, and documentation.

1.2 Goals, Objectives, and Metrics (Required)

Required: State the program goals and specific objectives with clear traceability to the Agency's vision and mission, as defined by NPD 1001.0, NASA Strategic Plan. In addition, goals and objectives should include commitment to safety and mission success.

Optional: Performance goals, and performance metrics, and their relationship to the Agency's vision and mission, as defined by NPD 1001.0, NASA Strategic Plan, should be expressed in an objective, quantifiable, and measurable form.

1.3 Customer or Beneficiary, Stakeholder and External Partner Definition and Advocacy (Required)

Required: Identify the main customers or beneficiaries, stakeholders, and external partners of the program (e.g., PI, science community, technology community, public, education community, Chief Information Officer (CIO), Mission Directorate, OCE, OSMA, OCFO, and NASA Centers).

Optional: Describe the process to be used to ensure customer or beneficiary, stakeholder, and external partner advocacy.

1.4 Program Authority and Management Structure (Required)

Required: Identify the location of the program management office (Center or Headquarters) and the management relationships with any program components, including projects, located elsewhere.

Required: Describe the NASA organizational structure for managing the program and projects, from the MDAA to the project managers. Identify lines of authority and reporting; illustrate the organization graphically.

Required: Identify the DA and Governing Program Management Committee or Council for oversight of the program, and the DA and Governing Program Management Committee or Council for oversight of projects, including delegations of authority, if any. Provide the rationale for any delegations.

Required: Identify the responsibilities of each NASA Center as they relate to their respective requirement allocations referenced in Section 2.1 below, if applicable.

Required: Define the management responsibilities of management personnel, include the MDAA, Division Director(s), program manager, and project manager(s) for selecting, formulating, approving, reviewing, and terminating projects. Identify the processes by which projects are selected, formulated, approved, reviewed, and terminated.

Required: Indicate the management responsibilities of management personnel for developing, concurring, and approving principal documents, such as Project Plans, NRAs, Requests for Proposals (RFPs) and other contract-related documents, reports associated with major reviews, and other key activities.

Required: Define the management responsibilities of management personnel, include the MDAA,

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Division Director(s), and program manager for recommending program termination.

Optional: Briefly describe the architecture of the program and its major components. If applicable, describe how the major components are intended to operate together and with legacy systems.

Optional: Provide a list of projects within the program and where the work will be performed.

2.0 PROGRAM BASELINE

2.1 Program Requirements (Required)

Required: Document the requirements levied on the program, including programmatic Mission Directorate requirements, performance requirements/objectives, technical success criteria, and the end state or final product of the program, in an objective, quantifiable, and measurable form. Document the requirements allocated to Center(s), if applicable.

Optional: Programmatic success criteria such as KPPs, outcomes, and other accompanying performance metrics should be expressed in objective, quantifiable, and measurable form, where applicable. Include any safety requirements, where applicable.

Optional: For multiple projects within a program, describe the way in which the program requirements will be allocated to the respective projects, if applicable.

Optional: If the program characteristics indicate a greater emphasis is necessary on maintaining either technical, cost, or schedule, then this section should also identify which is more important to be considered (e.g., it should address if the program is cost capped, or if schedule is paramount, or if it is critical to accomplish all the technical objectives).

2.2 Program Schedule/Key Program-Level Milestones (Required)

Required: Provide a schedule for completion of program objectives. Provide a schedule or list of major program activities and events covering the life of the program. Include all applicable events, such as scheduled or approval dates for major program products, deliverables, documents and reports; dates of major program reviews; launch dates (or equivalent system "delivery" dates), and other NASA AA or MDAA decisions, including all program PCA key milestones (e.g., start and end of operations, other milestones, or time periods identified in the PCA), if applicable.

Optional: Include the strategy for addressing schedule updates when impacts to the schedule occur.

2.3 Program Resources/Annual Cost Estimate (Optional)

Optional: Document the estimated life-cycle cost, the annual cost breakdown, or other appropriate cost description for the program and program elements (e.g., projects), including costs for each participating Center, if applicable. Identify yearly New Obligational Authority (NOA) estimates for system development and operations, facility construction, institutional support (including safety and mission assurance), and management (if applicable), and address civil service workforce levels.

Optional: Document the integrated budget (three or five years) in accordance with defined WBS elements.

3.0 PROCESS DESCRIPTION

3.1 Controls and Compliance (Optional)

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Optional: Describe the process by which the program ensures compliance with NASA policies and directives, as well as other applicable requirements. Describe the process for controlling changes to the program, and any associated projects.

Optional: Describe the process by which project requirements/objectives are validated for compliance with the program requirements/objectives. Describe the process for updating the R&T PCA as a result of any changes. Indicate key program parameters (cost, schedule, and technical) which will require NASA AA, MDAA, or program manager approval for change. If applicable, identify the unallocated future expenses (UFE) management strategy and approval authority to include identification of an Allowance for Program Adjustment (APA).

3.2 Relationships to Other Programs and Organizations (Optional)

Optional: Internal - Describe the way the program will relate to other institutions within NASA (e.g., crosscutting technology efforts, space communications, and launch services). List the internal agreements necessary for program success and projected dates of approval. This list may be maintained as a separate document that is referenced by the Program Plan and may be updated separate from the Program Plan (i.e., updates do not require formal revision to the Program Plan). This list should include those agreements that are concluded with the authority of the program manager, and reference those agreements concluded with the authority of the MDAA.

Optional: External - Describe the way the program will relate to entities outside of NASA (e.g., interagency or international). List the external agreements necessary for program success and projected dates of approval. This list may be maintained as a separate document that is referenced by the Program Plan and may be updated separate from the Program Plan (i.e., updates do not require formal revision to the Program Plan). This list should include those agreements that are concluded with the authority of the program manager, and reference those agreements concluded with the authority of the NASA AA and/or MDAA.

3.3 Budget and Acquisition Strategy or Research or Technology Selection Approach (Required)

Required: Briefly describe the budget and acquisition approach or the research or technology selection approach to be applied at the program level toward each project.

Optional: Address the respective roles, responsibilities, and relationships between the Government and its contractors, vendors, and/or partners, including a description of integration and surveillance responsibilities.

Optional: If applicable, the use of cost caps or other cost control strategies should be addressed, as well as the strategy for initiation of new program elements. The amount of UFE and at what level the UFE will be held should be stated, if applicable.

Optional: Define a process for determining openly competed, internally competed, and directed investments. Define a process for the solicitation, evaluation, and selection of proposals (including identifying Selection Official(s)). Establish proposal evaluation criteria, including considerations of technical merit, and relevance to the Agency's vision and mission, as defined by NPD 1001.0, NASA Strategic Plan, and cost realism.

Optional: If applicable, the Program Plan should incorporate by reference appropriate sections of standard R&T process documents, including the Guidebook for Proposers Responding to a NASA Funding Announcement,

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https://www.hq.nasa.gov/office/procurement/nraguidebook/proposer2017.pdf, and any Mission Directorate omnibus NASA Research Announcements.

3.4 Cooperation and Commercialization

(Optional)

Optional: Identify opportunities for establishing partnerships with private industry, academia, or other governmental organizations to conduct dual use research, develop mutually beneficial technologies, and transfer results into NASA missions and into the private sector for commercial application (if applicable).

3.5 Data Management and Distribution (Optional)

Optional: Data management planning is provided as either a section of this Program Plan or as a separate document (if applicable). Address what data will be captured by all projects within the program and how the data will be collected, stored, and accessed. Define plans for data rights and services addressing issues that are community-wide and require tradeoffs between projects, Center interests, and various communities.

3.6 Safety and Mission Assurance and Risk Management Strategy (Optional)

Optional: Summarize the SMA approach and risk management approach to be used for the R&T program. Summarize program (or project) de-scope plans, if applicable, identify primary risks, and list any program elements that will develop their own standalone risk and/or SMA plans (see Section 3.2.4.4.3 and 3.2.4.4.4).

3.7 Program Control Plans (Optional)

Optional: Identify any additional program control plans that are appropriate for the program. These may include, but are not limited to, a Configuration Management Plan, Systems Engineering Management Plan, Software Development Plan, Environmental Protection Plan, System Security Plan and associated security plans and assessments, Education and Public Outreach Plan, and Technology Transition Plan, or other plans as agreed to by the project and the DA. The System Security Plan documents the program's approach to implementing cybersecurity requirements in accordance with NPR 2810.1. The Environmental Protection Plan describes any activities specific to the program to be conducted with support from the cognizant Environmental Management Office (EMO) to comply with NPR 8580.1. The Technology Transition Plan documents how the program will enable/facilitate the transition of technology for the constituent projects.

3.8 Reviews (Required)

Required: List the reviews that the program will conduct, including KDPs (Authority to Proceed (ATP), Program Approval, Program Assessment Reviews (PARs), and Closeout), internal reviews, called PSRs, and IAs. Include reviews required by this NPR[9] and any additional reviews required by the program manager, DA, MDAA, or governing PMC.

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[9] KDPs are required at ATP (transition to Formulation), Program Approval (transition to Implementation), and Closeout. IAs are required, but timing and frequency are planned by the program manager with the approval of the MDAA and documented in this Program Plan. PSRs are required, but timing and frequency are determined by the program manager in coordination with the DA and documented in the Program Plan. PARs are required, but timing, frequency, and format are planned by the program manager and approved by the DA and documented in the Program Plan.

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Required: Describe the approach and processes for conducting PSRs and PARs (e.g., formal or informal, required participants, conducted as part of other reviews such as budget cycle meetings). Describe the approach and processes for conducting IAs, as determined by the MDAA with approval of the DA (e.g., formal (including use of SRBs); informal; as part of other reviews such as National Academy of Sciences (NAS) Decadal and peer reviews, or acceptance of papers for publication).

Required: Provide the technical, scientific, schedule, cost, and other criteria, which will be utilized in the KDPs and PSRs. This should include determination of gate products required prior to reviews and expected outputs from reviews. (Criteria, gate products, and expected outputs for IAs are established in the IA Expectations Document. (See Section 2.6.1.3.1.))

Optional: If applicable, identify the plans and approach for conducting IAs, PSRs and/or PARs concurrently.

Optional: Identify the timeline or frequency for IAs, PSRs, and PARs.

Optional: Identify the criteria that would trigger a Termination Review.

3.9 Tailoring Approach and Waiver Log (Optional)

Optional: Describe how the Program Plan has been tailored from the basic requirements identified in this NPR. Identify additional known waivers that the program has obtained or will obtain against NASA policies, directives, or other applicable external requirements. Provide rationale and risk impact for the waivers. Include characteristics such as scope, complexity, visibility, cost, and safety.

3.10 Change Log (Optional)

Optional: Document changes to the Program Plan.

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Appendix I. Research and Technology Project Work Breakdown Structure

1.0 INTRODUCTION

1.1 The project Work Breakdown Structure (WBS) is a key element of project management. The purpose of a WBS is to divide the project into manageable pieces of work to facilitate planning, control and performance measurement of cost, schedule, and technical content. As per section 2.3.1 of this document, R&T projects can be either technology development or research projects.

2.0 ASSUMPTIONS

2.1 The WBS standard elements defined in this appendix are only applicable to R&T projects.

3.0 PROJECT BUSINESS RULES

3.1 Purpose: The standardization of WBS elements for R&T projects is being driven by requirements for more consistent insight into project performance both internally and externally to the project.

3.2 Business Rules:

a. The standard R&T project technical product-based WBS applies to new projects established from the issue date for NPR 7120.8 and may be tailored. It is not intended to be applied retroactively to existing projects.

b. The R&T project WBS applies to the entire life cycle of the projects.

c. R&T projects will use the standard Level 1 and Level 2 WBS elements. (See Section 4.0 of this appendix.) Specifically:

(1) The project name will be WBS Level 1 (corresponds to Agency project six-digit alphanumeric designators).

(2) The title of each WBS Level 2 element can be modified to facilitate project-unique titles, such as adding the name of the project in front of the title. However, the content and definition of each WBS element remain the same, and if the linkage of the project-unique title to the standard title is not intuitive, the project-unique title is cross-referenced to the standard.

(3) The project manager is responsible for establishing the technical product-based WBS, and the complexity of the project will influence how many of the Level 2 WBS elements are needed. For extremely small ($100s of thousands annually) R&T projects, the use of only one Level 2 WBS element may be appropriate since further breakdown could cause the project unnecessary burden and provide no better insight into performance.

(4) Although very rare, additional WBS Level 2 elements may be added as long as the proposed new Level 2 content does not fit into the content of any existing standard WBS elements and there is a compelling rationale.

(5) For each WBS, project managers should coordinate with the OCFO to ensure visibility of all capital assets, whether fabricated or acquired.

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(6) The project can establish its own WBS elements below Level 2 different from other projects. However, these lower level elements are subordinate to the standard parent WBS elements.

(7) There is only one project WBS, which will be technical and product-based. Each project is unique, and it is understood that not all Level 2 elements are needed for each project. Therefore, only the WBS elements needed by the project at any level will be established in MdM. WBS elements can be added further in the life cycle if or when the project work dictates.

4.0 R&T PROJECT

4.1 Project WBS

Standard Level 2 WBS elements for projects are shown in Figure I-1. The standard WBS template below assumes a typical project with no flight elements. The elements that are not applicable do not need to be used (entered in the MdM).

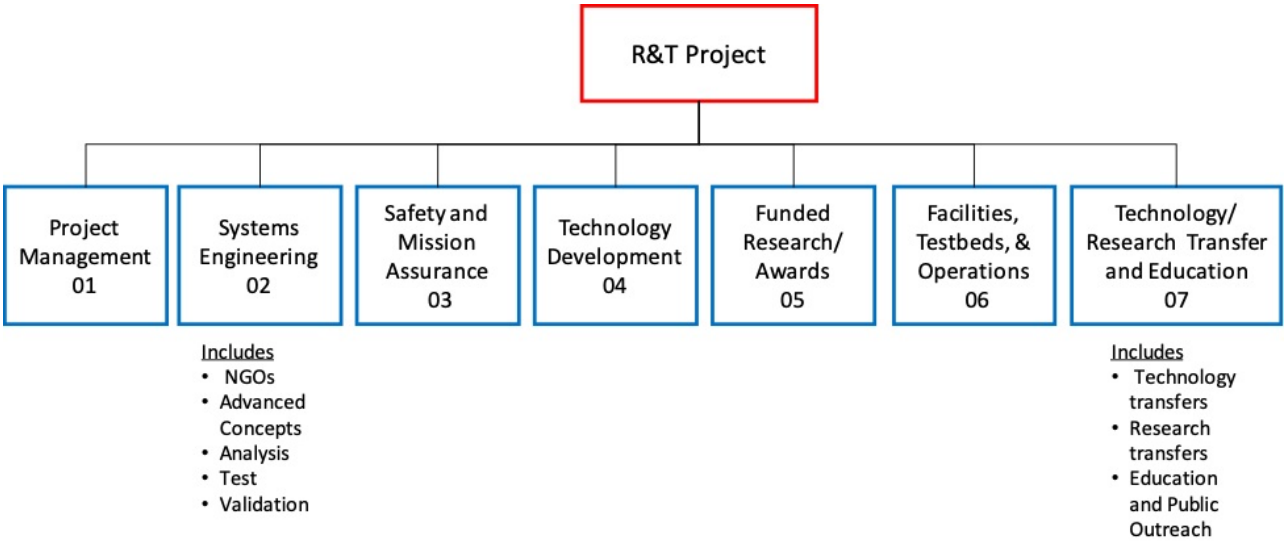

Figure I-1 Project WBS

4.2 Project Standard WBS Dictionary

Element 1 - Project Management: The business and administrative planning, organizing, directing, coordinating, controlling, and approval processes used to accomplish overall project objectives, which are not associated with specific hardware or software elements. This element includes project reviews and documentation, non-project owned facilities, and project UFE. It excludes costs associated with technical planning and management and costs associated with delivering specific engineering, hardware, and software products.

Element 2 - Systems Engineering: Includes the activities to define the needs, goals, and objectives of the project; the development of advanced concepts; performance of analyses, developmental testing, and any formal verification or validation activities as defined in the Project Plan. This WBS element encompasses low-level studies (possibly including laboratory experiments) intended to explore the feasibility of new ideas or approaches to accomplish programmatic or technical objectives. The product test, verification, and validation aspects of this element provide for a focus on specific activities to test, verify, and validate products when those activities represent a critical aspect of the overall Project Plan. Not all R&T projects require this level of attention on test,

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verification, and/or validation. The element encompasses the development hardware/software test validation articles; development or acquisition of special test or validation equipment or procedures; scheduling and staffing facilities or ranges; and development and execution of the test, verification, or validation plan.

Element 3 - Safety and Mission Assurance: The technical and management efforts of directing and controlling the safety and mission assurance elements of the project. This element includes design, development, review, and verification of practices and procedures and success criteria intended to ensure that the delivered product meets performance requirements and function for their intended lifetimes. This element excludes mission and product assurance efforts at partners/subcontractors other than a review/oversight function.

Element 4 - Technology Development: This WBS element encompasses the execution phase of implementing a Project Plan. Typically, most of the lower level (Level 3 and below) WBS elements associated with achieving the technical objectives (e.g., performance metrics) of the project are contained within this element. Once a project has started, technology development will include the continual assessment of progress, redistribution of resources, and schedule updates necessary to meet key milestones within the planned budget and time frame. When the intended outcome cannot be met within plan, the function of re-planning at the project level falls within project management. The primary project deliverables, including technical progress reports and documenting technical accomplishments, are part of this WBS element.

Element 5 - Funded Research/Awards: The awards from either competed or directed elements of the R&T portfolio project. This includes, but is not limited to, grants, Independent Assessment Teams, Research and Technology Objectives and Plans Summaries (RTOPSs), and contracts. This element provides for a focus on specific activities to test and validate products of technology development when those activities represent a critical aspect of the overall technology development plan. Not all technology projects require this level of attention on test and validation. Typically, a separate test and validation element will be part of the project that intends to achieve TRL 6/7. The element encompasses the development hardware/software test validation articles; development or acquisition of special test or validation equipment or procedures; scheduling and staffing facilities or ranges; as well as the development and execution of the test or validation plan. Often the full context and content of test and validation may not be known at the beginning of the project and will be developed as required. In some cases, if extensive use of large-scale facilities is required or the test/validation takes on the characteristics of a flight project (e.g., space-flight project), it will be conducted as a flight project (e.g., space-flight project) within this WBS element or transferred to a project managed under NPR 7120.5.

Element 6 - Facilities, Testbeds, & Operations: The non-award infrastructure costs and activities that support the R&T Projects. This may include the renting/use of existing special or multi-purpose facilities, work associated with the update or generation of a facility or testbed necessary to perform the research or technology development and work associated with operating the facility or testbed. May also contain the work associated with the operation of the project's product during testing or operations.

Element 7 - Technology/Research Transfer and Education: This WBS focuses principally on three types of activities: (1) transferring knowledge (research) and technology development products developed within the project to non-NASA entities that are not part of the project either as direct participants or as direct beneficiaries of the project, (2) acting on behalf of the project to identify and transfer into the project knowledge or technology from sources not directly participating in the

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project or benefiting from the project, and (3) providing supporting expertise to transfer knowledge and technology products between NASA and non-NASA entities, including project participants. Typically, technology transfer requires special expertise not associated with any specific project or required to accomplish primary technical objectives/milestones/metrics. Also, technology transfer activities are often an integral part of the overall Project Plan but not necessarily an integral part of the technology development process. As such, it is often appropriate to fund, implement, and manage research and technology transfer as a distinct element of a project. As part of transferring knowledge, this element also provides for the education and public outreach (EPO) responsibilities of NASA's missions, projects, and programs in alignment with the Strategic Plan for Education, including management and coordinated activities, formal education, informal education, public outreach, media support, and Web site development.

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Appendix J. Requirement Reference Table

The following table is provided as a reference to each of the requirements in this NPR. This table is for information and not intended to be a formal compliance matrix.

Section	Requirement
2.6.1.2	The DA shall approve decisions made at KDPs which are summarized and recorded in the decision documentation (e.g., memorandum or other appropriate format) that will become part of the retrievable program or project documentation.
2.6.1.4	The appointed IA team shall conduct Independent Assessments during the program and project life cycles. (From "NASA Independent Assessment Principles and Approach" white paper approved at the Agency Program Management Council (APMC) held May 18, 2016.)
3.2.1.1	For an R&T program, the MDAA or their delegated representative shall assign a program manager to manage the effort.
3.2.2.1.1	The MDAA or their delegated representative shall provide the purpose, scope, and constraints of the potential R&T program to the program manager.
3.2.3.1	The DA shall conduct the Authority to Proceed KDP to determine approval for a proposed program to enter the Formulation Phase.
3.2.4.2.2	The MDAA, or designee, shall develop an R&T PCA during program Formulation.
3.2.4.3.2	The program manager shall develop a Program Plan that provides the goals and objectives, management approach, program requirements, schedule/key milestones and cost estimate, the budget and acquisition strategy or the project selection approach, and the approach for reviewing and assessing projects.
3.2.5.1	The DA shall conduct the Program Approval KDP to determine the program's readiness to proceed to Implementation.
3.2.6.2	The program manager shall provide to the project managers, in writing, the purpose, scope, and constraints for each specific R&T project that is an official element of the program.
3.2.6.3	New technologies arising from technology programs shall be reported to the appropriate Center Technology Transfer Offices in a timely manner in accordance with NPR 7500.2 to be considered for intellectual property protection and transfer for secondary applications.
3.2.7.1.1	The program manager shall conduct PSRs to evaluate the status of the program.
3.2.7.2.1	The DA shall conduct decisional PARs during the Implementation Phase.

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3.2.8.1	When the program achieves its goals and objectives and completes the planned mission, the DA shall conduct the Closeout KDP.
3.2.8.6	The program manager shall develop a final program report at the conclusion of the program, capturing recommendations/actions and results from the closeout activity, including any issues.
4.2.3.1	The R&T program manager, in coordination with the DA, shall assign a project manager to lead the project effort.
4.2.5.1	The project manager shall provide to the DA documentation that establishes the technical and acquisition work that needs to be performed during the life cycle or at least during the Formulation Phase, including the management process, deliverables, preliminary schedule, and funding requirements.
4.2.6.1	The DA shall conduct the ATP KDP to determine approval for a proposed project to enter the Formulation Phase and begin developing more detailed plans.
4.2.7.1	The project manager shall develop a Project Plan that contains, as a minimum: a. A description of the project and its objectives. b. How the project will be managed. c. How the project will be monitored and controlled, including reviews. d. The expected cost and schedule. e. Deliverables.
4.2.8.1	Before the project can enter the Implementation Phase, the DA shall conduct the Project Approval KDP to determine the project's readiness to proceed to Implementation and document the decision.
4.2.9.2	For projects with an LCC of $250 million or greater, if the project exceeds the LCC costs by 30 percent or more, the project shall notify the DA and program manager.
4.2.10.2.1	The project manager shall conduct PPRs to evaluate the status of the project.
4.2.10.3.1	The DA shall conduct decisional CAs.
4.2.11.1	When a project achieves its goals and objectives and completes the planned mission, or if a project is terminated early, the DA shall conduct the Closeout KDP.
4.2.11.4.1	The project manager shall provide a Closeout report at the conclusion of each project.
4.2.11.5	New technologies derived from NASA R&T projects shall be reported to the appropriate Center Technology Transfer Office in a timely manner in accordance with NPR 7500.2 to be considered for intellectual property protection and transfer for secondary applications.

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4.2.11.6	At the conclusion of the project, the project manager shall archive data so that future users can assess the research results, technology maturity (e.g., TRL) and incorporate the research or technology into system designs or perform further investigations. (From NPR 1441.1 and NPD 7120.6.)
5.3.1	MDAAs and program and project managers shall ensure dissenting opinions are elevated through the Formal Dissent process described in this section in accordance with the following principles.
5.6.4	The person requesting a permanent change to a prescribed requirement in an Agency or Center document that is applicable to all programs and projects shall submit a "change request" to the office responsible for the requirement policy document unless formally delegated elsewhere.
5.6.6.1	The person requesting a waiver to a requirement in this directive shall document the request, obtain the required signature from the OCE or the organization responsible for the requirement, and submit a copy to the OCE. The request should include the rationale, a risk evaluation, and reference to all material that provides the justification supporting acceptance.

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Appendix K: Technology Maturity Assessment Process

For detailed guidance on technology assessment refer to the Technology Readiness Assessment Best Practices Guide, SP-20205003605, which can be found on the NODIS OCE page at

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Appendix L. Requirement Waiver Form for NPR 7120.8

Name of Program or Project Requesting Waiver:	Date of Request:	Date Waiver is Needed:
Name and Organization of Initiator:	Requirement to be Waived:	
Specific Deliverable Affected:	Waiver To: ☐ Policy ☐ Procedure ☐ Requirement ☐ Other	
	☐ Additional information is attached	
Original Requirement of Document to be Waived (list Appropriate Sections or Text):		
Waiver Requested:		
Reason/Justification (Attach additional information, if necessary):		
Risk Assessment of the Program and Project if Waiver is Approved:		

Required Signatures	Signature	Date	Approved (Yes/No)
Project Manager			
Program Manager (Research Director)			
Center Director			
Mission Directorate AA			
NASA Chief Engineer or Other Requirement Owner			
NASA AA (if required)			

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Appendix M. References

NASA programs/projects and Centers are required to comply with all applicable Agency directives, not limited to those listed in this appendix. The documents listed in this appendix are provided as a guide to help program and project managers determine the requirements imposed on them outside this document. The terms program and project managers may be referenced in the documents below in lieu of program and project leads. Applicable directives not cited in this document should be identified in Center processes and practices.

Similarly, not all related references or other resources for program/project management teams are identified.

M.1 Federal Regulations

a. The National Environmental Policy Act (NEPA) of 1969, as amended, 42 U.S.C. § 4321 et seq.

b. National Aeronautics and Space Administration, 14 CFR, Chapter V.

M.2 NASA Policy Directives

c. NPD 1080.1, Policy for the Conduct of NASA Research and Technology.

d. NPD 1400.2, Publishing NASA Documents in the Federal Register and Responding to Regulatory Actions.

e. NPD 1600.2, NASA Security Policy.

f. NPD 2190.1, NASA Export Control Program.

g. NPD 2570.5, NASA Electromagnetic Spectrum Management.

h. NPD 7100.8, Protection of Human Research Subjects.

i. NPD 7410.1, Management of Contract and Grant Support Services Obtained from External Sources.

j. NPD 7500.1, Program and Project Life-Cycle Logistics Support Policy.

k. NPD 8010.3, Notification of Intent to Decommission or Terminate Operating Space Systems and Terminate Missions.

l. NPD 8020.7, Biological Contamination Control for Outbound and Inbound Planetary Spacecraft.

m. NPD 8610.7, Launch Services Risk Mitigation Policy for NASA-Owned and/or NASA-Sponsored Payloads/Missions.

n. NPD 8610.12, Orbital Space Transportation Services.

o. NPD 8610.23, Launch Vehicle Technical Oversight Policy.

p. NPD 8610.24, Launch Services Program Pre-Launch Readiness Reviews.

q. NPD 8710.5, Policy for Pressure Vessels and Pressurized Systems.

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r. NPD 8720.1, NASA Reliability and Maintainability (R&M) Program Policy.

s. NPD 8730.5, NASA Quality Assurance Program Policy.

t. NPD 8900.4, NASA Use of Global Positioning System Precise Positioning Service.

u. NPD 8900.5, NASA Health and Medical Policy for Human Space Exploration.

v. NPD 9501.1, NASA Contractor Financial Management Reporting System.

M.3 NASA Procedural Requirements

a. NPR 1040.1, NASA Continuity of Operations (COOP) Planning Procedural Requirements.

b. NPR 1382.1, NASA Privacy Procedural Requirements.

c. NPR 1600.1, NASA Security Program Procedural Requirements.

d. NPR 2190.1, NASA Export Control Program.

e. NPR 2830.1, NASA Enterprise Architecture Procedures.

f. NPR 7120.10, Technical Standards for NASA Programs and Projects.

g. NPR 8020.12, Planetary Protection Provisions for Robotic Extraterrestrial Missions.

h. NPR 8621.1, NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping

i. NPR 8705.4, Risk Classification for NASA Payloads.

j. NPR 8705.5, Technical Probabilistic Risk Assessment (PRA) Procedures for Safety and Mission Success for NASA Programs and Projects.

k. NPR 8715.5, Range Flight Safety Program.

l. NPR 8735.1, Procedures for Exchanging Parts, Materials, Software, and Safety Problem Data Utilizing the Government-Industry Data Exchange Program (GIDEP) and NASA Advisories.

m. NPR 8900.1, NASA Health and Medical Requirements for Human Space Exploration.

n. NPR 9060.1, Accrual Accounting - Revenues, Expenses, and Program Costs.

o. NPR 9250.1, Property, Plant, and Equipment and Operating Materials and Supplies.

p. NPR 9420.1, Budget Formulation.

q. NASA/SP-2016-3424, NASA Project Planning and Control Handbook, https://www.nasa.gov/content/project-planning-control-handbook.

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