Ames Procedural Requirements

APR 7120.52
Effective Date: May 2, 2023
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COMPLIANCE IS MANDATORY

Subject: Program/Project Cost Estimating for Space Flight Systems

Responsible Office: Code C / Office of the Chief Financial Officer

CHANGE LOG

Status [Baseline /Revision /Cancelled]	Document Revision	Date of Change	Description
Baseline	0	7/13/2007	New document
Revision	1	11/14/2017	To update to reflect current estimation process, the use of "will", the new CLeMO associated with AQMS (section 2.2.7) and feedback from technical orgs. Changed to APR 7120.52 from 7120.7 to align with NPR document numeral.
Revision	2	5/2/2023	Update P.2 Applicability and Chapter 2 to re-align the contents with the sections; Update P.2 Applicability, P.3 Authority and P.4 Applicable Documents and Forms to reflect the content and section changes.

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PREFACE

P.1 PURPOSE

As NPR 7120.5 Section 3.2, Roles and Responsibilities, guided, Center Management is responsible and accountable for all activities assigned to their Center. They are responsible for the institutional activities and for ensuring the proper planning for and successful execution of programs and projects assigned to the Center. This includes concurring on the adequacy of cost/schedule estimates and the consistency of these estimates with Agency requirements, workforce, and other resources stipulated in proposed Program and Project Plans. This Ames Procedural Requirements (APR) document defines the Ames Research Center (ARC) requirements for the development of space flight systems program/project cost estimates. This directive defines roles and responsibilities for developing cost estimation that enable decision makers to manage resources effectively.

P.2 APPLICABILITY

a. This APR applies to the following NPR 7120.5 space flight programs/projects:
   (1) spacecraft,
   (2) instruments,
   (3) experiment payloads,
   (4) designated technology developments to be incorporated by space flight projects,
   (5) critical technical facilities specifically developed or significantly modified for space flight systems,
   (6) suborbital space missions (e.g., high altitude balloons), and
   (7) ground systems that are in direct support of space flight operations.

b. This APR also applies to NPR 7120.8 Research and Technology projects that directly impact the space flight mission's success and schedule per section P.2b, Applicability, of NPR 7120.5.

c. This APR applies to space flight project elements as listed in part P.2a, above, that are not governed by NPR 7120.5 and are greater than $20M in value.

d. This APR applies to contractors, grant recipients, or parties to agreements only to the extent specified or referenced in the appropriate contracts, grants, or agreements.

e. In this directive, 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 an expected outcome, and "are/is" denotes descriptive material.

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

g. This APR may be applied to other ARC activities at the discretion of the relevant program/project or line manager.

h. For those space flight activities wherein ARC is responsible for a task within a project led by an organization outside of Ames, the applicable procedural requirements will be jointly negotiated by the cognizant authorities and delineated in the statement of work or customer agreement for the task. This agreement will establish the hierarchy and reconciliation of the procedural requirements to be followed.

P.3 AUTHORITY

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

P.4 APPLICABLE DOCUMENTS AND FORMS

a. APD 8000.1, Ames Policy for Proposal Authorization, Review, Approval and Archiving

b. APR 7120.5, Project Management for Space Flight Systems

c. NASA Cost Estimating Handbook[1]

d. NASA Cost Analysis Data Requirements (CADRe)[2]

e. ARC Standard Pricing Template[3]

P.5 MEASUREMENT/VERIFICATION

a. Verification of conformance to requirements in this directive are measured through Center and Responsible Organizational management reviews, self-assessments, and subsequent analysis and reports of conformance to requirements, as well as periodic internal audits.

P.6 CANCELLATION

a. APR 7120.52, Program/Project Cost Estimating for Space Flight Systems dated November 14, 2017.

Eugene Tu
Director

DISTRIBUTION STATEMENT:

Internal and external distribution.

[1] NASA Cost Estimating Handbook: https://www.nasa.gov/content/cost-estimating-handbook
[2] CADRe: https://oncedata.hq.nasa.gov/Main.aspx
[3] ARC Standard Pricing Template: https://intranet.share.nasa.gov/arc/finance/Pages/Pricing_Templates_n_Rate_Sheets.aspx

CHAPTER 1 ROLES AND RESPONSIBILITIES

1.1 The Program or Project Manager (PM) shall:

a. Either develop an advocate cost estimate or coordinate with Cost Estimator, if available, to develop an advocate cost estimate.

b. Acquire an independent cost estimate (ICE) when required (as determined by Section 2.2.3).

c. Update and maintain the cost-to-complete estimate throughout the life cycle of the project during execution phase.

d. Ensure the advocate cost estimate and ICE (see chapter 2) are reviewed and assessed by the Office of the Chief Financial Officer.

1.2 Program/Project and Proposal Team Staff shall:

a. Comply with the requirements of this APR and support the PM in performing the activities required.

b. Notify the PM of any status or events which may affect the cost estimate or the project cost.

1.3 Line Organization Managers shall:

a. Review and approve cost estimates developed by their staff to ensure that they comply with the requirements of this APR.

b. Review and approve cost estimates against their organization's project support.

1.4 The Cost Estimators shall perform roles and responsibilities throughout the phases of the proposal/project life cycle.

1.4.1 The Cost Estimator during the Proposal Phase shall obtain a good understanding of the mission and key technical performance parameters to support estimating all life-cycle costs of a future mission. The intent of the life cycle cost estimate is to inform decision makers as to the cost feasibility of the proposed mission in the light of the technical baseline, constratints, undercertainty, and the project risk assessment. Results are to be documented and presented to the decision makers prior to the proposal phase gate reviews. Cost estimator responsibilities may include one or more of the following: parametric cost modeling, estimation by analogs, bottoms-up cost modeling, or production of formal ICEs. The final product is a proposal cost and basis justification to support a Technical Management Cost (TMC) review panel evaluation.

1.4.1.1 The Cost Estimator (or Project Manager) shall:

a. Conduct a full Life Cycle Cost Estimate, and reconcile it with the Non-Advocate Review (NAR) cost estimate (as defined in Appendix A) as more specific data is available to develop a technical baseline as defined in the NASA Cost Analysis Data Requirement (CADRe).

b. Refine the estimate's accuracy by reviewing assumptions, cost drivers and risks.

Note 1: Estimates should be informed by the debriefs received from milestones gate reviews

c. Ensure that the basis for the estimate is as complete and accurate as possible.

Note 2: The project Life Cycle Costs (LCCs) team and the NAR team should use the same version of mission baseline to build their estimates.

d. Work with the PM and acquisition team to ensure Work Breakdown Structure (WBS) reporting structures and data collection mechanisms for the production of the proposal are in place.

e. Recommend cost reserves based on updated cost risk assessments and stakeholders' input.

f. Review the advocate estimate for completeness and consistency and understand and validate the basis of estimate used to derive the underlying Subject Matter Experts' (SME) estimates.

1.4.2 The Cost Estimator during the Project Execution Phase shall obtain good understanding of the mission and key performance drivers to support forecasting future costs of a current mission. Cost estimator responsibilities may include some or all of the following: (i) bottoms-up cost modeling, (ii) ICEs, and (iii) JCLs. The final product is a project cost validation to support a Standing Review Boards (SRB) evaluation. The intent of the updated life cycle cost estimate is to inform decision makers as to the cost feasibility of the proposed mission in light of the technical baseline, constraints, uncertainty, and the project risk assessment. Results are to be documented and provided to the decision makers prior to appropriate gate reviews.

1.4.2.1 The Cost Estimator (or Project Manager) shall:

a. Work with the PM and acquisition team to ensure WBS reporting structures and data collection mechanisms for the execution of the project are in place.

b. Support budget formulation as well as source selection in the transitions from Phase C to Phase E .

c. The cost estimator shall review the advocate estimate for completeness and consistency and understand and validate the basis of estimate used to derive the underlying SME estimates.

d. The cost estimator shall support the PM in capturing accurate cost data for future projects.

1.5 The Office of the Chief Financial Officer shall:

a. Support the development of the advocate cost estimates for space flight projects.

b. Overee the development and results of the independent and advocate cost estimates.

c. Review and track the cost estimation processes described in Section 2.3 and 2.4.

1.6 Summary of Roles and Responsibilities

1.6.1 Table 1 below summarize the Cost Development roles and responsibilities and associated tasks during the project and proposal development phases discussed above.

Table 1 – Team Roles and Responsibilities in Project Proposal Phases in Cost Development

Roles	Proposal Development Phase	Project Implementation Phase
PM	- Lead advocate cost estimate - support independent cost estimate*	- Lead advocate cost estimate, support independent cost estimate* and update/maintain the cost-to-completion estimate
Team	- Identify and provide the requirements and resources needed for their assigned tasks to the PM	- Support and provide task status and risk analysis that might have cost impact to PM
Line Org Manager (Direct Supervisor)	- Verify and approve, with Code C concurrence, to ensure the cost estimates are compliant with requirements	- Verify and approve, with Code C concurrence, to ensure the cost estimates are compliant with requirements
Cost Estimator	- Products include: 1) Cost feasibility study based on proposal requirements, 2) cost assessment, 3) recommend required reserves, 4) cost estimate based on analogous (CADRe), 5) parametric & engineering build-up cost models, 6) cost analysis write up	- Products include: 1) Cost feasibility study based on project requirements, 2) cost assessment, 3) recommend required reserves, 4) cost estimate based on analogous (CADRe), 5) parametric & engineering build-up cost models, 6) budget formulation support, 7) source selection support, 8) collect actual cost data for CADRe

*if applicable

CHAPTER 2 COST ESTIMATION PROCEDURES

2.1 Overview

2.1.1 This APR recognizes that each program or project has unique aspects that must be accommodated to achieve mission success in an efficient and economical manner. The request for relief from these requirements shall follow the tailoring process discussed in section 3.5, Principles Related to Tailoring Requirements, of NPR 7120.5.

2.1.2 The estimation process shall begin when the high level mission objectives are defined. The Project/Proposal Management and assigned Cost Estimators will work together to determine the level of support and type of cost estimates needed. This communication will be continuous and start early in the process to ensure that the collection of the data that will form the basis of the estimate is as thorough as possible and will result in a usable output format. In this regard, it is critical to understand the requirements and limitations that the project/proposal will face, as the complexity of the cost reporting requirements will directly affect the effort that goes into preparing the estimate and its final submitted form.

2.1.3 Once the mission baseline is defined by the PM team, initial data is collected, and an understanding of the project is achieved, the Cost Estimator shall take a prudent approach to research previous missions and projects to the extent possible to perform the cost estimate. This serves to gauge the magnitude of various cost elements of the WBS, total cost, and the development schedules.

2.1.4 After an understanding of the overall project is achieved, the Project Manager and Cost Estimator shall determine how best to approach the cost estimate, taking into consideration complexity, available data, available time, and the desired fidelity of the cost output.

2.1.5 The cost estimation processes discussed in this APR shall apply to both projects and proposals developed for submittal. The deliverables for each review milestone will follow APR 7120.5 and the project specific requirements for the projects. The deliverables for the proposals will follow APD 8000.1 and the solicitation's announcement guidelines.

2.1.6 Cost estimates for ARC projects shall be consistent with the NASA Cost Estimating Handbook and the ARC Cost Estimating Process (see Figure 2 on the next page).

2.1.7 The PM team shall develop an initial cost estimate during the proposal and formulation phases of a project.

2.1.8 The PM team shall deliver the initial cost estimate for the Gates Review defined by the proposal/project managementduring the Proposal Development phase or after the Preliminary Design Review (PDR) of the project development phase

2.1.9 The Gate Review Panels shall provide documented review comments of the initial cost estimate to the PM.

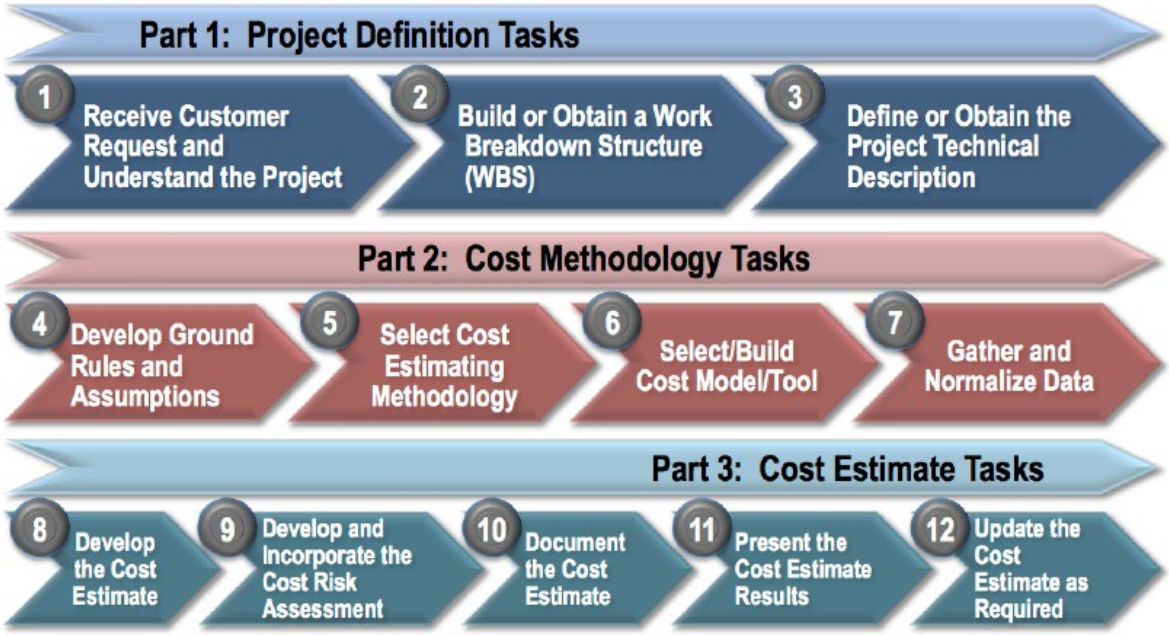

Figure 2 – ARC Cost Estimating Process (Summarized from the NASA Cost Estimating Handbook)

2.1.10 The PM shall:

a. Adjudicate all Gate Review Panels initial cost estimate review comments to baseline its cost estimate.

b. Provide the baseline cost estimate to the Non-Advocate Review.

c. Acquire and provide an independent cost estimate to the Non-Advocate Review, if required, as per Section 2.2.3.

d. Reconcile the differences between the baseline estimate and the ICE prior to providing both the Project's and ICE cost estimates to the NAR.

e. Update the baseline cost estimate by adjudicating all NAR comments.

2.2 Cost Estimate Products

2.2.1 There are two products of cost estimates that shall be prepared (advocate and independent, as defined in Appendix A) based on the requirements, with the goal of producing an approved baseline. The baseline cost is the best estimate of the program/project's full cost achieved through a reconciliation of the advocate and independent cost estimates with the inclusion of margins and reserves appropriate to the phase of the program/project. The entire breakdown of the Cost Estimating Process and products discussed below, including differing types of Cost Estimating Methodologies, can be found in the NASA Cost Estimating Handbook.

2.2.2 Advocate Cost Estimate

2.2.2.1 An advocate cost estimate is developed to ensure that all project costs are considered and that each project's LCC is appropriate.

2.2.2.2 The advocate cost estimate shall be structured to identify all required cost elements. As members of the product or project design team, cost estimators will prepare the estimate using established cost estimating methodologies from the NASA Cost Estimating Handbook. Iterative and on-going reviews are conducted with the technical team during the design process until the cost estimator and the project management teams are confident that the cost estimate credibly reflects the project's baseline design requirements, technical capabilities, management structure, and operational scenarios.

2.2.3 Independent Cost Estimate (ICE)

2.2.3.1 Mission LCC forecasted at or above $250 million for a project or $125 million for a proposal shall conduct an ICE with exceptions of management approval or solicitation guidance.

2.2.3.2 The ICE shall be based on the same project definition documentation (technical baseline or CADRe) as used for the advocate cost estimate - including life cycle, WBS, and phase. However, for this estimate, data sources and cost estimating approaches are intentionally external and independent from the advocate cost estimate and are performed by an independent review team (as opposed to the program or project team). This is designed to provide an independent assessment of the project LCC that validates whether the project is feasible at the advocate cost estimate. NPR 7120.5 identifies the types, purpose, and frequency of these independent reviews.

2.3 Cost Estimate Reporting

Project personnel should document the estimate, including all itemized costs, bases of estimate, assumptions, data sources, and approaches. These documents should be reviewed by the Office of the Chief Financial Officer. The format used for reporting the estimate shall meet the requirements of the solicitation or other requesting mechanism. The total cost estimate for the proposal/project generally should be reported with the ARC Standard Pricing Template.

2.4 Cost Estimate Tracking

2.4.1 The cost estimate should be maintained throughout the project life cycle after the cost estimate reports are developed and approved. The Office of the Chief Financial Officer shall maintain a log of all cost estimates that are generated in response to an Announcement of Opportunity (AO) or official project reviews.

2.4.2 The Office of the Chief Financial Officer should assess feedback of the Cost Estimate section of the proposal or review. The Office of the Chief Financial Officer shall track feedback to assess cost estimation trends toward continuous improvement.

APPENDIX A. DEFINITIONS

Advocate Cost Estimate	Prepared by cost analysts who are a part of the design team and provide the program/project management with an estimated cost based on translating the technical and design parameters and characteristics into cost estimates using established cost estimating methodologies such as grassroots, parametric or analogous.
Baseline	The technical performance and content, technology application, schedule milestones, and budget (including contingency and Allowances for Program Adjustment (APA), which are documented in the approved Program and Project Plans).
Baseline Cost	That cost agreed upon through reconciliation of the advocate and independent cost estimate which will be used as the full cost of the program/project for funding purposes.
Center Engineering and Safety Operations (CESO)	Costs are costs that cannot be related or traced to a specific project, but benefit all activities. Such costs are allocated to a project based on its proportion of the Center/s total budget. Examples of CESO cost include costs associated with financial management, procurement, security, legal and facilities and related costs as well as Information Technology.
Cost Estimate	The estimation of a project's life cycle costs, time-phased by fiscal year, based on the description of a project or system's technical, programmatic, and operational parameters. A cost estimate may also include related analyses such as cost-risk analyses, cost-benefit analyses, schedule analyses, and trade studies.
Cost-To-Complete	The cost necessary to carry the program/project through to completion from the point at which the estimate is being done.
Direct Costs	Costs that can be identified specifically with a particular sponsored project, an instructional activity, or any other institutional activity, or that can be directly assigned to such activities relatively easily with a high degree of accuracy. Costs incurred for the same purpose in like circumstances must be treated consistently as either direct or indirect costs. Where an institution treats a particular type of cost as a direct cost of sponsored agreements, all costs incurred for the same purpose in like circumstances will be treated as direct costs of all activities of the institution.
Indirect Costs	Costs incurred for common or joint objectives, and which are therefore not readily subject to treatment as direct costs.
Full Cost	The sum of all direct costs, indirect costs, and associated CESO costs.
Independent Cost Estimate (ICE)	A Life-Cycle Cost Estimate that is conducted independently of the Program/Project Management by an outside organization, using data sources external to and independent from the project.

Life Cycle Cost (LCC)	The total cost for all phases of a project or system including design, development, production, operations, and disposal. It is also referred to as a benefit-cost analysis.
Life Cycle Cost Estimate	Presents life cycle costs with alternatives, by comparing the current estimate to the independent estimate (or prior estimate).
Line Management	Project or Proposal participants' management in Directorate, Division or Branch
Margin	The allowances carried in budget, projected schedules, and technical performance parameters (e.g., weight, power, or memory) to account for uncertainties and risks. Margins are allocated in the formulation process, based on assessments of risks, and are typically consumed as the program/project proceeds through the life cycle.
Non-Advocate Review (NAR)	An independent verification of a candidate project's plans, LCC status, and readiness to proceed to the next phase of the project's life cycle. A Pre-NAR is conducted before the project moves from Phase A to Phase B. The NAR is conducted before a project moves from Phase B to Phase C. This review is a HQ function for the projects. For AO competed missions, this is done by the Technical Management and Cost (TMC) Review Panel under HQ control
Preliminary Design Review (PDR)	Demonstrates that the preliminary design meets all system requirements with acceptable risk and within the cost and schedule constraints and establishes the basis for proceeding with detailed design. It will show that the correct design options have been selected, interfaces have been identified, and verification methods have been described.
Program	A strategic investment by a Mission Directorate or Mission Support Office that has a defined architecture and/or technical approach, requirements, funding level, and 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.
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.

APPENDIX B. ACRONYMS

APD	Ames Policy Directive
AO	Announcement of Opportunity
APR	Ames Procedural Requirement
CADRe	Cost Analysis Data Requirement
CFG	Cost Accounting Branch
CESO	Center Engineering and Safety Operations
HQ	Headquarters
ICE	Independent Cost Estimate
LCC	Life Cycle Cost
NAR	Non-Advocate Review
NPD	NASA Policy Directive
NPR	NASA Procedural Requirement
PDR	Preliminary Design Review
PM	Project or Proposal Manager
SME	Subject Matter Expert
TMC	Technical Management Cost
WBS	Work Breakdown Structure

APPENDIX C. REFERENCES

C.1 Advocate Cost Estimate

Document	Requirement	Source
Requirements	NPR 7120.5, NASA Space Flight Program and Project Management Requirements	NODIS
Work Breakdown Structure	NPR 7120.5, NASA Space Flight Program and Project Management Requirements	NODIS
	G-6020a, Uniform WBS for NASA Ames-New NSM	https://intranet.share.nasa.gov/arc/finance/Center%20CFO%20Support/CostEstimating.aspx
Organizational Breakdown Structure	E-3010, Project Functional Org Chart	https://intranet.share.nasa.gov/arc/finance/Center%20CFO%20Support/CostEstimating.aspx
Schedule	NPR 7120.5, NASA Space Flight Program and Project Management Requirements	NODIS
Basis of Estimate (BoE)	G-6051, Basis of Estimate	https://intranet.share.nasa.gov/arc/finance/Center%20CFO%20Support/CostEstimating.aspx
Software Cost Estimate	APR 7150.2, Software Engineering Requirements	CDMS
NASA Software Engineering Handbook	SWE-015 Cost Estimation	http://swehb.nasa.gov/display/7150/SWE-015+-+Cost+Estimation
Life Cycle Cost Estimate	G-6030b, Life Cycle Cost - Background and Overview	https://intranet.share.nasa.gov/arc/finance/Center%20CFO%20Support/CostEstimating.aspx

C.2 Independent Cost Estimate

Document	Requirement	Source
Requirements	NPR 7120.5, NASA Space Flight Program and Project Management Requirements	NODIS
	51 USC 30307: Requirement for independent cost analysis from Title 51-NATIONAL and COMMERCIAL SPACE PROGRAMS	NATIONAL AND COMMERCIAL SPACE PROGRAMS (house.gov)
Work Breakdown Structure	NPR 7120.5, NASA Space Flight Program and Project Management Requirements	NODIS
	G-6020a, Uniform WBS for NASA Ames Code CFG	CostEstimating (nasa.gov)
Organizational Breakdown Structure	E-3010, Project Functional Org Chart	CostEstimating (nasa.gov)
Schedule	NPR 7120.5, NASA Space Flight Program and Project Management Requirements	NODIS
Basis of Estimate (BoE)	G-6051, Basis of Estimate	CostEstimating (nasa.gov)
Software Cost Estimate	APR 7150.2 Software Engineering Requirements	CDMS
Cost Analysis Data Requirements (CADRe)	G-6030a, Cost Analysis Data Requirement (CADRe)	CostEstimating (nasa.gov)
Life Cycle Cost Estimate	G-6030b, Life cycle Cost - Background and Overview	CostEstimating (nasa.gov)
NASA Procedural Requirements	NPR 7150.2, Software Engineering Requirements	NODIS
NASA Policy Directive	NPD 1280.1, NASA Integrated Management Systems Policy	NODIS
NASA Policy Directive	NPD 7120.4 Engineering and Program/Project Management Policy	NODIS