National Aeronautics and Space Administration

NNHXXZDAXXXO **Release Date Month DD, YYYY**

Announcement of Opportunity

Standard PI-led Mission AO

Standard AO Template v5.0
A Product of the AO Simplification Team

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OMB Approval Number 2700-0085

ANNOUNCEMENT OF OPPORTUNITY
<<PROGRAM NAME>> PROGRAM
NNHXXZDAXXXO

FOREWORD

The National Aeronautics and Space Administration (NASA) Science Mission Directorate (SMD) is releasing this Announcement of Opportunity (AO) to solicit Principal Investigator (PI)-led space science investigations for the <<PROGRAM NAME>> Program.

The AO Cost Cap for a <<PROGRAM NAME>> mission is $<<CAP>>M in NASA Fiscal Year (FY) <<CAP YEAR>> dollars, not including[AO OPTION] the cost of standard launch vehicle and launch services or[END OPTION] any contributions. Application of AO-specified incentives and/or charges may result in a proposal-specific Adjusted AO Cost Cap. The sum of contributions of any kind to the entirety of the investigation is not to exceed one-third (1/3) of the proposed PI-Managed Mission Cost. [AO OPTION 1]Proposed investigations will be evaluated and selected through a two-step competitive process. NASA intends to select approximately <<NUM PH A>> Step-1 proposals for the conduct of Phase A concept studies and submission of Concept Study Reports to NASA. NASA expects to down-select up to <<NUM FLT>> <<PROGRAM NAME>> mission(s) to proceed into Phase B and subsequent mission phases. The down-selected mission(s) must be ready for launch no later than <<LRD>>.[AO OPTION 2] Proposed investigations will be evaluated and selected through a single-step competitive process. NASA intends to select approximately <<NUM FLT>> proposals to proceed into Phase A and subsequent mission phases. The selected mission(s) must be ready for launch no later than <<LRD>>.[END AO OPTIONS]

[AO authors to update lists of changes below]
Proposers should be aware of the following major changes in this AO from previous <<PROGRAM NAME>> Program AOs.

- Reserves.
- Contributions.
- Launch services.
- Other special or new rules.
- Mission of Opportunity investigations are no longer solicited through the <<PROGRAM NAME>> AO. If applicable, Missions of Opportunity will be solicited through the Third Stand Alone Mission of Opportunity Notice (SALMON-3) AO.

This AO is based on SMD's Standard PI-led Mission AO. In addition to the changes listed above, proposers should be aware of the following changes in this AO from the language in the Standard PI-led Mission AO.

- Change 1 in Section 2.3.4.
- Change 2 in Section 4.5.6.

Proposers should be aware of the following major changes in this AO from the Draft <<PROGRAM NAME>> AO released for community comment on <<DRAFT DATE>>.

- The AO Cost Cap is now $XXM; this is specified in Section 5.6.1.

- Section 1.2.3 now requires something new.
- Sections 4.4.3 (*Title),* 8.4.2 (*Title),* Appendix B, Section H *(Title)* have been clarified.
- A new Section 3.4.5, *Title,* has been added.
- A new requirement for something has been added (Section 5.6.7).

In addition to the listed major changes, this AO incorporates a large number of additional changes relative to previous <<PROGRAM NAME>> Program AOs including both policy changes and changes to proposal submission requirements. All proposers must read this AO carefully, and all proposals must comply with the requirements, constraints, and guidelines contained within this AO.

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[AO OPTION: Additional appendices]

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1. Description of Opportunity

1.1 Introduction

The National Aeronautics and Space Administration (NASA) issues this Announcement of Opportunity (AO) for the purpose of soliciting proposals for investigations to be implemented through its <<PROGRAM NAME>> Program. All investigations proposed in response to this solicitation must support the goals and objectives of the <<PROGRAM NAME>> Program (Section 2), must be implemented by Principal Investigator (PI) led investigation teams (Section 5.3.1), and must be implemented through the provision of complete spaceflight missions (Section 5.2.1).

[AO OPTION 1 FOR TWO STEPS]
Proposed investigations will be evaluated and selected through a two-step competitive process (Section 7). Step 1 is the solicitation, submission, evaluation, and selection of proposals prepared in response to this AO. As the outcome of Step 1, NASA intends to select approximately <<NUM PH A>> Step-1 proposals and issue awards (provide funding to NASA Centers and the Jet Propulsion Laboratory (JPL), award contracts to non-NASA institutions, or utilize other funding vehicles as applicable) to the selected proposers to conduct Phase A concept studies and submit Concept Study Reports to NASA. Step 2 is the preparation, submission, evaluation, and continuation decision (down-selection) of the Concept Study Reports. As the outcome of Step 2, NASA intends to continue up to <<NUM FLT>> investigation(s) into the subsequent phases of mission development for flight and operations.
[END OPTION 1]

[AO OPTION 2 FOR SINGLE STEPS]
Proposed investigations will be evaluated and selected through a single-step competitive process (Section 7). The single-step competitive process entails the solicitation, submission, evaluation, and selection of proposals prepared in response to this AO. As the outcome of this solicitation, NASA intends to select at least one investigation for funding (provide funding to NASA Centers and/or the Jet Propulsion Laboratory (JPL), award contracts to non-NASA institutions, or utilize other funding vehicles as applicable) through all Phases (A-F) of mission development for flight and operations.
[END OPTION 2]

This AO, particularly Section 5, presents the requirements and constraints that apply to proposals that are to be submitted in response to this AO. Appendix B contains additional requirements on the format and content of the proposal. Appendix D lists the contents of the Program Library. In order to provide a consistent basis for proposals and evaluations, documents in the Program Library will be the versions used for evaluations even when superseded elsewhere.

Appendix E.1 lists the Program Library documents that specify requirements for Phase A concept studies (as applicable) and Appendix E.2 lists the Program Library documents that

specify requirements that will apply to subsequent phases of selected (single-step competitive process) or down-selected (two-step competitive process) investigations. These Program Library documents are intended to provide guidance for the development of proposals; they are specifically *not* intended to impose requirements on proposals.

In response to proposal community input to the Standard AO Request for Information NNH15ZDA013L, issued on December 2, 2015, the following proposal requirements have been deferred until Step 2.

- Curation plan elements (see Requirement 6, Requirement 9, and Requirement B-68)
- Detailed disposal plan (see Section 5.2.8)
- Science Enhancement Option or its cost (see Section 5.1.7)
- Independent Verification and Validation of Software (see Section 4.6.1)
- Costing of Conjunction Assessment Risk Analysis (see Section 4.6.4)
- Schedule-based end-to-end Data Management and Archive Plans (see Requirement B-23)
- Requirements for real year dollar costs (see Section 5.6.2, Requirement B-13, Requirement B-54, and Requirement B-56)

Details on each deferral are provided in the applicable section(s). As many of the deferred requirements included budgeting for related activities, proposing at the AO Cost Cap or Adjusted AO Cost Cap, as applicable, is strongly discouraged, unless associated costs have been included in the proposed [AO OPTION]Phase A-D portion of the [END OPTION]PI-Managed Mission Cost and/or Total Mission Cost (see Section 4.3.1 and Section 4.3.2).

NASA recognizes and supports the benefits of having diverse and inclusive scientific, engineering, and technology communities and fully expects that such values will be reflected in the composition of all proposal teams as well as peer review panels (science, engineering, and technology), science definition teams, and mission and instrument teams.

Discrimination and harassment, including sexual harassment, are not tolerated at NASA. Having a diverse, inclusive, and safe workplace is essential to achieving the excellence for which NASA strives. Proposers are reminded that contracts awarded under this AO will include conditions enforcing the civil rights acts that prohibit employment discrimination in all of its forms, including harassment. NASA enforces Federal equal employment opportunity obligations as directed by Executive Order 11246 (available in the Program Library) and in accordance with Federal Acquisitions Regulations (FAR) Section 22.808 (available in the Program Library).

When NASA receives reports of discrimination or harassment by contractor employees working on NASA-funded projects at non-federal facilities, NASA must refer these reports to the Office of Federal Contracts Compliance Programs in the Department of Labor in accordance with the FAR Section 22.808.

Where discrimination or harassment involves both civil servants and contractors, NASA policy and practice is to investigate and, when appropriate, apply remedies against the party whose conduct is discriminatory.

Accordingly, proposers and contractors are urged to be conscientious in ensuring that their officers, researchers and employees abide by anti-discrimination and anti-harassment laws at all times, both in their own workplaces and at NASA facilities.

Students, faculty or staff in programs receiving NASA financial assistance, such as grant awards, may raise allegations of discrimination, including harassment, by contacting the NASA Office of Diversity and Equal Opportunity. Information on filing a complaint through ODEO may be found at https://missionstem.nasa.gov/filing-a-complaint.html.

NASA recognizes that technology and technological progress is critical for the future of the science program and its missions. As part of our goals of scientific discovery, we are identifying and enabling technologies with high impact. Often the breakthrough science required to answer the most pressing science questions requires significant technological innovation—e.g., instruments or platforms with capabilities beyond the current state of the art. NASA's Science Mission Directorate's (SMD's) targeted technology investments fill technology gaps, enabling NASA to build the challenging and complex missions that accomplish groundbreaking science. The directorate works to ensure that NASA actively identifies and invests in the right technologies at the right time to enable the Agency's science program. SMD technology development is part of a comprehensive Agency-wide strategy that involves important partnerships with the Space Technology Mission Directorate and leveraging technologies, when appropriate, with the Human Exploration Mission Directorate.

1.2 NASA Safety Priorities

Safety is the freedom from those conditions that can cause death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment. NASA's safety priority is to protect: (1) the public, (2) astronauts and pilots, (3) the NASA workforce (including contractor employees working under NASA contracts), and (4) high-value equipment and property.

2. AO Objectives

2.1 NASA Strategic Goals

One of NASA's strategic goals is to <<PST 1>>. Further information on NASA's strategic goals may be found in NASA Policy Directive (NPD) 1001.0C, *The NASA 2018 Strategic Plan*, available in the Program Library (Appendix D).

The NASA Science Mission Directorate (SMD) is addressing this strategic goal by <<PST 2>>.

SMD is addressing the following research objectives: <<PST 3>>

Further information on the goals and objectives of NASA's <<PROGRAM NAME>> program may be found in the *2014 Science Plan* and in the *<<PROGRAM NAME>> Roadmap*, available in the Program Library.

2.2 <<PROGRAM NAME>> Program Goals and Objectives

2.3 <<PROGRAM NAME>> Program Background

3. Proposal Opportunity Period and Schedule

This solicitation has a single submission deadline. The following schedule describes the planned major milestones for this AO:

AO Release Date.....<<AO R DATE>>
Preproposal Conference.....<<AO R DATE + 3 weeks>>
Notice of Intent to Propose Deadline.....<<AO R DATE + 4 [ALTERNATIVE OPTION] 6 [END OPTION] weeks>>
Electronic Proposal Submittal Deadline at 11:59 p.m. Eastern Time.....<<AO R DATE + 3 months>>
Letters of Commitment Due (with Proposal).....<<AO R DATE + 3 months>>
Deadline for Receipt of Proposal on CD-ROMs at 4:30 p.m. Eastern Time.....<<AO R DATE + 3 months + 4 business days>>
Step-1 Selections Announced (target) .....<<AO R DATE + 8 months>>
Initiate Phase A Concept Studies (target) .....<<AO R DATE + 9 months>>
Phase A Concept Study Reports Due (target).....<<STP 2 DATE>>
Down-selection of Investigation(s) for Flight (target).....<<STP 2 DATE + 5 months>>
Launch Readiness Date.....NLT <<LRD>>

All proposals, U.S. and non-U.S., must be received before the proposal submittal deadline. For those received after the deadline, the Government reserves the right to consider proposals or modifications thereof received after the date indicated for such purpose, if the Selection Official deems it to offer NASA a significant technical advantage or cost reduction (see NFS 1815.208).

Requirement 1. Proposals submitted in response to this solicitation shall be submitted electronically no later than the Electronic Proposal Submittal Deadline.

Requirement 2. In addition to electronic submission, CD-ROMs containing the proposal and relevant files described in Section 6.2.3 shall be submitted. Proposals on CD-ROMs submitted in response to this solicitation shall be delivered no later than the Deadline for Receipt of Proposal on CD-ROMs. Proposals shall be delivered to the Address for Submittal of Proposals given in Section 6.2.3.

4. Policies Applicable to this AO

4.1 NASA Management Policies

The following policies will impose requirements on selected missions, for which planning may need to be considered and described as part of the proposal development process. These requirements are not levied on proposals.

4.1.1 NASA Flight Program and Project Requirements

Proposals selected in response to this AO will be implemented in accordance with NASA mission management processes. NASA mission management processes, as defined by NASA Procedural Requirements (NPR) 7120.5E, *NASA Space Flight Program and Project Management Requirements*, are Formulation, Approval, Implementation, and Evaluation. The NASA mission management processes are subdivided as follows:

Formulation is divided into:

- Phase A – Mission Concept and Requirements Definition and Technology Development; and
- Phase B – Preliminary Design and Technology Completion.

Approval is the Confirmation process for transitioning into Implementation.

Implementation is divided into:

- Phase C – Final Design and Fabrication;
- Phase D – System Assembly, Integration and Test, and Launch (extending through in-space checkout);
- Phase E – Operations and Sustainment; and
- Phase F – Closeout.

Evaluation is the ongoing independent review and assessment of the project's status during both Formulation and Implementation as described in NPR 7120.5E, which may be found in the Program Library.

A Key Decision Point (KDP) occurs before the project is approved to begin the next phase of development; KDPs are defined in NPR 7120.5E. For missions selected as a result of this AO, KDP-A is the selection of a proposal for a Phase A concept study; KDP-B is the down-selection of a mission to enter Phase B following evaluation of Concept Study Reports, or for single-step opportunities the evaluation of the credibility and responsiveness of the proposed mission/system architecture to the program requirements and constraints, including available resources; KDP-C is the culmination of the Confirmation process; KDP-D is a transition that occurs after the Systems Integration Review, KDP-E is the evaluation that the project and all supporting systems are ready for safe, successful launch and early operations; and KDP-F is the decision to terminate operations after completion of the mission. Scientific and other analyses [AO OPTION], including data analysis and preliminary analysis of returned samples,[END OPTION] may continue under project funding in Phase F. If the decision at down-selection is to maintain the selected investigation in an Extended Phase A, then a separate KDP-B will be required.

4.1.2 NASA Program Management

Owing to the significant expenditure of Government funds on these space flight investigations, as well as to their expected complexity, NASA intends to maintain an essential degree of insight into mission development; NASA will exercise essential oversight to ensure that the implementation is responsive to NASA requirements and constraints. NASA requirements and constraints are spelled out in the <<PROGRAM NAME>> safety, reliability, and quality assurance requirements document, in NPR 7120.5E, and in other NASA requirements documents

available in the Program Library and/or in the NASA Online Directives Information System (NODIS, http://nodis3.gsfc.nasa.gov/). The Associate Administrator for SMD has established a <<PROGRAM NAME>> Program Office at the NASA <<CENTER NAME>> Center to be responsible for project oversight. The <<PROGRAM NAME>> Program Manager at the NASA <<CENTER NAME>> Center reports to the <<PROGRAM NAME>> Program Director at NASA Headquarters (HQ). [AO OPTION]Additional details about the program office staffing, structure, and goals can be found in the *<<PROGRAM NAME>> Program Plan*, available in the Program Library.[END OPTION]

NPR 7120.5E defines project management responsibilities, and it presumes that project management is assigned to a NASA Center or JPL. If an organization other than a NASA Center or JPL is proposed and selected to provide project management for an investigation, then the NASA Center's project management responsibilities under NPR 7120.5E will be assigned to the implementing project management organization. That organization must be prepared to carry out these responsibilities. In such cases, the <<PROGRAM NAME>> Program Office at the NASA <<CENTER NAME>> Center will retain the Technical Authority (TA), as described in NPR 7120.5E, which would otherwise be invested in an implementing Center or JPL.

The <<PROGRAM NAME>> safety, reliability, and quality assurance requirements document, available in the Program Library, will apply to investigations that are selected for Phase A concept studies. Selected investigations that reside at institutions that have NASA-approved safety and mission assurance (S&MA) programs may use their own appropriate institutional practices in lieu of the guidelines and requirements in this document. Although this document may impose requirements on selected investigations, it does not impose requirements, either implicitly or explicitly, on proposals submitted in response to an AO.

In addition to its role as the site of the <<PROGRAM NAME>> Program Office, the NASA <<CENTER NAME>> Center (<<CENTER ABBRV>>) is eligible to submit and participate in proposals in response to this AO. The <<PROGRAM NAME>> Program Office will have access to the AO before it is released; this is necessary so that the <<PROGRAM NAME>> Program Office can review the AO and ensure that it correctly describes the post-selection project management processes. Other than that, the <<PROGRAM NAME>> Program Office plays no role in the AO process; specifically, it plays no role in defining the scientific scope of the AO, writing the AO, evaluating proposals, or selecting proposals. The Science Mission Directorate at NASA HQ will manage the evaluation and selection process. In order to manage <<CENTER ABBRV>>'s two roles, SMD has established functional and organizational firewalls between the <<PROGRAM NAME>> Program Office and those parts of <<CENTER ABBRV>> that might participate in proposals. These firewalls ensure that personnel identified as supporting the <<PROGRAM NAME>> Program Office and the AO process will protect all nonpublic information from all proposers, including those at <<CENTER ABBRV>>, and will be free of financial and other conflicts of interest with proposers.

[AO OPTION] Similarly, a firewall has been put in place for NASA <<CENTER NAME>> Center from which selected personnel are supporting the development of this AO and the evaluation of proposed investigations.

4.1.3 Roles and Responsibilities in Communications and Outreach

NASA is required to communicate the discoveries and results of its investigations to the American public. These efforts are intended to promote interest and foster participation in NASA's endeavors and to develop exposure to—and appreciations for—Science, Technology, Engineering, and Mathematics (STEM). Therefore, the PIs of selected investigations are required to work in conjunction with a NASA Center or JPL, and with NASA HQ to communicate mission updates, science, and new discoveries.

4.1.3.1 NASA Centers or Jet Propulsion Laboratory (JPL)

Each flight mission manages the communications plan and activities utilizing the communications office of a NASA Center or JPL. Missions managed by a NASA Center or JPL will request support of that Center's communications office. For missions not managed by a NASA Center or JPL, the Center where the Program Office resides will fulfill the communications management role.

The communications offices will be responsible for coordinating and executing mission communications activities—along with the mission's PI and Project Office for PI-led missions and Program Office for strategic missions—and with the approval of SMD and Office of Communications.

4.1.3.2 Principal Investigators

For PI-led missions, the PI fills a challenging, multidisciplinary role, which demands excellent communication, team building, and management skills. The PI is responsible for all aspects of the successful implementation of the mission. The PI is a key spokesperson for the mission—along with NASA officials—and is integral in communicating mission updates, science, and new discoveries.

The PI provides content, analysis, and context for communication campaigns and news stories. In keeping with NASA's communications goals, content should convey an understanding of the mission and its objectives, and the benefits to target audiences, the public, and other stakeholders.

As part of NASA's review and approval process, the PI, or his or her designee, 1) coordinates, 2) reviews, and 3) approves, with the designated NASA Center communications office, all mission-related communications activities. In case of incompatible views, NASA will have the final decision on release of public products, while ensuring that scientific and technical information remains accurate and unfiltered.

Selected and down-selected PIs also must work with NASA to ensure their mission follows NPD 2521.1B *Communications and Material Review* and NPR 2200.2D *Requirements for Documentation, Approval and Dissemination of Scientific and Technical Information* (see the Program Library). NASA, and through NASA the selected investigation, is required under the Information Quality Act (44 U.S.C. 3504(d)(1) and 3516) and associated guidelines to maximize the quality, objectivity, utility, and integrity of information and services provided to the public.

4.1.3.3 NASA HQ

NASA HQ and the program office personnel provide the necessary oversight and funding for communications in accordance with NASA and SMD policies for both PI-led and strategic missions.

4.1.4 Mission Category and Payload Risk Classification

NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*, establishes guidelines for categorizing NASA missions based on the estimated life-cycle cost and mission priority level. The mission categorization guidelines are given in Section 2.1.4 and Table 2-1 of NPR 7120.5E.

NPR 8705.4, *Risk Classification for NASA Payloads*, establishes baseline criteria that enable a definition of the risk classification level for NASA payloads. It defines four payload risk levels or classes, A thru D, and provides guidance for programmatic options during development based on this class. The requirements for each class are specified in Appendix C of NPR 8705.4.

[AO OPTION 1]<<PROGRAM NAME>> missions selected from this AO have been determined to be Category <<MISSION CATEGORY>> missions (per NPR 7120.5E) with Class <<MISSION CLASS>> payloads (per NPR 8705.4). Proposers must incorporate appropriate work effort and support in their proposals accordingly.[END OPTION 1]

[AO OPTION 2: When this option is used, Section 4.1.4 should be moved to Section 5 (between 5.2.8 and 5.2.9) so that there are no Requirements in Section 4.1.]

Requirement 3. Based on the criteria for mission categorization in NPR 7120.5E and risk classification in NPR 8705.4, proposers shall propose a mission categorization and risk classification for their proposed mission. Proposers shall incorporate appropriate work effort and support in their proposals accordingly.[END OPTION 2]

Proposed adjustments to NASA requirements described in NPR 7120.5E may be made by missions at any risk classification. Proposers must identify any tailorable requirements that are proposed to be adjusted, provide a rationale for each adjustment, and describe the cost, schedule, and/or other benefits that would be realized should one or more of the adjustments be accepted by NASA. Note that these adjustments reflect potential modifications to the baseline investigation, to be addressed after [AO OPTION for Single Steps]selection[AO OPTION for Two Steps]down-selection[END OPTIONs]. The panel evaluating the third evaluation criterion, TMC Feasibility of the Proposed Investigation Implementation, will provide comments to the Selection Official on the proposed adjustments and their justifications. These comments will not be considered for the TMC Feasibility of the Proposed Investigation Implementation risk rating but may be considered in the selection decision.

Requirement 4. Proposals shall identify any tailorable NASA requirements that are proposed to be adjusted, include the rationale for the adjustment, and describe the cost, schedule, and/or other benefits that would be realized should one or more of the adjustments be accepted by NASA.

Proposed categorization and risk classification will be confirmed or modified by the NASA Decision Authority at selection points KDP-A and KDP-B.

4.1.5 Remediation, Termination, or Cancellation

Any alteration of a mission that renders it unable to accomplish one or more of its baseline science objectives will be regarded as a descope of the investigation. NASA will review any such descoped set of achievable science objectives to ensure that the investigation remains at or above the Threshold Science Mission (see Section 5.1.3 of this AO). A descope made necessary by the PI's inability to remain within budget or schedule, or failure at any time during formulation and implementation to maintain a level of science return at or above the Threshold Science Mission, can result in mission cancellation accompanied by appropriate contract action, which may involve termination.

[AO OPTION 1 FOR SINGLE STEPS] The proposal must include a commitment by the PI for the PI-Managed Mission Cost, schedule, and scientific performance of the investigation. If, at any time, the cost, schedule, or scientific performance commitments made in the proposal appear to be in peril, the investigation will be subject to termination or cancellation. [END OPTION 1]

[AO OPTION 2 FOR TWO STEPS] During Phase A, each selected PI will conduct a concept study. The Phase A Concept Study Report must include a commitment by the PI for the PI-Managed Mission Cost, schedule, and scientific performance of the investigation. If, at any time, the cost, schedule, or scientific performance commitments made in the Phase A Concept Study Report appear to be in peril, the investigation will be subject to termination or cancellation. [END OPTION 2]

During Phase B, each selected PI will work with NASA to develop top-level science and technical performance requirements. Each PI will also work with NASA to establish a set of performance metrics for project evaluation with NASA. These will include cost, schedule, and others, as appropriate.

Once an investigation has been confirmed for implementation, failure of the PI to maintain reasonable progress within committed schedule and cost, and/or failure to operate within other applicable constraints, provide cause for NASA to convene a termination review. The Associate Administrator (AA) for the Science Mission Directorate may also call for a termination review any time an excursion above the agreed upon mission cost in Phase C through Phase E occurs, or is projected to occur, by the PI, the implementing organization, or NASA. The objective of such a review is to determine whether remedial actions, including changes in management structure and/or Key Management Team members, would better enable the project to operate within established cost, schedule, and/or technical constraints. If a termination review determines that no remedy is likely to improve matters, NASA may consider mission cancellation and/or contract termination. NASA may cancel a mission and/or terminate a contract notwithstanding any international or domestic partnerships established to enable the mission.

4.2 Participation Policies

4.2.1 Eligibility to Participate in this AO

Prospective investigators from any category of organizations or institutions, U.S. or non-U.S. with some restrictions as specified in this section and in Section 4.2.2, are welcome to respond to this solicitation. Specific categories of organizations and institutions that are welcome to respond include, but are not limited to, educational, industrial, and not-for-profit organizations, Federally Funded Research and Development Centers (FFRDCs), University Affiliated Research Centers (UARCs), NASA Centers, the Jet Propulsion Laboratory (JPL), and other Government agencies.

There is no restriction on the number of proposals that an organization may submit to this solicitation or on the teaming arrangements for any one proposal, including teaming with NASA Centers and JPL. However, each proposal must be a separate, stand-alone, complete document for evaluation purposes.

[THE LANGUAGE FOR THE DRAFT AO RECOGNIZES THAT THE LIMITATIONS ON AEROSPACE CORPORATION MIGHT BE UNKNOWN AT THE TIME OF THE DRAFT AO. HERE IS THE LANGUAGE FOR THE DRAFT AO]

NASA contracts for the services of outside, non-governmental organizations for support in evaluating proposals (see Section 7.1.1). Organizational conflicts of interest between proposing, evaluating, and executing organizations must be avoided. The approach to avoiding organizational conflicts of interest depends on the unique characteristics and roles of each evaluating organization. For non-governmental organizations, this requires limiting the extent to which the outside evaluating organizations can participate in proposal development and/or execution of the work proposed. NASA has two general classes of limitation for organizations.

Full Limitation: The NASA contract with the outside organization for evaluation support under this AO creates an unmitigable organizational conflict of interest for the evaluating organization in the event that any business unit of the organization has a proposed role as prime contractor, subcontractor, or participating organization. Because of this organizational conflict of interest, the evaluating organization is precluded from participating in any capacity in support of a respondent under this AO.

Partial Limitation: The NASA contract with the outside organization for evaluation support under this AO creates an organizational conflict of interest for the evaluating organization in the event that any business unit of the organization has a proposed role as prime contractor, subcontractor, or participating organization. Because of this organizational conflict of interest, the evaluating organization is precluded from responding to this AO, from participating as a member of any proposal performance team, and from being proposed as the recipient of any work awarded under this AO. Under appropriate circumstances, respondents to this AO may contract with the evaluating organization for supporting analysis services, including cost analysis, engineering analysis, and resource analysis, if it is deemed in the best interest of the Government and only under the following conditions.

(i) The evaluating organization is precluded from responding to this AO, from participating as a member of any proposal performance team, and from being proposed as the recipient

of any work awarded under this AO. The evaluating organization is precluded from providing or developing hardware, including any elements or components, that will be proposed for any work awarded under this AO. The evaluating organization should not be referenced in the proposal, nor should the evaluating organization's analysis be identified in the proposal.

(ii) The evaluating organization has established firewalls within the organization to prevent conflicts of interest between organizational units and employees supporting NASA's evaluation of proposals and organizational units and employees supporting proposal efforts. Any supporting analysis services, including supporting cost analysis and supporting engineering analysis, provided to a proposal team must comply with the firewall that has been established by the evaluating organization and is described in a NASA approved Organizational Conflict of Interest Avoidance Plan.

(iii) The proposer fully describes in a memorandum submitted to NASA at the same time as the proposal all of the supporting analysis services provided by the evaluating organization to the proposing team. The memorandum must be signed by the proposing organization and must be concurred on by the evaluating organization. The memorandum is not to be incorporated into the proposal itself, but must be a separate document submitted by mail or email to the NASA Point of Contact (POC) identified in Section 6.1.5. This memorandum must describe all of the work provided by the evaluating organization, must identify any work products of the evaluating organization that are included in the proposal or its appendices, and must list all employees of the evaluating organization who participated in the work.

For this opportunity, two outside evaluating organizations may be used. In this case, their participation in proposed investigations is thus limited, as follows:

- Cornell Technical Services (CTS) will be subject to the "Full Limitation" described above. The NASA Evaluations, Assessments, Studies, Services, and Support (EASSS) 2 contract with CTS creates an unmitigable organizational conflict of interest for CTS in the event that any business unit of CTS has a proposed role as prime contractor, subcontractor, or participating organization. Because of this organizational conflict of interest, CTS is precluded from participating in any capacity in support of a respondent under this AO.
- Arctic Slope Regional Corporation (ASRC) and affiliates will be subject to the "Full Limitation" described above. The NASA Research and Education Support Services (NRESS) contract creates an unmitigable organizational conflict of interest for ASRC in the event that any business unit of ASRC has a proposed role as prime contractor, subcontractor, or participating organization. Because of this organizational conflict of interest, ASRC and affiliates are precluded from participating in any capacity in support of a respondent under this AO.
- The Aerospace Corporation is subject to either the "Partial Limitation" described above or to no limitation. The Aerospace Corporation, as the Federally Funded Research and Development Center (FFRDC) for space systems acquisition, is available to the U.S. Government and other organizations under the terms of its sponsoring agreement with the U.S. Air Force. The Aerospace Corporation has no limitation and is permitted to participate fully in all proposal activities unless the final AO states that Aerospace is under a partial limitation for that AO. If Aerospace is subject to a partial limitation,

respondents to this AO may contract with The Aerospace Corporation for supporting analysis services, including cost analysis, engineering analysis, and resource analysis only under the conditions described in paragraphs (i), (ii), and (iii) above.

[END OF LANGUAGE FOR DRAFT AO. BEGINNING OF LANGUAGE FOR FINAL AO, INCLUDING OPTIONS DEPENDING ON THE LIMITATIONS PLACED ON THE AEROSPACE CORPORATION.]

NASA contracts for the services of outside, non-governmental organizations for support in evaluating proposals (see Section 7.1.1). Organizational conflicts of interest between proposing, evaluating, and executing organizations must be avoided. The approach to avoiding organizational conflicts of interest depends on the unique characteristics and roles of each evaluating organization. For non-governmental organizations, this requires limiting the extent to which the outside evaluating organizations can participate in proposal development and/or execution of the work proposed.

The NASA Evaluations, Assessments, Studies, Services, and Support (EASSS) 2 contract with Cornell Technical Services (CTS) for evaluation support under this AO creates an unmitigable organizational conflict of interest for CTS in the event that any business unit of CTS has a proposed role as prime contractor, subcontractor, or participating organization. Because of this organizational conflict of interest, CTS is precluded from participating in any capacity in support of a respondent under this AO.

The NASA Research and Education Support Services (NRESS) contract with Arctic Slope Regional Corporation (ASRC) Federal Technical Services for evaluation support under this AO creates an unmitigable organizational conflict of interest for ASRC and affiliates in the event that any business unit of ASRC has a proposed role as prime contractor, subcontractor, or participating organization. Because of this organizational conflict of interest, ASRC and affiliates are precluded from participating in any capacity in support of a respondent under this AO.

[AO OPTION 1] The NASA contract with The Aerospace Corporation (Aerospace) for evaluation support under this AO creates an unmitigable organizational conflict of interest for Aerospace in the event that any business unit of Aerospace has a proposed role as prime contractor, subcontractor, or participating organization. Because of this organizational conflict of interest, Aerospace is precluded from participating in any capacity in support of a respondent under this AO. [END OPTION 1]

[AO OPTION 2] The NASA contract with The Aerospace Corporation (Aerospace) for evaluation support under this AO creates an organizational conflict of interest for Aerospace in the event that any business unit of Aerospace has a proposed role as prime contractor, subcontractor, or participating organization. Because of this organizational conflict of interest, Aerospace is precluded from responding to this AO, from participating as a member of any proposal performance team, and from being proposed as the recipient of any work awarded under this AO.

The Aerospace Corporation is a FFRDC, and it has unique capabilities and skills that are made available to the U.S. Government and other organizations under the terms of its sponsoring

agreement with the U.S. Air Force. It is in NASA's best interest that, where appropriate and where it does not create organizational conflicts of interest, respondents to this AO be permitted to take advantage of these same capabilities and skills to improve their proposals. Under appropriate circumstances, respondents to this AO may contract with Aerospace for supporting analysis services, including cost analysis, engineering analysis, and resource analysis, if it is deemed in the best interest of the Government and only under the following conditions.

(i) Aerospace is precluded from responding to this AO, from participating as a member of any proposal performance team, and from being proposed as the recipient of any work awarded under this AO. Aerospace is precluded from providing or developing hardware, including any elements or components, that will be proposed for any work awarded under this AO. Aerospace should not be referenced in the proposal, nor should the evaluating organization's analysis be identified in the proposal.

(ii) Aerospace has established firewalls within the Aerospace organization to prevent conflicts of interest between Aerospace organizational units and employees supporting NASA's evaluation of proposals and Aerospace organizational units and employees supporting proposal efforts. Any Aerospace supporting analysis services, including supporting cost analysis and supporting engineering analysis, provided to a proposal team must comply with the firewall that has been established by Aerospace and is described in a NASA approved Organizational Conflict of Interest Avoidance Plan (OCIAP).

(iii) The proposer must fully describe in a memorandum submitted to NASA at the same time as the proposal all of the supporting analysis services provided by Aerospace to the proposing team. The memorandum must be signed by the proposing organization and must be concurred on by the evaluating organization. The memorandum must not be incorporated into the proposal itself, but must be a separate document submitted by mail or email to the NASA Point of Contact (POC) identified in in Section 6.1.5. This memorandum must describe all of the work that Aerospace provided, must identify any work products of Aerospace that are included in the proposal or its appendices, and must list all Aerospace employees who participated in the Aerospace work. [END OPTION 2]

[AO OPTION 3] There are no plans to use The Aerospace Corporation for evaluation support. There is no limitation on the participation of The Aerospace Corporation in any capacity under this AO. [END OPTION 3]

4.2.2 Restrictions Involving China

Proposals must not include bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds arrangement.

In accordance with existing laws and regulations, NASA is restricted from funding any NASA contract, grant, or cooperative agreement action that involves bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds arrangement.

Requirement 5. Proposals shall not include bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds arrangement.

4.2.3 Constraints on Investigations that are Candidates for Selection

Only those investigations that propose to meet cost, schedule, and launch vehicle requirements that do not exceed the constraints identified in this AO and that demonstrate sufficient margins, reserves, and resiliency to ensure mission success within committed cost and schedule, will be considered for selection.

4.2.4 Responsibility of Principal Investigator for Implementation

The primary responsibility for implementing and executing selected investigations rests with the PI, who will have latitude to accomplish the proposed objectives within committed schedule and financial constraints. However, this responsibility will be exercised with essential NASA oversight to ensure that the implementation is responsive to the requirements and constraints of the <<PROGRAM NAME>> Program.

4.2.5 NASA Concurrence for Change(s) of Named Key Management Team Members or Co-Is

Subsequent to selection, any replacement, addition, or removal of a named Key Management Team member (including, but not limited to, the [AO OPTION]PI and Project Manager (PM)[END OPTION] [ALTERNATIVE OPTION FOR FULL MISSIONS]PI, Project Manager (PM), and Project Systems Engineer (PSE)[END OPTION]) or any Co-I requires concurrence by NASA.[AO OPTION]Institutions with a recent history of replacing named Key Management Team members or Co-Is may receive Factor C-4 weaknesses.[END OPTION]

4.3 Cost Policies

4.3.1 PI-Managed Mission Cost

PI-Managed Mission Cost is defined as the cost proposed by the PI's implementation team to be funded by the <<PROGRAM NAME>> Program for the development and execution of the proposed project during Phases A through F. It includes any reserves applied to the development and operation of the mission as well. It also includes any costs that are required to be counted against the PI-Managed Mission Cost, even though the PI is not directly responsible for those costs. The term does not imply that a contractual relationship between the Proposing Organization and other proposal partners is required. The [AO OPTION] Phase A-D portion of the [END OPTION] PI-Managed Mission Cost is capped at the AO Cost Cap or Adjusted AO Cost Cap, as applicable (see Section 5.6.1).

Examples of costs to be included in the PI-Managed Mission Cost, as applicable and unless contributed, are: development activities (e.g., instrument development, spacecraft development, management, software, testing); [AO OPTION]launch services outside of the standard services provided by NASA; [END OPTION]Student Collaboration in excess of the associated incentive (see Section 5.5.3); [AO OPTION]PI-Team-Developed Enhancing Technology Demonstration Opportunity costs in excess of the associated incentive (see Section 5.2.3.2); [END OPTION]subcontracting costs, including fees; science Co-Is and all other personnel required to

conduct the investigation, analyze data and publish results, and deliver data in an acceptable format to an approved archive; insurance; NASA-provided telecommunications, tracking, and/or navigation support, with applicable costs (i.e., NASA's Near-Earth Network, Space Network); any program/project-specific costs (e.g., curation of returned samples); and all labor, including contractor and Civil Servant (NASA and non-NASA).

4.3.2 Total Mission Cost

Total Mission Cost is defined as the PI-Managed Mission Cost (see Section 4.3.1) plus any Student Collaboration costs up to the associated incentive (see Section 5.5.3)[AO OPTION], PI-Team-Developed Enhancing Technology Demonstration Opportunity costs up to the associated incentive (see Section 5.2.3.2),[END OPTION] and additional costs that are contributed or provided in any way other than through the <<PROGRAM NAME>> Program (see Section 5.6.7). The Total Mission Cost will define the total value of the baseline investigation, not including the costs of DSN Aperture Fees[AO OPTION], standard launch vehicle and launch services,[END OPTION] or other costs only included in the Enhanced PI-Managed Mission Cost (see Section 4.3.3).

4.3.3 Enhanced PI-Managed Mission Cost

Enhanced PI-Managed Mission Cost is defined as the PI-Managed Mission Cost (see Section 4.3.1) plus the costs of optional components such as Student Collaboration up to the associated incentive (see Section 5.5.3)[AO OPTION], PI-Team-Developed Enhancing Technology Demonstration Opportunity up to the associated incentive (see Section 5.2.3.2),[END OPTION] and Science Enhancement Option (see Section 5.1.7).

4.3.4 Mission Funding Profile

The<<PROGRAM NAME>> Program's planning budget can accommodate a selection at the AO Cost Cap or Adjusted AO Cost Cap, as applicable, with a typical funding profile over a nominal <<DEV YEARS>>-year development period. Proposers should propose a funding profile that is appropriate for their investigation and is consistent with the selection and launch readiness dates in Section 3 of this AO. Proposers must not assume that NASA can or will accommodate proposals whose requested funding profile differs significantly from the <<PROGRAM NAME>> Program's planning budget for this AO. While NASA will consider whether a different funding profile can be accommodated, NASA cannot guarantee that the proposed funding profile will be acceptable. The inability of NASA to accommodate the requested funding profile may be a reason for nonselection of a proposal. A final funding profile for each selected or down-selected mission will be negotiated.

4.3.5 Availability of Appropriated Funds

Prospective proposers to this AO are advised that funds are generally not available for awards at the time of its release. The Government's obligation to make awards is contingent upon the availability of sufficient appropriated funds from which payment can be made and the receipt of proposals that NASA determines are acceptable for award under this AO.

4.4 Data and Sample Return Policies and Requirements

4.4.1 Data Analysis

The PI will be responsible for analysis of the mission data (including returned samples) necessary to complete the proposed science objectives and for timely publication of initial scientific results in refereed scientific journals, as part of their mission operations (Phase E) and/or post-mission (Phase F) activities. Data analysis [AO OPTION]and preliminary analysis of returned samples [END OPTION]may be continued during Phase F.

4.4.2 Increasing Access to the Results of Federally Funded Research

As a Federal agency, NASA requires prompt public disclosure of the results of its sponsored research to generate knowledge that benefits the Nation. To this end, contracts arising from this AO will include the clause FAR 52.227-14, Rights in Data—General, and accordingly, Alternate IV to this clause, permitting the automatic assertion of copyright in any data produced under the contract by a contractor, will not be applicable. Thus, it is NASA's intent that all knowledge developed under awards resulting from this solicitation be shared broadly. In keeping with the *NASA Plan for Increasing Access to the Results of Scientific Research*, available in the program library, new terms and conditions about making manuscripts and data publicly accessible may be attached to awards that derive from this AO. Proposals are required to include a Data Management Plan (DMP) in accordance with the requirements and guidelines in the *NASA Plan for Increasing Access to the Results of Scientific Research* or to justify that one is not necessary given the nature of the work proposed (see Requirement 14). The kind of data that requires a DMP is described in the *NASA Plan for Increasing Access to the Results of Scientific Research*.

SMD anticipates that awards deriving from this AO will include terms and conditions requiring that as accepted manuscript versions of peer-reviewed publications (hereinafter "manuscripts") resulting from AO awards be uploaded into NASA's part of the PubMed Central (PMC) repository called NASA PubSpace at https://www.ncbi.nlm.nih.gov/pmc/funder/nasa/. This applies only to peer reviewed publications. Patents and publications that contain material governed by personal privacy, export control, proprietary restrictions, or national security law or regulations will not be covered by this requirement. The manuscript will appear in PMC for free public access following a maximum 12-month embargo period after the publication date. PMC will release the manuscript when the embargo has ended. For more details on public access to scientific publications and digital scientific data resulting from NASA-funded research, please see: https://www.nasa.gov/open/researchaccess. DMPs must describe how data sharing and preservation will enable validation of published results or how such results could be validated if data are not shared or preserved. Furthermore, DMPs must provide a plan for making science data that underlie the results and findings in peer-reviewed publications digitally accessible *at the time of publication or within a reasonable time period after publication*.

4.4.3 Delivery of Data to Archive

The investigation team will make mission data fully available to the public [AO OPTION]through a NASA-approved data archive (e.g., the Planetary Data System, Atmospheric Science Data Center, High Energy Astrophysics Science Archive Research Center, Mikulski Archive for Space Telescopes, Solar Data Analysis Center, Space Physics Data Facility, etc.),[END OPTION] in readily usable form, in the minimum time necessary, but, barring

exceptional circumstances, within six months following its collection. The PI will be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the data prior to [AO OPTION 1]delivery to the archive. [AO OPTION 2 FOR EARTH SCIENCE]making it fully available. During Phase A, NASA will assign a data center, e.g., one of the Earth Observing System Data and Information System (EOSDIS) Distributed Active Archive Centers (DAACs), to be the data archive for the selected mission; proposals should not be tailored to one specific data center. By the investigation closeout, the investigation will deliver all data products, along with the scientific algorithm software, coefficients, ancillary data used to generate these products, and the algorithm and calibration documentation to a NASA-assigned data center (e.g., one of the Earth Observing System Data and Information System (EOSDIS) Distributed Active Archive centers (DAACs)). Information on EOSDIS and the DAACs is available at http://esdis.eosdis.nasa.gov/eosdis/overview.html and http://esdis.eosdis.nasa.gov/dataaccess/datacenters.html.[END OPTION 2]

Archival data products will include low-level (raw) data, high-level (processed) data, and derived data products such as maps, ancillary data [AO OPTION OUTER](including [AO OPTION INNNER]valid SPICE (spacecraft, planet, instrument, C-matrix, events) kernels related to spacecraft, instrument, and body information, as well as [END OPTION INNER]radiometric and geometric calibrations for imagery)[END OPTION OUTER], calibration data (ground and in-flight, and intercalibration as needed), documentation, related software, and/or other tools or parameters that are necessary to interpret the data. The PI will be responsible for generating data products that are documented, validated, and calibrated in physical units that are usable by the scientific community at large.

NASA data archives have budgets to support core activities, including the basic ingestion and review of new data. Proposed mission data archiving plans and budgets must be consistent with the policies and practices of the appropriate NASA data archive. [AO OPTION]For the Planetary Data System (PDS), guides to the archiving process and tools for data archive preparation may be downloaded from the PDS website (http://pds.nasa.gov/tools/index.shtml). Information on SPICE kernels may be found at the Navigation and Ancillary Information Facility (NAIF) of the PDS (http://naif.jpl.nasa.gov/naif/). For other archives, [END OPTION, but change next word to lowercase]Proposers should contact the archive directly to obtain information regarding the appropriate policies and practices. [AO OPTION FOR EARTH SCIENCE] For information on NASA Earth Science data policy, nomenclature, standards, and EOSDIS, see http://science.nasa.gov/earth-science/earth-science-data/.[END OPTION] Proposals may include funding for up to one year after end-of-operations for the generation and archiving of derived data products. This funding will be included in the PI-Managed Mission Cost.

4.4.4 Preliminary Analysis and Curation of Returned Samples

All samples of extraterrestrial planetary materials returned by NASA missions are NASA property (see NPD 7100.10F, *Curation of Institutional Scientific Collections*, in the Program Library). They must be delivered to, and processed by, the NASA Astromaterials Acquisition and Curation Office located at NASA's Johnson Space Center (JSC); contact Dr. Francis McCubbin, Astromaterials Curator (Telephone: 281-483-5126; email: jsc-astromaterials-curator@mail.nasa.gov; http://curator.jsc.nasa.gov/)<<CHECK>>. The Curator will assist proposers in designing a curation plan that meets their mission’s requirements for sample

preservation and use as well as providing cost estimates for sample curation. The actual costs for all aspects of curation, from planning through distribution and storage, including all required laboratory construction or modification, must be borne by the mission from inception to two years following sample return.

Requirement 6. Proposals that include the return of extraterrestrial samples shall provide a draft Sample Curation Plan. See Appendix B, Section J.7, for details. Note that a final and complete Sample Curation Plan—including (i.) the methods used to prevent sample contamination or degradation during collection and return to Earth and (ii.) the general procedures for storage, subsampling, documentation, distribution, and security—will be required in the Concept Study Report.

Requirement 7. Proposals that include the return of extraterrestrial samples shall allocate funding for use of the JSC Curatorial Facility, including all aspects of curation.

4.4.5 Allocation of Returned Samples to Non-U.S. Partners

As a proportionate return for investment by non-U.S. partners in a mission that returns extraterrestrial materials, a fraction of the total returned sample may be forwarded to the national curatorial facility of the contributing country within six months after delivery to the NASA Astromaterials Acquisition and Curation Office. The amount of samples so transferred must be no more than 25% of the total. Any material allocated to non-U.S. partners during the preliminary examination period must be included in this 25% limitation.

Requirement 8. Proposals that include the return of extraterrestrial samples shall specify the terms and conditions of selection of a sample fraction no greater than 25% for transmission to the contributing country, if appropriate.

In the event that the investigation is selected, the final arrangements for the transfer of a fraction of the sample to the contributing country must be established through an international agreement between NASA (with the approval of the Astromaterials Curator) and the contributing non-U.S. partner. NASA will negotiate the terms and conditions of the agreement.

4.4.6 Curation of Space-Exposed Hardware

It is the policy of the <<PROGRAM NAME>> Program that any space-exposed hardware returned to Earth will be made available to the science and engineering community for study. Such hardware must be delivered to and processed by the NASA Astromaterials Acquisition and Curation Office located at the NASA Johnson Space Center (JSC). The Astromaterials Curator at the Johnson Space Center is responsible for the physical security, documentation, inventory accountability, environmental preservation, and distribution of any space-exposed hardware delivered to the NASA Astromaterials Acquisition and Curation Office. The Curator will assist proposers in designing a curation plan for returned space-exposed hardware. The actual costs for all aspects of curation, from planning through distribution and storage, including all required laboratory construction or modification, must be borne by the mission from inception to two years following sample return.

Requirement 9. Proposals that include the return of space-exposed hardware shall include the curation of this hardware in their draft Sample Curation Plan. See Appendix B, Section J.7, for details. Note that a final and complete Sample Curation Plan—including (i.) the methods used to prevent hardware contamination or degradation during return to Earth and (ii.) the general procedures for storage, sampling, documentation, distribution, and security—will be required in the Concept Study Report.

Requirement 10. Proposals that include the return of space-exposed hardware shall allocate funding for use of the NASA Astromaterials Acquisition and Curation Office to document, store and distribute hardware samples, including all aspects of curation.

4.5 Intellectual Property Rights

4.5.1 Invention Rights

Recipients that are Small Businesses or nonprofit organizations may elect to retain title to any inventions made under a funding agreement pursuant to the Bayh-Dole Act (35 U.S.C. § 202). Large business recipients are subject to section 20135 of the National Aeronautics and Space Act (51 U.S.C. § 20135) relating to property rights in inventions. Title to inventions made under an agreement by a large business recipient initially vests with NASA. However, these recipients may request a waiver to obtain title to inventions made under the agreement. Such a request may be made in advance of the agreement or within 30 days thereafter. Even if a waiver request is not made, or denied, a large business recipient may request a waiver on individual inventions made during the course of the agreement.

4.5.2 Data Rights

All science data returned from investigations led by NASA-funded PIs will be made available to the public as rapidly as possible (see Sections 4.4.2 and 4.4.3). Following a short latency period, all data will be made available to the user community, to the extent consistent with the approved Data Management Plan and the data rights clause incorporated into the award instrument. No period of exclusive access is permitted. The Principal Investigator proposes and justifies any data product latency period for standard data products listed in the proposal, based primarily on the time required to produce, quality check, and validate the products. Barring exceptional circumstances, data product latency may not exceed six months.

4.5.3 Sensitive Government Information

In addition, sensitive Government information is defined as information the Government has generated that qualifies for an exception to the Freedom of Information Act, which is not currently in the public domain, may embody trade secrets or commercial or financial information, and may be sensitive or privileged. If performing any contract resulting from this opportunity entails access to such sensitive Government information then the Contractor must limit utilization of the information to performing the services specified in said contract; must not utilize the information to improve its own competitive position in another procurement; must safeguard the information from unauthorized use and disclosure, allowing access only to those employees that need it to perform services under the contract; and must preclude access and disclosure of the information to persons and entities outside of the Contractor's organization. A

Contractor's Organizational Conflicts of Interest Avoidance Plan is a procedures and obligations compliance document that will be required for contract award.

4.5.4 Trademark

The National Aeronautics and Space Act directs NASA to "provide for the widest practicable dissemination of the information concerning its activities and the results thereof." 51 USC 20 112(a)(3). NASA's mission supports broad public engagement, enhanced educational opportunities, and open scientific inquiry. Accordingly, selected or down-selected missions may not assert trademark or other ownership rights in the mission name, mission logos, mission graphics, or any other program identifier.

4.6 Project Management Policies

4.6.1 Independent Verification and Validation of Software

The NASA Chief, Safety and Mission Assurance (CSMA) has the authority to select software projects to which Independent Verification and Validation (IV&V) must be applied, as defined in NASA-STD-8739.8, *Standard for Software Assurance,* and NPR 7150.2B, *NASA Software Engineering Requirements*. At a minimum, all Category 1 and those Category 2 missions with a payload risk classification A or B will require IV&V. If the software assurance classification assessment is expected to determine that IV&V is necessary, [AO OPTION FOR TWO STEPS] concept study teams will be required [END OPTION FOR TWO STEPS] [AO OPTION FOR SINGLE STEPS] proposal teams are encouraged [END OPTION FOR SINGLE STEPS] to contact the Office of the Director at the NASA IV&V Program to gain a preliminary understanding of the potential level of safety and software risks. The Office of the Director can be contacted at (304) 367-8248<<CHECK>>. When a project is required to obtain IV&V, exemption will require an assessment of the software project by the NASA Office of Safety and Mission Assurance (OSMA) and approval by the CSMA.

4.6.2 Earned Value Management Plan

For Government entities, the earned value management (EVM) requirements are listed in NPR 7120.5E. For entities receiving contracts, the EVM requirements are listed in NFS 1852.234-2.

4.6.3 Cost Analysis Data Requirement (CADRe)

NASA has established a Cost Analysis Data Requirement (CADRe) in NPR 7120.5E, Table I-4, which will apply to investigations selected through this AO. Support contractors funded directly by NASA HQ will perform the actual development of the CADRe; the costs for these services need not be included in the proposed PI-Managed Mission Cost. Selected investigations will have to spend project funds only to collect existing documentation and transmit it to the CADRe support contractor at selected major milestones and then to review the completed CADRe for completeness and accuracy.

4.6.4 Conjunction Assessment Risk Analysis

NASA has established conjunction assessment risk analysis requirements in NPR 8715.6B, Chapter 3 that will apply to investigations selected through this AO. Two organizations—the Conjunction Assessment Risk Analysis (CARA) team at NASA Goddard Space Flight Center for

Earth-orbiting missions and the MArs (and Moon) Deepspace Collision Avoidance Process (MADCAP) team at the Jet Propulsion Laboratory for Moon and Mars missions—are funded directly by NASA HQ and the Multi-Mission Ground Systems and Services (MGSS) program, respectively, to perform the actual analysis and risk assessment; the costs for these services need not be included in the mission PI-Managed Mission Cost. However, an investigation to which NPR 8715.6B, Chapter 3 is applicable will have to budget costs under the PI-Managed Mission Cost to establish a working interface between the Flight Operations Team and the CARA or MADCAP team in the [AO OPTION FOR TWO STEPS] Concept Study Report [END OPTION FOR TWO STEPS] [AO OPTION FOR SINGLE STEPS] proposal [END OPTION FOR SINGLE STEPS]. This interface will be used to routinely share orbital ephemerides data and covariance data, any maneuvering plans, and to perform any maneuver planning activities required for collision avoidance once on orbit. Additionally, estimates of how many maneuver planning events may be required in a particular Earth orbit regime are available from the CARA team. The interface between the mission and CARA or MADCAP team should be agreed-to and documented one year prior to launch.

For additional information regarding CARA, proposers may contact Ms. Lauri Newman (Telephone: 301-286-3155; email: lauri.k.newman@nasa.gov)<<CHECK>>. For information regarding MADCAP, please contact Mr. Roby Wilson (Telephone: 818-393-5301; email: roby.s.wilson@jpl.nasa.gov)<<CHECK>>.

4.6.5 [AO OPTION FOR EARTH SCIENCE]End-of-Mission Plan and End-of-Prime-Mission Review

NASA Earth science missions are required to develop an End-of-Mission Plan for approval and support an End-of-Prime-Mission Review. The End-of-Prime-Mission Review is held to determine if the mission has met its Baseline Science Requirements or Threshold Science Requirements and discuss any lessons learned from the mission. If the End-of-Prime-Mission Review is successful, the mission may propose to the NASA Earth Science Division Senior Review for approval to enter into an extended mission phase. The End-of-Mission Plan requirements may be found in NPR 7120.5E and in the *ESSP Program Plan;* the End-of-Prime-Mission Review requirement may be found in the *End-of-Prime-Mission Review* document; and information on the NASA Earth Science Division Senior Review can be found in the *2017 Call Letter for ESD Senior Review.* These documents are accessible from the Program Library.

5. Requirements and Constraints

This section provides general requirements on proposals. Supplemental requirements on standard proposal content and format are provided in Appendix B.

5.1 Science Requirements

5.1.1 Scope of Proposed Investigation

A goal is understood to have a broad scope (e.g., discover whether life exists elsewhere in the Universe; discover how and why the Earth's climate and the environment are changing), while an objective is understood as a more narrowly focused part of a strategy to achieve a goal (e.g., identify specific chemical, mineralogical, or morphological features on Mars that provide evidence of past or present life there; understand and improve predictive capability for changes

in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition). Proposed investigations must achieve their proposed objectives; however, the investigation might only make progress toward a goal without fully achieving it.

Requirement 11. Proposals shall describe a science investigation with goals and objectives that address the program science objectives described in Section 2.

Requirement 12. Proposals shall demonstrate how the proposed investigation will fully achieve the proposed objectives.

5.1.2 Traceability of Proposed Investigation

The <<PROGRAM NAME>> Program is intended to perform focused science investigations that advance knowledge and conclude with papers published in peer-reviewed archival journals, as well as deposition of appropriately reduced and calibrated data [AO OPTION]and derived products [END OPTION]in designated data archives (see Section 4.4.3).

Requirement 13. Proposals shall clearly state the relationship between the science objectives, the data to be returned, and the instrument complement to be used in obtaining the required data (see Appendix B, Section D, for additional detail).

Requirement 14. Proposals shall include Data Plans to calibrate (both preflight and in-flight), analyze, publish, and archive the data returned, and shall demonstrate, analytically or otherwise, that sufficient resources have been allocated to carry out the Data Plans within the proposed mission cost. The Data Management and Archiving Plan shall include a discussion and justification of any data latency period (see Appendix B, Section E.4, for additional detail). The Data Management and Archive Plan shall be in compliance with the requirements and guidelines in the *NASA Plan for Increasing Access to the Results of Scientific Research* or a justification shall be provided that this is not necessary given the nature of the work proposed (see Section 4.4.2).

5.1.3 Mission Science Objectives and Requirements

The ability to determine whether a proposed mission can successfully carry out the proposed science investigation depends on a well-formulated articulation of the proposed science objectives, the information and steps needed to bring closure to the objectives, and the measurements that must be obtained while conducting the mission.

Requirement 15. Proposals shall state the specific science objectives and their required measurements at a level of detail sufficient to allow an assessment of the capability of the proposed mission to make those specific measurements and whether the resulting data are necessary and sufficient to the achievement of these objectives (see Appendix B, Sections D and E, for additional detail).

Requirement 16. Proposals shall describe the proposed instrumentation, including a discussion of each instrument and the rationale for its inclusion in the proposed investigation.

5.1.4 Baseline and Threshold Science Missions

The Baseline Science Mission and the Threshold Science Mission are defined to be consistent with NPR 7120.5E as follows:

> The "Baseline Science Mission" is the mission that, if fully implemented, would fulfill the Baseline Science Requirements, which are the performance requirements necessary to achieve the full science objectives of the mission.
>
> The "Threshold Science Mission" is a descoped Baseline Science Mission that would fulfill the Threshold Science Requirements, which are the performance requirements necessary to achieve the minimum science acceptable for the investment.

The differences between the Baseline Science Mission and the Threshold Science Mission provide resiliency to potential cost and schedule growth in the proposed formulation and implementation plan. A Threshold Science Mission that does not provide meaningful resource reduction compared to the Baseline Science Mission fails to provide this intended resiliency while degrading the science return of the proposed mission. NASA recognizes that, in some circumstances, the Threshold Science Mission may be identical to the Baseline Science Mission.

Requirement 17. Proposals shall specify only one Baseline Science Mission and only one Threshold Science Mission.

Requirement 18. Proposals shall not identify any descopes or other risk mitigation actions that result in the mission being unable to achieve the Threshold Science Mission objectives.

5.1.5 [AO OPTION for single steps—AO authors to provide additional pages for Level 2 requirements]Level 1 and 2 Requirements

The Level 1 science requirements identify the mission, science, and programmatic requirements as well as constraints imposed on the project. Baseline requirements are the mission performance requirements necessary to achieve the full objectives of the mission. Threshold requirements are those mission performance requirements necessary to achieve the minimum mission objectives. The Level 1 requirements (referred to as program level requirements in NPR 7120.5E) and Level 2 project requirements specify requirements and constraints on science and engineering data collection, mission and spacecraft performance, prime mission lifetime, budget, schedule, launch vehicle, and any other requirements or constraints that need to be controlled. The requirements provide the criteria to be used to evaluate whether a project should be called for a termination review if it appears it might fail to meet its requirements.

Requirement 19. Proposals shall provide a set of proposed Level 1 requirements that will achieve the objectives of the Baseline Investigation. Both Baseline Mission requirements and Threshold Mission requirements shall be identified. The Level 1 requirements shall be unambiguous, quantifiable, objective, verifiable, and traceable to the mission objectives.

Requirement 20. Proposals shall provide Level 2 requirements that will guide the design and development of the mission. Lower level requirements shall be provided to the extent that they are known and necessary to explain and justify the design concept, including instrument

capability, instrument performance, and other aspects of the system architecture that enable the accomplishment of the mission science objectives. The Level 2 requirements shall be unambiguous, quantifiable, objective, verifiable, and traceable to the Level 1 requirements.

Provision of draft criteria for investigation success satisfying the Threshold Science Mission is deferred until after selection.

5.1.6 [AO OPTION]Planetary Protection

Investigations are subject to the established NASA policies and procedures that address forward contamination (transmittal from Earth to a targeted Solar System body) and backward contamination (transmittal to Earth from the targeted body) with respect to other Solar System bodies (see NPD 8020.7G, *Biological Contamination Control for Outbound and Inbound Planetary Spacecraft;* NID 8020.109, *Planetary Protection Provisions for Robotic Extraterrestrial Missions*; and NASA-HDBK-6022, *NASA Handbook for the Microbiological Examination of Space Hardware*, in the Program Library). Note that forward contamination is of particular concern for Mars, Europa, Enceladus, and for possible liquid water bodies within other icy satellites.

Investigations involving return of samples from certain target bodies may be required to adopt rigorous containment and biohazard testing protocols in accordance with NASA planetary protection policy (see NID 8020.109A, *Planetary Protection Provisions for Robotic Extraterrestrial Missions*, and NASA/CP-2002-211842, *A Draft Test Protocol for Detecting Possible Biohazards in Martian Samples Returned to Earth*, in the Program Library).

As part of AO requirements, it is required that proposers provide a thorough assessment of planetary protection categorization in their proposal submission.

Requirement 21. Proposals shall assess planetary protection categorization by addressing at least the following questions:

1. Where are you going (target body)?
2. How are you getting there (launch vehicle and propulsion method)?
3. Are you orbiting/landing/roving/hopping/drilling or doing something entirely new?
4. What is your planned instrument payload?
5. What is the end-of-mission plan for hardware such as shutdown in place or propulsion to new location? Include additional locations that could result from an unsuccessful disposal maneuver or relocation by natural processes such as wind and seasonal thawing.
6. Are you thinking of exploration beyond the prime mission to go somewhere else (extended missions to additional target bodies or special regions)?

Requirement 22. Proposals that include an encounter with another Solar System body, via flyby (including gravity assist), orbiter, lander, or end of mission impact shall address plans to comply with planetary protection requirements as required by NPD 8020.7G and NID 8020.109A.

Requirement 23. Proposals that include the return of extraterrestrial samples shall address plans to comply with planetary protection requirements as required by NPD 8020.7G and NID 8020.109A.

Investigations must bear all additional costs generated by any special planetary protection requirements.

See Appendix B, Section J.6, for additional detail.

5.1.7 Science Enhancement Options

Activities such as extended missions, guest investigator programs, general observer programs, participating scientist programs, and/or interdisciplinary scientist programs, where appropriate, have the potential to broaden the scientific impact of investigations. These and other optional activities *may* be proposed as Science Enhancement Options (SEOs). Flight hardware *may not* be proposed as SEOs.

NASA considers any proposed SEO activities as optional. Inclusion of such optional activities in a proposal and/or a Concept Study Report does not imply a commitment from NASA to fund them, even if the baseline investigation is selected. NASA assumes that one or more of the activities specified above will be proposed, even after down-selection, so SEOs need only to be described in proposals if they are atypical (e.g., a guest investigator program that is envisioned to be significantly larger than the historical norm). NASA reserves the right to accept or decline proposed SEO activities at any time during the mission; in particular, the decision may not be made at the time the baseline investigation is down-selected for flight. The process for deciding on SEO activities may involve further reviews (e.g., a "Senior Review" for extended missions). NASA reserves the right to solicit and select all participants (e.g., guest investigators, archival data analysts, and participating scientists) in such programs.

Costs for proposed SEO activities [AO OPTION FOR SINGLE STEPS] must be defined in the proposal, but [END OPTION FOR SINGLE STEPS] [AO OPTION FOR TWO STEPS] may be defined in proposals and must be defined in Concept Study Reports, but in either case [END AO OPTION FOR TWO STEPS] will not count against the PI-Managed Mission Cost. Funding requested for SEO activities prior to Phase E should be minimized. As these proposed activities are optional and are not included within the baseline investigation, the science enabled by SEO activities is not considered as part of the scientific merit of the proposed investigation nor can it be necessary to achieve the proposed investigation objectives.

Requirement 24. If SEO activities are proposed, the proposal shall define and describe the proposed activities[AO OPTION FOR SINGLE STEPS] and their costs[END OPTION FOR SINGLE STEPS].

Requirement 25. If SEO activities are proposed, they shall be clearly separable from the Baseline Science Mission and Threshold Science Mission investigations.

Requirement 26. If an extended mission SEO is proposed, it shall conform to the guidelines provided in the *SMD Mission Extension Paradigm* document found in the Program Library.

See Appendix B, Section E, for additional detail.

5.2 Technical Requirements

5.2.1 Complete Spaceflight Missions

The term "complete" encompasses all appropriate mission phases (see Section 4.1.1) from project initiation (Phase A) through mission operations (Phase E), which must include analysis and publication of data in the peer reviewed scientific literature, delivery of the data to an appropriate NASA data archive, [AO OPTION]preliminary analysis of returned samples, [END OPTION]and, if applicable, extended mission operations or other science enhancements (see Section 5.1.7), and closeout (Phase F). The term "spaceflight missions" is defined as Earth orbital to deep-space missions; it specifically excludes suborbital missions (e.g., via sounding rockets, balloons, and aircraft).

Requirement 27. Proposals submitted in response to this AO shall demonstrate that the proposed investigation is a complete and compelling science investigation requiring a spaceflight mission.

Requirement 28. Proposals shall describe the proposed mission architecture and the rationale for each mission element.

Requirement 29. Proposals shall describe the proposed mission design and mission operations concept.

Requirement 30. Proposals shall describe the proposed flight system concept, including the spacecraft bus and its major subsystems.

Requirement 31. Proposals shall describe the development approach for implementing the proposed mission within schedule and cost constraints, including a project schedule covering Phases A-F.

[AO OPTION]
Proposals traditionally considered as "data buys" are not permitted in response to this AO.
[END OPTION]

Most NASA observations from space require stringent and well-defined calibration and validation plans. NASA expects each proposal to fully describe the requirements for calibration and validation.[AO OPTION] If the collection of some validation data are not to be funded directly by the selected PI-led investigation, the proposal must provide information about the expectations for available calibration and validation instruments and/or commitment to fund the collection of those data in the time frame of five to ten years after selection of the investigation and describe the implications to meeting the requirements if such data do not become available.[END OPTION]

Requirement 32. Each proposal shall fully describe the requirements for calibration and validation.[AO OPTION] If the collection of some validation data are not to be funded directly

by the selected PI-led investigation, the proposal shall provide information about the expectations for available calibration and validation instruments and/or commitment to fund the collection of those data in the time frame of five to ten years after selection of the investigation and describe the implications to meeting the requirements if such activities do not become available.[END OPTION]

See Appendix B, Section F, for additional detail.

5.2.2 Accepted Management Processes and Practices

The document NPR 7120.5E, *NASA Space Flight Program and Project Management Processes and Requirements*, delineates activities, milestones, and products typically associated with Formulation and Implementation of projects; it should be used as a reference in defining an investigation team's management approach. Each implementing organization is free to propose its own processes, procedures, and methods for managing its mission; however, they must be consistent with the principles of NPR 7120.5E. Any deviations from the prescribed requirements in NPR 7120.5E will require a waiver during formulation.

Requirement 33. Proposals shall describe the investigation's proposed management approach, including the management organization and decision-making process, the teaming arrangement, the responsibilities of the PI and other team members, and the risk management and risk mitigation plans (see Appendix B, Section G, for additional detail).

The document NPR 7123.1B, *NASA Systems Engineering Processes and Requirements*, clearly articulates and establishes the requirements on the implementing organization for performing, supporting, and evaluating systems engineering. This systems approach is applied to all elements of a system and all hierarchical levels of a system over the complete project life cycle. NPR 7123.1B should be used in defining the Investigation Team's systems engineering approach. Each implementing organization is free to propose its own processes, procedures, and methods for systems engineering; however, they must be consistent with NPR 7123.1B.

Requirement 34. Proposals shall describe the investigation's proposed systems engineering approach, including plans, tools, and processes for requirements, interfaces, and configuration management. (See Appendix B, Section F, for additional detail).

Requirement 35. Proposals shall describe any deviations from the prescribed requirements in NPR 7120.5E, NPR 7123.1B, or other NASA procedural requirements that will require a waiver during formulation.

5.2.3 New Technologies/Advanced Engineering Developments

NASA has defined four classes of new technologies/advanced engineering developments. Each class is defined by the identity of the technology developer (NASA or the proposal team) and the reliance of the proposed investigation on the technology (enabling or enhancing). Enabling technologies are required for investigation success (e.g., radio-isotope power system for a mission to Uranus); enhancing technologies are not required to investigation success but may contribute to it. NASA-developed technologies are those technologies offered for use in this AO.

Any other new technology proposed to be used will be considered PI-Team-Developed technology.

This AO solicits flight missions, not technology or advanced engineering development projects. However, proposals may contain less mature technologies and/or advanced engineering developments necessary to achieve the Baseline and Threshold Science Missions, which will be considered PI-Team-Developed Enabling Technology Demonstration Opportunities (TDOs). These are permitted as long as proposals contain plans for maturing associated systems to TRL 6 (see NASA/SP-2016-6105 Rev 2, *NASA Systems Engineering Handbook*) by no later than PDR, as well as backup plans that will provide adequate mitigation in the event that the systems cannot be matured as planned. The realism of maturation plans will be evaluated during Step 1 and Step 2, and the technological maturity of these systems will be independently validated at PDR.

For the purpose of TRL assessment, systems are defined as level 3 WBS payload developments (i.e., individual instruments) and level 3 WBS spacecraft elements (e.g., electrical power system); see Figure 3-7 of the *NASA WBS Handbook*, NASA/SP-2010-3404, which can be found in the Program Library. TRLs are defined in NPR 7123.1B *NASA Systems Engineering Processes and Requirements*, Appendix E, which can be found in the Program Library as well.

[AO OPTION—AO authors adjust as necessary]This AO provides the opportunity for additional TDOs, including NASA-Developed Enabling, NASA-Developed Enhancing, and/or PI-Team-Developed Enhancing.[END AO OPTION]

[AO OPTION]Section 5.2.3.1 of this AO provides guidelines for NASA-Developed Enabling TDOs. NASA assumes the responsibility for maturing the offered TDOs to TRL 6. Therefore, proposals that utilize these TDOs, consistent with their specifications, will *not* be required to include a maturation plan for them. Proposals will, however, be required to include a plan for the infusion of these TDOs (see Appendix B, Section J.9). [END OPTION]

[AO OPTION OUTER]Section 5.2.3.2 of this AO provides guidelines for PI-Team-Developed[AO OPTION INNER] and NASA-Developed[END OPTION INNER] Enhancing TDOs. Enhancing TDOs—which are not required to achieve the Baseline or the Threshold Science Mission, but could enhance the scientific return of the proposed mission and/or future missions—are exempt from the requirement to mature systems to TRL 6 by PDR.[END OPTION OUTER]

[AO OPTION—AO authors adjust as necessary]The following table provides a summary of TDO options offered in this AO:

	Relationship to Investigation Success	
	Enabling	**Enhancing**

Technology Developer	**NASA-Developed: NASA is guaranteeing that the technology will be ready by its required milestones**	Panel evaluates infusion of technology, but not its feasibility. Evaluation occurs in Step 1. Backup plan not required.	Panel evaluates accommodation and separability of technology, but not its feasibility. Evaluation occurs in Step 1. Backup plan not required.
	PI-Team-Developed: No NASA guarantee that the technology will be at TRL 6 by mission PDR	Panel evaluates technology as part of the baseline mission. Evaluation occurs in Step 1. Backup plan required.	Panel evaluates merit and feasibility of technology independent of the baseline mission. Separability is also evaluated. Evaluation occurs in Step 1. Backup plan not required.

[END OPTION]

Requirement 36. Proposals that use systems currently at less than TRL 6 shall include a plan for system maturation to TRL 6 by no later than PDR and a backup plan in the event that the proposed systems cannot be matured as planned (see Appendix B, Section F, for additional detail).[AO OPTION] For any system that includes a NASA-Developed Enabling TDO described in Section 5.2.3.1, this requirement only applies to the balance of the system.[END OPTION][AO OPTION] Any TDOs that are Enhancing, whether PI-Team-Developed or NASA-Developed (see Section 5.2.3.2), are exempt from this requirement.[END OPTION]

5.2.3.1 [AO OPTION—AO authors expand as required]NASA-Developed Enabling Technology Demonstration Opportunity

NASA recognizes that technology and continued technological progress are essential to ensure continued success for future missions. NASA is implementing processes to better infuse technology into new missions. A NASA-Developed Enabling TDO consists of NASA-developed technology offered for use as part of a Baseline Science Mission, where NASA will be responsible for development to at least TRL 6. Therefore, proposals that include utilization of a NASA-developed technology will not be required to include a maturation plan for it, as long as the technology is used as specified (e.g., performance and environment). However, proposals will be required to include a plan for the infusion of any NASA-Developed Enabling TDO (see Appendix B, Section J.9). Only the infusion of the proposed TDO will be evaluated against the TMC Feasibility (Criterion C), as applicable; the feasibility of the TDO will not be evaluated.

5.2.3.2 [AO OPTION]Technology Demonstration Opportunity—Enhancing

As part of a new emphasis on innovation, NASA is encouraging the introduction of new technologies for selected mission opportunities. The goal of this effort is to provide a pathway

for new capabilities to be introduced such that investigations with enhanced scientific return may be realized. An Enhancing Technology Demonstration Opportunity (TDO) consists of either PI-team-developed or NASA-developed technologies that may have a TRL of less than 6 when proposed, is not required to achieve the Baseline or the Threshold Science Mission, but could enhance the scientific return of the proposed mission and/or future missions. An Enhancing TDO may be an instrument, investigation, new technology, hardware, or software demonstrated on either the flight system or ground system.

Constraints on the proposed Enhancing TDO are that it may not include the demonstration of a radioisotope power system, and it must be clearly separable from the proposed Baseline and Threshold Science Missions to the extent that it will not impact either if the TDO development has technical, schedule, or cost problems and is deleted from the mission, or if the TDO fails in flight.

If the technology to be demonstrated is PI-team-developed, then the Scientific Merit (Factor A-6) and Implementation Merit (Factor B-7) will be evaluated. TMC Feasibility (Criterion C) will be evaluated independent of the Baseline Science Mission, unless the technology is assessed to not be separable from the Baseline and/or Threshold Science Missions, whereupon the impact to the Missions will also be evaluated. Any PI-Team-Developed Enhancing TDO will be outside of the PI-Managed Mission Cost, with [AO OPTION 1]no specified cost limit.[END OPTION 1][AO OPTION 2]a PI-Team-Developed Enhancing TDO Cost Cap of <<PI-DEV TDO CAP>>.[END OPTION 2][AO OPTION 3]an incentive of <<PI-DEV TDO INCENTIVE>>—any costs in excess of which must be included in the PI-Managed Mission Cost.[END AO OPTION3] Any PI-Team-Developed Enhancing TDO must use innovative technological approaches that may have continuing applicability to future SMD missions.

[AO OPTION 1]No NASA-developed technologies are offered as potential Enhancing TDOs.[END OPTION 1][AO OPTION 2]NASA-developed technologies available for Enhancing TDOs include <<NASA-DEV TDO>>. Only the TMC Feasibility (Criterion C) of the accommodation of the technology will be evaluated, unless it is assessed to not be separable from the Missions, whereupon the impact to the Missions will also be evaluated. Selection or nonselection of an Enhancing TDO will be independent of that for the Baseline and Threshold Science Missions; proposals must address the consequence of nonselection of the Enhancing TDO. Incentives that increase the Adjusted AO Cost Cap include <<NASA-DEV TDO INCENTIVE>>.[END AO OPTION 2]

The cost of any Enhancing TDO accommodation that directly affects the resources available to the Baseline or Threshold Science Mission (e.g., increased launch mass, increased power) must be included in the PI-Managed Mission Cost.

The proposer must clearly identify the proposed Enhancing TDO and describe the innovative technology and/or the enhanced science return. If proposed, the proposer must clearly identify the development schedule of the TDO and describe how it can be developed so as to be separable from the proposed Baseline and Threshold Science Missions.

Review and decision points for determining the TDO readiness for flight must be identified.

Enhancing TDOs will be evaluated as described above using the criteria described in Section 7.2. If NASA selects the proposed mission, NASA may or may not choose to select the TDO.

Requirement 37. If Enhancing TDO activities are proposed, the proposal shall define and describe the proposed activities and their costs. The cost of any Enhancing TDO accommodation that directly affects the resources available to the Baseline or Threshold Mission (e.g., increased launch mass, increased power) shall be included in the PI-Managed Mission Cost.

Requirement 38. If Enhancing TDO activities are proposed, they shall be clearly separable from the Baseline Science Mission and Threshold Science Mission investigations.

5.2.4 Environmental Compliance

The *National Environmental Policy Act* (NEPA) *of 1969*, as amended (42 USC 4321 *et seq.*), is the Nation's policy for the protection, maintenance and enhancement of the environment. It requires NASA to integrate environmental considerations into Agency decisions before taking action. NASA actions include all programs or projects that are financed (even partially), assisted, conducted, regulated, approved or permitted by NASA.

NASA complies with the NEPA by following Council on Environmental Quality (CEQ) and internal Agency regulations. NASA policy requires the preparation of an Environmental Management Plan to ensure the NEPA process is completed during the preliminary design and technology development phase of a mission. When responding to an announcement, proposers must include NEPA cost and schedule needs into their estimates. Please also note that proposers of missions conducted outside the U.S. must comply with Executive Order 12114 (*Environmental Effects Abroad of Major Federal Actions*).

Depending on the complexity of a proposal, the NEPA process will require preparation of one of three levels of NEPA documentation: (i) Record of Environmental Consideration (REC) Routine Payloads; (ii) Environmental Assessment (EA); or (iii) Environmental Impact Statement (EIS).

As of 2011, NASA updated the NASA Routine Payloads EA that provides NEPA coverage for commonly used launch locations and expendable launch vehicles. The EA provides a checklist (available at http://www.nasa.gov/agency/nepa/NRPchecklist) that enables NASA to determine if a proposed mission can be considered “routine" based on the planned launch location, launch vehicle, and envelope payload characteristics. If so, then a REC is prepared that describes the planned mission and includes the completed checklist to provide NEPA compliance. If the checklist reveals that the planned mission does not constitute a “routine” payload, then a mission-specific EA or EIS will be required. An EIS is typically required for payloads that use radioisotope power systems (RPS) and may be required for payloads that use radioisotope heater units (RHUs).

Depending upon the complexity of analysis required, NEPA documentation requiring an EA or EIS can be resource intensive. Costs for an EA are often in the $100K+ range and can require one year to complete. Typical cost estimates to prepare an EIS involving a RPS or RHUs can be $1M+ and require more than one year to complete. NEPA compliance costs specifically

identified in this AO or documents posted to the Program Library must be reflected as reductions to the Adjusted AO Cost Cap; major NEPA milestones must be included in the proposed schedule.

Please contact the NASA NEPA Manager, by phone or email if you have questions concerning NASA environmental compliance requirements. The NASA NEPA Manager phone number and email address may be found at http://www.nasa.gov/agency/nepa/NEPATeam.html.

Requirement 39. The costs of environmental review and launch approval shall be reflected as reductions to the Adjusted AO Cost Cap. The key milestones for environmental review and launch approval shall be accounted for in the proposed schedule.

5.2.4.1 Use of Radioactive Material

[AO OPTION 1 radioactive materials prohibited]The proposed use of radioactive materials of any quantity and any isotope, including radioisotope power sources, radioisotope heater units, or radiological sources for science instruments is prohibited for this AO.[END OPTION 1—delete balance of section]

The proposed use of radioactive materials of any quantity and any isotope, including radioisotope power sources, radioisotope heater units, or radiological sources for science instruments, will require review for environmental impact and Nuclear Launch Safety Approval (NLSA). The environmental review requirements flow from NEPA and are specified in NPR 8580.1, *Implementing the National Environmental Policy Act* and Executive Order 12114. The NLSA requirements are specified in NPR 8715.3D, *NASA General Safety Program Requirements*, Chapter 6: "Nuclear Safety for Launching of Radioactive Materials." The effort required for NLSA varies between a concurrence from the NASA Office of Safety and Mission Assurance for low-level radioactive sources (i.e., with an A2 mission multiple less than 10, as defined in NPR 8715.3D, Chapter 6 and Appendix D) to a full interagency review and approval from the Executive Office of the President for radioisotope power sources or radioisotope heater units.

Requirement 40. If use of radioactive materials is proposed (e.g., for radiological sources or other operational purposes), the proposal shall include a listing of the estimated radioactive materials to be used (isotope, form, quantity). The proposal shall provide a rationale for the use of radioactive materials and reasonable, nonnuclear alternatives.

[AO OPTION 2—only radiological sources]This AO allows for investigations to baseline use of radiological sources for science instrumentation. No radioactive material may be used for supplemental heating or power.[END OPTION 2]

[AO OPTION 3—includes RHU and possibly RPS]This AO allows for missions to baseline use of radioisotope heater units (RHUs). If RHUs are to be used in a mission proposed for this AO, NASA, under an agreement with the Department of Energy (DOE), will provide these, as well as the services associated with their provisioning on space missions. However, the use of RHUs is not without costs; missions will have to reimburse the Department of Energy for the cost of the RHUs (see Requirement 41) and fund the environmental and nuclear launch safety review processes (see Section 5.2.4.3).

Requirement 41. The costs of RHUs and their associated services and any minor sources shall be reflected as reductions to the Adjusted AO Cost Cap (for pricing information, see the *Radioisotope Heater Unit Information Summary* document in the Program Library).

Launch processing of a mission that uses radioisotope heater units and/or radioisotope power systems is a nonstandard launch service that will reduce the Adjusted AO Cost Cap (see Section 5.9.3).[END OPTION 3]

Questions concerning the NLSA process may be addressed to the Nuclear Flight Safety Assurance Manager, NASA Office of Safety and Mission Assurance, by phone or email. The Nuclear Flight Safety Assurance Manager, NASA Office of Safety and Mission Assurance phone and email may be found at https://sma.nasa.gov/sma-disciplines/nuclear-flight-safety.

5.2.4.2 Restricted Sample Return

If a mission plans on returning samples to the Earth from a Solar System body deemed by scientific opinion to potentially harbor indigenous life, a safety approval process with the Executive Office of the President will be necessary (see NID 8020.109). Specific planetary protection requirements for each planned mission will be determined by the NASA Planetary Protection Officer, in accordance NID 8020.109. The direct or indirect environmental effects that may be associated with sample return will have to be documented and the decision to approve the sample return will rest with the NASA Administrator and the Director of the Office of Science and Technology Policy (OSTP). Proposers are encouraged to review the *Sample Return Primer and Handbook* found in the Program Library, which contains procedures for Unrestricted Earth Return. Additional constraints on Restricted Earth Return missions are outlined in NID 8020.109.

5.2.4.3 Accommodating Environmental Review and Launch Approval Requirements

The costs associated with satisfying the requirements of the NEPA and NLSA are borne by a range of organizations.

- If a Radioisotope Power System (RPS) is proposed to be used, the costs of safety analyses associated with its design will be paid for by NASA.
- The launch of radioactive materials entails "nonstandard launch services" which are detailed in the *Launch Services Information Summary* document in the Program Library. The costs for these services are to be considered reductions to the Adjusted AO Cost Cap for missions using RPSs (see Section 5.9.3).
- The costs for the development of some NEPA and NLSA documents are also to be considered reductions to the Adjusted AO Cost Cap. These last costs vary depending on the attributes of the proposed mission, as shown in Table 1.

Also shown in Table 1 are the key milestones that missions will have to accommodate in their scheduling. The proposed mission will only be responsible for providing portions of the documents required to meet these milestones; NASA, DOE, and their contractors will produce the majority of them. Proposed missions, however, must be cognizant of the environmental review and launch approval schedule constraints imposed by NASA's processes.

<<CHECK—particularly if RPSs are allowed>>**Table 1: Key milestones and costs for launch approval processes in FY15 dollars. Costs for nonstandard launch services are not included.**

Mission Attributes				
RHUs?	**Sample Return?**	**A2 Mission Multiple[§]**	**Cost**	**Key Milestones**
No	No	Less than 10	$100K	Final NEPA Document: by PDR
No	No	Between 10 and 500	$800K	Final NEPA Document: by PDR OSMA Nuclear Safety Review Document: 5 months before launch
No	No	Between 500 and 1000	$9M	NEPA Notice of Intent: 19 months before CDR Representative Databook: 26 months before CDR Final NEPA Document: 1 month before CDR Safety Analysis Summary to OSMA: 5 months before launch Final Risk Communication Plan: 1 month before PDR
No	Unrestricted	Less than 10	$500K	Final NEPA Document: by PDR
No	Unrestricted	Between 10 and 500	$800K	Final NEPA Document: by PDR OSMA Nuclear Safety Review Document: 5 months before launch
No	Unrestricted	Between 500 and 1000	$9M	NEPA Notice of Intent: 19 months before CDR Representative Databook: 26 months before CDR Final NEPA Document: 1 month before CDR Safety Analysis Summary to OSMA: 5 months before launch Final Risk Communication Plan: 1 month before PDR
No	Restricted	Any	$7M*	NEPA Notice of Intent: 19 months before CDR Final NEPA Document: 1 month before CDR Final Risk Communication Plan: 1 month before PDR
Yes	No	Any	$25M[†]	NEPA Notice of Intent: 19 months before CDR Representative Databook: 26 months before CDR Final NEPA Document: 1 month before CDR SAR Launch Vehicle Databook: 3 years before launch OSTP Request for Launch Approval: 6 months before launch Final Risk Communication Plan: 1 month before PDR
Yes	Unrestricted	Any	$28M[†]	NEPA Notice of Intent: 19 months before CDR Representative Databook: 26 months before CDR Final NEPA Document: 1 month before CDR SAR Launch Vehicle Databook: 3 years before launch OSTP Request for Launch Approval: 6 months before launch Final Risk Communication Plan: 1 month before PDR
Yes	Restricted	Any	$35M*[†]	NEPA Notice of Intent: 19 months before CDR Representative Databook: 26 months before CDR Final NEPA Document: 1 month before CDR SAR Launch Vehicle Databook: 3 years before launch OSTP Request for Launch Approval: 6 months before launch Final Risk Communication Plan: 1 month before PDR

[§]For a definition of the A2 mission multiple, see NPR 8715.3D, Appendix D.

*This does not include environmental documentation that may be required to cover any use/modification/development of a sample receiving facility.

[†] Use of RHUs will also incur a cost of $11M for nonstandard launch services.

Requirement 42. The costs of environmental review and launch approval shall be reflected as reductions to the Adjusted AO Cost Cap. The key milestones for environmental review and launch approval shall be accounted for in the proposed schedule.

5.2.5 Telecommunications, Tracking, and Navigation

Use of NASA's Near-Earth Network, Space Network, or Deep Space Network (DSN) may be proposed, as appropriate. Points of contact and cost information for these services may be found in the *NASA's Mission Operations and Communications Services* document in the Program Library.

A cost estimation algorithm for the DSN and persons to contact to obtain costs for other networks and various Government-operated facilities are contained in the *NASA's Mission Operations and Communications Services* document or at the DSN Future Missions Planning Office website at http://deepspace.jpl.nasa.gov/advmiss/. For assistance with the cost calculation, contact the persons named on the website. Proposers to this AO who propose the use of the DSN should compute the estimated DSN Aperture Fees and report this in their proposal as a means of assessing the reasonableness of the proposed DSN use. DSN Aperture Fees should not be included in the PI-Managed Mission Cost nor should they appear in any cost table.

When the use of non-NASA communication services is proposed, NASA reserves the option of contracting for those services directly through its Space Communication and Navigation (SCaN) office. Further information may be obtained from the point of contact in the *NASA's Mission Operations and Communications Services* document. NASA funds may not be used for the construction of new facilities for non-NASA communications services.

Requirement 43. Proposals shall include mission requirements for telecommunications, tracking, and navigation; proposals shall also include a plan for meeting those requirements. If non-NASA networks are used, a cost plan for the use of services shall also be included in the PI-Managed Mission Cost.

Where the use of NASA's network services is clearly within the capabilities and capacities described in the *NASA's Mission Operations and Communications Services* document, no Letter of Commitment is required from the NASA network provider.

Where the use of NASA's network services may not be within the capabilities and capacities described in the *NASA's Mission Operations and Communications Services* document, discussions should be initiated with the POC named in that document. In this case, a Letter of Commitment is required from the NASA network provider describing the network's ability to deliver the required capabilities and capacities and the cost for doing so.

It is SMD policy that only one DSN 34-meter antenna will be scheduled at the same time during normal operations of the selected <<PROGRAM NAME>> mission. It is SMD policy that none of the DSN 70-meter antennas may be proposed to support normal operations of the selected <<PROGRAM NAME>> mission. These restrictions do not apply to station hand-offs, critical event coverage, emergency services, radio science measurements, or navigation observations (e.g., delta differential one-way ranging or delta-DOR).

NASA intends to transition all space missions to the use of Ka-band for science data return (telemetry, tracking, and commanding (TT&C) data may still be transmitted using X-band or S-Band). In order to better manage the Agency's transition to Ka-band service, proposed investigations are required to baseline the use of Ka-band for science data return, unless it is inappropriate.

Radio frequency spectrum for telecommunications is allocated by service (e.g., Earth Exploration-Satellite, Space Research, and Space Research (Deep Space)) and may be further constrained by maximum channel bandwidth limits (see the *Available Spectrum and Channel Limits By Allocated Service* document in the Program Library). Proposals are required to address conformance to the applicable maximum channel bandwidth limit(s).

Requirement 44. If use of NASA's network services is proposed, costs for services, as described in the *NASA's Mission Operations and Communications Services* document, including the cost of any development but excluding DSN Aperture Fees, shall be included in the PI-Managed Mission Cost and the proposal's cost plan. Cost estimates for DSN Aperture Fees shall be included in the proposal but not in any cost table.

Requirement 45. If use of NASA's network services beyond the capabilities and capacities described in the *NASA's Mission Operations and Communications Services* document is proposed, the proposal shall include a Letter of Commitment from the NASA network provider; the Letter should confirm the ability of the network to provide the required capabilities and capacities and shall include an estimate of the additional costs for these capabilities and capacities.

Requirement 46. Proposals shall baseline the use of Ka-band for science data return, unless it is inappropriate for the proposed investigation; proposal of an alternative communications approach shall be justified.

Requirement 47. Proposals shall address conformance to the applicable maximum channel bandwidth limit(s).

Requirement 48. Proposals that propose the use of the DSN shall baseline the use of only one DSN 34 meter at any time for normal operations (not including periods of station hand-off, emergencies, Delta-Differential One-Way Ranging measurements, etc.).

5.2.6 Critical Event Coverage

Critical events in the operation of a spacecraft are defined as those that must be executed successfully, usually in a single opportunity, as failure could lead to early loss or significant degradation of the mission if not executed successfully or recovered from quickly in the event of a problem.

NPR 8705.4, *Risk Classification for NASA Payloads,* requires that critical event telemetry be recovered for reconstruction of an anomaly, should one occur. Telemetry coverage is required during all mission critical events to assure data is available for critical anomaly investigations to

prevent future recurrence. NPR 8705.4 provides examples of critical events. Critical event coverage may be provided in any fashion that is deemed appropriate for the proposed investigation.

Requirement 49. Proposals shall specify all critical events for the proposed mission and shall discuss the technical approach, required resources, and implementation concepts for providing critical event telemetry.

5.2.7 [AO OPTION FOR EARTH SCIENCE]Orbital Constellations

If a mission has a need to fly in an existing orbital constellation, such as the Afternoon Constellation (A-train), the proposer should be aware that the constellation members may levy additional requirements on the mission. The *Afternoon Constellation Operations Coordination Plan and Afternoon Constellation Contingency Procedures* documents for the Afternoon Constellation (A-train) can be found in the Program Library.

Requirement 50. Proposals for missions that need to fly in an existing orbital constellation shall acknowledge these requirements and demonstrate that the requirements will be accommodated if the mission is selected. [END AO OPTION FOR EARTH SCIENCE]

5.2.8 Orbital Debris Assessment and End-of-Mission Spacecraft Disposal Requirement

NPR 8715.6B, *NASA Procedural Requirements for Limiting Orbital Debris*, specifies that spacecraft are to limit the generation of orbital debris during operations and spacecraft disposal requirements for all Earth- and Moon-orbiting spacecraft. Earth-orbiting spacecraft must be passivated at the end of the mission prior to disposal and be deorbited within 25 years of end-of-mission (or 30 years after launch, whichever comes first), or be placed in a disposal orbit above 2000 km but not within 300 km of geosynchronous orbit (GEO). Lunar missions must address disposal to avoid increasing the hazard to other spacecraft.

[AO OPTION FOR TWO STEPS]
The requirement associated with this section has been deferred until Step 2.
[END OPTION]
[AO OPTION FOR SINGLE STEPS]
Requirement 51. As applicable for Earth and Moon orbiters, proposals shall demonstrate satisfaction of requirements to limit the generation of orbital debris during mission operations and the disposal per NPR 8715.6B and NASA-STD-8719.14A (see Appendix B, Section J.8, for additional detail).[END OPTION]

5.2.9 Deviations from Recommended Payload Requirements

AO OPTION: <<PROGRAM NAME>> missions are required to meet the requirements for safety, reliability, and mission assurance in the <<PROGRAM NAME>> safety, reliability, and quality assurance requirements document (see Program Library).

Requirement 52. Proposals shall indicate any expected deviations from the recommended requirements in the <<PROGRAM NAME>> safety, reliability, and quality assurance requirements document and in Appendix C of NPR 8705.4 for the payload class specified in Section 4.1.4.

5.2.10 Mission Operations Tools and Services

NASA's Advanced Multi-Mission Operating System (AMMOS) comprises a set of tools and services that support the operations of robotic flight missions (see the AMMOS catalog at http://ammos.jpl.nasa.gov/). AMMOS may be proposed, as appropriate. AMMOS tools and services and their long-term sustaining engineering are fully funded by NASA, and are provided by NASA free of charge to all missions. Only mission-unique adaptations to the AMMOS must be funded by missions. Use of applicable AMMOS tools is expected, although not required. Points of contact and cost information for these services may be found on the AMMOS website specified above.

It is expected that any mission operations tools or services to be developed by the investigation, and their sustaining engineering, will be described and budgeted in the proposal.

Requirement 53. If a ground/operations system solution other than the AMMOS or mission-unique adaptations to the AMMOS is proposed, it shall be described and budgeted for in the proposal.

5.3 Management Requirements

See Appendix B, Section G, for additional detail.

5.3.1 Principal Investigator

The Principal Investigator (PI) is accountable to NASA for the success of the investigation, with full responsibility for its scientific integrity and for its execution within committed cost and schedule. Designation of a deputy PI is recommended, however is not required.

The PI must be prepared to recommend project termination when, in her/his judgment, the minimum subset of science objectives identified in the proposal as the Threshold Science Mission (Section 5.1.4) is not likely to be achieved within the committed cost and schedule.

Requirement 54. A proposal shall identify and designate one, and only one, PI as the individual in charge of the proposed investigation.

5.3.2 Project Manager

The Project Manager (PM) oversees the technical and programmatic implementation of the project. The PM works closely with the PI in order to ensure that the mission meets its objectives within the resources outlined in the proposal.

Proposals may designate a Project Manager Alternate. At selection and subject to approval of NASA, the Alternate may be named as the PM. The qualifications of both the PM and the PM Alternate will be evaluated.

NASA will approve the PM at each transition to the next Phase of implementation as part of the KDP approval process.

Requirement 55. A proposal shall identify and designate one, and only one, PM as the individual charged with the responsibility for overseeing the technical and programmatic implementation of the proposed project. Proposals may optionally name a single Project Manager Alternate.

5.3.3 [AO OPTION FOR FULL MISSIONS]Project Systems Engineer

The Project Systems Engineer (PSE) is responsible for the systems engineering management of the project.

Requirement 56. A proposal shall identify and designate, one and only one, PSE as the individual responsible for the systems engineering process implementation of the proposed project.

5.3.4 PI and PM [ALTERNATIVE OPTION FOR FULL MISSIONS]PI, PM, AND PSE [END OPTION]Roles

Requirement 57. Proposals shall clearly define the respective roles of the PI and PM [ALTERNATIVE OPTION FOR FULL MISSIONS]PI, PM, and PSE[END OPTION].

5.3.5 Management and Organization Experience and Expertise

The qualifications and experience of the PI, PM, Project Systems Engineer (PSE), Deputy PI (if specified), Project Manager Alternate (if specified), Project Scientist (where appropriate), partner leads for substantial efforts, and other named Key Management Team members of the PI-led investigation team must be—taken together—commensurate with the technical and managerial needs of the proposed investigation.[AO OPTION FOR STREAMLINED CLASS D—update Factors B-5 and C-4 as appropriate (i.e., when Class C or higher risk classifications are not possible)] For missions with a proposed risk classification of Streamlined Class D, the spaceflight experience of the PI will not be considered in the assessment of the experience and expertise of the members of the named Key Management Team. However, comments may be provided to the Selection Official—including whether appropriate mentoring and support tools are in place—for consideration in selection and down-selection.[END OPTION]

The PI may delegate some responsibility for the ensurance that the mission meets schedule and cost constraints to the institutions as overseen by the PI. Regardless of such delegation, NASA will hold the PI ultimately responsible for mission success. It is responsibility of the PM, the implementing organization, and all partners to provide the quality personnel and resources necessary to meet the technical and managerial needs of the mission.

The commitment, spaceflight experience, and prior working relationships of the implementing organization and all partners will be assessed against the needs of the investigation.

Requirement 58. Proposals shall identify named Key Management Team members. At a minimum, the individuals proposed to fill the roles of [AO OPTION]PI and PM per Requirement 54 and Requirement 55[END OPTION][ALTERNATIVE OPTION FOR FULL MISSIONS]PI, PM, and PSE per Requirement 54, Requirement 55, and Requirement 56[END OPTION] shall be named. Proposals shall describe the qualifications and experience of the individuals who will

occupy the positions. Proposals shall also demonstrate that the qualifications and experience are commensurate with the technical and managerial needs of the proposed investigation. The time commitment of each named Key Management Team member shall be provided by mission phase.

Requirement 59. Proposals shall identify other positions that will be filled by Key Management Team members. These requirements are, at a minimum, the [AO OPTION]PSE, [END OPTION]Deputy PI (if specified), Project Manager Alternate (if specified), and, where appropriate, the PS and partner leads for substantial efforts. For Key Management Team positions to which members are not named, proposals shall describe the qualifications and experience required of any candidate who will occupy those positions. Proposals shall also demonstrate that the qualifications and experience are commensurate with the technical and managerial needs of the proposed investigation.

Requirement 60. Proposals shall describe the qualifications and experience of the implementing organization and all partners, and demonstrate that they are commensurate with the technical and managerial needs of the proposed investigation.

5.3.6 Risk Management

Proposers must demonstrate clear understanding of specific risks inherent in the formulation and implementation of their proposed investigation and must discuss their approaches to mitigating these risks. Examples of such risks that must be discussed in the proposal are: any new technologies/advanced engineering developments; any nontrivial modifications or upgrades of existing technologies; any validation of heritage technology for the mission context; any manufacturing, test, or other facilities needed to ensure successful completion of the proposed investigation; any need for long-lead items that must be placed on contract before the beginning of Phase C to ensure timely delivery; any contributions that are critical to the success of the mission; and potential launch delay costs—including penalties and storage fees—as a result of spacecraft or payload delays.

Requirement 61. Proposals shall define and discuss the major risks to the formulation and implementation of the proposed investigation.

Requirement 62. Proposals shall discuss management approaches to mitigate risks to ensure successful achievement of the investigation objectives within the committed cost and schedule.

The differences between the Baseline Science Mission and the Threshold Science Mission (see Section 5.1.4) may provide some resiliency to potential cost and/or schedule growth in the proposed formulation and implementation of the investigation. One method of responding to such growth is to descope the mission. Any set of descopes, which still allows the investigation to satisfy the objectives of the Threshold Science Mission, may be proposed.

Requirement 63. If the proposed risk management approach includes potential descoping of mission capabilities, the proposal shall include a discussion of the approach to such descopes, including savings of resources (mass, power, dollars, schedule, etc.) by implementing descopes,

the decision milestone(s) for implementing descopes, and the scientific impact of individual, as well as combined, descopes.

Requirement 64. Proposals that include international participation shall address the risk resulting from any international contributions to the proposed mission (see Section 5.6.7 and Section 5.7).

5.3.7 Compliance with Procurement Regulations by NASA PI Proposals

Proposals submitted by NASA Centers are required to comply with regulations governing proposals submitted by NASA PIs (NASA FAR Supplement (NFS) 1872.306).

Requirement 65. Proposals submitted by NASA Centers shall contain any descriptions, justifications, representations, indications, statements, and/or explanations that are required by the regulations in NFS 1872.306 (see Appendix B, Section J.10, for additional detail).

5.4 Science Team, Co-Investigators, and Collaborators

5.4.1 Science Team

Requirement 66. Proposals shall clearly define the science team necessary to successfully conduct the science investigation.

5.4.2 Co-Investigators

A Co-Investigator (Co-I) is defined as an investigator who plays a necessary role in the proposed investigation. A Co-I's services are either funded by the <<PROGRAM NAME>> Program or are contributed.

Every Co-I must have a role that is required for the successful implementation of the mission, and the necessity of that role must be justified. The identification of any unjustified Co-Is may result in the downgrading of an investigation and/or the offer of only a partial selection by NASA.

Requirement 67. Proposals shall designate all Co-Is, describe the role of each Co-I in the development of the mission, and justify the necessary nature of the role.

Requirement 68. Proposals shall identify the funding source for each Co-I. If funded by the <<PROGRAM NAME>> Program, costs shall be included in the PI-Managed Mission Cost. If contributed, the costs shall be included in the Total Mission Cost.

5.4.3 Collaborators

A collaborator is an individual who is less critical to the successful development of the mission than a Co-I. A collaborator must not be funded by the <<PROGRAM NAME>> Program. A collaborator may be committed to provide a focused contribution to the project for a specific task, such as data analysis. If <<PROGRAM NAME>> Program funding support is requested in the proposal for an individual, that individual must not be identified as a collaborator, but must be identified as a Co-I or another category of team member.

Requirement 69. Proposals shall identify and designate all collaborators and describe the role of each collaborator in the development of the mission.

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Requirement 70. Proposals shall identify the funding source for each collaborator; the costs shall be included in the Total Mission Cost.

5.5 Small Business Participation, Education Program Plan, and Communications and Outreach Program

5.5.1 Small Business Participation

It is the policy of the Government when contracts are issued to emphasize subcontracting opportunities for small businesses. Proposers are advised that NASA is subject to statutory goals to allocate a fair portion of its contract dollars to small businesses, small disadvantaged business (SDB) concerns, Historically Black Colleges and Universities (HBCUs), and Other Minority Institutions (OMIs), as these entities are defined in Federal Acquisition Regulations (FAR) 52.219-8 and 52.226-2. Proposers are encouraged to assist NASA in achieving these goals by using best efforts to involve these entities as subcontractors to the fullest extent consistent with efficient performance of their investigations.

Proposers are advised that, by law, for NASA prime contracts resulting from this solicitation that offer subcontracting possibilities, exceed <<FAR 19.708(B) TSHLD>>, and are with organizations other than small business concerns, the clause at FAR 52.219-9 will apply. Proposers other than small businesses submitting a proposal are advised that a small business subcontracting plan is required with goals for subcontracting with small business (SB), small disadvantaged business (SDB), veteran-owned small business (VOSB), service-disabled veteran-owned small business (SDVOSB), Historically Underutilized Business Zone (HUBZone) small business (HBZ), women-owned small business (WOSB), Historically Black Colleges and Universities (HBCU), and Other Minority Institutions (OMI) entities to the maximum practicable extent. Failure to submit a required subcontracting plan will make the proposer ineligible for selection. The subcontracting plans will be evaluated on the participation goals and quality and level of work performed by small business concerns overall, as well as that performed by the various categories of small business concerns listed in FAR 52.219-9.

Proposals are *not* required to include small business subcontracting plans; however, selected investigations *will be required* to provide them prior to negotiation and award, as applicable (see Section 7.4.3). Failure to submit a subcontracting plan after selection will make the proposer ineligible for award of a contract. The subcontracting plans will be evaluated on the participation goals and quality and level of work performed by small business concerns overall, as well as that performed by the various categories of small business concerns listed in FAR 52.219-9.

At the time the Phase A Concept Study Report is delivered, regardless of whether subcontracting plans are submitted with the Step-1 proposal, proposers other than small business concerns are required to submit small business subcontracting plans, covering Phases B/C/D/E/F. Failure to submit a subcontracting plan will make the proposer ineligible for subsequent implementation and operation phases. As part of the Step-2 continuation (down-select) decision process, these subcontracting plans will be evaluated on the participation goals and quality and level of work

performed by small business concerns overall, as well as that performed by the various categories of small business concerns listed in FAR 52.219-9.

5.5.2 Education Program Plan, and Communications and Outreach Program

Among NASA's strategic goals is to communicate the results of its efforts to the American public and to enhance the science and technical education of the next generation of Americans. However, Education Program plans are not needed at this time. NASA may impose Education Program requirements during or subsequent to Phase A, and will negotiate any additional funding necessary to meet these requirements.

A Communications and Outreach Program (previously referred as Public Outreach) will be required. Mission-related communications will be negotiated and funded directly through a NASA Center. The communications plan must be developed during Phase B of the mission. The plan must include topline messaging, target audiences, and media processes linked to reaching target audiences and associated detailed budgets, milestones, metrics and timelines, and reporting requirements.

5.5.3 Student Collaboration (SC) (optional)

PI-led missions potentially provide active research opportunities for current or aspiring graduate or undergraduate students, including advanced high schoolers. SCs may involve students in multiple aspects of a mission spanning scientific formulation; mission planning; systems engineering; design and development of flight hardware; qualification, test and integration; and mission operations.

An ideal SC provides a hands-on experience for students that focuses on the unique demands of instrument development, flight systems, environments, and operations, and on the opportunity to acquire early knowledge of systems engineering techniques. SC provides the opportunity for authentic, real-world experiences that span development through the operational phases of a mission. The focus on graduate students and undergraduate students, as well as advanced high schoolers, for SC is a priority because it is at this critical junction that individuals, including from groups traditionally underrepresented or underserved in STEM, make decisions to pursue and persist in degrees that will provide the skills required by the future space science workforce.

The objective of an SC is enhancement of student research experience through collaborative work associated with a specific NASA spaceflight mission. This is not to be confused with a Scholarship or Fellowship, where the sole objective is the training/development of a particular student. This flight mission SC is not one of the specific opportunities for NASA Scholarships and Fellowships. OMB Uniform Guidance, 2 CFR Part 200.466, "Scholarships and student aid costs", clarifies the difference between a Scholarship or Fellowship and the allowable compensation of a student research assistant employed under an SC.

SC funds may also be requested to purchase special equipment, modify equipment, or provide services required specifically for the work to be undertaken by special needs students. Examples of such efforts include, but are not limited to, the provision of prosthetic devices to manipulate a particular apparatus; the acquisition of equipment to convert sound to visual signals, or vice versa, for a particular experiment; accessing a special site or usage of a mode of transportation

(rental services only—no vehicle purchases permitted); or, support of a reader or interpreter with special technical competence related to the project.

If a proposed investigation is selected, NASA retains the option to fund or not to fund the proposed SC in full or in part. There is no minimum and no maximum allowable cost for a SC. NASA is providing a SC option that is defined to be 1% of the PI-Managed Mission Cost. Contributions to the SC are permitted. The proposed NASA cost of the SC, up to the SC incentive, will be outside of the PI-Managed Mission Cost. If the SC costs NASA more than the SC incentive, then the balance of the NASA cost of the SC must be within the PI-Managed Mission Cost. SC resources, as an addition to a mission's implementation, are not available to solve mission cost overrun issues. SC provides no cost-savings to a NASA mission.

A proposed SC will be evaluated only for its impact on mission feasibility. The merit of the proposed SC will be evaluated later, as part of [AO OPTION FOR TWO STEPS]the Step-2 evaluation[ALTERNATIVE AO OPTION FOR SINGLE STEPS]the reviews leading to KDP-B[END AO OPTIONs]; see SMD Student Collaboration document in the Program Library. The three SC review criteria are:

- *Quality, Scope, Realism, and Appropriateness*. Student level and the project's SC research objectives are both clearly defined. SC mentors and supervisors are identified and have clear lines of responsibilities. A description of what constitutes, to the proposer, a successful SC effort.
- *Diversity*. SC participant recruitment and retention (R&R) practices or proposed inclusion strategies are described. Proposed R&R likely to reach disadvantaged individuals and/or those from groups underrepresented in STEM.
- *Evaluation*. The SC has proposed evaluation methodology based on techniques appropriate to the SC activities proposed. The evaluative processes will document outputs and intended outcomes and use metrics to demonstrate progress or explain the lack of achievement by the SC component.

To address the merit evaluation, SC proposals will be required to include appropriate plans and budgets for evaluation, participant recruitment and retention, mentoring and oversight of students to maximize their learning and describe R&D conduct, particularly design and development of flight systems; assembly, integration and test; and mission operations and data analysis that enhances without interference the mission's success.

Requirement 71. If a proposal contains a SC, the proposal shall demonstrate that the proposed SC is clearly separable from the proposed Baseline and Threshold Science Missions; will not increase the mission development risk; and will not impact the science investigation in the event that the SC is not funded, fails during flight operations, or encounters technical, schedule, or cost problems during development (see Appendix B, Section I, for additional detail).

Requirement 72. If a proposal contains a SC, the proposal shall identify the funding set aside for the SC. This funding may be outside the PI-Managed Mission Cost up to the Student Collaboration incentive, and any SC costs beyond the Student Collaboration incentive shall be within the PI-Managed Mission Cost.

5.6 Cost Requirements

5.6.1 PI-Managed Mission Cost and Total Mission Cost

The [AO OPTION]Phase A-D portion of the [END OPTION]PI-Managed Mission Cost, including all mission phases, excluding the cost of launch vehicles (Section 5.9.3), is capped at the AO Cost Cap of $<<CAP>> FY <<CAP YEAR>> dollars, or an Adjusted AO Cost Cap as applicable.

Requirement 73. Proposals shall include the proposed PI-Managed Mission Cost and the proposed Total Mission Cost in the required AO cost table [ALTERNATIVE AO OPTION FOR SINGLE STEPS] all required AO cost tables [END OPTION] (see Appendix B, Section H).

Requirement 74. The proposed costs shall comply with and specify the AO Cost Cap or Adjusted AO Cost Cap, as applicable.

Requirement 75. No more than 25% of the PI-Managed Mission Cost shall [AO OPTION] typically [END OPTION] be incurred prior to KDP-C (Confirmation). [AO OPTION] With proper justification based on heritage and/or risk reduction, up to <<KDP-C LIMIT>>% may be proposed.

5.6.2 [AO OPTION FOR TWO STEPS]Cost of the Phase A Concept Study

Proposers selected through this AO will be awarded a contract to conduct a Phase A concept study with a duration of approximately <<PH A DUR>> months following the establishment of initial contracts. The cost of the Phase A concept study is capped at $<<PH A CAP> FY <<CAP YEAR>> dollars (FY<<CAP YEAR>>$). See Sections 7.4.3 and 7.4.4 for additional information on the Phase A concept study.

Requirement 76. Proposals shall include the cost of the Phase A concept study funded by the Program sponsoring the AO; the cost shall be included within the PI-Managed Mission Cost, and shall not exceed $<<PH A CAP> FY <<CAP YEAR>> dollars (FY<<CAP YEAR>>$).

The unique mission management approaches and organizational arrangements in the selected proposals may require the Program Office to implement diverse contract administration and funding arrangements.

Requirement 77. Proposals shall specify the proposed teaming arrangements for the Phase A concept study, including any special contracting mechanisms that are advantageous for specific partners in the team. If more than one contractual arrangement between NASA and the proposing team is required, proposals shall identify how funds are to be allocated among the partnering organizations.

5.6.3 Cost Estimating Methodologies and Cost Reserve Management

As the provision of cost details is not anticipated until the conclusion of concept studies, proposals may use estimates derived from models or cost estimating relationships from analogous missions (see Appendix B, Section H, for additional detail). However, the credibility

of proposed costs is likely to be enhanced by the application of methodologies that are typically employed for mature projects.

Requirement 78. Proposals shall identify the methodologies (cost models, cost estimating relationships of analogous missions, etc.) and rationale used to develop the proposed cost.

Requirement 79. Proposals shall include a discussion of sources of estimate error and uncertainty in the proposed cost and management approaches for controlling cost growth.

Proposals that are unable to show adequate unencumbered cost reserves are likely to be judged a high risk and not selected. For the purpose of this AO, the unencumbered cost reserves on the PI-Managed Mission Cost are measured as a percentage against the cost to complete through Phases A/B/C/D. The numerator is the amount of unencumbered cost reserves for Phases A/B/C/D, not including funded schedule reserve. The denominator is the PI-Managed Mission Cost to complete Phases A/B/C/D, including the cost of technical design margin, including funded schedule reserve, and encumbered cost reserve, but not including unencumbered cost reserve. [AO OPTION] The calculation for Phases E/F is separate but uses the same methodology. [END OPTION]

Adequate unencumbered cost reserves must be demonstrated at each of the following milestones: KDP-A (demonstrated in the proposal), KDP-B (demonstrated in the Phase A Concept Study Report), KDP-C (the independent cost estimate for Confirmation), and KDP-D (at the end of Phase C). [ALTERNATIVE AO OPTION] KDP-D (at the end of Phase C), KDP-E (generally 30 days before launch), and KDP-F (at the end of Phase E). [END OPTION]

Requirement 80. Proposals shall identify and justify the adequacy of the proposed cost reserves. Proposals shall include a minimum of 25% of unencumbered cost reserves against the cost to complete Phases A/B/C/D and shall demonstrate an approach to maintaining required unencumbered cost reserves through subsequent development phases.

Requirement 81. [AO OPTION] Although minimum unencumbered cost reserves are not specified in this AO for Phases E or F, proposals shall establish, identify and justify adequate reserves for these phases of the mission. [END OPTION]

5.6.4 Work Breakdown Structure

Requirement 82. Proposals shall provide a Work Breakdown Structure (WBS) that conforms to the standard prescribed in Appendix G of NPR 7120.5E. Costs for most elements shall be specified to WBS Level 2. Exceptions are the costs of elements that explicitly appear only at a level below WBS Level 2; these exceptions include individual instruments, unique flight system elements, the use of NASA or NASA-procured tracking and communications, and data analysis/archiving (see Appendix B, Section H, for additional detail).

5.6.5 Master Equipment List

Requirement 83. Proposals shall include a Master Equipment List (MEL) summarizing all spacecraft system element components and individual instrument element components to support

validation of proposed mass estimates, power estimates, contingencies, design heritage, and cost (see Appendix B, Section J.11, for additional detail).

5.6.6 Full Cost Accounting for NASA Facilities and Personnel

For the purpose of calculating the full cost of NASA-provided services, proposal budgets from NASA Centers, whether as the proposing organization or as a supporting organization, are to include within the PI-Managed Mission Cost all costs normally funded by an SMD Project under NASA's full cost accounting practices, including civil servant labor (salaries and benefits), civil service travel, and procurements. All of these costs must be clearly identified by year within the budget justification section of the proposal.

Estimated NASA Center Management and Operations (CM&O) overhead costs must also be included within the PI-Managed Mission Cost, to enable a level playing field for all proposers. Per NASA HQ policy guidance signed in June 2010 by the Associate Administrator for the Mission Support Directorate and by the Agency Chief Financial Officer, all NASA Centers are to use an identical CM&O burden rate of $47K (Fiscal Year 2019) per "equivalent head." As per Agency policy, this rate must be applied as a "cost per equivalent head" to all Civil Servant Full-Time Equivalents (FTEs) plus on or near-site contractor Work-Year Equivalents (WYEs) associated with the proposal. The estimated FTEs and WYEs per Fiscal Year, and the resulting CM&O burden, must be identified in a separate table within the budget justification section of the proposal. The CM&O rate will not change from year to year in Fiscal Year (FY) 2019 dollars, but in Real Year (RY) terms, it will inflate.

The CM&O burden costs must be clearly denoted in all budget tables. These costs may not be included or rolled into any other budget lines in such a way that they become unidentifiable.

Do not include within the cost proposal, or within the PI-Managed Mission Cost, any estimate for Agency Management and Operations (AM&O, a.k.a. NASA HQ overhead).

Cost Elements for NASA Center Budget Proposals in response to SMD AOs

	Identify in proposal?	Include in PI-Managed Mission Cost?	Funding source	Comments
Civil Service Labor	Yes	Yes	SMD Program	Includes salaries and benefits
Civil Service Travel	Yes	Yes	SMD Program	
Other Direct/Procurements	Yes	Yes	SMD Program	Includes procurements as typically identified by flight projects in the NASA N2 budget database
CM&O	Yes	Yes	CASP	Applied to NASA-provided labor, including Center civil servants and on-site contractors
AM&O	No	No	CASP	

NASA Contributed Costs	Yes	No	Identify	Must be non-SMD
Non-NASA Federal Government (funding requested from NASA)	Yes	Yes	SMD Program	If NASA funding is requested for the non-NASA Federal Government agency
Contributions	Yes	No	Identify	Includes all non-NASA contributions

Requirement 84. Proposals including costs for NASA Centers shall conform to the full cost policy stated in this section. Each of the elements of the NASA Center costs (direct labor, travel, procurements) shall be separately identified by year.

If any NASA funded item(s) or services are to be considered as contributed costs, then the contributed item(s) must be separately funded by a non-SMD effort complementary to the proposed investigation, the value of the contribution(s) must be estimated, and the funding source(s) must be identified.

Requirement 85. If any NASA funded item(s) or services are considered as contributed costs, then the proposal shall estimate the value of the contribution(s) and shall identify the funding source(s).

Any non-NASA Federal Government costs must follow the appropriate Agency accounting standards for full cost. If no standards are in effect, the proposers must follow the *Managerial Cost Accounting Concepts and Standards for the Federal Government*, as recommended by the Federal Accounting Standards Advisory Board and available in the Program Library.

Requirement 86. Proposals including costs for non-NASA Federal Government agencies shall follow the applicable accounting standards.

5.6.7 Contributions

Contributions from both U.S. and non-U.S. sources other than the <<PROGRAM NAME>> Program and other SMD programs are welcome. These may include, but are not limited to, labor, services, [AO OPTION]alternative access to space, [END OPTION]and/or contributions to the instrument complement or the spacecraft, subject to the following exceptions and limitations: (i) contributions of non-U.S. nuclear power sources are prohibited; and (ii) in order to ensure a preponderance of NASA interest in the mission, as well as to ensure that missions of roughly comparable scope are proposed for purposes of equitable competition, the sum of contributions of any kind to the entirety of the investigation is not to exceed one-third (1/3) of the proposed PI-Managed Mission Cost. Such contributions will not be counted against the PI-Managed Mission Cost, but they must be included in the calculation and discussion of the Total Mission Cost (Section 4.3.2).

A contribution does not alleviate the responsibility of the PI and management team to exert penetrating and timely oversight on the development, delivery, and performance of the contribution. The PI remains accountable to NASA for the success of the entire investigation,

including contributions, with full responsibility for its scientific integrity and for its execution within committed cost and schedule (Section 5.3.1).

Values for all contributions of property and services must be established in accordance with applicable cost principles. The cost of contributed hardware must be estimated as either: (i) the cost associated with the development and production of the item, if this is the first time the item has been developed and if the mission represents the primary application for which the item was developed; or (ii) the cost associated with the reproduction and modification of the item (i.e., any recurring and mission-unique costs), if this is not a first-time development. If an item is being developed primarily for an application other than the one in which it will be used in the proposed investigation, then it may be considered as falling into the second category (with the estimated cost calculated as that associated with the reproduction and modification alone).

The cost of contributed labor and services must be consistent with rates paid for similar work in the proposer's organization. The cost of contributions does not include funding spent before the start of the investigation (i.e., before initiation of Phase B). [ALTERNATIVE AO OPTION FOR SINGLE STEPS] The cost of contributions does not include funding spent before selection of the investigation. [END OPTION] The value of materials and supplies must be reasonable and must not exceed the fair market value of the property at the time of the contribution.

Requirement 87. If a proposal includes one or more contributions, the proposal shall separately identify all contributions, the organizations providing the contributions, and the organizations providing the funding for the contributions; the costs for the contributions shall be separately identified within the Total Mission Cost.

Requirement 88. If a proposal includes one or more contributions, the total value of the contributions shall be established in accordance with the applicable and stated cost principles and shall comply with the stated cap on the sum of all contributions[AO OPTION] and the cap on contributed instruments[END OPTION].

Letters of Commitment are required from each organization responsible for a contribution (for U.S. organizations, see Section 5.8.1.1 and Requirement 99; for non-U.S. contributing organizations, see Section 5.7.2, Section 5.8.1, and Requirement 93).

The requirement for institutional Letters of Commitment for contributions does not apply to contributed support for collaborators. The requirement for personal statements of commitment from collaborators is given in Section 5.8.2 and Requirement 101.

A contributed item that is essential for the success of the proposed investigation and/or is in the critical path of mission development is a risk factor. Risks include the failure of funding or contributions to materialize when they are outside the control of the PI. Mitigation may include, but is not limited to, descoping the contributed items and/or holding reserves to develop the contribution directly. When no mitigation is possible, this should be explicitly acknowledged and the rationale for accepting the unmitigated or residual risk should be explicitly stated.

Requirement 89. If a proposal includes contributions that are essential to the success of the proposed investigation or in the critical path, the proposal shall include: (i) demonstrations of clear and simple technical and management interfaces in the proposed cooperative arrangements, (ii) explicit evidence that the proposed contributions are within the contributors' scientific and technical capabilities, and (iii) contingency plans for coping with potential failures of proposed cooperative arrangements or, where no mitigation is possible, an explicit acknowledgement to that effect and an explicit rationale for accepting the risk.

[AO OPTION TO END OF SECTION]For proposals with contributed alternative access to space (Section 5.9.4), all requirements in Appendix B still apply. Where a resource is being contributed (e.g., launch services, host spacecraft), all of the information required might not be available to the proposer (e.g., Appendix B, Section F.2). Nevertheless, the proposal must provide sufficient information on the availability of that resource for NASA to assess whether the mission's resource requirements can be met and steps the PI will take to assure the mission's success.

Requirement 90. If a proposal includes contributed alternative access to space, it shall provide sufficient information for NASA to assess whether the mission's resource requirements can be met and how the PI will assure the mission's success.

5.7 Non-U.S. Participation Requirements

5.7.1 Overview of Non-U.S. Participation

NASA solicits research proposals from both U.S. and non-U.S. sources (see NFS 1835.016-70) with some restrictions (see Section 4.2.2).

NASA's policies for international cooperation in space research projects may be found in NPD 1360.2B, *Initiation and Development of International Cooperation in Space and Aeronautics Programs* (available in the Program Library). The characteristics of successful international cooperation include mutual benefits, clearly defined division of responsibilities, responsibilities for each participant within known capabilities, recognition of export control laws prohibiting the unwarranted transfer of technology abroad, and no-exchange-of-funds. Because space research projects generally involve major investments of resources, and because NASA is a Government agency, NASA's counterparts will generally be non-U.S. Government agencies rather than non-U.S. universities or private organizations.

Owing to NASA's policy to conduct research with non-U.S. entities on a cooperative, no-exchange-of-funds basis, NASA does not normally fund non-U.S. research proposals or non-U.S. research efforts that are part of U.S. research proposals. Rather, cooperative research efforts are normally implemented via agreements between NASA and the appropriate non-U.S. entity. Non-U.S. proposers, whether as primary proposers or as participants in U.S. research efforts, must arrange for non-U.S. financing for their portion of the research.

The direct purchase of supplies and/or services, which do not constitute research, from non-U.S. sources by U.S. award recipients is permitted.

[AO OPTION]

Requirement 91. Foreign contributions to the science instruments shall not to exceed one-third (1/3) of the science payload (elements 4.0 (Science) and 5.0 (Payload(s)) in the standard Work Breakdown Structure). See NPR 7120.5E and references therein.
[END OPTION]

5.7.2 General Guidelines Applicable to Non-U.S. Proposals and Proposals including Non-U.S. Participation

All non-U.S. proposals will undergo the same evaluation and selection process as those originating in the U.S. All proposals must be typewritten in English and must comply with all submission requirements stated in this AO and in Appendix B of this AO.

Requirement 92. Unless otherwise noted, proposals from non-U.S. entities shall not include a cost plan unless the proposal involves collaboration with a U.S. institution, in which case a cost plan that covers only the participation of the U.S. entity shall be included. Proposals from U.S. institutions with non-U.S. participation shall include a cost plan that only covers U.S. entities.

Requirement 93. Proposals from non-U.S. entities and proposals from U.S. entities that include non-U.S. participation shall be formally endorsed, through Letters of Commitment, by the responsible funding agency in the country of origin. The required elements of a Letter of Commitment for a contribution are given in Section 5.8.1.1. In addition to these required elements, endorsements from foreign entities shall indicate that the proposal merits careful consideration by NASA and that, if the proposal is selected, sufficient funds will be made available to undertake the proposed activity. Officials who are authorized to commit the resources of the non-U.S. funding agencies shall sign these Letters of Commitment.

Contributions from non-U.S. sources offer benefits but also represent complexity and risk to a project. The benefits of proposed contributions will be assessed as they contribute to scientific and technical merit and feasibility. The stability and reliability of proposed partners, and the appropriateness of any proposed contribution, will be assessed outside of the evaluation process, as a programmatic risk element in the proposal.

Requirement 94. Proposals from U.S. proposers shall include a discussion of mitigation plans, where possible, for the failure of non-U.S. funding or contributions to materialize when they are outside the control of the PI. When no mitigation is possible, this shall be explicitly acknowledged and the rationale for accepting the unmitigated or residual risk shall be explicitly stated.

Mitigation may include, but is not limited to, descoping the contributed items and/or holding reserves to develop the contribution directly. Note that reserves held for this purpose should be weighted by likelihood and will be considered by NASA to be encumbered. When no mitigation is possible, this must be explicitly acknowledged and the rationale for accepting the unmitigated or residual risk must be explicitly stated. In addition to budget and technical risk, non-U.S. contributions introduce schedule risk for implementing agreements, as well as for obtaining any necessary licenses for exchanges of goods and technical data. An adequate and realistic schedule must be allocated for having international agreements executed. NASA will not normally initiate

development of any international agreements until after the down-select decision is made at the conclusion of Phase A.

Any proposed non-U.S. participation must be described at the same level of technical, schedule, and management detail as that of U.S. partners. A cost plan for the non-U.S. participation should not be included, though (see Requirement 92). Failure to document technical and schedule data, management approaches, or failure to document the commitment of team members or funding agencies may cause a proposal to be found unacceptable.

Requirement 95. To the maximum extent practical, and allowing for any AO-specified exemptions (e.g., Requirement 92) any proposed non-U.S. contribution shall be described at the same level of detail as those of U.S. partners.

Requirement 96. Proposals with non-U.S. participation shall include a table listing: (i) non-U.S. participants (individuals, institutions), (ii) roles and responsibilities, (iii) funding organization, (iv) approximate value of any non-U.S. participation and method for estimating value (detailed budget not required), and (v) cross-reference to any Letters of Commitment in the proposal appendix. Proposals with non-U.S. participation shall clearly describe the flow of design requirements (potentially export-controlled information) and hardware between U.S. and non-U.S. participants. This description may take the form of an exploded diagram. See Section J.4 of Appendix B.

5.7.3 Agreements with Selected Non-U.S. Participants

Should a non-U.S. proposal or a U.S. proposal with non-U.S. participation be [AO OPTION 1 for two steps]down-selected[END OPTION][AO OPTION 2 for single steps]selected[END OPTION], NASA's Office of International and Interagency Relations will arrange with the non-U.S. sponsor for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsor will each bear the cost of discharging its respective responsibilities.

It is the policy of NASA to establish formal agreements with non-U.S. partners in cooperation on flight missions. [AO OPTION FOR TWO STEPS]Owing to the short duration of the concept study phase, it is not possible for NASA to conclude an international agreement prior to the due date for Concept Study Reports. [END OPTION]In some cases, interim agreements may be put in place, after the conclusion of Phase A, until a more permanent arrangement is reached.

Requirement 97. If applicable, proposals shall show how formulation can be completed in the absence of an international agreement.

5.7.4 Export Control Guidelines Applicable to Non-U.S. Proposals and Proposals including Non-U.S. Participation

Requirement 98. Non-U.S. proposals and U.S. proposals that include non-U.S. participation shall describe plans for compliance with U.S. export laws and regulations, e.g., 22 CFR parts 120–130 and 15 CFR parts 730–774, as applicable to the circumstances surrounding the particular non-U.S. participation (see Appendix B, Section J.5, for additional detail).

5.8 Additional Proposal Requirements

5.8.1 Institutional Letters of Commitment

Institutional Letters of Commitment signed by an institutional official must be provided from (i) all organizations offering contributions of goods and/or services (both U.S. and non-U.S.) on a no-exchange-of-funds basis and (ii) all major organizational partners in the proposal regardless of source of funding. See Appendix B, Section J.2, for additional detail.

5.8.1.1 Institutional Letters of Commitment for Contributions

The required elements in an Institutional Letter of Commitment for a contribution are: (i) evidence that the institution and/or appropriate Government officials are aware and supportive of the proposed investigation; (ii) a precise description of what is being contributed by the partner and what assumptions are being made about NASA's role; (iii) a statement that the organization intends to provide the contribution or required funding for the investigation, if it is selected by NASA; (iv) the strongest possible statement of financial commitment from the responsible organization to assure NASA that all contributions will be provided as proposed, including whether the contribution and/or funding has been approved and/or what further decisions must be made before the funding is committed by the partner; and (v) a signature by an official authorized to commit the resource of the organization for participation in the investigation (if it is not clear from the signer's title that the signer has the necessary authority, then the signer's authority should be explicitly stated in the Letter).

Requirement 99. For all U.S. organizations offering contributions, proposals shall include appropriate Letters of Commitment from both the organization(s) providing any contributed property or service and from the organization(s) providing any required funding.

Additional requirements for Institutional Letters of Commitment from non-U.S. organizations offering contributions are given in Section 5.7.2 and Requirement 93.

5.8.1.2 Institutional Letters of Commitment for Major Partners

Major partners are the organizations, other than the proposing organization, responsible for providing science leadership, project management, system engineering, spacecraft (as applicable), science instruments, PI-Team-Developed TDOs, integration and test, alternative access to space, mission operations, and other critical or essential products or services as defined by the proposer; regardless of role, all organizations, other than the proposing organization, receiving or contributing more than 10% of the PI-Managed Mission Cost are included as major partners. All other participants are regarded as not major. Major partners are listed in Section (i) of the Table of Proposal Partners (see Appendix B, Section J.1, for additional detail).

The required elements in an Institutional Letter of Commitment for a major partner are: (i) a statement of commitment for the effort that is assigned to that participant in the proposal, (ii) a description of what is being provided, and (iii) a signature by an official authorized to commit the organization.

Requirement 100. Unless otherwise explicitly exempted elsewhere in this AO (e.g., Section 5.2.5), proposals shall include an Institutional Letter of Commitment from each major partner in

the proposal, regardless of source of funding. For major partners providing one or more contributions, only a single Letter of Commitment is required.

5.8.2 Personal Letters of Commitment

No Personal Letters of Commitment are required in the proposal, however every Proposal Team member must indicate his/her commitment to the proposed investigation and specifically to the role, responsibilities, and participating organization proposed for him/her, through the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES). The Proposal Team is defined to include, but not be limited to, all named Key Management Team members, all Co-Is, and all collaborators. Proposal Team members are identified on the NSPIRES proposal cover page (see Appendix B, Section A.3, for more information).

Requirement 101. Every Proposal Team member shall indicate his/her commitment to the proposed investigation and specifically to the role, responsibilities, and participating organization proposed for him/her, through NSPIRES. By committing, Proposal Team members are certifying that their linked organization in NSPIRES is correct, for the purposes of the proposal.

No Institutional Letters of Commitment are required for individuals in the Step-1 proposal, unless the individual's effort is contributed and the individual is part of the Proposal Team, collaborators exempted.

Requirements to provide Personal and Institutional Letters of Commitment in Step-2 Concept Study Reports are given in the *Guidelines and Criteria for the Phase A Concept Study* document (available in the Program Library).

5.8.3 Export-Controlled Material in Proposals

Under U.S. law and regulations, spacecraft and their specifically designed, modified, or configured systems, components, and parts are generally considered "Defense Articles" on the United States Munitions List and are, therefore, subject to the provisions of the International Traffic in Arms Regulations (ITAR), 22 CFR parts 120–130. Consideration must also be given to the Export Administration Regulations (EAR), 15 CFR parts 730–774, issued by the United States Department of Commerce, Bureau of Industry and Security (BIS) under laws relating to the control of certain exports, reexports, and activities.

While inclusion of export-controlled material in proposals is not prohibited, proposers are advised that the inclusion of such material in proposals may complicate NASA's ability to evaluate proposals, as NASA may employ the services of non-U.S. persons (roughly individuals who are neither U.S. citizens nor lawful permanent residents of the U.S.) to review proposals submitted in response to this AO. In order to enable proper evaluation of proposals, any export-controlled information subject to ITAR or EAR must be marked with a notice to that effect.

Requirement 102. If the proposal contains export-controlled material, the material shall be presented in a red font or enclosed in a red-bordered box, and the following statement shall be prominently displayed in Section A of the proposal (following the Proposal Summary Information):

"The information (data) contained in [insert page numbers or other identification] of this proposal is (are) subject to U.S. export laws and regulations. It is furnished to the Government with the understanding that it will not be exported without the prior approval of the proposer under the terms of an applicable export license or technical assistance agreement. The identified information (data) is (are) printed in a red font and figure(s) and table(s) containing the identified information (data) is (are) placed in a red-bordered box."

Note that it is the proposer's responsibility to determine whether any proposal information is subject to the provisions of ITAR or EAR. Information about U.S. export regulations is available at http://www.pmddtc.state.gov/ and at http://www.bis.doc.gov/.

5.8.4 Classified Materials

Requirement 103. Proposals submitted in response to this AO, as well as the proposed investigations and all proposed technologies, shall be unclassified. The proposal shall be complete including an unclassified appendix regarding heritage (see Appendix B, Section J.12, for further details).

In order to increase the capabilities of investigations proposed in response to this AO while minimizing the development and operations risks within the PIMMC, proposers may choose to leverage technology with classified heritage that was developed by other institutions and agencies, as well as by NASA and NASA-funded partners.

If a proposer chooses to submit a classified appendix regarding heritage, the requirements on content, format, and length are the same as, but independent from, those for the unclassified appendix regarding heritage included in the proposal (see Appendix B, Section J.12, for further details) with the exceptions that Letters of Validation and cost bases of estimate may be included in the classified appendix regarding heritage.

The entire proposal including the unclassified appendix regarding heritage will be read and evaluated by the entire evaluation panel. The evaluation panel will *not* have access to the classified appendix regarding heritage, however. Proposers are strongly encouraged to provide as much information and detail as possible on their technology heritage in the unclassified appendix regarding heritage.

NASA allows three options for proposers to support heritage claims from classified programs: 1) delivery to NASA of a classified appendix regarding heritage, 2) "delivery in place" of a classified appendix regarding heritage, and subject to possible restriction 3) sponsor verification of the heritage claims derived from classified programs. Each option is explained in a subsection below.

5.8.4.1 Delivery to NASA

Proposers may provide NASA access to a classified proposal appendix for validation of classified heritage claims. The classified appendix regarding heritage may include Letters of Validation for classified heritage claims from technology development sponsors and a classified cost bases of estimate. The proposer is responsible for determining which information is classified and which information is unclassified; any classified information provided to NASA

must be handled appropriately, including appropriate marking must comply with the applicable Security Classification Guide (SCG) or similar document. The proposer is responsible for obtaining any "need to know" permission for at least one reviewer with appropriate clearance and relevant expertise to evaluate the classified appendix regarding heritage.

The delivery to NASA option of a classified appendix regarding heritage requires delivery to NASA Headquarters (HQ) separately from the proposal. A single copy of the classified appendix regarding heritage must be submitted along with a cover letter referencing the submitted proposal by name, PI, and proposing organization. The "need to know" permission for the reviewer should be discussed in a cover letter. The proposer assumes all responsibility for determining the appropriate security clearance and method of delivery to NASA HQ of the classified appendix regarding heritage. The classified appendix regarding heritage must be handled and delivered to NASA HQ in compliance with NPR 1600.1A, *NASA Security Program Procedural Requirements*.

Requirement 104. Proposers that choose to deliver to NASA a classified appendix regarding heritage shall submit the appendix and a cover letter to NASA HQ no later than the deadline for receipt for the CD-ROM in Section 3. The proposer shall determine the appropriate security classification for the classified appendix, the proposer shall obtain any permission required for a reviewer to read the classified appendix, and the proposer shall ensure that all appropriate security requirements are followed in delivering the classified appendix to NASA HQ.

Requirement 105. The point-of-contact (POC) for the AO (see Section 6.1.5) shall be notified of the intent to submit a classified appendix regarding heritage and its level of classification to ensure sufficient evaluator clearance. The POC notification shall include whether the sender is considering delivery to NASA via a classified email system in lieu of physical delivery. The unclassified appendix regarding heritage shall also indicate that a classified appendix is being submitted.

The address for delivery of the package containing the classified appendix regarding heritage is: Mr. Paul Raudenbush, Chief, NASA Headquarters Security Office, Suite 1M40, 300 E Street SW, Washington, DC 20546.<<CHECK>> The package containing the classified appendix regarding heritage should be sent to NASA HQ by an appropriate means (e.g., courier, U.S. Registered Mail, etc.) with coordination in advance with the receiving facility.

Should a proposer choose to deliver a classified appendix regarding heritage to NASA in addition to a complete proposal, the evaluation process (see Section 7.1.1) will be supplemented. At least one NASA-selected evaluator with appropriate clearance and relevant expertise will review the classified appendix regarding heritage; this evaluator may be a member of the evaluation panel or this evaluator may be a specialist reviewer. All findings generated during the review of the classified appendix regarding heritage will be unclassified, and these findings will be provided as input for assessing the Technical, Management, and Cost (TMC) Feasibility of the Proposed Mission Implementation. Clarifications may be requested concerning findings from evaluation of the classified appendix regarding heritage.

5.8.4.2 "Delivery in Place"

Proposers may choose to utilize the option for "delivery in place" of the classified appendix regarding heritage, where the classified material is not delivered to NASA but is kept at the point of origin. The complete, unclassified proposal must state that a classified appendix regarding heritage has been delivered in place and provide the classification level of the material, the location of the material, and the POC to be contacted to access the material.

Should a proposer choose to submit a classified appendix regarding heritage to NASA in addition to a complete proposal using the "delivery in place" mechanism, the evaluation process (see Section 7.1.1) will be supplemented. At least one NASA-selected evaluator with appropriate clearance and relevant expertise will travel to the delivery location at <<PROGRAM NAME>> Program cost to review the classified appendix regarding heritage; this evaluator may be a member of the evaluation panel or this evaluator may be a specialist reviewer. All findings generated during the review of the classified appendix regarding heritage will be unclassified, and these findings will be provided as input for assessing the Technical, Management, and Cost (TMC) Feasibility of the Proposed Mission Implementation. Clarifications may be requested concerning findings from evaluation of the classified appendix regarding heritage.

Requirement 106. Proposers that choose the option of "delivery in place" of a classified appendix regarding heritage shall develop—and deliver to a designated POC/custodian—the appendix by the deadline for electronic proposal submission in Section 3, with a cover page record of the last date that the document was edited. The POC/custodian of the classified appendix shall certify the date of receipt of the document and its unchanged status, each time the classified appendix is viewed by a reviewer. The proposer shall determine the appropriate security classification for the classified appendix, the proposer shall obtain any permission required for a reviewer to read the classified appendix at the proposer's designated facilities, and the proposer shall ensure that all appropriate security requirements are followed in the handling of the classified appendix.

Requirement 107. The POC for the AO (see Section 6.1.5) shall be notified of the intent to utilize the "delivery in place" option for a classified appendix regarding heritage, the level of classification to ensure sufficient evaluator clearance, and the POC/custodian contact information.

5.8.4.3 Sponsor Verification

Proposals that include technologies with classified heritage may utilize sponsor verification. This option is only available if the sponsor organization is not a proposed partner. Such proposals would only *reference* classified materials, including associated cost bases of estimate; the materials would not be provided to NASA in any format. In lieu of a direct review of the classified materials, the evaluation panel will compile a list of questions regarding claims made in the proposal that need substantiation by the classified material. The list would be sent to the sponsor of the classified programs who must verify that the claims are supported.

Requirement 108. Proposers that choose the option of sponsor verification of classified materials shall provide an enumeration of claims related to the classified materials in the body of the

proposal.

Requirement 109. The POC for the AO (see Section 6.1.5) shall be notified of the intent to utilize the sponsor verification option and the POC to whom associated questions would be sent.

5.9 Program Specific Requirements and Constraints

5.9.1 [AO OPTION FOR SINGLE STEPS]Commitment for a Single-Step Selection

For each selection, and unless otherwise stated in the selection letter, the selected mission's cost will be set at the proposed cost.

Requirement 110. Each proposal shall include a commitment by the PI for the cost, schedule, and scientific performance of the investigation.

5.9.2 Schedule Requirements

Requirement 111. Proposals shall propose a launch readiness date no later than <<LRD>>.

5.9.3 AO-Provided Access to Space

5.9.3.1 [AO OPTION]AO-Provided Primary Launch Services

A <<PROGRAM NAME>> investigation [AO OPTION1]will [END OPTION 1][AO OPTION 2]may [END OPTION 2]be launched as the primary payload on a single expendable launch vehicle (ELV) that NASA will provide as Government Furnished Equipment (GFE)[AO OPTION] at a cost of <<ELV COST>>, which is to be reflected as a reduction in the Adjusted AO Cost Cap[END OPTION]. Standard launch services utilizing a domestic launch vehicle certified as category [AO OPTION]2 or [END OPTION][ALTERNATIVE AO OPTION for Class D]1, 2, or [END OPTION]3 per NPD 8610.7D, *NASA Launch Services Risk Mitigation Policy for NASA-Owned or NASA-Sponsored Payloads/Missions*, regardless of the payload classification, will be provided. There will typically be a charge against the PI-Managed Mission Cost for any launch services beyond the standard launch services offered. Detailed information on launch vehicle performance options, including a description of standard launch services and the nominal costs for nonstandard services, is provided in the *ELV Launch Services Information Summary* document in the Program Library.

[AO OPTION—AO authors should edit the example table below]The *ELV Launch Services Information Summary* describes categories of launch vehicles in the intermediate performance class. The standard launch service will provide the launch capability specified. If a less capable category is also specified and required, the associated credit is to be considered an increase to the Adjusted AO Cost Cap. If a more capable category is also specified and required, the associated cost is to be considered a reduction to the Adjusted AO Cost Cap. Options are summarized in the table below.

		FAIRING SIZE	
		4m	5m
PERF.	Low	(16)	13
	Med	—	28

High	14	43

Cost deltas for launch services in $M. Credits in $M are shown in parentheses.

[END OPTION]

[AO OPTION]Funds allocated to the PI-Managed Mission Cost cannot be used to purchase a launch vehicle or standard launch services beyond those vehicles and services described in this AO.[END OPTION]

Missions will not be responsible for any costs that exceed those listed in this AO and the ELV Launch Services Information Summary in the Program Library, or the impact to the mission of any launch delay caused by AO-provided access to space.

Requirement 112. Proposals shall define the required launch vehicle capability and demonstrate that the mission is compatible with the specified launch services.

Requirement 113. If launch services not specified as standard launch services in *ELV Launch Services Information Summary* are required, the proposal shall include the cost of such services in the PI-Managed Mission Cost.

The launch service and the launch event are critical elements affecting mission success. When NASA is responsible for the launch service acquisition, risk management of the launch service is performed through technical oversight of the commercial service. Technical oversight is a combination of focused approvals and technical insight of the launch provider; reference NPD 8610.23C *Launch Vehicle Technical Oversight Policy* is available in the Program Library. However, in order to take advantage of the full range of launch capabilities available, NASA varies its insight and oversight while ensuring that the risks associated with access to space are consistent with the risk classification approved for individual payloads and missions; reference NPD 8610.7D *NASA Launch Services Risk Mitigation Policy for NASA-Owned and/or NASA-Sponsored Payloads/Missions* is available in the Program Library. Therefore, policy allows for a modified technical oversight approach for payloads and missions able to tolerate more risk, such as for Class D payloads.

[AO OPTION] For investigations using radioactive materials, an as-built databook for the launch system (i.e., payload and launcher) must be completed under the NASA Launch Services contract no later than three years before launch. Launch processing of a mission that utilizes radioactive materials (e.g., radioisotope heating units) will involve nonstandard launch services. The costs for these services will be considered as reductions to the Adjusted AO Cost Cap. Costs associated with the launch of radioactive materials are shown in <<NUKE REF>>, and are similarly to be considered as reductions to the Adjusted AO Cost Cap.[END OPTION]

[AO OPTION—include if applicable]Due to the volatility of the launch services market, NASA cannot ensure which launch vehicles will be available at the time of the launch vehicle procurement. Accordingly, proposers are [AO OPTION 1]advised [END OPTION 1][AO OPTION 2]required [END OPTION 2]to plan for compatibility with [AO OPTION 1]vehicle

families that provide the required performance and are expected to be available through spacecraft Preliminary Design Review (PDR; see the *ELV Launch Services Information Summary* in the Program Library). It is recommended that payload designs accommodate launch environments for these vehicle families[END OPTION 1][AO OPTION 2]the enveloping launch vehicle characteristics and capabilities provided in the *ELV Launch Services Information Summary* in the Program Library[END OPTION 2].

Requirement 114. [AO OPTION 1]Proposals shall discuss flexibility to be accommodated on multiple launch vehicle families[END OPTION 1][AO OPTION 2] Proposals shall discuss compatibility with the enveloping launch vehicle characteristics and capabilities provided in the *ELV Launch Services Information Summary* in the Program Library[END OPTION 2].[END OPTION]

[AO OPTION for VCLS or other alternative AO-provided primary launch services—AO Authors to add appropriate language.]

5.9.3.2 [AO OPTION—rename as necessary]AO-Provided Secondary and/or Co-Manifested Launch Services

[AO OPTION for ESPA accommodation]
[AO OPTION for CubeSat Launch Initiative (CSLI)]
[AO OPTION for Co-manifested]

5.9.3.3 [AO OPTION]Investigations on the International Space Station

Investigations to be flown aboard or deployed—solely (i.e., no CubeSat Launch Initiative option)—from the International Space Station (ISS) may be proposed. NASA will provide necessary accommodations on the ISS, as well as transportation to the ISS, [AO OPTION 1] and thus these costs are not levied against the PI-Managed Mission Cost [END OPTION 1] [AO OPTION 2] for which a reduction of <<ISS COST>> will be imposed on the Adjusted AO Cost Cap [END OPTION 2]. The interface requirements on the <<PROGRAM NAME>> side of the ISS interface (e.g., hardware, software, logistics, mission operations, etc.), as well as costs for preparing flight and ground safety data packages, participating in flight and ground safety reviews, developing an integration verification plan, and conducting any related testing and analyses to satisfy the verification requirements, must be included within the PI-Managed Mission Cost. The proposer is responsible for costs associated with instrument or observatory operations and the support for any contingency diagnostic activities. Investigations requiring flight on the ISS may be proposed for periods of on-orbit performance of generally up to three years; however, baseline mission performance requirements must be met prior to the nominal end of ISS operations. Although the FY19 presidential budget proposes an end to government support of ISS by 2025, NASA expects the ISS to be accessible as a science platform beyond that, in part, due to commercial and international partnerships.

Investigations requiring flight on or deployment from the ISS must provide a Letter of ISS Technical Interface and Resource Accommodation Feasibility Assessment from the NASA International Space Station Research Integration Office. This ISS Feasibility Assessment Letter must contain: (1) a preliminary assessment of the feasibility of proposed provisions for access to

and accommodation on or deployment from the ISS, (2) identification of known technical interface challenges and/or conditional provisions for access or accommodation, and (3) a description of the level of technical interchange and negotiation required to mature the proposed provisions for access and accommodation. For any selected investigations, flight commitment to the ISS will be negotiated with NASA's Human Exploration and Operations Mission Directorate during Phase A. Selection of any investigation to be flown aboard the ISS is conditional until negotiations for ISS access and accommodation are successfully completed.

Requirement 115. The proposer shall provide a Letter of ISS Technical Interface and Resource Accommodation Feasibility Assessment from the NASA Space Station Research Integration Office demonstrating that the proposed payload to be flown aboard or deployed from the ISS can meet the ISS technical interface and resource accommodation requirements.

Proposers requiring an ISS Letter of Technical Interface and Resource Accommodation Feasibility Assessment should contact Dr. George C. Nelson, ISS Research Integration Office, Mail Stop OZ, NASA Johnson Space Center, Houston, TX 77058; Tel: (281) 244-8514; email:george.nelson-1@nasa.gov<<CHECK>>. Additional information is found through the *Information on International Space Station Resources* links in the Program Library.

5.9.4 [AO OPTION]Alternative Access to Space

Alternative access to space, rather than the use of AO-provided access to space, may be utilized under this AO. Alternative access to space may include [AO OPTIONs—adjust as necessary after consulting NPD 8610.12, Responsibilities section]non-AO-provided launch services as primary, secondary (e.g., on a secondary payload adapter), or co-manifested payloads on a U.S.- or foreign-manufactured launch vehicle; payload accommodations as a hosted payload (e.g., instrument package) on a U.S.- or non-U.S.-provided spacecraft launching on a U.S.- or foreign-manufactured launch vehicle; Department of Defense (DoD) Space Test Program (STP) Rideshare; and deployment from a spacecraft not related to this AO[END OPTIONS].

Alternative access to space will be handled by NASA consistent with existing law and policy (*National Space Transportation Policy*, dated November 21, 2013). The demonstrated reliability and the resultant probability of mission success for alternative access to space will be evaluated by NASA consistent with NASA's Launch Services Risk Mitigation Policy (NPD 8610.7D, *NASA Launch Services Risk Mitigation Policy for NASA-Owned and/or NASA-Sponsored Payloads/Missions*). The proposed alternative access to space will be assessed in conjunction with NASA stakeholders as part of the selection and down-selection processes.

Requirement 116. Proposers providing their own alternative access to space shall include the effects of any known risks in their project risk assessments. Launch delay costs—including penalties and storage fees—as a result of delays in spacecraft and/or payload elements the PI-team is responsible for shall be funded out of the PI-Managed Mission Cost and, therefore, represent a potential top risk. Uncertainty associated with unknown risks shall be included in the basis of the proposed unencumbered cost reserves; it is expected that significant uncertainty will result in an associated unencumbered cost reserve percentage higher than the minimum AO requirement.

Participation of investigators as a contributor to a larger mission, what NASA SMD has traditionally called a “Partner Mission of Opportunity” in prior AOs, is not permitted in response to this AO.

5.9.4.1 [AO OPTION]Non-AO-Provided Primary Launch Services

Non-AO-provided contributed primary launch services on U.S.- or foreign-manufactured launch vehicles may be proposed under this AO. Purchased primary launch services may only be obtained on a U.S.-manufactured launch vehicle.

The launch service and the launch event are critical elements affecting mission success. When NASA is responsible for the launch service acquisition, risk management of the launch service is performed through technical oversight of the commercial service. Technical oversight is a combination of focused approvals and technical insight of the launch provider; reference NPD 8610.23C *Launch Vehicle Technical Oversight Policy* is available in the Program Library. However, in order to take advantage of the full range of launch capabilities available, NASA varies its insight and oversight while ensuring that the risks associated with access to space are consistent with the risk classification approved for individual payloads and missions; reference NPD 8610.7D *NASA Launch Services Risk Mitigation Policy for NASA-Owned and/or NASA-Sponsored Payloads/Missions* is available in the Program Library. Therefore, policy allows for a modified technical oversight approach for payloads and missions able to tolerate more risk, such as for Class D payloads. For missions proposing non-AO-provided launch services, proposals must address the management approach of the launch service with sufficient details regarding insight and oversight of the launch service to enable assessment of whether the management of the launch service risks are appropriate for the mission.

[AO OPTION]For proposals submitted in response to this AO, NASA will accept a launch service that has an equivalent risk characterization to that of NASA’s Launch Vehicle Risk Category 1<<CHECK>> (per NPD 8610.7D, *NASA Launch Services Risk Mitigation Policy for NASA-Owned and/or NASA Sponsored Payloads/Missions*) for non- AO-provided launch services.[END OPTION]

The desired use of a U.S. Government furnished or U.S. excess ballistic missile launch vehicle will be formally coordinated with NASA per NPD 8610.12H, *Orbital Space Transportation Services*, in order to evaluate if the appropriate determination can be made to allow use of a non-commercial U.S. launch vehicle. However, given the state of the U.S. commercial launch industry, approval for use of an excess ballistic missile launch vehicle would be unlikely, and use of the Space Launch System would need to be determined.

For non-AO-provided launch services, a reduction of $2.0M in the Adjusted AO Cost Cap must be applied for the expected NASA launch vehicle monitoring functions and advisory services. The functions, operating structure, and policies of the NASA Launch Services Program (LSP) with regards to defining and executing advisory services or consulting for Government or commercial entities are defined in the *Launch Services Program (LSP) Advisory Services Plan* that can be found in the Program Library accessible at <<PROG LIB>>. The NASA Flight Planning Board will approve final mission assignment(s) assuring consistency with Agency risk

strategy. Information on the reliability of ELVs may be obtained from the point of contact listed in the *AO ELV Launch Services Program Information Summary* document.

Non-AO-provided launch services involve several complex issues at this stage of project maturity. It is in the proposer's best interest to clearly support the maturity of their plan and non-AO-provided launch service possibilities. The minimum expectations for non-AO-provided launch service arrangements must be included in the proposal to the level of detail outlined in Requirement 117 (ii). Any additional evidence of maturity or commitment provided will be used to support risk posture.

Requirement 117. Proposals that include a non-AO-provided U.S.-manufactured (purchased or contributed) or foreign-manufactured (contributed) primary launch vehicle shall meet the following requirements:

(i) When flying on a contributed launch vehicle, the proposer shall demonstrate the level of commitment that the sponsoring program or agency has made to fund that flight opportunity; this commitment shall be documented in a letter from the appropriate organization.

(ii) The proposal shall identify the launch opportunity and shall provide evidence in the proposal that the launch service provider agrees to manifest the mission should the proposal be selected and confirmed for flight by NASA. This evidence shall include a letter from the launch services provider containing, at a minimum, the following information:
   a. Evidence that the launch services provider will provide the services described in the proposal under the conditions (cost, schedule) described in the proposal;
   b. A description of the opportunity (or opportunities, if more than one is under consideration) that the launch service provider can offer for consideration by the PI, including applicable mission-unique or special launch services; and
   c. A description of the process that the launch service provider will use in order to commit to the PI to provide specific launch services for the proposed investigation, should NASA select the proposed investigation; this process description shall include a notional schedule for identifying the specific launch opportunity and definitizing the cost.

(iii) The proposal shall describe the launch services, demonstrate compatibility with the proposed launch vehicle, and show how the provider will fulfill the mission requirements.

(iv) The proposal shall describe the arrangement between the PI and the launch service provider to enable the PI's insight for launch services, consistent with NASA Procedural Documents (NPD) 8610.7 and 8610.23. Note that these NPDs allow unique arrangements for payloads able to tolerate more risk.

(v) For non-AO-provided launch services, NASA will develop an advisory approach based on the insight the PI is provided from the non-NASA launch service provider. The Adjusted AO Cost Cap shall be reduced by $2.0M for NASA launch vehicle monitoring functions and advisory services, which will enable NASA to review and advise the PI on launch vehicle information from launch service provider.

Requirement 118. For proposed missions with non-AO-provided primary launch services, the PI assumes all risk for any delays in the implementation of the launch services and shall, therefore, propose appropriate reserves for such schedule contingencies. The expected cost of the reserves when weighted by likelihood may be provided. Any funded schedule reserve may be applied after the AO's launch readiness date of <<LRD>>. Proposal shall provide justification for the schedule risks.

[AO OPTION for Contributions]
Contributed launch services may be obtained on a U.S.- or foreign-manufactured launch vehicle; the contribution must be part of a legitimate scientific collaboration. The planned use of a foreign-manufactured launch vehicle will be formally coordinated with NASA per NPD 8610.12H so the appropriate interagency coordination and/or approval actions can be conducted in a timely manner.

The provision of launch services, as a contribution to a <<PROGRAM NAME>> mission by a U.S. or non-U.S. partner, may be proposed only if the following requirements are met:

(i) The contributed launch services must be provided on a no-exchange-of-funds basis (i.e., at no cost to SMD) (see Requirement 120).
(ii) The proposer must secure the organization(s) that will contribute launch services (see Requirement 87).
(iii) The value of the contributed launch services must be within the constraint on contributions (see Requirement 88).
(iv) The proposer must identify the launch opportunity in the proposal and must provide evidence in the proposal that the launch service provider agrees to manifest the mission should the proposal be selected and confirmed for flight by NASA (see Requirement 117 (ii)).
(v) For any cooperative contributed launch services, the approach for NASA's insight for launch services must be submitted in the proposal (see Requirement 117 (iv)).

Contributed launch services will be assessed in conjunction with NASA stakeholders as part of the selection and down-selection processes. The NASA Flight Planning Board will approve final mission assignment assuring consistency with Agency risk strategy. Information on the reliability of ELVs may be obtained from the point of contact listed in the *Launch Services Information Summary* (located in the Program Library).

Requirement 119. If a contributed launch service is proposed, the proposal shall demonstrate compliance with all of the requirements for contributions given in this section, as well as Sections 5.6.7, 5.7 (as applicable), and 5.8.

Contributed launch services launching a NASA payload on a foreign-manufactured launch vehicle as part of a legitimate scientific collaboration will require a Memorandum of Understanding between NASA and the foreign space agency providing the launch services, as well as coordination within the U.S. Government.

The launch of a NASA payload on a contributed foreign-manufactured launch vehicle is subject to certain U.S. Government review and approval processes. Selection of any proposal that

includes the contribution of launch services on a foreign-manufactured launch vehicle is conditional until approval has been obtained.

Requirement 120. Proposals that include non-NASA launch services on a foreign-manufactured launch vehicle shall meet the following requirements:

(i) The proposal shall demonstrate that the launch services are being contributed on a no-exchange-of-funds basis.

(ii) The proposal shall demonstrate that the provision of launch services on a foreign-manufactured launch vehicle is part of a legitimate scientific collaboration.

5.9.4.2 [AO OPTION]Non-AO-Provided Co-Manifested or Secondary Launch Services

Non-AO-provided co-manifested or secondary launch services on a purchased or contributed U.S.-manufactured launch vehicle or a contributed foreign-manufactured launch vehicle may be proposed under this AO.

The launch service and the launch event are critical elements affecting mission success. When NASA is responsible for the launch service acquisition, risk management of the launch service is performed through technical oversight of the commercial service. Technical oversight is a combination of focused approvals and technical insight of the launch provider; reference NPD 8610.23C *Launch Vehicle Technical Oversight Policy* is available in the Program Library. However, in order to take advantage of the full range of launch capabilities available, NASA varies its insight and oversight while ensuring that the risks associated with access to space are consistent with the risk classification approved for individual payloads and missions; reference NPD 8610.7D *NASA Launch Services Risk Mitigation Policy for NASA-Owned and/or NASA-Sponsored Payloads/Missions* is available in the Program Library. Therefore, policy allows for a modified technical oversight approach for payloads and missions able to tolerate more risk, such as for Class D payloads. For missions proposing non-AO-provided launch services, proposals must address the management approach of the launch service with sufficient details regarding insight and oversight of the launch service to enable assessment of whether the management of the launch service risks are appropriate for the mission.

Missions deploying from another spacecraft not associated with this AO (e.g., geosynchronous communications satellites)—ISS excepted—are to be proposed as utilizing non-AO-provided secondary launch services.

[AO OPTION]Procedures for proposing DoD STP Rideshare launch services are provided in the Program Library.[END OPTION]

[AO OPTION]For proposals submitted in response to this AO, NASA will accept a launch service that has an equivalent risk characterization to that of NASA's Launch Vehicle Risk Category 1<<CHECK>> (per NPD 8610.7D, *NASA Launch Services Risk Mitigation Policy for NASA-Owned and/or NASA Sponsored Payloads/Missions*) for non- AO-provided launch services.[END OPTION]

For non-AO-provided launch services—deploying from another spacecraft not associated with this AO excepted—a reduction of $2.0M in the Adjusted AO Cost Cap must be applied for the expected NASA launch vehicle monitoring functions and advisory services. The functions, operating structure, and policies of the NASA Launch Services Program (LSP) with regards to defining and executing advisory services or consulting for Government or commercial entities are defined in the *Launch Services Program (LSP) Advisory Services Plan* that can be found in the Program Library accessible at <<PROG LIB>>. The NASA Flight Planning Board will approve final mission assignment(s) assuring consistency with Agency risk strategy. Information on the reliability of ELVs may be obtained from the point of contact listed in the *AO ELV Launch Services Program Information Summary* document.

Non-AO-provided launch services involve several complex issues at this stage of project maturity. It is in the proposer's best interest to clearly support the maturity of their plan and non-AO-provided launch service possibilities. The minimum expectations for non-AO-provided launch service arrangements must be included in the proposal to the level of detail outlined in Requirement 121 (ii). Any additional evidence of maturity or commitment provided will be used to support risk posture.

Requirement 121. Proposals that include non-AO-provided co-manifested or secondary launch services purchased from or contributed by a U.S., or contributed by a non-U.S. partner, shall meet the following requirements:

(i) The proposer shall demonstrate a commitment from the proposed co-manifested or primary mission organization(s) to accommodate the proposed payload or demonstrate that the launch services provider has an appropriate process to provide specific launch services; these commitments shall be documented in a letter from the appropriate organization(s).

(ii) The proposal shall identify the launch opportunity and shall provide evidence in the proposal that the launch service provider agrees to manifest the mission should the proposal be selected and confirmed for flight by NASA. This evidence shall include a letter from the launch services provider containing, at a minimum, the following information:
   a. Evidence that the launch services provider will provide the services described in the proposal under the conditions (cost, schedule) described in the proposal;
   b. A description of the opportunity (or opportunities, if more than one is under consideration) that the launch service provider can offer for consideration by the PI, including applicable mission-unique or special launch services; and
   c. A description of the process that the launch service provider will use in order to commit to the PI to provide specific launch services for the proposed investigation, should NASA select the proposed investigation; this process description shall include a notional schedule for identifying the specific launch opportunity and definitizing the cost.

(iii) The proposal shall describe the launch services, demonstrate compatibility with the proposed launch vehicle, and show how the provider will fulfill the mission requirements.

(iv) The proposal shall describe the arrangement between the PI and the launch service provider to enable the PI's insight for launch services, consistent with NASA

Procedural Documents (NPD) 8610.7 and 8610.23. Note that these NPDs allow unique arrangements for payloads able to tolerate more risk.

(v) For non-AO-provided launch services—deploying from another spacecraft not associated with this AO excepted—NASA will develop an advisory approach based on the insight the PI is provided from the launch service provider. The Adjusted AO Cost Cap shall be reduced by $2.0M for NASA launch vehicle monitoring functions and advisory services, which will enable NASA to review and advise the PI on launch vehicle information from the launch service provider.

Requirement 122. For proposed non-AO-provided secondary or co-manifested missions, the PI assumes all risk for any delays in the implementation of the parent or partner mission and shall, therefore, propose appropriate reserves for such schedule contingencies. The expected cost of the reserves when weighted by likelihood may be provided, but proposals shall include a minimum of <<PARENT DELAY>> months fully funded schedule reserve for these risks. The funded schedule reserve may be applied after the AO's launch readiness date of <<LRD>>. Proposal shall provide justification for the schedule risks.

[AO OPTION for Contributions]
Contributed launch services may be obtained on a U.S.- or foreign-manufactured launch vehicle; the contribution must be part of a legitimate scientific collaboration. The planned use of a foreign-manufactured launch vehicle will be formally coordinated with NASA per NPD 8610.12H so the appropriate interagency coordination and/or approval actions can be conducted in a timely manner.

The provision of launch services, as a contribution to a <<PROGRAM NAME>> mission by a U.S. or non-U.S. partner, may be proposed only if the following requirements are met:

(i) The contributed launch services must be provided on a no-exchange-of-funds basis (i.e., at no cost to SMD) (see Requirement 124).

(ii) The proposer must secure the organization(s) that will contribute launch services (see Requirement 87).

(iii) The value of the contributed launch services must be within the constraint on contributions (see Requirement 88).

(iv) The proposer must identify the launch opportunity in the proposal and must provide evidence in the proposal that the launch service provider agrees to manifest the mission should the proposal be selected and confirmed for flight by NASA (see Requirement 121 (ii)).

(v) For any cooperative contributed launch services, the approach for NASA's insight for launch services must be submitted in the proposal (see Requirement 121 (iv)).

Contributed launch services will be assessed in conjunction with NASA stakeholders as part of the selection and down-selection processes. The NASA Flight Planning Board will approve final mission assignment assuring consistency with Agency risk strategy. Information on the reliability of ELVs may be obtained from the point of contact listed in the *Launch Services Information Summary* (located in the Program Library).

Requirement 123. If a contributed launch service is proposed, the proposal shall demonstrate compliance with all of the requirements for contributions given in this section, as well as Sections 5.6.7, 5.7 (as applicable), 5.8.

Contributed launch services launching a NASA payload on a foreign-manufactured launch vehicle as part of a legitimate scientific collaboration will require a Memorandum of Understanding between NASA and the foreign space agency providing the launch services, as well as coordination within the U.S. Government.

The launch of a NASA payload on a contributed foreign-manufactured launch vehicle is subject to certain U.S. Government review and approval processes. Selection of any proposal that includes the contribution of launch services on a foreign-manufactured launch vehicle is conditional until approval has been obtained.

Requirement 124. Proposals that include non-AO-provided contributed launch services on a foreign-manufactured launch vehicle shall meet the following requirements:

(i) The proposal shall demonstrate that the launch services are being contributed on a no-exchange-of-funds basis.

(ii) The proposal shall demonstrate that the provision of launch services on a foreign-manufactured launch vehicle is part of a legitimate scientific collaboration.

5.9.4.3 [AO OPTION]Hosted Payloads

Purchased or contributed payload accommodations as a hosted payload (e.g., instrument package) on a U.S.- or foreign-manufactured spacecraft launching on a U.S.- or foreign-manufactured launch vehicle may be proposed under this AO.

- Purchased payload accommodations may be obtained on a U.S.- or a foreign-manufactured spacecraft. Launch may, in turn, occur on a U.S.- or a foreign-manufactured launch vehicle.
- Contributed payload accommodations may be obtained on a U.S.- or a foreign-manufactured spacecraft, in conjunction with a U.S.- or a foreign-manufactured launch vehicle, on a no-exchange-of-funds basis.
- Contributed payload accommodations may be obtained on a foreign-provided spacecraft and/or on a foreign-provided launch vehicle only if the accommodations are provided as part of a legitimate scientific collaboration on a no-exchange-of-funds basis.

Requirement 125. Proposals that include payload accommodation as a hosted payload shall meet the following requirements:

(i) The proposer shall secure the organization(s) that will provide the payload accommodations.

(ii) The proposal shall identify the mission opportunity or opportunities and provide evidence in the proposal that the mission provider agrees to manifest the <<PROGRAM NAME>> investigation should the proposal be selected and confirmed for flight by NASA. This evidence shall include a letter from the provider of the hosted payload accommodation.

(iii) The proposal shall describe the accommodation, demonstrate compatibility with the proposed spacecraft and show how the host will fulfill the mission requirements.

(iv) The proposed <<PROGRAM NAME>> investigation shall be self-sufficient (with the exception of any critical resources provided by the host platform) and the success of the <<PROGRAM NAME>> investigation shall not depend on data from other payloads accommodated on the host platform. The NASA PI is responsible for the entire <<PROGRAM NAME>> investigation including mission assurance. The proposal shall describe how mission assurance will be met for those areas that are not under the PI's control.

A NASA hosted payload on a non-U.S. Government-provided spacecraft is subject to certain U.S. Government review and approval processes. Selection of any proposal that includes hosted payload accommodations on a non-U.S. Government spacecraft is conditional until approval has been obtained.

Launching a NASA hosted payload on a foreign-provided spacecraft and/or foreign-provided launch services will require a formal agreement between NASA and the foreign entity providing the accommodation and launch services, as well as coordination within the U.S. Government.

Requirement 126. For missions proposed as hosted payloads, the PI assumes all risk for any delays in the implementation of the parent mission and shall, therefore, propose appropriate reserves for such schedule contingencies. The expected cost of the reserves when weighted by likelihood may be provided, but proposals shall include a minimum of <<PARENT DELAY>> months fully funded schedule reserve for the risks. The funded schedule reserve may be applied after the AO's launch readiness date of <<LRD>>. Proposal shall provide justification for the schedule risk.

5.9.5 [AO OPTION]Program Infrastructure Requirements and Opportunities

Program specific language.

6. Proposal Submission Information

6.1 Preproposal Activities

6.1.1 Preproposal Conference

A Preproposal Conference will be held[AO OPTION 1] in the <<PPC LOC>> area[AO OPTION 2] via web/teleconference[END OPTIONS], in accordance with the schedule in Section 3. Further information[AO OPTION], including logistics, [END OPTION] will be available at the <<PROGRAM NAME>> Acquisition Homepage (see Section 6.1.4) prior to the Preproposal Conference.

All interested parties may participate. All expenses and arrangements for participating in this meeting are the responsibility of the attendees. [AO OPTION] Note that travel and associated costs of participation are not allowable as direct costs under another Federal Government award, e.g., a contract, grant, or cooperative agreement. Government employees may attend and be authorized travel and associated costs as a matter of official business. [END OPTION]

The purpose of this Conference will be to address questions about the proposal process for this AO. Questions should be sent to the <<PROGRAM NAME>> Program Scientist at the address

given in Section 6.1.5. NASA personnel will address all questions that have been received no later than five working days prior to the Conference. Questions submitted after this date may be addressed at the Conference as time permits and as appropriate answers can be generated. Anonymity of the authors of all questions will be preserved. Presentations made at the Preproposal Conference, including answers to all questions addressed at the conference, will be posted on the <<PROGRAM NAME>> Acquisition Homepage at the address given in Section 6.1.4 two weeks after this event. Additional questions and answers subsequent to the conference will also appear in this location, if necessary. Questions may be submitted until 14 days before the proposal due date given in Section 3. Answers will be provided no later than 10 days before the proposal due date.

6.1.2 Notice of Intent to Propose

To facilitate planning of the proposal evaluation and peer review process, and to inform prospective proposers of any changes to this AO, NASA strongly encourages [ALTERNATIVE AO OPTION] requires [END OPTION] all prospective proposers to submit a Notice of Intent (NOI) to propose. NOIs are due by 11:59 pm Eastern Time on the date given in Section 3 of this AO. [AO OPTION] Proposals will not be accepted without prior submission of a NOI. [END OPTION] Material in a NOI is deemed confidential and will be used for NASA planning purposes only.

A NOI is submitted electronically by entering the requested information at http://nspires.nasaprs.com/. Registration on the NSPIRES website is required to submit NOIs and proposals. Proposers who experience difficulty in using the NSPIRES site should contact the Help Desk by email at nspires-help@nasaprs.com for assistance.

The following information (to the extent that it is known by the NOI due date) is requested for the NOI:

(a) Name, address, telephone number, email address, and institutional affiliation of the PI.
(b) Full names and institutional associations(s) of each known Proposal Team member. If any Proposal Team members are from non-U.S. institutions, the vehicle by which these people expect to be funded should be identified in the comments box on the NOI form.
(c) Use of the NSPIRES NOI "Summary" section to provide a brief statement (4000 characters or less) covering the following:
    (i) Science objectives of the proposed mission;
    (ii) General design or architecture of the mission;
    (iii) Instruments that may be included in the payload; and
    (iv) Identification of new technologies that may be employed as part of the mission.
(d) Addressing check boxes for the following:
    (i) Whether or not nuclear materials will be proposed as part of the mission[AO OPTION]; and
    (ii) Any infused technologies from Section 5.2.3.1 that will be proposed as part of the mission[END OPTION].
(e) The name of the organizational lead from each organization (industrial, academic, nonprofit, and/or Federal) included in the proposing team, and the organization's role in the proposed investigation, as may be known at the time of the NOI.

SMD requests that proposers communicate any changes to the investigation team, between NOI and proposal submission, to the <<PROGRAM NAME>> Program Scientist identified in Section 6.1.5 of this AO. Submitting an NOI does not commit the team to submitting a proposal.

6.1.3 Teaming Interest

As a result of recent AOs similar to this one, commercial aerospace and technology organizations have requested a forum to inform potential proposers of their services and/or products. NASA is willing to offer this service with the understanding that the Agency does not endorse any information thus transmitted and does not accept responsibility for the capabilities or actions of these organizations. The organizations listed on the <<PROGRAM NAME>> Teaming Interest page of the <<PROGRAM NAME>> Acquisition Homepage (see address given in Section 6.1.4) have expressed interest in teaming with other organizations on <<PROGRAM NAME>> proposals. This is not a comprehensive list of organizations that are capable of teaming; it is simply a list of those organizations that have asked to be included. Proposers are *not* required to team with any organization on this list.

6.1.4 Acquisition Home Page and Program Library

A <<PROGRAM NAME>> Acquisition Homepage, available at <<SOMA AHP>>, will provide updates and any AO addenda during the <<PROGRAM NAME>> AO solicitation process. It will provide links to the Program Library, information about the Preproposal Conference, a list of potential teaming partners, and questions and answers regarding the AO.

The <<PROGRAM NAME>> Program Library provides additional regulations, policies, and background information on the <<PROGRAM NAME>> Program. Information on the Program Library is contained in Appendix D. The Program Library is described in Appendix D and is accessible at <<PROG LIB>>.

Any amendments to the AO will be posted on the NSPIRES website and will be announced by email to all subscribers to the SMD general information list in NSPIRES. Proposing teams should also check the NSPIRES website periodically for any AO correction, clarifications, or additional information. A link will be provided on the <<PROGRAM NAME>> Acquisition Homepage to the NSPIRES index page for the AO.

6.1.5 Point of Contact for Further Information

Inquiries about this AO may be directed to the <<PROGRAM NAME>> Program Scientist:

Dr. <<POC NAME DETAILS>>
<<POC DIV DETAILS>> Division
Science Mission Directorate
National Aeronautics and Space Administration
Washington, DC 20546-0001
Telephone: 202-358-<<POC PHN DETAILS>>
Email: <<POC AUID DETAILS>>@nasa.gov

6.2 Proposal Preparation and Submission

6.2.1 Structure of the Proposal

A uniform proposal format is required from all proposers to aid in proposal evaluation. The required proposal format and contents are summarized in Appendix B. Failure to follow Appendix B may result in reduced ratings during the evaluation process or, in some cases, could lead to rejection of the proposal without review.

Requirement 127. Proposals shall conform to the uniform proposal format outlined in Appendix B.

6.2.2 Certifications

The authorizing institutional signature on the proposal certifies that the proposing institution has read and is in compliance with the required certifications referenced in Appendix H. Therefore, it is not necessary to separately submit these certifications with the proposal.

If the certifications need to be amended, they may be submitted as an additional proposal appendix.

6.2.3 Submission of Proposals

Requirement 128. Electronic proposal files (see Appendix B) shall be submitted electronically via NASA's master proposal database system, the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at http://nspires.nasaprs.com/. This data site is secure and all information entered is strictly for NASA's use only. The proposal submittal deadline is specified in Section 3.

Requirement 129. In addition to electronic submission, two identical, clearly labeled CD-ROMs that contain electronic proposal file(s) and Microsoft Excel files of tables (see Appendix B) shall be delivered to the following address by the proposal submittal deadline specified in Section 3.

NASA Research and Education Support Services (NRESS)
Suite 500
2345 Crystal Drive
Arlington, VA 22202

Telephone for commercial delivery: 202-479-9030

NSPIRES will notify proposers virtually immediately upon successful submission of the electronic proposal. NASA will notify proposers that their CD-ROMs have been received within two weeks of submission. Proposers who have not received this confirmation within two weeks after submittal of their proposals should contact the <<PROGRAM NAME>> Program Scientist at the address given in Section 6.1.5.

The Government reserves the right to consider proposals or modifications thereof received after the date indicated for such purpose, if the selecting Selection Official deems it to offer NASA a significant technical advantage or cost reduction.

6.2.4 Electronic Submission of Proposal Summary Information

This AO requires that proposal summary information, referred to as the Electronic Cover Page, must be submitted electronically through NSPIRES, NASA's master proposal database system located at http://nspires.nasaprs.com/. This data site is secure and all information entered is strictly for NASA's use.

Potential proposers should access this site well in advance of the proposal due date to familiarize themselves with its structure and to enter the requested identifier information. Every individual named as a Proposal Team member on the proposal's Electronic Cover Page must be registered in NSPIRES. Such individuals must register themselves; that is, no one may register a second party, even the PI of a proposal in which that person is committed to participate. The proposal's Electronic Cover Page must be submitted electronically by one of the officials at the proposing organization who is authorized to make such a submission. Every organization that intends to submit a proposal to NASA in response to this AO must be registered in NSPIRES. Such registration must be performed by the organization's Electronic Business Point-of-Contact (EBPOC) in the System for Award Management (SAM).

Requirement 130. The proposing organization and all individuals named as Proposal Team members on the Electronic Cover Page shall be registered in NSPIRES.

All Proposal Team members must indicate their commitment to the proposed investigation through NSPIRES (see Requirement 101).

Frequently Asked Questions (FAQs) on the use of NSPIRES can be accessed through the NSPIRES Proposal Online Help site at http://nspires.nasaprs.com/external/help.do.

Additional instructions for creating the Electronic Cover Page are given in Appendix B, Section A.2.

7. Proposal Evaluation, Selection, and Implementation

7.1 Overview of the Proposal Evaluation and Selection Process

7.1.1 Evaluation Process

All proposals will be initially screened to determine their compliance with requirements and constraints of this AO. Additional compliance checks occur during the evaluation process. Proposals that do not comply may be declared noncompliant and returned to the proposer without further review. A submission compliance checklist is provided in Appendix F. This checklist provides proposers a list of the items that NASA will check for compliance before releasing a proposal for evaluation. This checklist is for the convenience of proposers; it is *not* required to be submitted as part of a proposal.

Compliant proposals will be evaluated against the criteria specified in Section 7.2 by panels of individuals who are peers of the proposers. Proposals will be evaluated by more than one panel (e.g., a science panel and a technical/management/cost panel). Panel members will be instructed to evaluate every proposal independently without comparison to other proposals. These panels

may be augmented through the solicitation of nonpanel (mail in) reviews, which the panels have the right to accept in whole or in part, or to reject. Proposal Evaluation Plans will be posted upon the release of final versions of AOs.

Proposers should be aware that, during the evaluation and selection process, NASA may request clarification of specific points in a proposal; if so, such a request from NASA and the proposer's response must be in writing. In particular, before finalizing the evaluation of [AO OPTION 1]*Scientific Merit* (see Section 7.2.2), *Scientific Implementation Merit and Feasibility* (see Section 7.2.3) and, [AO OPTION 2]Scientific Implementation Merit and Feasibility (see Section 7.2.3) and [END OPTIONS]*TMC Feasibility of the Proposed Mission Implementation* (see Section 7.2.4), NASA will request clarification on specific, potential major weaknesses in [AO OPTION 1]*Scientific Merit*, *Scientific Implementation Merit and Feasibility*, and [AO OPTION 2]*Scientific Implementation Merit* and [END OPTIONS]*TMC Feasibility of the Proposed Mission Implementation* that have been identified in the proposal. NASA will request clarification in a uniform manner from all proposers. The ability of proposers to provide clarification to NASA is limited, as NASA does not intend to enter into discussions with proposers. A typical limited response is to direct NASA's attention to pertinent parts of the proposal without providing further elaboration.

7.1.2 Categorization and Steering Process

Subsequent to the evaluation process, NASA will convene a Categorization Committee, composed wholly of Civil Servants and Intergovernmental Personnel Act appointees (some of whom may be from Government agencies other than NASA) and appointed by the Associate Administrator for the Science Mission Directorate. The Categorization Committee will consider the *Scientific Merit*, *Scientific Implementation Merit and Feasibility*, and *TMC Feasibility of the Proposed Mission Implementation* and, based on the evaluations, categorize the proposals in accordance with procedures required by NFS 1872.404. The categories are defined in NFS 1872.404(k) as follows:

Category I. Well-conceived, meritorious, and feasible investigations pertinent to the goals of the program and the AO's objectives and offered by a competent investigator from an institution capable of supplying the necessary support to ensure that any essential flight hardware or other support can be delivered on time and that data can be properly reduced, analyzed, interpreted, and published in a reasonable time. Investigations in Category I are recommended for acceptance and normally will be displaced only by other Category I investigations.

Category II. Well-conceived, meritorious, and feasible investigations that are recommended for acceptance, but at a lower priority than Category I, whatever the reason.

Category III. Meritorious investigations that require further development. Category III investigations may be funded for further development and may be reconsidered at a later time for the same or other opportunities.

Category IV. Proposed investigations which are recommended for rejection for the particular opportunity under consideration, whatever the reason.

NASA will convene a Steering Committee, composed wholly of Civil Servants and Intergovernmental Personnel Act appointees (some of whom may be from Government agencies other than NASA), appointed by the Associate Administrator for the Science Mission Directorate. The Steering Committee will then review the results of the evaluations and categorizations. The Steering Committee will conduct an independent assessment of the evaluation and categorization processes regarding their compliance to established policies and practices, as well as the completeness, self-consistency, and adequacy of all supporting materials.

7.1.3 Selection Process

After the review by the Steering Committee, the final evaluation results will be presented to the Associate Administrator for the Science Mission Directorate, who will make the final selection(s). As the Selection Official, the SMD Associate Administrator may consult with senior members of SMD and the Agency concerning the selections.

As part of the selection process, a decision will be made as to whether or not any Category III proposals will receive funding for technology development.

7.2 Evaluation Criteria

7.2.1 Overview of Evaluation Criteria

The evaluation criteria, which are defined more fully in the following sections and will be used to evaluate proposals as described in Section 7.1.1, are as follows:

- Scientific merit of the proposed investigation;
- Scientific implementation merit and feasibility of the proposed investigation; and
- Technical, management, and cost (TMC) feasibility of the proposed mission implementation.

The proposal categorizations, discussed in Section 7.1.2, will be based on these criteria. For categorization, scientific merit is weighted approximately 40%, scientific implementation merit and feasibility is weighted approximately 30%, and TMC feasibility, is weighted approximately 30%.

These criteria are defined more fully in the following sections. Evaluation findings for each evaluation criterion will be documented with narrative text in the form of specific major and minor strengths and weaknesses, as well as an adjectival summary rating. The adjectival summary rating for the first two criteria (scientific merit and scientific implementation merit) will be reported as Excellent, Very Good, Good, Fair, or Poor, as defined in the table below.

Summary Evaluation	Basis for Summary Evaluation
Excellent	A comprehensive, thorough, and compelling proposal of exceptional merit that fully responds to the objectives of the AO as documented by numerous and/or significant strengths and having no major weaknesses.
Very Good	A fully competent proposal of very high merit that fully responds to the objectives of the AO, whose strengths fully outbalance any weaknesses.
Good	A competent proposal that represents a credible response to the AO, having neither significant strengths nor weaknesses and/or whose strengths and weaknesses essentially balance.
Fair	A proposal that provides a nominal response to the AO, but whose weaknesses outweigh any perceived strengths.
Poor	A seriously flawed proposal having one or more major weaknesses (e.g., an inadequate or flawed plan of research or lack of focus on the objectives of the AO).

The third criterion, TMC feasibility, will be reported as Low Risk, Medium Risk, or High Risk, as defined in the table below.

Summary Evaluation	Basis for Summary Evaluation
Low Risk	There are no problems evident in the proposal that cannot be normally solved within the time and cost proposed. Problems are not of sufficient magnitude to doubt the proposer's capability to accomplish the investigation well within the available resources.
Medium Risk	Problems have been identified, but are considered within the proposal team's capabilities to correct within available resources with good management and application of effective engineering resources. Investigation design may be complex and resources tight.
High Risk	One or more problems are of sufficient magnitude and complexity as to be deemed unsolvable within the available resources.

7.2.2 Scientific Merit of the Proposed Investigation

The information provided in a proposal will be used to assess the intrinsic scientific merit of the proposed investigation. Scientific merit will be evaluated for the Baseline Science Mission and the Threshold Science Mission; Science Enhancement Options beyond the Baseline Science Mission will not contribute to the assessment of the scientific merit of the proposed investigation. The factors for scientific merit include the following:

- Factor A-1. Compelling nature and scientific priority of the proposed investigation's science goals and objectives. This factor includes the clarity of the goals and objectives; how well the goals and objectives reflect program, Agency, and national priorities; the potential scientific impact of the investigation on program, Agency, and national science objectives; and the potential for fundamental progress, as well as filling gaps in our knowledge relative to the current state of the art.
- Factor A-2. Programmatic value of the proposed investigation. This factor includes the unique value of the investigation to make scientific progress in the context of other ongoing and planned missions; the relationship to the other elements of NASA's science programs; how well the investigation may synergistically support ongoing or planned missions by NASA and other agencies; and the necessity for a space mission to realize the goals and objectives.
- Factor A-3. Likelihood of scientific success. This factor includes how well the anticipated measurements support the goals and objectives; the adequacy of the anticipated data to complete the investigation and meet the goals and objectives; and the appropriateness of the mission requirements for guiding development and ensuring scientific success.
- Factor A-4. Scientific value of the Threshold Science Mission. This factor includes the scientific value of the Threshold Science Mission using the standards in the first factor of this section and whether that value is sufficient to justify the proposed cost of the mission.
- Factor A-5. Scientific value of any Science Enhancement Options (SEOs), if proposed. This factor includes assessing the potential of the selected activities to enlarge the impact of the investigation. Although evaluated by the same panel as the balance of Scientific Merit factors, this factor will not be considered in the overall criterion rating.
- [AO OPTION]Factor A-6. Scientific value of any PI-Team-Developed Enhancing Technology Demonstration Opportunities (TDOs), if proposed. This factor includes assessing the potential of the TDO to enlarge the impact of the investigation and/or the value to future investigations of demonstrating the selected technology. Although evaluated by the same panel as the balance of Scientific Merit factors, this factor will not be considered in the overall criterion rating.[END OPTION]

Factors A-1 through A-3 are evaluated for the Baseline Science Mission assuming it is implemented as proposed and achieves technical success. Factor A-4 is similarly evaluated for the Threshold Science Mission.

This evaluation will result in narrative text, including specific major and minor strengths and weaknesses, as well as an appropriate adjectival rating for the scientific merit of the investigation.

7.2.3 Scientific Implementation Merit and Feasibility of the Proposed Investigation

The information provided in a proposal will be used to assess merit of the plan for completing the proposed investigation, including the scientific implementation merit, feasibility, resiliency, and probability of scientific success of the proposed investigation. The factors for scientific implementation merit and feasibility include the following:

- Factor B-1. Merit of the instruments and mission design for addressing the science goals and objectives. This factor includes the degree to which the proposed mission will address the goals and objectives; the appropriateness of the selected instruments and mission design for addressing the goals and objectives; the degree to which the proposed instruments and mission can provide the necessary data; and the sufficiency of the data gathered to complete the scientific investigation.
- Factor B-2. Probability of technical success. This factor includes the maturity and technical readiness of the instruments or demonstration of a clear path to achieve necessary maturity; the adequacy of the plan to develop the instruments within the proposed cost and schedule; the robustness of those plans, including recognition of risks and mitigation plans for retiring those risks; the likelihood of success in developing any new technology that represents an untested advance in the state of the art; the ability of the development team—both institutions and individuals—to successfully implement those plans; and the likelihood of success for both the development and the operation of the instruments within the mission design.
- Factor B-3. Merit of the data[OPTION 1] analysis, data availability, and data archiving plan. [OPTION 2] and/or sample analysis plan.[END OPTIONS] This factor includes the merit of plans for data [OPTION 1]analysis[OPTION 2]and/or sample analysis, curation,[END OPTIONS] and data archiving to meet the goals and objectives of the investigation; to result in the publication of science discoveries in the professional literature; and to preserve data and [OPTION 1]analysis[OPTION 2]samples[END OPTIONS] of value to the science community. Considerations in this factor include assessment of planning and budget adequacy and evidence of plans for well-documented, high-level data products and software usable to the entire science community; assessment of adequate resources for physical interpretation of data; [OPTION] an assessment of the planning and budget adequacy and evidence of plans for the preliminary evaluation and curation of any returned samples;[END OPTION] reporting scientific results in the professional literature (e.g., refereed journals); and assessment of the proposed plan for the timely release of the data to the public domain for enlarging its science impact.
- Factor B-4. Science resiliency. This factor includes both developmental and operational resiliency. Developmental resiliency includes the approach to descoping the Baseline Science Mission to the Threshold Science Mission in the event that development problems force reductions in scope. Operational resiliency includes the ability to withstand adverse circumstances, the capability to degrade gracefully, and the potential to recover from anomalies in flight.
- Factor B-5. Probability of science team success. This factor will be evaluated by assessing the experience, expertise, and organizational structure of the science team and the mission design in light of any proposed instruments. The role of each Co-Investigator will be evaluated for necessary contributions to the proposed investigation; the inclusion of Co-Is who do not have a well-defined and appropriate role may be cause for downgrading during evaluation.
- Factor B-6. Scientific Implementation Merit and Feasibility of any Science Enhancement Options (SEOs), if proposed. This factor includes assessing the appropriateness of the selected activities to enlarge the science impact of the mission and the costing of the selected activities. Although evaluated by the same panel as the balance of Scientific

Implementation Merit and Feasibility factors, this factor will not be considered in the overall criterion rating.

- [AO OPTION]Factor B-7. Scientific Implementation Merit and Feasibility of any PI-Team-Developed Enhancing Technology Demonstration Opportunities (TDOs), if proposed. This factor includes assessing the appropriateness of the TDO to enlarge the impact of the investigation and/or add value to future investigations. There will be no penalty for potential low inherent maturity of the TDO itself. Although evaluated by the same panel as the balance of Scientific Implementation Merit and Feasibility factors, this factor will not be considered in the overall criterion rating.[END OPTION]
- [AO OPTION FOR SINGLE STEPS]Factor B-8. Maturity of proposed Level 1 science requirements and Level 2 project requirements. This factor includes assessment of whether the Level 1 science requirements are mature enough to guide the achievement of the objectives of the Baseline Mission and the Threshold Mission, and whether the Level 2 requirements are consistent with the Level 1 requirements. The Levels 1 and 2 requirements will be evaluated for whether they are stated in unambiguous, objective, quantifiable, and verifiable terms that do not conflict and for whether they are traceable to the science objectives. They will be evaluated for the adequacy, sufficiency, and completeness, including their utility for evaluating the capability of the instruments and other systems to achieve the mission objectives.[END OPTION]

Student Collaboration proposals, if any, will be evaluated only for the impact they have on science implementation feasibility to the extent that they are not separable; Student Collaboration proposals will not be penalized in for any inherent higher cost, schedule, or technical risk, as long as the Student Collaboration is shown to be clearly separable from the implementation of the Baseline Science Mission.

This evaluation will result in narrative text, including specific major and minor strengths and weaknesses, as well as an appropriate adjectival rating for the scientific implementation merit and feasibility of the scientific investigation.

7.2.4 TMC Feasibility of the Proposed Mission Implementation

The technical and management approaches of all submitted investigations[AO OPTION FOR SINGLE STEPS], including any PI-Team-Developed Enhancing TDOs proposed,[END OPTION] will be evaluated to assess the likelihood that they can be successfully implemented as proposed, including an assessment of the likelihood of their completion within the proposed cost and schedule. The factors for feasibility of mission implementation include the following:

- Factor C-1. Adequacy and robustness of the instrument implementation plan. The maturity and technical readiness of the instrument complement will be assessed, as will the ability of the instruments to meet mission requirements. This factor includes an assessment of the instrument design, accommodation, interface, heritage, and technology readiness. This factor includes an assessment of the instrument hardware and software designs, heritage, and margins. This factor includes an assessment of the proposer's understanding of the processes, products, and activities required to accomplish development and integration of the instrument complement. This factor also includes adequacy of the plans for instrument systems engineering and for dealing with

environmental concerns. This factor includes an assessment of plans for the development and use of new instrument technology, plans for advanced engineering developments, and the adequacy of backup plans to mature systems within the proposed cost and schedule when systems having a TRL less than 6 are proposed.

- Factor C-2. Adequacy and robustness of the mission design and plan for mission operations. This factor includes an assessment of the overall mission design and mission architecture, the spacecraft design and design margins (including margins for launch mass, delta-V, and propellant), the concept for mission operations (including communication, navigation/tracking/trajectory analysis, and ground systems and facilities), and the plans for launch services (including the approach the PI will utilize to make the flight worthiness determination if proposing non-AO-provided launch services, ensuring the adequacy of the technical work performed by the launch provider). This factor includes mission resiliency—the flexibility to recover from problems during both development and operations—including the technical resource reserves and margins, system and subsystem redundancy, and reductions and other changes that can be implemented without impact to the Baseline Science Mission.
- Factor C-3. Adequacy and robustness of the flight systems. This factor includes an assessment of the flight hardware and software designs, heritage, and margins. This factor includes an assessment of the proposer's understanding of the processes, products, and activities required to accomplish development and integration of all elements (flight systems, ground and data systems, etc.). This factor includes an assessment of the adequacy of the plans for spacecraft systems engineering, qualification, verification, mission assurance, launch operations, and entry/descent/landing. This factor includes the plans for the development and use of new technology, plans for advanced engineering developments, and the adequacy of backup plans to ensure success of the mission when systems having a TRL less than 6 are proposed. The maturity and technical readiness of the spacecraft, subsystems, and operations systems will be assessed. The adequacy of the plan to mature systems within the proposed cost and schedule, the robustness of those plans, including recognition of risks and mitigation plans for retiring those risks, and the likelihood of success in developing any new technologies will be assessed.
- Factor C-4. Adequacy and robustness of the management approach and schedule, including the capability of the management team. This factor includes: the adequacy of the proposed organizational structure and WBS; the management approach including project level systems engineering; the roles, qualifications, and experience of the PI, PM, other named Key Management Team members, and implementing organization, mission management team, and known partners; the commitment, spaceflight experience, relevant performance of the PI, PM, other named Key Management Team members, and implementing organization, mission management team, and known partners against the needs of the investigation; the prior working relationships of the implementing organization and known partners; the commitments of partners and contributors; and the team's understanding of the scope of work covering all elements of the mission, including contributions. Also evaluated under this factor is the adequacy of the proposed risk management approach, including any risk mitigation plans for new technologies, any long-lead items, and the adequacy and availability of any required manufacturing, test, or other facilities. The approach to any proposed descoping of mission capabilities will be assessed against the potential science impact to the proposed Baseline Science Mission.

The plans for managing the risk of contributed critical goods and services will be assessed, including the plans for any international participation, the commitment of partners and contributors, as documented in Letters of Commitment, and the technical adequacy of contingency plans, where they exist, for coping with the failure of a proposed cooperative arrangement or contribution. This factor also includes assessment of elements such as the relationship of the work to the project schedule, the project element interdependencies, the associated schedule margins, and an assessment of the likelihood of meeting the proposed launch readiness date. Also evaluated under this factor are the proposed project and schedule management tools to be used on the project.

- Factor C-5. Adequacy and robustness of the cost plan, including cost feasibility and cost risk. This factor includes elements such as cost, cost risk, cost realism, and cost completeness including assessment of the basis of estimate, the adequacy of the approach, the methods and rationale used to develop the estimated cost, the discussion of cost risks, the allocation of cost reserves by phase, and the team's understanding of the scope of work (covering all elements of the mission, including contributions and all elements associated with a non-AO-provided launch or rideshare provider, such as launch site payload processing and mission unique services). The adequacy of the cost reserves and understanding of the cost risks—including those associated with alternative access to space associated delay and/or opportunity uncertainty—will be assessed. This factor also includes an assessment of the proposed cost relative to estimates generated by the evaluation team using parametric models and analogies. Also evaluated under this factor are the proposed cost management tools to be used on the project.

[AO OPTION]The application and proposed use of any NASA-Developed Enabling TDO will be evaluated for appropriateness and conformance to the guidelines in Section 5.2.3.1. The infusion (see Appendix B, Section J.9) of the proposed TDO will be evaluated against the factors in this section, as applicable; the feasibility of the TDO will not be evaluated. As the use of a NASA-Developed Enabling TDO is part of the Baseline Science Mission, the evaluation of the TDO will be included in the risk rating. All proposers will receive feedback on any proposed use of a NASA-Developed Enabling TDO.[END OPTION]

[AO OPTION]The application and proposed use of any NASA-Developed Enhancing TDO will be evaluated for appropriateness and conformance to the guidelines in Section 5.2.3.2. The feasibility of the TDO will not be evaluated. Only the TMC Feasibility (Criterion C), as applicable, of the accommodation of the TDO will be evaluated, unless it is assessed to not be separable from the Baseline Science Investigation, whereupon the impact to the Baseline Mission will be evaluated and considered in the risk rating.[END OPTION]

[AO OPTION]The application and proposed used of any PI-Team-Developed Enhancing TDO will be evaluated for appropriateness and conformance to the guidelines in Section 1.1.1.2. The feasibility of the technology implementation will be evaluated against the factors in this section. The TMC evaluation will be independent of the Baseline Science Mission and will not impact the TMC risk rating for the Baseline Science Mission, unless the TDO is assessed to not be separable from the Baseline Science Investigation, whereupon the impact to the Baseline Mission will be evaluated and considered in the risk rating.[END OPTION]

[AO OPTION]When appropriate, Factor C-2 will include an assessment of proposed planetary protection provisions to avoid potential biological contamination (forward and backward) that may be associated with the mission. An evaluation of the implementation of these provisions in the preparation or processing of proposed instruments, the development of the flight system, in project management, and to proposed costs will be included in the evaluations of Factors C-1, C-3, C-4, and C-5, as appropriate.[END OPTION]

Student Collaboration proposals, if any, will be evaluated only for the impact they have on overall TMC mission feasibility to the extent that they are not separable; Student Collaboration proposals will not be penalized in Step 1 for any inherent higher cost, schedule, or technical risk, as long as the Student Collaboration is shown to be clearly separable from the implementation of the Baseline Science Mission.

Programmatic risks may be assessed but are not included in the TMC risk rating. Examples include but are not limited to: stability and reliability of proposed partners and their contributions, environmental assessment approvals, and late/non-delivery of NASA-provided project elements.

This evaluation will result in narrative text, including specific major and minor strengths and weaknesses, as well as an appropriate risk rating for the TMC Feasibility of the Proposed Mission Implementation.

7.3 Selection Factors

As described in Section 7.1.3, the results of the proposal evaluations based on the criteria above and the categorizations will be considered in the selection process.

Considering the critical role of the PI, PM, [AO OPTION FOR FULL MISSIONS] PSE, [END OPTION]and their institutions, prior experience (especially in meeting cost and schedule constraints) will be an important factor in the selection of an investigation under this AO.

The Selection Official may take into account a wide range of programmatic factors in deciding whether or not to select any proposals for Phase A study and in selecting among top-rated proposals, including, but not limited to, planning and policy considerations, available funding, programmatic merit and risk of any proposed partnerships, and maintaining a programmatic and scientific balance across SMD. While SMD develops and evaluates its program strategy in close consultation with the scientific community through a wide variety of advisory groups, SMD programs are evolving activities that ultimately depend upon the most current Administration policies and budgets, as well as program objectives and priorities that can change quickly based on, among other things, new discoveries from ongoing missions.

The overriding consideration for the selection of proposals submitted in response to this AO will be to maximize scientific return and minimize implementation risk while advancing NASA's science goals and objectives within the available budget for this program. Therefore, the proposed PI-Managed Mission Cost will be considered in the final selection of investigations through this AO. Depending on the availability of proposals of appropriate merit, this objective may be achieved by the selection of investigation(s) at the AO Cost Cap or Adjusted AO Cost

Cap, one or more investigations significantly below the AO Cost Cap or Adjusted AO Cost Cap that would allow a more rapid release of the next AO, or a combination of investigations of various costs. Proposers are encouraged to propose well below the AO Cost Cap or Adjusted AO Cost Cap, as that permits greater flexibility and robustness in the Program and in SMD.

7.4 Implementation of Selected Proposals

7.4.1 Notification of Selection

Following selection, the PIs of the selected investigations will be notified by telephone, followed by formal written notification which may include any special conditions or terms of the offer of selection (e.g., By submitting a proposal, the investigator and the organization agree that NASA has the option to make a tentative selection pending a successful feasibility or definition effort. NASA has the option to contract in phases for a proposed experiment and to discontinue the investigative effort at the completion of any phase. NASA may desire to select only a portion of the proposed investigation and/or that the individual participates with other investigators in a joint investigation. In this case, the investigator will be given the opportunity to accept or decline such partial acceptance or participation with other investigators prior to a NASA selection. Where participation with other investigators as a team is agreed to, one of the team members will normally be designated as its leader or contact point. NASA reserves the right not to make an award or cancel this AO at any time.) and any special instructions for the concept study. The formal notification will also include instructions for scheduling a debriefing at which written debriefing materials will be provided, and any issues noted during the evaluation that may require attention during the Phase A concept study will be discussed, as well as instructions for attending the Project Initiation Conference. Travel and associated costs of attendance at the debriefing and Project Initiation Conference are not allowable as direct costs under another Federal Government award (i.e., contract, grant, or cooperative agreement) and may not be allowable under the Phase A contract. Government employees may attend and be authorized travel and associated costs as a matter of official business.

The Selection Statement for this solicitation, which will be signed by the Selection Official, may include information from the Proposal Summary for any proposal, whether or not it is selected. Since the Selection Statement is a releasable document, the Proposal Summary must not contain proprietary or confidential information that the submitters wish to protect from public disclosure.

7.4.2 Principal Investigator-Led Team Masters Forum

One step toward successful execution of PI-led missions is to ensure that PI-led mission management teams receive the instruction necessary to enable them to better execute their missions for NASA. SMD has established a single day PI-led Team Masters Forum for newly selected PI-led mission management teams. The purpose of the PI-led Team Masters Forum is to facilitate knowledge sharing in areas that are deemed necessary to successfully execute PI-led SMD science missions. Course attendance by the leaders of newly selected PI-led mission management teams (PI, Project Manager, Project Scientist, Project Systems Engineer, and Project Resource Control Manager) and the NASA HQ Program Scientist and Program Executive (where assigned) is required as soon as practical after proposal selection. Travel and associated costs of attendance at the Principal Investigator-Led Team Masters Forum are not allowable as direct costs under another Federal Government award (i.e., contract, grant, or

cooperative agreement) and may not be allowable under the Phase A contract. Government employees may attend and be authorized travel and associated costs as a matter of official business.

7.4.3 Award Administration and Funding

Oversight management responsibilities have been assigned to the <<PROGRAM NAME>> Program Office at the <<CENTER NAME>> Center. The responsibilities of the Program Office will include oversight of mission implementation; coordination of Government-furnished services, equipment and facilities; and contract management for selected investigations.

[AO OPTION 1: Original approved Standard AO Template language]
It is anticipated that the <<PROGRAM NAME>> Program Office will provide funding to each selected investigation, as stated in Section 5.6.2; this award to perform a Phase A concept study is to be initiated as soon as possible after notification of selection. NASA Centers will receive funding via intra-Agency funding mechanisms. In order to place Phase A awards in place, Statements of Work (SOWs), certified cost and pricing data (as applicable), and small business subcontracting plans (as applicable) will be required for the Phase A concept studies.

Proposals are *not* required to include SOWs, certified cost and pricing data for Phase A concept studies and subsequent phases (as applicable), or small business subcontracting plans (as applicable). These will be required *only* for investigations that are selected at the outcome of the Step-1 competition. If more than one contractual arrangement between NASA and the proposing team is required, a separate SOW will be required for each organization.

For those investigations that are selected, it will be in the best interest of their PI-led mission management teams to provide SOWs, certified cost and pricing data (as applicable), and small business subcontracting plans (as applicable) in as timely a manner as possible. The process of awarding contracts cannot begin until SOWs, cost and pricing data (as applicable), and small business subcontracting plans (as applicable) have been received, and funds cannot be provided to any implementing organization until this process has been completed.

[AO OPTION]However, an Advance Agreement on Pre-contract Costs will allow Phase A concept study work to begin prior to submission of the document(s) above, to facilitate meeting the schedule established for the Phase A concept study, the down-select, and ultimately the implementation phase. The term “pre-contract costs” is defined at FAR 31.205-32. Included in this work will be attendance at the Concept Study Kick-Off Meeting and the relevant PI-led Team Masters Forum. If a contract is successfully awarded, costs incurred before the effective date of the contract will be allowable to the extent that they would have been allowable if incurred after the effective date of the contract, subject to the conditions that will be specified in the Advance Agreement on Pre-contract Costs letter.[END OPTION]

SOWs will be required for selected investigations regardless of whether a proposing organization is Governmental or non-governmental. SOWs will include the requirement for a Phase A Concept Study Report as described in the *Guidelines and Criteria for the Phase A Concept Study* document available in the Program Library, as well as general task statements for Phases B through F. SOWs will include the following as a minimum: Scope of Work, Deliverables

(including science data), and Government Responsibilities (as applicable). SOWs need not be more than a few pages in length.

For Phase A contracts that exceed <<FAR 15.403-4 TSHLD>>, the contractor will be required to provide certified cost and pricing data to support the Phase A cost estimate, in the format specified in the *<<PROGRAM NAME>> Budget Summary, Exhibit A* document posted in the Program Library accessible at <<PROG LIB>>, and to execute a Certificate of Current Cost or Pricing Data in accordance with FAR 15.406-2.

Proposers are advised that, by law, NASA prime contracts resulting from this solicitation which offer subcontracting possibilities, exceed <<FAR 19.708(B) TSHLD>>, and are with organizations other than small business concerns, the clause at FAR 52.219-9 will apply. Accordingly, proposers awarded contracts for Phase A concept studies that exceed <<FAR 19.708(B) TSHLD>> will be required to submit small business subcontracting plans consistent with the FAR unless they adequately demonstrate that subcontracting opportunities are not reasonably available in the performance of these concept studies. Failure to do so will make the proposer ineligible for award. These plans should be submitted for negotiation after selection in conjunction with contract execution.

Phase A contracts for investigations down-selected to proceed into Phase B will be modified to include a priced option for a bridge phase. The bridge phase is intended to cover a five-month period of Phase B effort to provide program continuity while negotiations are completed to modify the contract to include Phases B, C/D, and E/F. [AO OPTION]As with selected investigations, an Advance Agreement on Pre-contract Costs will allow Phase B work to begin prior to the bridge phase modification.[END OPTION]
[END OPTION 1]

[AO OPTION 2: Planetary Missions Program Office language]
It is anticipated that the Program Office will provide funding to each selected investigation. The award of the Phase A concept study is to be initiated as soon as possible after notification of selection. NASA Centers will receive funding via intra-Agency funding mechanisms. For each Phase A selection, NASA will request Statements of Work (SOWs), certified cost and pricing data (as applicable), and small business subcontracting plans (as applicable). If more than one contractual arrangement between NASA and the proposing team is required, a separate SOW and budget breakdown is required for each organization. For Phase A contracts that exceed <<FAR 15.403-4 TSHLD>>, the contractor will be required to provide certified cost and pricing data to support the Phase A cost estimate, in the format specified in the *<<PROGRAM NAME>> Budget Summary, Exhibit A* document posted in the Program Library accessible at <<PROG LIB>>, and to execute a Certificate of Current Cost or Pricing Data in accordance with FAR 15.406-2. For Phase A contracts that exceed <<FAR 19.708(B) TSHLD>>, the contractor will be required to submit small business subcontracting plans consistent with the FAR, covering the study phase only, unless they adequately demonstrate that subcontracting opportunities are not reasonably available in the performance of these concept studies.

The contactor will be required to subsequently provide certified cost and pricing data (as applicable), small business subcontracting plans (as applicable), and a SOW, for a 5-month Phase B bridge option.

For those investigations that are selected, it will be in the best interest of their PI-led mission management teams to provide SOWs, cost and pricing data, and small business subcontracting plans in as timely a manner as possible. The process of awarding contracts cannot begin until SOWs, cost and pricing data, and small business subcontracting plans have been received, and funds cannot be provided to any implementing organization until this process has been completed.

SOWs will be required for selected investigations regardless of whether a proposing organization is Governmental or non-governmental. SOWs will include the requirement for a Phase A Concept Study Report as described in the *Guidelines and Criteria for the Phase A Concept Study* document available in the Program Library, as well as general task statements for Phases B through F. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science data), and Government Responsibilities (as applicable). SOWs need not be more than a few pages in length.

Each Phase A contract will be modified to include a priced option for a Bridge Phase, to be exercised upon investigations down-selected to proceed into Phase B. The Bridge Phase option will allow work to be continued uninterrupted under the contract after a Step-2 down-selection decision is made. The Bridge Phase is intended to cover a five-month period of Phase B effort to provide program continuity while negotiations are completed to modify the contract to include Phases B, C/D, and E/F. The Bridge Phase option will be exercised only on the contract for the mission(s) chosen during the Step-2 down-selection process to continue beyond the Phase A concept study. [OPTION 2A] Additional phases will be added to the contract after each Phase has been approved through the program review process. [OPTION 2B] The five-month Bridge Phase period will be used to begin the negotiation of the remaining phases of the contract with the successful PI down-selected following Phase A.
[END OPTION 2]

[AO OPTION 3: For other Program Offices on two-step opportunities, determine whether one of the AO OPTIONs above applies or can be updated][END OPTION 3]

[AO OPTION 4: Single-step opportunities]
It is anticipated that the <<PROGRAM NAME>> Program Office will provide funding to each selected investigation.

It is anticipated that contracts will be awarded to begin formulation, to be initiated as soon as possible after notification of selection. NASA Centers will receive funding via intra-agency funding mechanisms. Statements of Work (SOWs), certified cost and pricing data (as applicable), and small business subcontracting plans (as applicable) will be required in order to put awards in place.

Proposals are *not* required to include SOWs and certified cost and pricing data for formulation and subsequent phases (as applicable), or small business subcontracting plans (as applicable). These will be required *only* for investigations that are selected at the outcome of the competition. If more than one contractual arrangement between NASA and the proposing team is required, a separate SOW is required for each organization.

For those investigations that are selected, it will be in the best interest of their PI-led investigation management teams to provide SOWs, certified cost and pricing data (as applicable), and small business subcontracting plans (as applicable) in as timely a manner as possible. The process of awarding contracts cannot begin until SOWs, cost and pricing data, and small business subcontracting plans have been received, and funds cannot be provided to any implementing organization until this process has been completed.

SOWs will be required for selected investigations regardless of whether a proposing organization is Governmental or non-Governmental. SOWs will include the requirements for Phase A, as well as general task statements for Phases B through F. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science and/or engineering data), and Government responsibilities (as applicable). SOWs need not be more than a few pages in length.

For contracts that exceed <<FAR 15.403-4 TSHLD>>, the contractor will be required to provide certified cost and pricing data to support the cost estimate, in the format specified in the *<<PROGRAM NAME>> Budget Summary, Exhibit A* document posted in the Program Library accessible at <<PROG LIB>>, and to execute a Certificate of Current Cost or Pricing Data in accordance with FAR 15.406-2.

Should a non-U.S. proposal or a U.S. proposal with non-U.S. participation be selected, NASA's Office of International and Interagency Relations will arrange with the non-U.S. sponsoring agency for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail a letter of notification by NASA with a subsequent exchange of letters between NASA and the sponsoring governmental agency or a formal agency-to-agency memorandum of understanding.
[END OPTION 4]

7.4.4 Conduct of the Phase A Concept Study

The concept studies are intended to provide NASA with more definitive information regarding the cost, risk, and feasibility of the investigations, as well as a detailed plan for the conduct of any optional Student Collaboration, TDO, or SEO, before down-selection for implementation. The product of the concept studies is a Phase A Concept Study Report to be delivered by each selected investigation team <<PH A DUR>> months following the establishment of initial contracts. The content and format of the study reports are specified in the *Guidelines and Criteria for the Phase A Concept Study* document in the Program Library.

The PI will provide in the Phase A Concept Study Report a proposed set of Level 1 requirements, including the criteria for full mission success satisfying the Baseline Science

Mission and the criteria for minimum mission success satisfying the Threshold Science Mission. The PI will also provide in the Phase A Concept Study Report the allocation of the proposed cost reserves among the appropriate WBS elements. The [AO OPTION]Phase A-D portion of the [END OPTION]PI-Managed Mission Cost will not increase by more than 20% from that in the Step-1 proposal to that in the Phase A Concept Study Report, and, in any case, will not exceed the AO Cost Cap or Adjusted AO Cost Cap. The NASA review of the completed Concept Study Report will include all mission facets. Risk reduction that has been accomplished during Phase A will be closely reviewed. NASA may request presentations and/or site visits to review the final concept study results with the investigators.

Each mission's Concept Study Report must conclude with a commitment by the PI for the cost, schedule, and scientific performance of the investigation. For each Phase B selection, and unless otherwise stated in the selection letter, the selected mission's cost will be set at the Concept Study Report's proposed cost.

NASA cannot guarantee that the proposed funding profile can be accommodated within the <<PROGRAM NAME>> Program's budget. A funding profile for the selected mission will be negotiated during Phase B.

7.4.5 Down-selection of Investigations

The SMD Associate Administrator will make down-selection decisions based on the evaluation of the Phase A Concept Study Reports and on programmatic considerations. The criteria for evaluating the concept study are as follows:

- Scientific merit of the proposed investigation;
- Scientific implementation merit of the proposed investigation;
- Technical, management, and cost feasibility, of the proposed investigation; and
- Quality of plans for small business subcontracting plans and optional Student Collaboration, if proposed.

The evaluation criteria and down-selection factors are described in the *Guidelines and Criteria for the Phase A Concept Study* document in the Program Library. Any substantial changes to the science objectives contained in the Phase A Concept Study Report will result in the re-evaluation of the scientific merit of the proposed investigation; if no substantial changes are found to have been made to the science objectives, the Step-1 evaluation of the scientific merit will be maintained.

Proposers may be asked for specific information at the time of selection for a competitive Phase A. This requested information will need to be included in the Phase A Concept Study Report and will be considered at the time of down-selection for flight.

At the conclusion of Phase A, it is anticipated that the Selection Official will select <<NUM FLT>> investigation to proceed into the subsequent phases of mission development for flight and operation. The target date for this continuation decision (i.e. "down-selection") is given in Section 3.

Investigations may be down-selected to enter Phase B or may be down-selected for a funded Extended Phase A so one or more risks can be retired before it is allowed to proceed to Phase B. For investigations down-selected to enter Phase B immediately, the down-select serves as the KDP-B; an investigation down-selected for an Extended Phase A must subsequently pass a KDP-B with the appropriate decision authority (e.g., Agency Program Management Council [APMC], SMD Program Management Council [DPMC], or SMD Division) before entering Phase B. There is no guarantee that an investigation down-selected for an Extended Phase A will be approved to enter Phase B, even if all risks have been retired during the Extended Phase A. [AO OPTION]In no case is NASA required to exercise any option. NASA will not exercise any contract option nor continue funding those investigations not selected to proceed.[END OPTION]

Upon a down-selection to enter Phase B, the <<PROGRAM NAME>> Program Office will host a project kick-off with the project that is continued beyond the Phase A concept study, as well as a transition briefing provided by a subset of the evaluation team to Civil Servants and Intergovernmental Personnel Act Assignees in the Program Office and at NASA Headquarters who have implementation responsibilities. NASA will execute the Bridge Phase option and begin to provide Phase B funding for the project that is continued beyond the Phase A concept study. During the Bridge Phase, NASA and the continued project will negotiate and sign a contract modification necessary for the remaining portion of Phase B. Deliverables for Phase B will be negotiated during the Bridge Phase, on the basis of information provided in the Concept Study Report.

Alternatively, upon a down-selection for an Extended Phase A, NASA will modify the existing Phase A contract to extend its period of performance and to provide any additional funds to address areas that must be addressed over the course of the Extended Phase A.

For those investigations that are not continued, the contracts will be allowed to terminate without further expense to NASA. Every investigation team will be offered a debriefing of the evaluations of its Concept Study Report.

Should a non-U.S. mission or a U.S. mission with non-U.S. participation be down-selected, NASA's Office of International and Interagency Relations, Science Division, will arrange with the non-U.S. sponsoring agency for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail a letter of notification by NASA with a subsequent exchange of letters between NASA and the sponsoring governmental agency or a formal agency-to-agency memorandum of understanding.

The contract or other funding mechanism for further formulation and implementation will conform to all applicable Federal and NASA procurement requirements. A *Draft Model Contract* for Phase B[OPTION 1 FOR EXPLORERS PROGRAM OFFICE]-E formulation and implementation[END OPTION 1][OPTION 2 FOR PLANETARY MISSIONS PROGRAM OFFICE], which includes the clause "Advanced Agreement to Add Additional Phases,"[END

OPTION 2][OPTION 3 FOR ALL OTHERS—AO WRITER TO CHECK WITH PO][END OPTION 3] is available in the Program Library.

7.4.6 Confirmation of Investigations

Per NPR 7120.5E, at the end of Phase B, NASA will conduct an independent review of the investigation's readiness to proceed. This review must be completed before the project will be authorized to spend more than 25% [ALTERNATIVE AO OPTION] of the agreed to Phase A/B fraction [OPTION END] of the PI-Managed Mission Cost. The results of the independent review and the project status will be presented to the appropriate decision authority (e.g., Agency Program Management Council [APMC], SMD Program Management Council [DPMC], or SMD Division) at the Confirmation Review (KDP-C) for Confirmation to enter Phase C. Following Confirmation, no rephasing of costs from Phase E to Phase C/D will be permitted.

7.5 Opportunity for Debriefing of Nonselected Proposers

Proposers of investigations that are not selected will be notified [AO OPTION] by telephone and [END OPTION] in writing and offered oral debriefings for themselves and a representative from each of their main partners (if any). Written debriefing materials will be provided at the time of the oral debriefing. Such debriefings may be in person at NASA HQ or by telephone if the proposal PI prefers. In the former case, please note that all expenses and arrangements for attending a debriefing are the responsibility of the attendee. Travel and associated costs of attendance are not allowable as a direct cost under another Federal Government award, i.e., contract, grant, or cooperative agreement. Government employees may attend and be authorized travel and associated costs as a matter of official business.

7.6 Process for Appeals

7.6.1 Agency Procurement Ombudsman

The Agency Procurement Ombudsman, designated in NPD 5101.32E, *Procurement, Financial Assistance*, will take action to resolve concerns, disagreements, and recommendations submitted by interested parties that cannot be resolved at the Center level, or those having NASA-wide implications, refer Center-specific issues to the appropriate Center Procurement Ombudsman for action, and periodically communicate with Center Procurement Ombudsmen on common NASA-wide issues and refer those issues to the appropriate office for action. Under NPD 5101.32E, the designated Agency Procurement Ombudsman is:

Director of the Contract and Grant Policy Division
Office of Procurement
NASA Headquarters
Washington, DC 20546
USA

7.6.2 Protests

Only prospective proposers seeking contract awards under this AO have the right to file a protest, either at the Government Accountability Office (GAO) or with the Agency, as defined in FAR 33.101. The provisions at FAR 52.233-2 (“Service of Protest”) and NFS 1852.233-70 (“Protests to NASA”) are incorporated into this AO. Under both of these provisions, the

designated official for receipt of protests to the Agency and copies of protests filed with the GAO is:

Assistant Administrator for Procurement
Office of Procurement
NASA Headquarters
Washington, DC 20546
USA

8. Conclusion

The <<PROGRAM NAME>> Program provides an opportunity for NASA and its partners to accomplish important scientific exploration, as well as to generate opportunities to enhance education and engage the public in the excitement of science discoveries. NASA invites both the U.S. and international science communities to submit proposals for <<PROGRAM NAME>> investigations in response to this AO.

<<DIVISION DIRECTOR NAME>>
Director
<<DIVISION NAME>>

<<AA NAME>>
Associate Administrator
for Science Mission Directorate

APPENDIX A

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APPENDIX B

REQUIREMENTS FOR PROPOSAL PREPARATION

INTRODUCTION

The following requirements apply to preparation of proposals in response to this AO. While the body of the AO specifies the general policies and requirements for preparing Step-1 proposals, as well as for implementing missions proposed in response to this opportunity, Appendix B provides further definition of the proposal requirements in the AO and contains the specific requirements for the format and content of Step-1 proposals. Some AO requirements do not require further definition by an Appendix B requirement; however, they must be addressed in the proposal. Failure to follow Appendix B may result in reduced ratings during the evaluation process or, in some cases, could lead to rejection of the proposal without review. In the event of apparent conflicts between this Appendix and the policies and requirements specified within the body of the AO, the latter takes precedence.

GENERAL REQUIREMENTS

The following expands requirements in the AO, in particular Requirement 127.

Requirement B-1. A proposal shall consist of one file comprising readily identifiable sections that correspond and conform to Sections A through J of this appendix. It shall be written in English and shall employ metric (SI) and/or standard astronomical units, as applicable. It shall contain all data and other information that will be necessary for scientific and technical evaluations; provision by reference to external sources, such as Internet websites, of additional material that is required for evaluation of the proposal is prohibited.

Requirement B-2. Proposal page size shall be either American standard 8.5 x 11 inches or European standard A4. Foldout pages (11 x 17 inches or A3) may also be employed at the proposers' discretion (see below for assessment of foldout pages against the page limit).

Requirement B-3. Text shall not exceed 55 lines per page and page numbers shall be specified. Margins at the top, both sides, and bottom of each page shall be no less than 1 inch if formatted for 8.5 x 11 inch paper; no less than 2.5 cm at the top and both sides, and 4 cm at the bottom if formatted for A4 paper. Single-column or double-column formats are acceptable for text pages. Type fonts for text and figure captions shall be no smaller than 12-point (i.e., no more than 15 characters per inch; six characters per centimeter). There is no minimum requirement for fonts used within figures and tables, but all text in figures and tables shall be legible; fonts smaller than 8-point are often illegible.

Proposal Structure and Page Limits		
Section	**Contents**	**Page Limits**
A	Proposal Summary Information Graphic Cover Page Export-controlled material statement (Section 5.8.3) Optional Restriction on Use statement* [AO OPTION FOR SINGLE STEPS] PI Commitment	As per NSPIRES 1 0.5 0.5 1 [END OPTION]
B	Fact Sheet	2
C	Table of Contents	None
D E	Science Investigation Science Implementation, including optional SEO and Enhancing TDO	25 [ALTERNATIVE AO OPTION FOR LARGE MISSION] 30 [END OPTION] + <<INSTR XTRA>> pages / additional non-identical instrument + <<SEO XTRA>> pages for SEO ** + <<TDO XTRA>> pages for Enhancing TDO
F G	Mission Implementation Schedule Foldout(s) Management	25 [ALTERNATIVE AO OPTION FOR LARGE MISSION] 35 [END OPTION] + <<FLT EL XTRA>> pages / additional non-identical flight element ** + 3 pages for alternative access to space (3 Schedule Foldouts do not count against limit)
H	Cost and Cost Estimating Methodology Cost [AO OPTION FOR SINGLE STEPS] Table B3a and [END OPTION] Table B3b	8 [ALTERNATIVE AO OPTION FOR LARGE MISSION] 15 [END OPTION] (Cost Table Foldout(s) do(es) not count against limit)
I	Optional Student Collaboration Plan	2
J J.1	Proposal Appendices (no others permitted): Table of Proposal Participants	 None

J.2	Letters of Commitment	None
J.3	Resumes	None
J.4	Summary of Proposed Program Cooperative Contributions	None
J.5	Draft International Participation Plan Discussion on Compliance with U.S. Export Laws and Regulations	None
J.6	[AO OPTION] Planetary Protection Plan	None
J.7	[AO OPTION] Draft Sample and Space-Exposed Hardware Curation Plan	None
J.8	[AO OPTION FOR SINGLE STEPS] Discussion of End-of-Mission Spacecraft Disposal Requirements	None
J.9	[AO OPTION] Infusion Plan for NASA-Developed Enabling TDO	5
J.10	Compliance with Procurement Regulations by NASA PI Proposals	None
J.11	Master Equipment List (MEL)	None
J.12	Heritage	30
J.13	Certifications Amendments (optional)	None
J.14	List of Abbreviations and Acronyms	None
J.15	List of References (optional)	None

* It is NASA policy to use information contained in proposals and quotations for evaluation purposes only. While this policy does not require that the proposal or quotation bear a restrictive notice, offerors or quoters should, in order to maximize protection of trade secrets or other information that is commercial or financial and confidential or privileged, place the following notice on the title page of the proposal or quotation and specify the information, subject to the notice by inserting appropriate identification, such as page numbers, in the notice. In any event, information (data) contained in proposals and quotations will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

RESTRICTION ON USE AND DISCLOSURE OF
PROPOSAL AND QUOTATION INFORMATION (DATA)

The information (data) contained in (insert page numbers or other identification) of this proposal or quotation constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed for other than evaluation purposes; provided, however, that in the event a contract is awarded on the basis of this proposal or quotation, the Government shall have the right to use and disclose this information (data) to the extent provided in the contract.

This restriction does not limit the Government's right to use or disclose this information (data), if obtained from another source without restriction

** Total extra pages limited to <<MAX XTRA>> + <<TDO EXTRA>> (for Enhancing TDO) as described in Requirement B-4; extra pages may be distributed between Sections D-G as desired.

Requirement B-4. Proposals shall conform to the page limits specified in the *Proposal Structure and Page Limits* table. <<INSTR XTRA>> extra pages are allotted for each additional separate, non-identical science instrument in the Science Section (Sections D and E); <<FLT EL XTRA>> extra pages are allotted for each additional separate, non-identical flight element[AO OPTION 1] (e.g., cruise element, landed element, sample return element, additional spacecraft).[AO OPTION 2] (e.g., additional spacecraft are allotted <<FLT EL XTRA>> extra pages, but only non-identical spacecraft)[END OPTIONS] in the Mission Implementation and Management Sections (Sections F and G); [AO OPTION]three extra pages are allocated to proposals utilizing alternative access to space; [END OPTION]and <<SEO XTRA> extra page(s) is (are) allotted for all science enhancement options (SEOs) *combined*, if they are permitted by the AO, in the Science Implementation Section (Section E). Different instruments on identical spacecraft will only be allotted extra pages for additional non-identical science instruments; no extra pages will be allotted for the resulting additional non-identical flight elements. The total number of such extra pages in Sections D-G shall not exceed a maximum of <<MAX XTRA>> + <<TDO XTRA>> (for Enhancing TDO) extra pages regardless of the number of science instruments and flight elements. Every page upon which printing appears will count against the page limits and, unless specifically exempted (e.g., Requirement B-43 and Requirement B-54), each foldout page will count as two pages against the page limits as appropriate for its area (e.g., a fold-out with the total area of two standard pages counts as two pages, etc.).

Requirement B-5. Electronic proposals shall be a single unlocked (e.g., without digital signatures) searchable Adobe Portable Document Format (PDF) file, composed of the main proposal, all tables (see Requirement B-56 and Requirement B-77), and all applicable proposal appendices (see Section J of this appendix). Images (e.g., figures and scans) shall be converted into machine-encoded text using optical character recognition. Electronic proposals shall be limited to 25 MB in size. Links to other parts of the proposal are permitted, but links to materials outside of the proposal are not. Once submitted, the document uploaded to NSPIRES will be considered the official submission.

Requirement B-6. CD-ROMs of proposals shall include electronic proposals specified in Requirement B-5, and shall additionally include Microsoft Excel files of tables (see Requirement B-56 and Requirement B-77)[AO OPTIONS], Microsoft Project file of project schedule (see Requirement B-44), and trajectory files (see Requirement B-34)[END OPTIONS]. CD-ROMs of proposals may additionally include up to 100 MB, higher resolution but otherwise identical, versions of electronic proposals. In the event of a conflict between versions of electronic proposals, the version specified in Requirement B-5 shall take precedence.

A. NSPIRES COVER PAGES AND GRAPHIC COVER PAGE

The following expands requirements in the AO, in particular Requirement 127.

Requirement B-7. The NSPIRES Cover Pages and the Graphic Cover Page, prepared as directed below, shall preface every proposal. The NSPIRES Cover Pages will not be counted against the page limits. The Proposal Summary (abstract) shall not contain proprietary or confidential information that the submitters wish to protect from public disclosure. Note that the Graphic Cover Page should be the first page of the electronic proposal document specified in Requirement B-5; when combined by NSPIRES with the NSPIRES Cover Pages, the Graphic Cover page will follow that information.

A.1. NSPIRES Cover Pages.

The following expands requirements in the AO, in particular Requirement 130.

Electronic submission must be through the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at http://nspires.nasaprs.com/.

Requirement B-8. This AO requires that summary information, referred to as the Electronic Cover Pages, shall be submitted electronically. The forms for the Electronic Cover Page are found in NSPIRES at http://nspires.nasaprs.com/.

The Program Specific Data part of the NSPIRES electronic cover page includes the response to the following instruction: "List all participants in this investigation, both requesting funding and not requesting funding, who were not added to the Proposal Team section of the proposal's cover page as a Co-Investigator, collaborator, or any other category of participant. Include name, institution, city, state or country, and a description of the role in five words or less (e.g., data analyst, facility provider, support technician)." It is recognized that individuals may be affiliated with the proposed investigation without being listed as team members on the proposal cover page. The information provided is used to ensure that the evaluation panels do not include individuals as reviewers who have participated in one or more proposals, as they have the appearance of being biased.

Requirement B-9. Proposers shall ensure that the response to this instruction includes all team members as may be known at this time not listed in the Team Member section of the cover page who participated in a substantial way in the development of the investigation concept or the proposal itself, or who will participate substantially in the development and conduct of the investigation.

The proposal evaluation process requires evaluators be free of Conflict of Interest. In order to assist in planning of the proposal evaluation process, NASA requires a comprehensive list of proposed investigation participants.

Requirement B-10. With the proposal submission via NSPIRES, the proposers shall identify any institution that is specified in the proposal but that does not appear in either the "Team Member" section of the cover page or in answer to the question about "participants […] who do not appear

on the proposal's cover page." The proposer shall list the institution and division name, role (e.g., instrument component provider), and estimated funds to be received. This information will be used to avoid financial and organizational conflicts of interest during the evaluation process by checking evaluators against institutions that are proposed to supply materials, parts, or services.

The following expands requirements in the AO, in particular Requirement 101 and Requirement 130.

Every Proposal Team member must be identified on the Proposal Team section of the NSPIRES proposal cover page, and must indicate his/her commitment to the proposed investigation through NSPIRES prior to proposal cover page submission. Team members must additionally confirm the organization through which they are participating on this proposal; identification of the organization serves as the commitment to the team specified in Requirement 130. The organization through which the Proposal Team member is participating in the proposal might not be the Proposal Team member's primary employer or primary mailing address. Note that the proposal cannot be submitted until all identified team members have confirmed their participating organization.

Requirement B-11. Every Proposal Team member named on the proposal cover page shall personally commit to the proposed investigation through NSPIRES and identify the organization through which he/she is participating. The PI and every Proposal Team member shall ensure that the organization listed on the proposal cover page is the organization through which the Proposal Team member is participating in the proposal.

A.2. Graphic Cover Page.

Requirement B-12. The Graphic Cover Page shall contain, at a minimum, the following information and elements displayed on the cover page of the proposal:

- The proposal title;
- The name of the proposing organization;
- The name of the PI;
- The name and title of an official who is authorized to commit the proposing organization through the submission of the proposal;
- The physical or images of signatures of the PI and the authorizing official, and

Optionally, the Graphic Cover Page may also contain:

- Any illustrations or graphic elements of the proposer's choice (or none); and
- Any additional information of the proposer's choice that is nonproprietary and that does not provide additional content beyond what is in the proposal (or none).

B. FACT SHEET

The following expands requirements in the AO, in particular Requirement 127.

Requirement B-13. Every proposal shall include a fact sheet that provides a brief summary of the proposed investigation. Information conveyed on this fact sheet shall include:

- Science objectives (including the importance of the science to the program science goals);
- Mission overview;
- Instrument complement;
- Key spacecraft characteristics;
- Mission management and participating organizations (including teaming arrangements, as known);
- Anticipated need for curatorial services for returned samples, as applicable;
- Schedule summary;
- [AO OPTION 1 FOR TWO STEPS] The proposed PI-Managed Mission Cost in FY <<CAP YEAR>> dollars (FY<<CAP YEAR>>$) from Table B3b; and
- The proposed Total Cost, including a breakdown of any contributed costs by contributing organization, in FY <<CAP YEAR>> dollars (FY<<CAP YEAR>>$) from Table B3b. [END OPTION 1]
- [AO OPTION 2 FOR SINGLE STEPS] The proposed PI-Managed Mission Cost in real year dollars (RY$) and in FY <<CAP YEAR>> dollars (FY<<CAP YEAR>>$) from Tables B3a and B3b respectively; and
- The proposed Total Cost, including a breakdown of any contributed costs by contributing organization, in real year dollars (RY$) and in FY <<CAP YEAR>> dollars (FY<<CAP YEAR>>$) from Tables B3a and B3b respectively. [END OPTION 2]

C. TABLE OF CONTENTS

The following expands requirements in the AO, in particular Requirement 127.

Requirement B-14. Every proposal shall contain a table of contents that conforms to the outlines provided in Sections D through J of this appendix, below.

D. SCIENCE INVESTIGATION

The following expands requirements in the AO, in particular Requirement 11 through Requirement 27.

D.1. Scientific Background, Goals, and Objectives.

Requirement B-15. This section shall describe the goals and objectives of the investigation; the compelling nature of the investigation; the investigation's value to advancing NASA's science objectives; and the relationship of the proposed investigation to past, current, and future investigations and missions.

D.2. Science Requirements.

Requirement B-16. This section shall describe the investigation to be performed, the types of measurements to be taken; the characteristics, precision, and accuracy required to attain the scientific objectives; and the projected instrument performance. This section shall describe the data to be returned in the course of the investigation. The quality (e.g., resolution, coverage, pointing accuracy, measurement precision, etc.) and quantity (bits, images, etc.) of data required

to be returned shall be described. The relationship between the proposed data products (e.g., flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, [OPTION]sample returns, witness samples,[END OPTION] laboratory data, etc.) and the scientific objectives, as well as the expected results, shall be described. How the science products and data obtained will be used to fulfill the scientific requirements shall be demonstrated and supported by quantitative analysis. These descriptions shall constitute the Baseline Science Mission.

Requirement B-17. Traceability from science goals to measurement requirements to instrument requirements (functional and performance), and to top-level mission requirements shall be provided in tabular form and supported by narrative discussion. Projected instrument performance shall be compared to instrument performance requirements.

Table B1 of this appendix provides an example of a tabular Science Traceability Matrix, with examples of matrix elements. This matrix provides the reference points and tools needed to track overall mission requirements, provide systems engineers with fundamental requirements needed to design the mission, show clearly the effects of any descoping or losses of elements, and facilitate identification of any resulting degradation to the science.

D.3. Threshold Science Mission.

Requirement B-18. This section shall identify the minimum acceptable data and scientific return for the mission (the Threshold Science Mission), below which the mission would not be worth pursuing. The Threshold Science Mission is identified with the "Threshold Science Requirements" in NPR 7120.5E. The scientific value of the Threshold Science Mission shall be discussed. NASA recognizes that, in some circumstances, the Threshold Science Mission may be identical to the Baseline Science Mission. In such cases, the proposer shall explain why there is no viable mission below the Baseline Science Mission.

E. SCIENCE IMPLEMENTATION

The following expands requirements in the AO, in particular Requirement 13 through Requirement 27 and Requirement 67 through Requirement 69.

E.1. Instrumentation.

Requirement B-19. This section shall describe the instrumentation and the rationale for its selection. It shall identify the instrument systems (i.e., individual instruments), instrument subsystems, instrument components, and sample collection and preservation systems as applicable, including their characteristics and requirements, and indicate items that are proposed for development, as well as any existing instrumentation or design/flight heritage. It shall provide a clear understanding of how the concept will provide the required data, show how it can be accommodated by the spacecraft, demonstrate that instruments have the necessary unobstructed fields-of-view over the measurement period required, describe the technology readiness levels and the approach to bring each instrument to technology readiness level (TRL) 6 by preliminary design review (PDR). If no development plan is needed, the reasons for this shall

be explicitly stated and the rationale shall be described. A preliminary description of each instrument design, with a block diagram showing the instrument subsystems and components, and their interfaces, along with a description of the estimated performance of the instrument, shall be included. These performance characteristics (which shall be considered as requirements on the flight system) shall include mass, power, volume, data rate(s), thermal, pointing (such as control, stability, jitter, drift, accuracy, etc.), spatial and spectral resolution, observable precision, retrieved parameter sensitivity and accuracy, and calibration requirements. This section shall demonstrate that the instrumentation can meet the measurement requirements, including factors such as retrieval results for each remote sensor, error analysis of the information in all sensors, vertical and horizontal resolution, signal-to-noise (S/N) calculations, etc. It shall also discuss environmental effects, such as radiation, temperature, and contamination, on each instrument's measurement capabilities as a function of mission time.

Requirement B-20. The following information shall be provided for each science instrument proposed:

- Mass (include breakouts of electronics and optics);
- Viewing direction in body coordinates;
- Pointing accuracy and stability requirements;
- Operational modes;
- Operational mode timeline;
- Data demand for each instrument operational mode;
- Onboard data processing and storage required from spacecraft;
- Power demand for each instrument operational mode including peak, average, and stand-by power;
- Instrument thermal control capability;
- Applicable instrument diagrams (e.g., optical path); and
- Characteristics of relevant instrument components (e.g., listing of size of optics) in the MEL.

E.2. Data Sufficiency.

Requirement B-21. This section shall discuss the quality and quantity of data delivered and processed by the ground data system.

E.3. Science Mission Profile.

Requirement B-22. This section shall discuss the science observing profile, including all mission-relevant parameters, such as orbit, navigation accuracy, operational time lines (including observing periods, data transmission periods and techniques, and time-critical events), etc. The manner in which the proposed investigation objectives, selected instruments, and measurement requirements drive the proposed mission design and operations plan shall be included in this discussion.

E.4. Data Plans.

Requirement B-23. A Data Analysis Plan including approaches for data retrieval, validation, and preliminary analysis shall be described. The science products (e.g., flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, [AO OPTION]sample returns, witness samples, [END OPTION]laboratory data, etc.) shall be identified, including a list of the specific data products and the individual team members responsible for the data products.

Requirement B-24. A [AO OPTION FOR SINGLE STEPS]schedule-based end-to-end [END OPTION]Data Management and Archive Plan, including approaches for the release of peer-reviewed publications, the release of the science data that underlie the results and findings in peer-reviewed publications, and the archiving of all science products shall be described. The science products (e.g., flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, [AO OPTION]sample returns, witness samples, [END OPTION]laboratory data, etc.) shall be identified, including a list of the specific data products and the individual team members responsible for the data products. The Data Management and Archive Plan shall be in compliance with requirements and the guidelines in the *NASA Plan for Increasing Access to the Results of Scientific Research* or a justification shall be provided that this is not necessary given the nature of the work proposed (see Section 4.4.1). The Data Management and Archive Plan shall identify the appropriate NASA data archive and the formats and standards to be used. It shall include an estimate of the raw data volume [AO OPTION 1 FOR TWO STEPS]and the data latency by product[END OPTION 1][AO OPTION 2 FOR SINGLE STEPS]and a schedule—including the data latency by product—END OPTION 2]for submission of raw and reduced data, to the data archive, in physical units accessible to the science community.

See Section 4.4.4 for policies on preliminary analysis and curation of returned samples.

E.5. Science Team.

Requirement B-25. This section shall identify each member of the science team and his/her role and responsibilities. Resumes or curriculum vitae of science team members shall be included as appendices to the proposal (see Section J.3 of this appendix). The role of the PI and each Co-investigator (Co-I) shall be explicitly defined, the necessity of that role shall be justified, and the funding source (NASA or contributor) shall be noted; the role of each collaborator shall be described and the funding source shall be noted.

E.6. Plan for Science Enhancement Option (SEO).

Requirement B-26. If an SEO is proposed, this section shall define and describe the proposed activities (see Section 5.1.7 of this AO).

[AO OPTION FOR SINGLE STEPS]E.7. Plan for Enhancing Technology Demonstration Opportunity (TDO).[END OPTION]

Requirement B-27. If an Enhancing Technology Demonstration Opportunity (TDO) is proposed, this section shall define and describe the proposed activities (see Section 5.2.3.2 of this AO).

F. MISSION IMPLEMENTATION

The following expands requirements in the AO, in particular AO Requirement 27 through Requirement 36.

F.1. General Requirements and Mission Traceability.

Requirement B-28. This section shall provide a description of the spaceflight mission that is proposed to enable the science investigation.

In some areas *(*e.g., instruments), the data requested may have already been presented in another section of the proposal (e.g., the Science Implementation section). In such a case, a proposal may provide a reference to that section and need not repeat the data in this section.

Requirement B-29. The mission requirements that the science goals and objectives impose on the mission design elements, including mission design, instrument accommodation, spacecraft design, required launch vehicle capability, ground systems, communications approach, and mission operations plan, shall be provided in tabular form and supported by narrative discussion. Table B2 provides an example of a tabular Mission Traceability Matrix, with examples of matrix elements. Specific information that describes how the science investigation imposes unique requirements on these mission design elements shall be included.

This matrix, along with Table B1, provides the reference points and tools needed to track overall mission requirements, provides systems engineers with fundamental requirements needed to design the mission, shows clearly the effects of any descoping or losses of mission elements, and facilitates identification of any resulting degradation to the science.

Requirement B-30. NASA recognizes that the full depth of information requested in Requirement B-31 through Requirement B-43 may not be available for some aspects of mission implementation at this stage of mission design. In such cases, this section shall (i) describe the current design concept, (ii) explain why the design information is not complete, (iii) provide a time-based plan for completing the design, (iv) justify that the development of that aspect of the design is not required at this stage and that it is acceptable to develop details later, and (v) explain why the lack of information at this stage does not translate into a risk to the proposer's ability to implement the mission as proposed. The approach for developing the required depth of information, along with a corresponding development schedule, shall be included among the plans for future activity. In cases where a mission is proposed at or near the AO Cost Cap or its Adjusted AO Cost Cap, but depth of technical implementation detail is deferred, the proposal shall justify the adequacy of the proposed cost reserves to prevent

increases beyond the AO Cost Cap or its Adjusted AO Cost Cap during Phase A and subsequent phases.

This requirement is levied to establish NASA's standard for completeness of information necessary to support a comprehensive assessment of implementation feasibility and risk. The quality of the proposal's response to this requirement contributes significantly to the quality of the TMC assessment. However, NASA recognizes the preliminary nature of Step-1 proposals, and thus Requirement B-30 will apply to all cases where the required information cannot, for whatever reason, be provided.

F.2. Mission Concept Descriptions.

Requirement B-31. Designs for all elements of the mission shall be described in sufficient detail to demonstrate that the proposed concept meets all of the basic requirements for a space flight mission, including mission design, spacecraft design, and supporting ground systems. Discussion of how the various mission elements meet the Mission Functional Requirements shall be included. At a minimum, the following mission elements shall be addressed: mission design, flight system capabilities, mission operations, and any additional elements.

Requirement B-32. Mission Design: This section shall address the following elements of mission design to the extent that they are applicable to the proposed mission and that they are known at the time of proposal submission. Any additional elements that are applicable to explaining the mission and demonstrating its feasibility shall also be addressed.

- Launch readiness date;
- Launch date flexibility;
- Mission duration;
- Orbit type (Earth orbit, heliocentric, etc.) and orbit information (semimajor axis, eccentricity, inclination, node time of day, argument of perigee, altitude, allowable dispersions), and/or trajectory design, as applicable to the proposed investigation;
- Critical events; and
- Ground station(s) usage (e.g. location(s) and transmitting and receiving communication parameters).

Requirement B-33. Launch Services and Launch Vehicle Compatibility: Any non-AO-provided launch services shall be described. For both AO- provided and non-AO-provided launch services, compatibility with the proposed launch vehicle shall be demonstrated by providing in the appropriate proposal section the launch site, fairing size, spacecraft mass, and mission orbit characteristics such as altitude (km—circular or apogee/perigee), inclination, C3, heliocentric and/or declination (DLA). Any known nonstandard requirements such as additional fairing doors, cleanliness and purge requirements, planetary protection, etc. shall be described.

[AO OPTION]
Requirement B-34. Trajectory: The following information shall be provided in a file or files on the CD-ROM containing the electronic version of the proposal. There is no requirement that this data also be included in the electronic proposal (uploaded PDF file). Any graphical references, tables, figures, etc. shall be presented in a minimum of 150 dots per inch (dpi).

- Checkout Duration: The minimum duration allocated after launch before the primary propulsion system will be commanded to provide required ΔV.
- Initial Mass Assumptions: Provide the initial mass used for generation of the trajectories including propellant loading assumptions.
- Event Basics: Provide the date/time of each trajectory event with a brief event description (e.g., Launch, Gravity Assist, Fly-by, Rendezvous, Mid-Course Burn) and the appropriate data for the event (e.g., flyby altitude, flyby angle, flyby/intercept velocity, delta-v magnitude). These data should be included for three different scenarios corresponding to the Open, Middle, and Closing of the proposed launch period.
- Event Body Ephemeris: Provide ephemeris data for all event bodies (fly-by planet, asteroid fly-by, comet rendezvous, etc.). Include the source of the ephemeris data and the epoch for the actual ephemeris point used for a particular event.

For investigations using solar electric propulsion, the following information shall also be included:

- Power model for performance based on solar distance: Provide the functional relationship showing the performance of the solar arrays as a function of the spacecraft's distance from the Sun.
- EP Throttling Model: Provide the throttling model used to generate EP engine performance at any point during the trajectory and a brief explanation of the approach.
- Assumed Engine Duty Cycle: Provide the overall Duty Cycle for the EP engines and if applicable provide the duty cycle over each trajectory segment.
- Number of Engines: Provide the maximum number of engines on the spacecraft that could be operating simultaneously. In addition, provide the number of engines operating throughout each phase of the trajectory.

Any other trajectory specific information not called out above that would be relevant to reviewers attempting to validate the trajectory should also be included.
[END OPTION]

Requirement B-35. Flight System Capabilities: This section shall address the following flight system capabilities to the extent that they are applicable to the proposed mission and that they are known at the time of proposal submission. Any additional elements that are applicable to explaining the mission and demonstrating its feasibility shall also be addressed.

- Spacecraft Parameters:
  (a) Figure of the complete spacecraft/instrument system, on the launch vehicle and inflight, with major components labeled and approximate overall dimensions.
  (b) Block diagram of the spacecraft subsystems and their components.
- Subsystem descriptions including structure, telecommunications, thermal, power, propulsion (if required), attitude determination and control, command and data handling, in-flight fault management, flight software, and ground software. (Note that the discussion of the telecommunications subsystem should be limited to specifications, design, and proposed component hardware—discussion of the link performance is addressed as part of the mission operations approach). Subsystem detail shall include to the extent possible the following information:
  (a) Propulsion, including (i) Delta-V budget; (ii) for each propulsion mode propulsion type(s) (monoprop, bi-prop, dual-mode, solar electric, etc.), engines and thrust levels, and specific impulse; (iii) propellant allocation (impulse vs. attitude control system); and (iv)

propellant margin, including nominal (to meet Delta-V requirement) and additional (to meet mass growth).

(b) Command and Data Handling, including (i) spacecraft housekeeping data rates for nominal and safing strategy; (ii) data storage unit size (Mbits); and (iii) maximum storage record and playback rate.

(c) Power

Solar-powered missions:

(i) expected power requirement for each mission phase, (ii);type of array structure (rigid, flexible, body mounted); (iii) solar array axes of rotation (vector projected in spacecraft coordinates); (iv) array size; (v) solar cell type and efficiency; (vi) expected power generation at Beginning of Life and End of Life; (vii) worst case Sun incidence angle to solar panels during science mission; (viii) battery type and storage capacity; (ix) phased and worst case battery Depth of Discharge (DOD); (x) spacecraft bus voltage.

[AO OPTION FOR RPS] RPS-powered missions:

(i) number of RPSs; (ii) power bus interface (i.e. battery dominated *vs.* capacitance) and characteristics (of battery or capacitors); (iii) expected power requirement for each mission phase; and (iv) minimum power capability needed to meet all requirements.[END OPTION]

(d) Attitude Determination and Control, including system pointing requirements and capabilities. Describe or define the following: (i) each spacecraft operational mode, including the sensors and actuators used, control method, and safing and/or contingency modes; (ii) attitude determination methodology and estimate of accuracy, including identifying whether ground post-processing is required to meet science needs; (iii) agility requirements for slews or scanning; (iv) appendage pointing requirements, including articulation control methods and deployment accommodations; (v) sensor selection and performance, including identifying mounting location and field-of-view (FOV); (vi) actuator selection and sizing, including identifying mounting location(s); (vii) translational maneuver (Delta-V) control and accuracy; (viii) momentum management approach and mitigation of impacts on navigation accuracy, if applicable; (ix) on-orbit calibrations, if required, including expected accuracy; and (x) attitude control requirements for the spacecraft pointing control, pointing knowledge (at the instrument interface), pointing stability, or jitter.

(e) Thermal control, including (i) temperature requirements including deltas, (ii) temperature control approach (i.e. passive *vs.* active), (iii) cooling loads, and (iv) special thermal design considerations (e.g., cryogenic instrument requirements[OPTION 2] or RPS use[END OPTION 2]).

(f) [AO OPTION FOR SINGLE STEPS] Flight software, including (i) logical lines of code by Computer Software Configuration Item (CSCI), (ii) description of the functionality for each CSCI, (iii) code counts categorized as either New, Modified, Full Reuse, or Auto-generated, (iv) development method (spiral, waterfall, agile, etc.), and (v) development language.

Requirement B-36. Additional Mission Elements: This section shall address any other major mission elements (i.e., lander, upper-stage, etc.) to the extent that they are applicable to the proposed mission and to the extent that they are known at the time of proposal submission. Any

additional elements that are applicable to explaining the mission and demonstrating its feasibility shall also be discussed.

- Provide a block diagram and description of relevant subsystems; and
- Demonstrate that the proposed design can accomplish the mission within the allocated resources.

Requirement B-37. Flight System Contingencies and Margins: This section shall summarize contingencies and margins of all key flight systems resources. For the driving mission element requirements derived from the Mission Functional Requirements, it should provide estimates of implementation performance and design margins with respect to the required performance. At a minimum, it shall include the following:

- Dry Mass;
- Launch Mass not useable by the proposed mission;
- Propellants;
- Power;
- Data Storage; and
- Attitude Control System.

For any other driving mission element requirements derived from the Mission Functional Requirements, provide estimates of implementation performance and design margins with respect to the required performance. If internal documents such as Flight Project Practices are referenced, an externally accessible URL shall be provided to download them.

Definitions:
Contingency, when added to the current estimate for a resource, results in the maximum expected value for that resource. Percent contingency is the value of the contingency divided by the value of the resource less the contingency.
Margin is the difference between the maximum possible capability of a resource (the physical limit or the agreed-to limit) and the maximum expected value for a resource. Percent margin for a resource is the available margin divided by its maximum expected value.
Example: A payload in the design phase has a maximum expected mass of 115 kg, including a mass contingency of 15 kg. There is no other payload on the ELV and the ELV provider plans to allot the payload the full capability of the vehicle, if needed. The ELV capability is 200 kg. The mass contingency is 15/100 = 15% and the mass margin is 85 kg or 85/115 = 74%.
Example: The end-of-life (EOL) capability of a spacecraft power system is 200 Watts, of which 75 Watts has been allocated to the instrument and 100 Watts has been allocated to the spacecraft bus. The power margin is the unallocated 25 Watts or 25/175 = 14.3%. The current best estimate for the instrument power is 60 Watts, leaving 15 Watts or 15/60 = 25% contingency to the 75 Watt maximum expected value.

Acknowledging that the maximum expected resource value is equal to the maximum proposed resource value (including contingency), the above technical terms can be expressed in equation form as:

Contingency = Max Expected Resource Value – current estimate of Resource Value

$$\% \text{ Contingency} = \frac{\text{Contingency}}{\text{Max Expected Resource Value} - \text{Contingency}} \times 100$$

Margin = Max Possible Resource Value – Max Expected Resource Value

$$\% \text{ Margin} = \frac{\text{Margin}}{\text{Max Expected Resource Value}} \times 100$$

Requirement B-38. Mission Operations: This section shall address, at a minimum, the following elements of mission operations to the extent that they are applicable to the proposed mission and that they are known at the time of proposal submission. Any additional elements that are applicable to explaining the mission operations and demonstrating their feasibility shall also be addressed. This section shall provide, at a minimum, the following items:

- Description of ground systems and facilities, including supporting ground software required for development and testing;
- Telecommunications, Tracking, and Navigation (Deep-Space/Lunar and Earth Orbital missions, as well as missions that utilize telecom relay orbiters), including (i) downlink information data volume; (ii) uplink information; (iii) for all transmit and receive modes, provide mode timeline, data rate(s), and durations; and (iv) ground network utilization plan, including ground stations, downlink parameters (frequencies, periods, capacities, margins, etc.), and retransmission capability;
- Description of approach for acquiring and returning critical event data, including clear identification of procurement and costing for supplemental resources (e.g., mobile ground stations) if such are needed; and
- A high-level discussion of operations plan, including nominal sequence planning and commanding, team training, availability of spacecraft experts for operations, and operations center development.

F.3. Development Approach.

Requirement B-39. This section shall describe the systems engineering development approach. This description shall include the following items:

- Roles and responsibilities for the interface management process—as specified in NPR 7123.1B—and product development responsibilities;
- A description of how the interface management process will be developed and maintained;

- Mission assurance approach, including (i) fault tolerance and fault management, (ii) product assurance, and (iii) reliability;
- Essential trade studies to be conducted in Phase A including the considered options and driving requirements;
- Identification of the key Technical Performance Measures (TPMs)—as specified in NPR 7123.1B—and descriptions of how these margins and reserves are to be allocated, tracked, and monitored, with what tools and by whom, and who will have the authority to release the associated reserves and margins;
- Descriptions of when contracts are required, the acquisition strategy, including any incentive strategy.

F.4. New Technologies/Advanced Engineering Developments.

Requirement B-40. This section shall describe any proposed new technologies and/or advanced engineering developments and the approaches that will be taken to reduce associated risks. Descriptions shall address, at a minimum, the following topics:

- Identification and justification of the TRL for each proposed system (level 3 WBS payload developments and level 3 WBS spacecraft elements) incorporating new technology and/or advanced engineering development at the time the proposal is submitted (for *TRL definitions*, see NPR 7123.1B, *NASA Systems Engineering Processes and Requirements*, Appendix E, in the Program Library);
- Rationale for combining the TRL values of components and subsystems to derive each full system TRL as proposed, appropriately considering TRL states of integration (see NASA/SP-2016-6105 Rev 2, *NASA Systems Engineering Handbook*);
- Rationale for the stated TRL value of an element that is an adaptation of an existing element of known TRL;
- The approach for maturing each of the proposed systems to a minimum of TRL 6 by PDR:
  - Demonstration (testing) in a relevant environment can be accomplished at the system level or at lower level(s);
  - If applicable, justify what demonstration(s) in a relevant environment at lower level(s) (subsystem and/or subsystem-to-subsystem) would be sufficient to meet system level TRL 6, considering (i) where any new technology is to be inserted, (ii) the magnitude of engineering development to integrate elements, (iii) any inherent interdependencies between elements (e.g., critical alignments), and/or (iv) the complexity of interfaces—see the Program Library for examples; and
  - Include discussion of simulations, prototyping, demonstration in a relevant environment, life testing, etc., as appropriate;
- An estimate of the resources (staffing, cost, and schedule) required to complete the technology and/or advanced engineering development; and
- Approaches to fallbacks/alternatives that exist and are planned, a description of the cost, decision date(s) for fallbacks/alternatives, relevant development schedules, and performance liens they impose on the baseline design, and the decision milestones for their implementation.

If no new technologies or advanced engineering development is required, system TRL 6 or above at the time of proposal submission shall be clearly demonstrated.

F.5. Assembly, Integration, Test, and Verification.

Requirement B-41. An illustration and brief discussion of the time-phased flow of the Integration and Test (I&T) Plan shall be presented. It shall summarize the key facilities, testbeds, and team members involved in the I&T Plan.

Requirement B-42. The project's verification approach shall be described briefly in this section. Flow diagrams, narrative text, and/or other relevant data may be used to convey this information. Elements of the approach that pose special challenges for the project (e.g., mission critical performance or functional requirements that can't be tested on the ground, special facilities that may be required for testing, large scale simulation tools that are required to be developed and how they will be validated, critical path items, etc.) shall be included. The I&T description shall demonstrate the credibility of the overall I&T approach, as reflected by consistency between the described test plans and the schedule, cost, and other resources needed to carry them out.

F.6. Schedule.

Requirement B-43. A project schedule foldout(s) covering all phases of the investigation shall be provided to at least WBS level 3, except where greater detail is necessary to identify critical paths, as well as significant TRL or engineering development activities and events. The first 3 foldouts will not be counted against the page limits. The schedule format shall indicate the month and year of each milestone, have a corresponding table of dates, and follow standard NASA WBS elements for task descriptions as prescribed in NPR 7120.5E. The schedule foldout(s) and accompanying narrative (included in the page count for this section) shall address proposed major milestones including, at a minimum, the following items:

- Spacecraft development and major review dates;
- Instrument development and major review dates, including instrument-to-spacecraft/host integration and test;
- Ground systems development and major review dates (e.g., mission operations and data analysis development schedule);
- Major deliverables (e.g., Interface Control Documents (ICDs), simulators, engineering modules, flight modules, etc.);
- Launch vehicle integration and launch readiness;
- Compliance with National Environmental Policy Act (NEPA) and Nuclear Launch Safety Approval processes, if appropriate;
- Long-lead item specifications, development paths, and their impacts to schedule;
- Development schedule for SEOs, if any;
- Schedule critical path identification; and
- Funded schedule reserve, with indications of appropriate reserves associated with major milestones and deliverables.

[AO OPTION]
Requirement B-44. The project schedule shall be additionally provided in Microsoft Project format on each CD-ROM submitted. Although the project schedule foldout(s) in Requirement B-43 does not need to have been generated in Microsoft Project, the project schedule provided on each CD-ROM shall address the items specified in Requirement B-43 at a level of detail

commensurate with that of the graphical foldout. The Microsoft Project schedule is not intended to be a fully Integrated Master Schedule for the project, but rather, it is to be a representation of the summarized schedule foldout that provides a quantified data set that will facilitate understanding of the proposed flow of development activities, timelines, milestones, schedule reserves, and risk. Although tasks in this high-level summary schedule are not expected to be fully linked to their predecessor and successor tasks, the level of linkage detail should support the assignment of the critical path in the graphical foldout. Task links are also needed to identify points of assembly, integration, and testing in the schedule and links to major milestones.
[END OPTION]

G. MANAGEMENT

The following expands requirements in the AO, in particular Requirement 33, Requirement 54 through Requirement 63, Requirement 77, and Requirement 94.

Requirement B-45. This section shall describe the investigator's proposed management approach. The management organization (including an organization chart), decision-making authority, and the teaming arrangement and responsibilities shall be discussed. The organization chart should clearly indicate how the mission team is structured. The names of the primary team members, their organization, and their reporting relationship within the project shall be provided.

Requirement B-46. This section shall describe the specific roles and responsibilities of the PI, PM, [AO OPTION FOR FULL MISSIONS] PSE, [END OPTION] and other named Key Management Team members. It shall describe the qualifications and experience, especially any unique capabilities or previous experience with similar systems and/or equipment (including their performance in meeting cost and schedule), of these Key Management Team members, and demonstrate that they are commensurate with the technical and managerial needs of the proposed investigation. The time commitment of each named Key Management Team member shall be provided by mission phase. This section shall also describe the qualifications and experience of the implementing organization and major partners and demonstrate that they are commensurate with the technical and managerial needs of the proposed investigation.

Requirement B-47. This section shall describe the project risks and project resiliency considering these risks.

- Provide, at a minimum, the top five risks considered significant by the PI and the PM, especially technical risks and risks associated with contributed hardware (if any), and potential mitigation strategies and associated schedule impacts. Proposal shall provide an indication of where resources to address these risks are held. If cost risks are in this list, they shall be described here and then discussed in Section H (see Requirement B-53).
- The approach to any potential descopes, including savings of resources (mass, power, dollars, schedule, etc.) by implementing descopes, the decision milestone(s) for implementing descopes, and the scientific impact of individual as well as combined descopes shall be discussed.

Requirement B-48. If the proposal contains proposed contributions or cooperative arrangements, this section shall describe the technical and management interfaces in any proposed cooperative arrangements, explicitly demonstrating that the contributions are within the contributors' scientific and technical capabilities, and contingency plans for coping with potential failures of the proposed cooperative arrangements.

Requirement B-49. In the case where a proposal does not provide the required management and schedule details, for whatever reason, this section shall (i) describe the current management approach and schedule, (ii) justify that the development of that aspect of the project management and schedule is not required at this stage and that it is acceptable to develop details later, (iii) explain why the lack of information at this stage should not translate into a risk to the proposer's ability to implement the mission as proposed, and (iv) justify the adequacy of the proposed cost reserves, given that any increase in the [AO OPTION]Phase A-D portion of the [END OPTION]PI-Managed Mission Cost is constrained during the Phase A Concept Study (see Section 7.4.4) and may subsequently subject the investigation to termination or cancellation (see Section 4.1.5). The process for developing the required depth of information, along with a corresponding schedule, shall be explicitly included among the plans for future activity.

H. COST AND COST ESTIMATING METHODOLOGY

The following expands requirements in the AO, in particular Requirement 73 through Requirement 76 and Requirement 78 through Requirement 88.

This section of the proposal must include an estimated cost of the investigation, a description of the methodologies used to develop the estimate, and a discussion of cost risks.

Requirement B-50. This section shall include the estimated cost of the proposed investigation. The estimated cost shall encompass all proposed activities, including all applicable mission phases, mission unique or special launch services (e.g., loads isolation systems, unique mechanical/electrical interfaces, payload processing facilities, commodities, post-encapsulation access requirements, supplemental propulsion systems, deployable telemetry tracking assets, and GN2 Purge), flight systems, ground systems, ground network fees, contributions, any other AO-specific activities (e.g., SC), and all cost reserves. These costs shall be consistent with the policies and requirements described in Sections 4 and 5 of this AO.

Requirement B-51. This section shall provide a Basis of Estimate, including a description of the methodologies used to develop the primary cost estimate. The cost estimating methodology discussion in this section shall provide an overview of the cost estimate development process. Additional cost estimates or other validation efforts shall be described, the results presented, and any significant discrepancies discussed. The rationale for the proposed cost reserve levels shall be presented. Proposers shall provide additional Basis of Estimate data to assist the validation of their costs estimates. Examples of useful Basis of Estimate data include cost comparisons to analogous items/missions, vendor quotes, and parametric model results.

[ALTERNATIVE AO OPTION FOR LARGE MISSIONS]

Requirement B-52. This section shall describe the Basis of Estimate (BOE), including a description of the methodologies used to develop the estimate and an overview of the cost estimate development process. The full scope of effort, including labor, hardware, software, and materials shall be described for significant elements of the Work Breakdown Structure. The BOE shall be replicable and clearly traceable to Table B3b. Ground rules, assumptions, and other supporting data shall be quantified and presented. Data supporting the BOE should include:

- For Build Up, Grassroots, Bottoms Up, Subject Matter Expertise, Engineering Judgment, and Expert Opinion estimates: Estimates based on these techniques and methodologies should detail, quantify and justify how these estimates were generated. Driving cost assumptions should be clearly identified and explained.
- For Analogy estimates: Comparisons (e.g. relevant technical, performance, programmatic, and cost) should be presented and any adjustments or scaling factors should be quantified and justified. Clear linkages should be made between the BOE and relevant discussions in proposal Appendix J.12 Heritage.
- For Parametric estimates: Key model inputs, settings, and results should be presented. Rationale for driving inputs and significant model settings should be provided. Model mechanics should also be described for parametric models and tools that are not commonly accessible.
- For Vendor Quotes: The date of the quote, expiration date, and similar purchase history should be described.
- For Proprietary cost/pricing/bidding systems: The cost basis and underlying mechanics should be substantiated to the extent possible.

Additional cost estimates or other validation efforts shall be described, including results and discussion of any significant discrepancies. Key inputs and settings should also be provided. The rationale for the proposed unencumbered cost reserve level(s) shall be presented. The rationale should provide insight into the adequacy and robustness of the proposed unencumbered cost reserve level(s).
[END AO OPTION]

Requirement B-53. This section shall include a discussion of cost risks.

[AO OPTION 1 FOR TWO STEPS]
Requirement B-54. This section shall provide foldout cost Table B3b, which will not be counted against the page limit. Table B3b shall identify the proposed cost required in each mission phase and in each Fiscal Year; the costs shall be in FY <<CAP YEAR>> dollars (FY<<CAP YEAR>>$). The top portion of Table B3b shall contain cost data relevant to the PI-Managed Mission Cost. The lower portion shall contain cost data for contributions and enhanced mission costs. The rows in Table B3b shall be the NASA standard WBS elements as defined in NPR 7120.5E. The costs for most elements shall be provided to WBS level 2, as shown in Table B3b. Exceptions are the costs of individual instruments and any unique flight system elements such as [AO OPTION 1]coordinating science ground stations, or nonstandard facilities, [AO OPTION 2]landers or sample return capsules, and non-standard elements such as sample facilities, [END OPTIONS]which shall be explicitly shown. The columns in Table B3b shall be grouped and subtotaled by mission phase and shall be labeled with the appropriate Fiscal Years. Years that span more than one mission phase shall be split into two columns by mission phase. The final columns are totals in Fiscal Year <<CAP YEAR>> dollars (FY<<CAP YEAR>>$).

[END OPTION 1]

[AO OPTION 2 FOR SINGLE STEPS]
Requirement B-55. This section shall provide foldout cost tables, Tables B3a and B3b, which will not be counted against the page limit. Tables B3a and B3b shall identify the proposed cost required in each mission phase and in each Fiscal Year; the costs shall be in real year dollars (RY$) in Table B3a and FY <<CAP YEAR>> dollars (FY<<CAP YEAR>>$) in Table B3b. The top portion of Tables B3a and B3b shall contain cost data relevant to the PI-Managed Mission Cost. The lower portion shall contain cost data for contributions and enhanced mission costs. The rows in Tables B3a and B3b shall be the NASA standard WBS elements as defined in NPR 7120.5E. The costs for most elements shall be provided to WBS level 2, as shown in Tables B3a and B3b. Exceptions are the costs of individual instruments and any unique flight system elements such as [OPTION 1]coordinating science ground stations, or nonstandard facilities, [OPTION 2]landers or sample return capsules, and non-standard elements such as sample facilities, [END OPTIONS] which shall be explicitly shown. The columns in Tables B3a and B3b shall be grouped and subtotaled by mission phase and shall be labeled with the appropriate real or Fiscal Years. Years that span more than one mission phase shall be split into two columns by mission phase. The final columns in each of Tables B3a and B3b are totals in real year dollars (RY$) and totals in Fiscal Year <<CAP YEAR>> dollars (FY<<CAP YEAR>>$). Proposers shall use their own forward pricing rates to translate between real year dollars (RY$) and Fiscal Year <<CAP YEAR>> dollars (FY<<CAP YEAR>>$). For organizations that are without approved forward pricing rates, proposers shall use the NASA inflation/deflation indices in Table B4 to translate between real year dollars (RY$) and Fiscal Year <<CAP YEAR>> dollars (FY<<CAP YEAR>>$).
[END OPTION 2]

Requirement B-56. Table B3b [ALTERNATIVE AO OPTION FOR SINGLE STEPS] Tables B3a and B3b [END ALTERNATIVE OPTION] shall be provided additionally in Microsoft Excel format on each CD-ROM submitted. Microsoft Excel format templates of tables B1, B2, [AO OPTION SINGLE STEPS] B3a [END OPTION], B3b, and B5 are available for download in a consolidated workbook from the Program Library.

[AO OPTION FOR SINGLE STEPS]
Requirement B-57. This section shall include a statement as to whether the proposer's approved forward pricing rates were used or NASA's inflation/deflation indices were used. If the proposer's approved forward pricing rates were used, this section shall include the forward pricing rates, with an explanation of how they were derived to translate between real year dollars (RY$) and Fiscal Year <<CAP YEAR>> dollars (FY<<CAP YEAR>>$) in Table B3.
[END OPTION]

I. OPTIONAL STUDENT COLLABORATION PLAN

The following expands requirements in the AO, in particular Requirement 71 and Requirement 72.

Requirement B-58. If a Student Collaboration (SC), as described in Section 5.5.3 of this AO, is proposed, then this section shall provide details of the development schedule of the SC, including decision points for determining SC readiness for flight. This section shall describe how the SC can be incorporated into the mission on a nonimpact basis. This section shall show that the SC is clearly separable from the rest of the proposed effort.

J. PROPOSAL APPENDICES

Requirement B-59. The following additional information is required to be supplied with the proposal as Appendices and, as such, will not be counted within the specified page limit, except as noted in the Proposal Structure and Page Limits table. The proposer shall *not* include in these Appendices material required in the page-limited sections in the body of the proposal. Any additional information *not* specifically required in a given appendix will not be considered by the evaluation panel and may result in reduced ratings during the evaluation process or, in some cases, could lead to rejection of the proposal without review. No other appendices are permitted.

J.1. Table of Proposal Participants

The following expands requirements in the AO, in particular Requirement 100.

Requirement B-60. A table of Proposal Participants shall be provided. The table shall include all organizations named in the proposal including contributing organizations. The primary purpose of the table is to aid NASA in avoiding conflicts of interest during the evaluation of the proposal. A secondary purpose is to provide material helpful for the evaluation and selection process. The table shall have three columns: (i) name of organization, including city and state/country where it is located, (ii) role of organization, and (iii) total cost or budget for that organization (over the life of proposal for baseline mission). The table shall have a row for every organization named in the proposal, and the rows shall be organized into three sections: (i) major partners, (ii) science only, nonhardware partners, and (iii) minor partners, vendors, and suppliers, as known at the time of the proposal. Major partners are defined to be organizations, other than the proposing organization, responsible for providing science leadership, project management, system engineering, spacecraft (as applicable), science instruments, PI-Team-Developed TDOs, integration and test, alternative access to space, mission operations, and other critical or essential products or services as defined by the proposer; all organizations, other than the proposing organization, receiving or contributing more than 10% of the PI-Managed Mission Cost are included, regardless of role.

J.2. Letters of Commitment.

The following expands requirements in the AO, in particular Requirement 45, Requirement 93, Requirement 99, and Requirement 100.

Requirement B-61. Letters of commitment signed by an institutional official shall be provided from (i) all organizations offering contributions of goods and/or services (both U.S. and non-U.S.) on a no-exchange-of-funds basis and (ii) unless otherwise explicitly excepted elsewhere in this AO, all major participants in the proposal regardless of source of funding. Major partners are the organizations in Section (i) of the Table of Proposal Participants. Requirements for letters of commitment may be found in Section 5.8.1 of this AO.

J.3. Resumes.

The following expands requirements in the AO, in particular Requirement 54, Requirement 55, Requirement 66, and Requirement 67.

Requirement B-62. This section shall include resumes or curriculum vitae for the PI, PM,[AO OPTION FOR FULL MISSIONS] PSE,[END OPTION] any other named Key Management Team member, and all Co-Is. Specifically, each resume shall cite the individual's experience that is pertinent to the role and responsibilities that she/he will assume in the proposed investigation. Project management experience shall be included in the resumes of the[AO OPTION] PI and PM[END OPTION][ALTERNATIVE OPTION FOR FULL MISSIONS] PI, PM, and PSE[END OPTION]. Resumes or curriculum vitae shall be no longer than three pages for the PI and one page for each additional participant. Resumes shall be organized alphabetically after that of the PI, by surname.

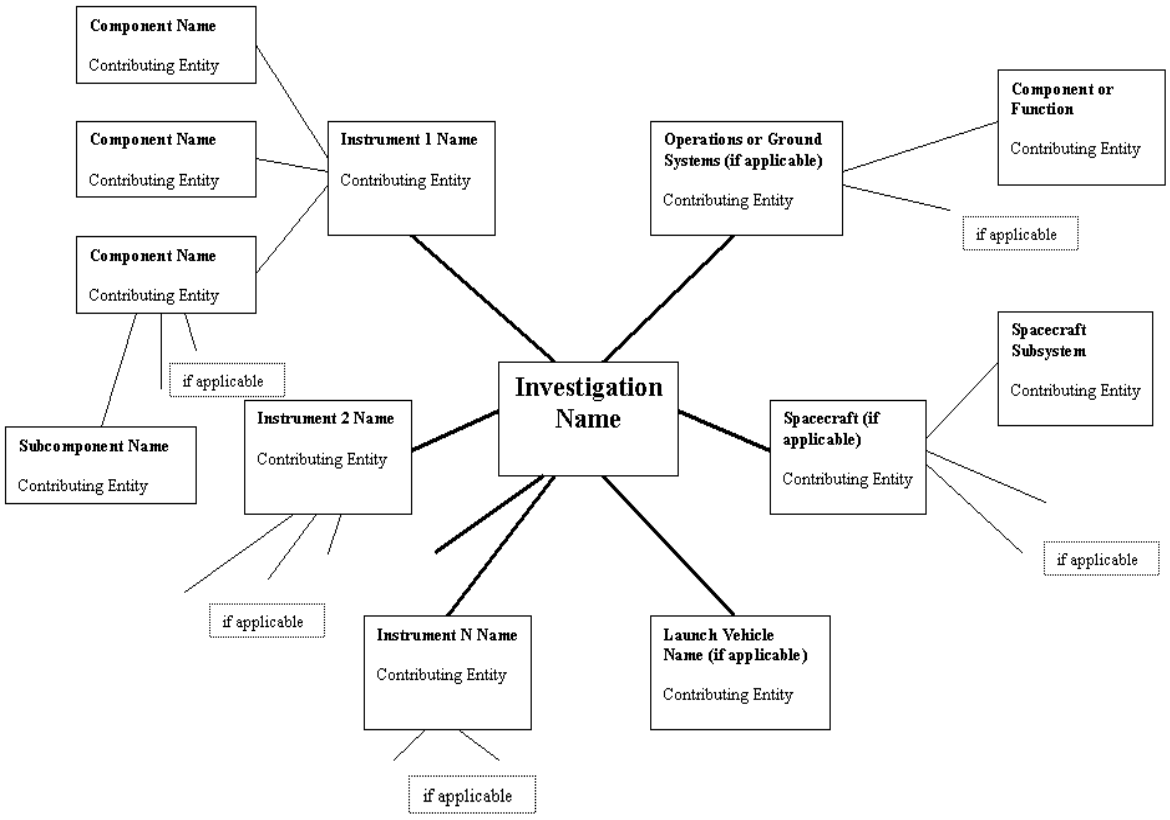
J.4. Summary of Proposed Program Cooperative Contributions.

The following expands requirements in the AO, in particular Requirement 87 through Requirement 89 and Requirement 96.

Cooperative contributions are defined to be those that are to be provided to the proposed investigation from a U.S. or non-U.S. partner on a no-exchange-of-funds basis. In order to aid NASA in conducting an equitable assessment of risks, this section must include (a) an "exploded diagram" of the investigation and (b) a supporting table.

a. An "exploded diagram" of the investigation.

SAMPLE EXPLODED DIAGRAM



Requirement B-63. If a proposal includes cooperative contributions, this section shall include an "exploded diagram" of the investigation (see example figure) that provides a clear visual representation of cooperative contributions incorporated in the proposed implementation approach. All cooperative contributions, including those that will require an international agreement or interagency memorandum of agreement, shall be shown in this diagram. Each contribution shown shall display a unique name for the contribution, as well as the identity of the contributing entity. However, the following shall not be shown:

(i.) If there are no cooperative contributions of spacecraft, launch vehicle or services, or ground operations or facilities, these boxes shall not be shown on the diagram at all.

(ii.) Scientific collaborations, such as joint data analysis that do not involve contribution of flight hardware or other critical items, shall not be shown.

(iii.) U.S. or non-U.S. goods and services obtained by contract using NASA funds are not cooperative contributions and shall not be shown.

b. A supporting table of collaborative contributions

Requirement B-64. If a proposal includes cooperative contributions, this section shall include a supporting table with more information that elaborates upon each cooperative contribution shown in the exploded diagram. The table shall include, for each contribution, the following information:

(i.) Unique name identifying the contribution (matching the name on the exploded diagram);
(ii.) The identity of the providing organization, whether U.S. or non-U.S.;
(iii.) The roles and responsibilities of the providing organization, including cross reference to information in the proposal providing further detail as required in Section 5.6.7 of this AO;
(iv.) The identification of the funding sponsor, if different from the organization identified in item (ii) above;
(v.) The approximate value of the contribution, in U.S. dollars, as defined in Section 5.6.7 of this AO; and
(vi.) Cross reference to letters of commitment, as required in Section 5.8.1 of this AO.

J.5. Draft International Participation Plan - Discussion on Compliance with U.S. Export Laws and Regulations.

The following expands requirements in the AO, in particular Requirement 98.

Requirement B-65. If a proposal includes international participation, either through involvement of non-U.S. nationals and/or involvement of non-U.S. entities, this section shall discuss compliance with U.S. export laws and regulations; e.g., 22 CFR parts 120–130, *et seq*. and 15 CFR parts 730–774, *et seq*., as applicable to the scenario surrounding the particular international participation. The discussion shall describe in detail the proposed international participation and is to include, but not be limited to, whether or not the international participation may require the proposer to obtain the prior approval of the Department of State or the Department of Commerce via a technical assistance agreement or an export license, or whether a license exemption/exception may apply. If prior approvals via licenses are necessary, discuss whether the license has been applied for or, if not, the projected timing of the application and any implications for the schedule. Information regarding U.S. export regulations is available at http://www.pmddtc.state.gov/ and http://www.bis.doc.gov/. Proposers are advised that under U.S. law and regulation, spacecraft and their specifically designed, modified, or configured systems, components, parts, etc., such as instrumentation responsive to this AO, are generally considered "Defense Articles" on the United States Munitions List and subject to the provisions of the International Traffic in Arms Regulations (ITAR), 22 CFR parts 120–130, *et seq*.

Requirement B-66. Foreign nationals requiring access to NASA facilities and information systems will be required to comply with Homeland Security Presidential Directive HSPD-12 (see http://www.dhs.gov/homeland-security-presidential-directive-12), where applicable. This appendix shall also discuss the impact, if any, on the investigation and the proposed international participation of compliance with HSPD-12. If no impact is anticipated, this shall be explicitly stated.

J.6.[AO OPTION]Planetary Protection Plan

The following expands requirements in the AO, in particular Requirement 21 to Requirement 23.

Requirement B-67. If applicable, this section shall describe the plan for compliance with the planetary protection requirements described in Section 5.1.6 of this AO. At a minimum, it shall address:

(i.) the anticipated planetary protection Category of the mission under NASA directives;
(ii.) the proposed mission operational accommodations to comply with the anticipated requirements, including organizational responsibilities; and
(iii.) the proposed steps to be taken for the preparation of flyby, orbital, and/or landed portions of the spacecraft to comply with any requirements for overall microbiological cleanliness and recontamination prevention prior to launch.

If describing a sample return mission, this appendix shall additionally address:

(iv.) the nature of the proposed implementation of back-contamination control and subsequent containment and testing of returned samples or the proposed rationale for the mission to be relieved from a containment requirement.

This appendix shall address steps intended to be taken for planetary protection compliance and the implementing organization and any partners responsible for implementing those steps.

J.7. [AO OPTION]Draft Sample and Space Exposed Hardware Curation Plan

The following expands requirements in the AO, in particular Requirement 6 and Requirement 9.

Requirement B-68. If applicable, this section shall describe the draft plan for sample and space-exposed hardware curation at the NASA JSC Astromaterials Acquisition and Curation Office in accordance with the requirements in Sections 4.4.4 and 4.4.6. At a minimum, this draft plan shall describe:

(i.) the nature of samples expected to be returned,
(ii.) the environmental conditions required of the sample curatorial facility,
(iii.) the preliminary examination of the samples, and
(iv.) the preparation (within 6 months of return) of a sample catalog sufficient for other scientists to request samples.

The draft plan shall demonstrate that no more than 25% of the returned sample shall be consumed by the mission-team during the funded period of curation (two years following sample return). The draft plan shall also demonstrate that the remaining portion of the sample will remain in as undisturbed a condition as possible for studies that may be carried out in the indefinite future.

If non-U.S. partners are to receive fractions of the returned sample, they shall contribute proportionately to the sample allocated to the mission team.

Example: The proposed mission requires 10 g of returned sample to accomplish its science requirements; thus the mission must demonstrate that it will return at least 40 g of sample to

ensure that the mission consumes no more than 25%. Country A is contributing 20% of the mission costs, and thus is to be allocated 20% of the returned sample. Therefore, Country A would be expected to provide 20% of the sample to be used for accomplishing mission science requirements, i.e., 2 g (20% of 10 g); the remainder of the sample to be used for mission science (8 g) would come from the US portion of the total sample. Notes: 1) in the event that the actual sample return were to exceed the baseline requirement of 40 g, the mission would still be expected to accomplish its science goals without exceeding the planned 10 g allotment for mission science; 2) in the event that the actual sample return were to fall short of the baseline requirement of 40 g, the sample available to accomplish mission science would still be limited to 25% of the actual return. In the latter case, allocations of samples to partners would scale down as well, in proportion to the size of the actual return.

In the case if a nominal sample return of 40 g, with a 20% contribution from Country A, the sample would be allocated as follows:

Country A:

- Up to 2 g allocated to mission science, with any unused portion transferred to Country A;
- 6 g transferred to Country A under an international agreement with NASA.

US:

- Up to 8 g allocated to mission science, with any unused portion retained for future use by NASA;
- 24 g retained for future use by NASA.

J.8. [AO OPTION FOR SINGLE STEPS]Discussion of Limiting the Generation of Orbital Debris and End of Mission Spacecraft Disposal Requirements.

The following expands requirements in the AO, in particular Requirement 51.

This appendix is required only for proposed missions to Low Earth Orbit (LEO) (<2000 km perigee), near Geosynchronous orbit (GEO) (GEO ± 300 km), or the Moon (orbiters and landers).

Requirement B-69. This section shall discuss briefly how the mission meets the NPR 8715.6B and NASA-STD-8719.14A orbit debris requirements applicable to its proposed orbit.

Requirement B-70. For LEO missions, this section shall briefly discuss the lifetime of the mission and whether it meets the 25-year postmission (or 30-year from launch—whichever comes first) requirement. An orbital lifetime analysis addressing all assumptions and inputs contributing to the analysis shall be provided and describe, at a minimum:

- Vehicle Mass
- Drag Area or Cross-sectional Area
- Initial orbit used for the analysis
- Solar and atmospheric conditions assumptions (i.e., models or parameters)
- Methodology: analytical tool, table lookup, reference plot.

Requirement B-71. If the plan is to dispose of the satellite at the end of mission, this section shall provide the parameters of the disposal orbit, the delta-v allocation for disposal, and any other relevant assumptions.

Requirement B-72. For Lunar missions, this section shall include a discussion of how end-of-mission requirements will be met.

The following references are available in the Program Library:

- NPR 8715.6B, *NASA Procedural Requirements for Limiting Orbital Debri*s; and
- NASA-STD-8719.14A, *NASA Process for Limiting Orbital Debris.*

J.9. [AO OPTION]Infusion Plan for NASA-Developed Enabling Technology Demonstration Opportunity.

The following expands requirements in the AO, in particular Requirement 36.

Requirement B-73. This section, which shall not exceed five pages in length, shall describe any proposed utilization of NASA-developed technology as Enabling TDO(s). At a minimum, this description shall address the following topics to the extent that they are not addressed in the body of the proposal:

1) Demonstration of the proposers' understanding of the chosen NASA-developed technology, as well as their understanding of inherent risks associated with its use.
2) Description of technology infusion implementation plan with respect to utilization of the chosen NASA-developed technology. At a minimum, this shall include:
   a. Description of any required flight hardware development and integration plans for producing flight-qualified hardware/software.
   b. If any fallbacks/alternatives exist and are planned, description of the cost, schedule, and performance liens they will impose on the baseline design, as well as the decision milestones for their implementation.
3) Description of the application, appropriate use, and benefits of the NASA-developed technology in the proposed investigation, including description of how this technology could enhance the proposed investigation's science return.
4) Description of how the proposer would engage with the relevant NASA program office's intention to have insight into the flight hardware development, IV&V testing and results, flight development lessons learned, and performance data obtained during flight for the chosen NASA-developed technology.

This section need not repeat information that may be found in the body of the proposal. However, for completeness, discussions of NASA-Developed Enabling TDOs in the body of the proposal should be referenced from this section.

J.10. Compliance with Procurement Regulations by NASA PI Proposals.

The following expands requirements in the AO, in particular Requirement 65.

This appendix is required only for proposals submitted by NASA PIs or NASA Centers (excluding JPL). Proposals submitted by NASA Centers must comply with regulations governing proposals submitted by NASA PIs (NFS 1872.306).

Requirement B-74. For NASA Center proposals, this section shall include any descriptions, justifications, representations, indications, statements, and/or explanations that are required by the regulations.

J.11. Master Equipment List.

The following expands requirements in the AO, in particular Requirement 83.

Requirement B-75. This section shall include a Master Equipment List (MEL) summarizing all major components of each flight element subsystem and each instrument element component to support validation of proposed mass estimates, power estimates, contingencies, design heritage, and cost. A template for this MEL is included as Table B5.

Requirement B-76. Contributed flight element subsystem components and individual instrument element components that are a part of the PI's proposed hardware development shall be included in the MEL. However, do not include the spacecraft and/or any instrument when entirely contributed.

Requirement B-77. The MEL shall be additionally provided in Microsoft Excel format on each CD-ROM submitted. A Microsoft Excel template of the MEL is available for download in the Program Library.

The breakouts should be traceable to block diagrams and heritage claims provided in other parts of the proposal. For each major component, current best estimates (CBE) and contingency for mass and power, number of flight units required, and some description of the heritage basis must be provided. Power values should represent nominal steady-state operational power requirements. Information to be provided includes identification of planned spares, identification of engineering models and prototypes with their fidelities, required deliveries for simulators and testing, contingency allocations for individual components, and other component description/characteristics. Certain items should include additional details, sufficient to assess functionality and/or cost, to identify and separate individual elements.

[AO OPTION FOR SINGLE STEPS] List each electronic board separately, identify the functionality of each board (either in the MEL or in the Mission Implementation section), and provide the speed the board will be running at. If proposing Field-Programmable Gate Arrays (FPGAs) or Application-Specific Integrated Circuits (ASICs), or Radio Frequency Integrated Circuits (RFICs), list the design size (in the appropriate sizing parameter such as logic cells,

logic elements), the board the chip(s) will be integrated onto, and how much heritage will be used in the design.

J.12. Heritage.

The following expands requirements in the AO, in particular Requirement 78.

Requirement B-78. This section shall discuss each element of any heritage from which the proposed investigation derives substantial benefit, including heritage from spacecraft subsystems, instruments, ground systems, flight and ground software, test set ups, simulations, analyses, etc. This discussion shall be at an appropriate level of granularity (e.g., component, assembly, subsystem) to clearly separate the heritage element from other elements of the design. The discussion of each element shall include:

- a concise description of the design heritage claimed;
- the anticipated benefits to the proposed investigation;
- a brief rationale supporting the claim that the benefits of heritage will be achieved; and
- for any proposed elements with substantial design heritage, a comparison of the cost of the heritage items to the proposed cost.

The length of this Appendix is limited. See the Proposal Structure and Page Limits table.

Proposals must substantiate all heritage claims, including descriptions of changes required to accommodate project-unique applications and needs. Where enhancements to heritage elements are proposed or heritage is from a different application, sufficient descriptions must be provided to independently assess the current level of maturity.

Requirement B-79. If a proposal claims any heritage from which the proposed investigation derives substantial benefit, this appendix shall discuss each element to an appropriate level of granularity (e.g., component, assembly, subsystem) to clearly separate the heritage element from other elements of the design.

The evaluation team will use a scale with three levels (full, partial, or none) as illustrated in the table below.

	Full heritage	Partial heritage	No heritage
Design	Identical	Minimal modifications	Major modifications
Manufacture	Identical	Limited update of parts and processes necessary	Many updates of parts or processes necessary
Software	Identical	Identical functionality with limited update of software modules (<50%)	Major modifications (≥50%)
Provider	Identical provider and development team	Different however with substantial involvement of original team	Different and minimal or no involvement of original team
Use	Identical	Same interfaces and similar use within a novel overall context	Significantly different from original
Operating Environment	Identical	Within margins of original	Significantly different from original
Referenced Prior Use	In operation	Built and successfully ground tested	Not yet successfully ground tested

J.13. Certifications Amendments (optional).

This appendix *may* provide amendments to certifications, as provided for in Section 6.2.2.

J.14. List of Abbreviations and Acronyms.

The following expands requirements in the AO, in particular Requirement 127.

Requirement B-80. This appendix shall provide a list of abbreviations and acronyms.

J.15. List of References (optional).

This appendix *may* provide a reference list of documents and other materials that were fundamentally important in generating the proposal. This *may* include a Uniform Resource Locator (URL) for documents that are available through the Internet. As noted at the outset of Appendix B of this AO, however, *proposals must be self-contained*: any data or other information intended as part of a proposal must be included within the proposal itself. If any documents or other materials are submitted as a part of a proposal, they must fit within the prescribed page limits.

TABLE B1
EXAMPLE SCIENCE TRACEABILITY MATRIX

Science Goals	Science Objectives	Scientific Measurement Requirements		Instrument Requirements		Projected Performance	Mission Requirements (Top Level)
		Physical parameters	**Observables**				
GOAL 1	Objective 1	Column Density of Absorber	Absorption Line	Alt. Range	XX km	ZZ km	Observing strategies: requires yaw & elevation maneuvers Launch window: to meet nadir and limb overlap requirement. Window applies day-to-day.
		Density and Temperature of Emitter	Emission Line				
		Size of Features	Morphological Feature	Vert. Resolution	XX km	ZZ km	Need NN seasons to trace evolution of phenomenon
				Horiz. Resolution	XX deg x XX lat x XX long	ZZ deg x ZZ lat x ZZ long	
			Rise Time of Eruptive Phenomena	Temperature Resolution	XX min	ZZ min.	Need MM months of observation to observe variability of phenomenon.
				Precision	XX K	ZZ K	
				Accuracy	XX K	ZZ K	

TABLE B2
EXAMPLE MISSION TRACEABILITY MATRIX

Mission Requirements	Mission Design Requirements	Spacecraft Requirements	Ground System Requirements	Operations Requirements
From Table B1	Rocket type Launch date: Mission length Orbit altitude requirement and rationale Geographic coverage and how it drives orbit requirement Orbit local time and rationale for the requirement Type of orbit, e.g. Sun synchronous, precessing, Lagrangian point, other Other	Spinning, stabilized Mass Power Volume: Data Rate Temperature Range for spacecraft systems Pointing Control: Knowledge, Stability, Jitter, Drift , Other Detector radiation shielding requirements and rationale Other	Passes per day and duration Assumed antenna size Data volume per day Real time data transmission requirements Transmit frequency Power available for comm (Watts) Downlink data rate Number of data dumps per day Spacecraft data destination (e.g., mission operations center) Science data destination (e.g., science operations center) Other	General spacecraft maneuver requirements and frequency Special maneuvers requirements Rationale for maneuvers Ephemeris requirements Changes in viewing modes and directions per orbit, per day or over longer time periods. Rationale for these changes Other
Examples				
Four different observing strategies: Solar, limb, nadir, zenith; requires yaw and elevation maneuvers		Agility requirements Slew rate = y deg/sec Settle = stability < .001 deg/sec after 30 secs		Target planning on 3 day centers Ephemeris accuracy of x with updates every 2 days
Instrument X precision of 5K		Thermal stability of 1 deg/hr S/C bus stability of .01 deg over 10 secs	Bit error rate < 1e-5 Time correlation to 2 msec over 1 week	Weekly time correlation

[AO OPTION FOR SINGLE STEPS] TABLE B3a
TOTAL MISSION COST RY$ PROFILE TEMPLATE

Total Mission Cost Profile Template
FY Costs and Totals in Real Year Dollars (RY$)

WBS#	WBS Element	Phase A			Phase B			Phase C/D				RY$	Phase E				Phase F			RY$
		FY2017	FY2018	Total	FY2018	FY2019	Total	FY2019	FY2020	FY2021	Total	A-D Total	FY2021	FY2022	FY2023	Total	FY2023	FY2024	Total	A-F Total
01	Project Management																			
02	Systems Engineering																			
03	Safety & Mission Assurance																			
04	Science / Technology																			
	Breakout pre-launch science from technology development activities																			
05	Payload(s)																			
	List each instrument separately																			
06	Spacecraft																			
	List each major flight system element separately																			
07	Mission Operations																			
	Breakout separable services, e.g., DSN, etc.																			
08	Launch Vehicle / Services																			
09	Ground System(s)																			
	Breakout non-standard cost, e.g., coordinating ground stations																			
10	Systems Integration & Testing																			
11	Student Collaboration in Excess of Incentive																			
	Reserves																			
	PI-Managed Mission Cost																			
	Student Collaboration Incentive (if applicable)																			
	Contributions																			
	List by organization and WBS element																			
	Total Mission Cost																			
	Student Collaboration Incentive (if applicable)																			
	Other AO-specific Activities																			
	List by activity and WBS element																			
	Enhanced PI-Managed Mission Cost																			

Label columns with actual fiscal years. Add or remove FY

A Microsoft Excel version of this template is available in the Program Library.

TABLE B3b
TOTAL MISSION COST FY$ PROFILE TEMPLATE

Total Mission Cost Profile Template
FY Costs and Totals in Fiscal Year <<CAP YEAR>> Dollars (FY<<CAP YEAR>>$)

WBS#	WBS Element	Phase A			Phase B			Phase C/D			FY<<CAP YEAR>>$	Phase E			Phase F			FY<<CAP YEAR>>$
		FY2017	FY2018	Total	FY2018	FY2019	Total	FY2019	FY2020	FY2021	Total	A-D Total	FY2021	FY2022	FY2023	Total	FY2023	FY2024	Total	A-F Total
01	Project Management																			
02	Systems Engineering																			
03	Safety & Mission Assurance																			
04	Science / Technology																			
	Breakout pre-launch science from technology development activities																			
05	Payload(s)																			
	List each instrument separately																			
06	Spacecraft																			
	List each major flight system element separately																			
07	Mission Operations																			
	Breakout separable services, e.g., DSN, etc.																			
08	Launch Vehicle / Services																			
09	Ground System(s)																			
	Breakout non-standard cost, e.g., coordinating ground stations																			
10	Systems Integration & Testing																			
11	Student Collaboration in Excess of Incentive																			
	Reserves																			
	PI-Managed Mission Cost																			
	Student Collaboration Incentive (if applicable)																			
	Contributions																			
	List by organization and WBS element																			
	Total Mission Cost																			
	Student Collaboration Incentive (if applicable)																			
	Other AO-specific Activities																			
	List by activity and WBS element																			
	Enhanced PI-Managed Mission Cost																			
	Phase B Bridge Phase Funding (*included above*)																			

Label columns with actual fiscal years. Add or remove FY columns as necessary.

A Microsoft Excel version of this template is available in the Program Library.

TABLE B4
2017 NASA NEW START INFLATION INDEX
FOR FY18 USE

Fiscal Year	2019	2020	2021	2022	2023	2024	2025	2026
Inflation Rate		2.6%	2.7%	2.7%	2.7%	2.6%	2.6%	2.6%
Cumulative Inflation Index	1.000	1.026	1.054	1.082	1.111	1.140	1.170	1.200

Use an inflation rate of 2.6% for all other years beyond 2026.

Note: Proposers must use their own forward pricing rates. For organizations that are without forward pricing rates, proposers must use the NASA New Start Inflation Index above.

TABLE B5
MASTER EQUIPMENT LIST

MASTER EQUIPMENT LIST Template - MISSION X

S/C Element 1		# OF UNITS			FLIGHT HARDWARE MASSES			FLIGHT HARDWARE POWER			OTHER COMPONENT INFORMATION	
Subsystem/Component	Unit Mass, Current Best Estimate (CBE)	Flight Units	Flight Spares	EMs & Proto-types	Total Mass, kg CBE	Contin-gency %	Total Mass w/ Contin-gency	Total Power, W CBE	Contin-gency %	Total Power w/ Contin-gency	Description (Vendor, Part #, Heritage Basis)	Other characteristics/issues (volume, other component-specific information)
Total Mass/Power												

S/C Element *n*		# OF UNITS			FLIGHT HARDWARE MASSES			FLIGHT HARDWARE POWER			OTHER COMPONENT INFORMATION	
Subsystem/Component	Unit Mass, Current Best Estimate (CBE)	Flight Units	Flight Spares	EMs & Proto-types	Total Mass, kg CBE	Contin-gency %	Total Mass w/ Contin-gency	Total Power, W CBE	Contin-gency %	Total Power w/ Contin-gency	Description (Vendor, Part #, Heritage Basis)	Other characteristics/issues (volume, other component-specific information)
Total Mass/Power												

Payload Element 1		# OF UNITS			FLIGHT HARDWARE MASSES			FLIGHT HARDWARE POWER			OTHER COMPONENT INFORMATION	
Subsystem/Component	Unit Mass, Current Best Estimate (CBE)	Flight Units	Flight Spares	EMs & Proto-types	Total Mass, kg CBE	Contin-gency %	Total Mass w/ Contin-gency	Total Power, W CBE	Contin-gency %	Total Power w/ Contin-gency	Description (Vendor, Part #, Heritage Basis)	Other characteristics/issues (volume, other component-specific information)
Total Mass/Power												

Payload Element *n*		# OF UNITS			FLIGHT HARDWARE MASSES			FLIGHT HARDWARE POWER			OTHER COMPONENT INFORMATION	
Subsystem/Component	Unit Mass, Current Best Estimate (CBE)	Flight Units	Flight Spares	EMs & Proto-types	Total Mass, kg CBE	Contin-gency %	Total Mass w/ Contin-gency	Total Power, W CBE	Contin-gency %	Total Power w/ Contin-gency	Description (Vendor, Part #, Heritage Basis)	Other characteristics/issues (volume, other component-specific information)
Total Mass/Power												

A Microsoft Excel version of this template is available in the Program Library.

APPENDIX C

GLOSSARY OF TERMS AND ABBREVIATIONS

Part C.1: GLOSSARY OF TERMS

Adjusted AO Cost Cap — The value that [AO OPTION]the Phases A-D portion of [END OPTION]a proposal's PI-Managed Mission Cost is limited to, after adjustment from the AO Cost Cap for proposal-specific incentives and/or charges associated with NASA-provided items that have firm fixed values. Expressed in applicable Fiscal Year Dollars.

Announcement of Opportunity (AO) — A document used to announce opportunities to participate in NASA programs.

AO Cost Cap — The typical value that the [AO OPTION]Phases A-D portion of [END OPTION]PI-Managed Mission Cost is limited to. Represents the publicly announced Program funding available to all proposers to an opportunity. May be adjusted for individual proposals by incentives and/or charges (see Adjusted AO Cost Cap). Expressed in applicable Fiscal Year Dollars.

AO Process — A term used to describe the program planning and acquisition procedure used to acquire investigations through an AO.

AO Steering Committee — A NASA committee composed wholly of Civil Servants and Intergovernmental Personnel Act appointees (some of whom may be from Government agencies other than NASA) and appointed by the Associate Administrator for the Science Mission Directorate, which provides procedural review over the investigation evaluation, categorization, and selection process.

Backward contamination — The transmittal to Earth from another body of viable organisms by a spacecraft or spacecraft component.

Baseline Science Mission — The mission that, if fully implemented, would fulfill the Baseline Science Requirements that are defined in NPR 7120.5E as the performance requirements necessary to achieve the full science objectives of the mission.

Baseline science objectives — The entire set of scientific objectives proposed for the investigation.

Basis of Estimate (BOE) — A record of the procedures, ground rules and assumptions, data, environment, and events that underlie a cost estimate's development or update. Good documentation of the BOE supports the cost estimate's credibility.

Categorization — The process whereby proposed investigations are classified into four categories synopsized here as Category I (recommended for acceptance); Category II (recommended for acceptance but at a lower priority than Category I proposals); Category III (sound investigations requiring further development); Category IV (not recommended).

Categorization Committee — A committee composed wholly of Civil Servants and Intergovernmental Personnel Act appointees (some of whom may be from Government agencies other than NASA) and appointed by the Associate Administrator for the Science Mission Directorate, which categorizes proposals for investigations submitted in response to an AO based on the evaluations.

Co-Investigator (Co-I) — An investigator who plays a necessary, defined role in the proposed investigation and whose services are either funded by the <<PROGRAM NAME>> Program or are contributed. A NASA employee can participate as a Co-I on an investigation proposed by a private organization.

Collaborator — An individual who is less critical to the successful development of the mission than a Co-I. A collaborator may not be funded by the <<PROGRAM NAME>> Program. A collaborator may be committed to provide a focused contribution to the project for a specific task, such as data analysis. If <<PROGRAM NAME>> Program funding support is requested in the proposal for an individual, that individual must not be identified as a collaborator but must be identified as a Co-Investigator or another category of funded team member.

Complete spaceflight mission — A science investigation requiring an Earth-orbiting, near-Earth, or deep-space mission, that encompasses all appropriate mission phases from project initiation (Phase A) through mission operations (Phase E) and closeout (Phase F), including the analysis and publication of data in the peer reviewed scientific literature, delivery of the data to an appropriate NASA data archive, and, if applicable, extended mission operations or other science enhancements.

Communications — Comprises the comprehensive set of functions necessary to effectively convey—and provide an understanding of—a program, its objectives and benefits to target audiences, the public, and other stakeholders. This includes a diverse, broad, and integrated set of efforts and is intended to promote interest and foster participation in NASA's endeavors and develop exposure to, and appreciation for, science, technology, engineering, and mathematics (STEM).

Contingency — That quantity, when added to a resource, results in the maximum expected value for that resource.

Contribution — Labor, services, or hardware funded by any source other than Program sponsoring the AO.

Cost plan — The plan for meeting the funding resource requirements of a mission's development and operations, to include support for proposed cost estimates (e.g., basis of estimate, heritage, and letters of commitment), justification and adequacy of proposed encumbered and unencumbered cost reserves, feasibility of the costs to perform the mission, and cost risks to the mission.

Data buy — An investigation based on data purchased using NASA funds but collected by an observational platform developed and operated without NASA support or oversight.

Data product latency — The period of time between data collection and release to the public. During this period the data may be in sole possession of the investigation team for initial calibration and validation purposes only.

Descope — Any alteration of a mission that results in savings of resources (mass, power, dollars, schedule, etc.) at the cost of reduced scientific performance.

Earned Value Management (EVM) — A tool for measuring and assessing project performance through the integration of technical scope with schedule and cost objectives during the execution of the project. EVM provides quantification of technical progress, enabling management to gain insight into project status and project completion costs and schedules.

Education — Comprises those activities designed to enhance learning in science, technology, engineering, and mathematics (STEM) content areas using NASA's unique capabilities.

Enhanced PI-Managed Mission Cost — the PI-Managed Mission Cost plus costs of optional components such as any Student Collaboration up to any associated incentive.

Federal Acquisition Regulation (FAR) — The regulations governing the conduct of acquisition.

Flight worthiness — The competency and adequacy of the technical work performed by a provider of a non-AO-provided launch service.

Forward contamination — The transmittal from Earth to a targeted Solar System body of viable organisms by a spacecraft or spacecraft component.

Guest Investigators — Investigators selected to conduct observations and obtain data within the capability of a NASA mission, which are additional to the mission's primary objectives. Sometimes referred to as Guest Observers or General Observers.

Hosted Payload — A payload composed of one or more sensors or instruments that is attached and/or integrated into a host space vehicle for the purpose of obtaining one or more ongoing resources from the host for the life of the hosted payload. Hosted payloads are typically arranged through a partnership.

Implementing organization — The organization chosen by the Principal Investigator to manage the development of the mission.

Investigation — Activities or effort aimed at the generation of new knowledge. NASA-sponsored investigations generally concern the generation and analysis of data obtained through measurement of space phenomena or Earth phenomena using spaceflight hardware developed and operated for that purpose.

Investigation Team — The group of scientists, engineers, and other professionals implementing an investigation.

Key Management Team members **—** The project leaders whose qualifications and experience are relevant and necessary to the success of the project. These positions must include, as a minimum, the PI, PM, PSE, Deputy PI (if specified), Project Manager Alternate (if specified), and, where appropriate, the PS and partner leads for substantial efforts. Individuals to be identified as named Key Management Team members minimally include the [AO OPTION FOR FULL MISSIONS]PI, PM, and PSE[END OPTION][ALTERNAIVE AO OPTION]PI and PM[END OPTION].

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, but not extended operations. The Life-Cycle Cost of a project or system can also be defined as the total cost of ownership over the project or system's planned life cycle from Formulation (excluding Pre-Phase A) through Implementation (excluding extended operations). The Life-Cycle Cost includes the cost of the launch vehicle.

Major partners — The organizations, other than the proposing organization, responsible for providing science leadership, project management, system engineering, spacecraft (as applicable), science instruments, PI-Team-Developed TDOs, integration and test, alternative access to space, mission operations, and other critical or essential products or services as defined by the proposer; all organizations, other than the proposing organization, receiving or contributing more than 10% of the PI-Managed Mission Cost are included, regardless of role.

Margin — The allowance carried on a resource (e.g., budget, schedule, mass) to account for uncertainties and risks. It is the difference between the maximum possible capability of a resource (the physical limit or the agreed-to limit) and the maximum expected value for a resource.

Mission — Used interchangeably with investigation.

Mission Architecture — The summary level description of the overall approach to the mission in the context of achieving the science objectives including mission elements such as flight systems, instruments, high-level mission plan, high-level operations concept, etc.

NASA FAR Supplement — Acquisition regulations promulgated by NASA in addition to the FAR.

Notice of Intent — A notice or letter submitted by a potential investigator indicating the intent to submit a proposal in response to an AO.

Passivation — The complete removal of any stored energy on board a spacecraft including residual propellants (by venting or burning), residual pressurants (by venting), electrical energy (by discharge or disconnection of batteries), kinetic energy (by unloading or de-spinning momentum wheels or gyros), and the disabling of range safety explosives.

Payload — A specific complement of instruments, space equipment, and support hardware carried to space to accomplish a mission or discrete activity in space.

Peer Review (n) — A gathering of experts in related disciplinary areas convened as a subcommittee of the AO Steering Committee to review proposals for flight investigations.

Peer Review (v) — The process of proposal review utilizing a group of peers in accordance with the review criteria as outlined in the AO.

Performance Metrics — A multi-party agreement between the Program Office, the PI institution, the project management institution, and other major partners that is used for project evaluation by NASA.

PI-Managed Mission Cost — The cost proposed by the PI's implementation team to be funded by the Program sponsoring the AO for the development and execution of the proposed project, Phases A through F. It includes any reserves applied to the development and operation of the mission as well. It also includes any costs that are required to be accounted for against the PI-Managed Mission Cost even though the PI is not responsible for those costs (e.g., NASA-provided telecom and network). The term does not imply that a contractual relationship between the Proposing Organization and other proposal partners is required. The [AO OPTION]Phases A-D portion of the [END OPTION]PI-Managed Mission Cost is capped at the AO Cost Cap or Adjusted AO Cost Cap, as applicable.

Planetary Protection — The practice of avoiding biological contamination of other planetary bodies and samples to be returned to Earth, to preserve the capability to perform future scientific and other investigations.

Principal Investigator (PI) — The person who conceives of an investigation and leads implementation of it. The PI is invested by NASA with primary responsibility for implementing and executing selected investigations. A NASA employee can participate as a PI only on a Government-proposed investigation.

Program — An activity involving human resources, materials, funding, and scheduling necessary to achieve desired goals.

Project — Within a program, an undertaking with a scheduled beginning and ending, which normally involves the design, construction, and operation of one or more spacecraft and necessary ground support in order to accomplish a scientific or technical objective.

Project Manager (PM) — The individual responsible to the PI for overseeing the technical and programmatic implementation of the project. The PM works closely with the PI in order to ensure that the mission meets its objectives within the resources committed to the project.

Project Office — An office established to manage a project.

Project Scientist (PS) — The member of the science team designated by the PI to be responsible for ensuring the scientific success of the project. The Project Scientist may have other responsibilities as defined by the PI or the implementing organization.

Project Systems Engineer (PSE) — The individual responsible to the PI for all system engineering aspects of the mission per NPR 7123.1B**.**

Proposal Team — The Proposal Team includes, but is not be limited to, named Key Management Team members and any Co-I or collaborator who is not part of the Key Management Team.
Proposing Organization — The organization that submits the proposal; commonly this is also the Principal Investigator's home institution.

Reserve — Resource not allocated to any specific task but held by the project for unexpected needs.

Resiliency — The quality of a mission to gracefully degrade from the Baseline Science Mission to the Threshold Science Mission as technical, schedule, or budgetary problems occur.

Risk — The combination of the probability that a program or project will experience an undesired event and the consequences, impact, or severity of the undesired event, were it to occur. The undesired event may come from technical or programmatic sources (e.g., a cost overrun, schedule slippage, safety mishap, health problem, malicious activities, environmental impact, failure to achieve a needed scientific or technological objective, or success criterion). Both the probability and consequences may have associated uncertainties.

Science data — the recorded factual material commonly accepted in the scientific community as necessary to validate research findings, but not any of the following: preliminary analyses, drafts of scientific papers, plans for future research, peer reviews, or communications with colleagues. This "recorded" material excludes physical objects (e.g., laboratory samples).

Science data also do not include:

> (A) Trade secrets, commercial information, materials necessary to be held confidential by a researcher until they are published, or similar information which is protected under law; and
>
> (B) Personal and medical information and similar information[,] the disclosure of which would constitute a clearly unwarranted invasion of personal privacy, such as information that could be used to identify a particular person in a research study.

Data are understood to include not only the recorded technical information, but also metadata (describing the data), descriptions of the software required to read and use the data, associated software documentation, and associated data (e.g., calibrations).

Exclusion: NASA creates and provides a large suite of scientific and engineering "data products" whose dissemination to the research community and the general public advance the Agency's core mission objectives. These "data products" come from NASA missions, instruments, and projects and typically have well-established scientific or technological goals and requirements. Subject to Federal laws regarding sensitive data and privacy, these data products are captured and archived by NASA for public access and use and are thus already compliant with the OSTP February 22, 2013, memorandum on access to research results. This plan therefore excludes these types of data.

Science Enhancement Option (SEO) — An activity, such as extended mission, guest investigator program, general observer program, participating scientist program, interdisciplinary scientist program, or archival data analysis program that has the potential to broaden the scientific impact of investigations.

Selection Official — The NASA official designated to determine the source for award of a contract or grant.

Technology Demonstration Opportunity (TDO) — An activity that demonstrates innovative technological approaches.

Termination review — A review established to determine whether remedial actions, including changes in management structure and/or key personnel, would better enable a project to operate within established cost, schedule, and/or technical constraints. If a termination review determines that no remedy is likely to improve matters, NASA may consider termination of the project.

Threshold Science Mission — A descoped Baseline Science Mission that would fulfill the Threshold Science Requirements, which are defined in NPR 7120.5E as the performance requirements necessary to achieve the minimum science acceptable for the investment.

Total Mission Cost — The PI-Managed Mission Cost plus any Student Collaboration or other specified costs up to any associated incentive(s), and any additional costs that are contributed or provided in any way other than through the Program sponsoring the AO. The Total Mission Cost will define the total value of the baseline investigation, not including any excluded costs or other costs only included in the Enhanced PI-Managed Mission Cost.

Unencumbered reserve — Reserves that are free of liens identified by proposers and are held for risks that may be realized during project execution.

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

Part C.2: COST ELEMENT DEFINITIONS

This is a short dictionary of definitions for the cost elements shown in the tables and discussed in the body of this AO.

Instruments — Instrument costs include costs incurred to design, develop, and fabricate the individual scientific instruments or instrument systems through delivery of the instruments to the spacecraft for integration. Costs for instrument integration, assembly, and test are to be shown separately from instrument development. Costs incurred for integration of the instruments to the spacecraft are included in the Spacecraft Integration, Assembly and Test cost element (see below).

Launch Approval Engineering or Launch Approval Process — The process by which National Environmental Protection Act and any applicable launch safety approval requirements are satisfied.

Launch Checkout and Orbital Operations — Launch checkout and orbital operations support costs are those involving prelaunch planning, launch site support, launch vehicle integration (spacecraft portion), and the first 30 days of flight operations.

Launch Services — Launch vehicles and services are either procured and provided by NASA to launch spacecraft under fixed price contracts or provided by the proposer. The launch service price includes procurement of the ELV, spacecraft-to-launch vehicle integration, placement of spacecraft into designated orbit, analysis, flight mission data evaluation, oversight of the launch service and coordination of mission-specific integration activities.

Mission Operations and Data Analysis (MO&DA) — This cost element refers only to Phases E and F (postlaunch) and has two major components: Mission Operations and Data Analysis. Mission operations comprises all activities required to plan and execute the science objectives, including spacecraft and instrument navigation, control, pointing, health monitoring, and calibration. Data analysis activities include collecting, processing, distributing, and archiving the scientific data. MO&DA costs include postlaunch all costs for people, procedures, services, hardware, and software to carry out these activities. It includes postlaunch science team support costs. It does not include costs of any Science Enhancement Option (SEO) activities.

NASA Center Costs (all categories) — Additional costs borne by the science investigation for NASA Center participation. For example, there may be additional project management/systems engineering costs, above those incurred by the spacecraft prime contractor, which are due to NASA employee participation. These costs must be reported on a full-cost accounting basis.

Prelaunch Science Team Support — Includes all Phase B/C/D (prelaunch) support costs for the science team. (See MO&DA for postlaunch component.)

Prelaunch Ground Data System (GDS)/Mission Operations Services (MOS) Development — Includes costs associated with development and acquisition of the ground infrastructure used to transport and deliver the telemetry and other data to/from the Mission Operations Center and the Science Operations Center. (For more information, refer to *NASA's Mission Operations and Communications Services* document in the Program Library.) Includes development of science data processing and analysis capability. Also includes prelaunch training of the command team, development and execution of operations simulations, sequence development, and flight control software. This element includes any mission-unique tracking network development costs.

Project Management/Mission Analysis/Systems Engineering — Project management costs include all efforts associated with project level planning and directing of prime and subcontractor efforts and interactions, as well as project-level functions such as quality control and product assurance. Mission Analysis includes preflight trajectory analysis and ephemeris development. Systems engineering is the project-level engineering required to ensure that all satellite subsystems and payloads function properly to achieve system goals and requirements. This cost element also includes the data/report generation activities required to produce internal and deliverable documentation.

Project-Unique Facilities — If the proposed science investigation requires construction or lease of any ground facilities, include here only the portion of costs to be borne by the proposed investigation, with description of the nature and extent of any cost-sharing arrangements assumed.

Reserves — In that NASA maintains no reserves for science investigations or missions, reserves must include those funds that are not allocated specifically to estimated resources, but are held against contingencies or underestimation of resources to mitigate the investigation risk. Reserves must be reported according to the proposed reserve management strategy. For example, if the reserve is divided into funds to be preallocated to the flight system and instrument payload, with another portion held at the science investigation level, specific dollar amounts to fund each must be identified.

SEO Activities — Options for enlarging the science/technology impact beyond the baseline investigation, such as extended missions, guest investigator programs, general observer programs, or archival data analysis programs are termed SEO activities. These costs do not count against the funding cap.

Spacecraft Bus — Spacecraft bus costs include costs incurred to design, develop, and fabricate (or procure) the spacecraft subsystems. Costs for integration and assembly are not included in this element. Component level test and burn-in is included in this cost element. System tests are included in Spacecraft IAT (see below).

Spacecraft Integration, Assembly, and Test (IAT) — Spacecraft integration, assembly and test is the process of integrating all spacecraft subsystems and payloads into a fully tested, operational satellite system. The total cost of IAT for a satellite includes research/requirements specification, design and scheduling analysis of IAT procedures, ground support equipment, systems test and evaluation, and test data analyses. Typical satellite system tests include thermal vacuum, thermal cycle, electrical and mechanical functional, acoustic, vibration, electromagnetic compatibility/interference, and pyroshock.

Tracking Services including DSN — This line item includes all costs associated with this service for the specific proposed mission profile. (Refer to *NASA' s Mission Operations and Communications Services* document, in the Program Library.)

Part C.3: ABBREVIATIONS AND ACRONYMS

AA	Associate Administrator
AO	Announcement of Opportunity
AOR	Authorized Organizational Representative
APPEL	NASA Academy of Program, Project, and Systems Engineering Leadership
ASIC	Application-Specific Integrated Circuits
CADRe	Cost Analysis Data Requirement
CARA	Conjunction Assessment Risk Analysis
CASP	Cross-Agency Support Programs
CBE	Current Best Estimate
CCR	Central Contractor Registry
CD-ROM	Compact Disc-Read Only Memory
CDR	Critical Design Review
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations

CM&O	Center Management and Operations
Co-I	Co-Investigator
CSCI	Computer Software Configuration Item
CTS	Cornell Technical Services
DAAC	Distributed Active Archive Center
DOR	Differential One-way Ranging
DOE	Department of Energy
DPI	Deputy Principal Investigator
DSN	Deep Space Network
EA	Environmental Assessment
EAR	Export Administration Regulations
EASSS	Evaluations, Assessments, Studies, Services, and Support
EBPOC	Electronic Business Point of Contact
EIS	Environmental Impact Statement
ELV	Expendable Launch Vehicle
EOSDIS	Earth Observing System Data and Information System
ESSP	Earth System Science Pathfinder
EV	Earth Venture
EVM	Earned Value Management
FAQ	Frequently Asked Questions
FAR	Federal Acquisition Regulations
FASAB	Federal Accounting Standards Advisory Board
FFRDC	Federally Funded Research and Development Center
FONSI	Finding of No Significant Impact
FPGA	Field-Programmable Gate Array
FY	Fiscal Year
G&A	General and Administrative
GAO	Government Accountability Office
GDS	Ground Data System
GEO	Geosynchronous Orbit
GFE	Government Furnished Equipment
GFS	Government Furnished Service
HBCU	Historically Black Colleges and Universities
HBZ	HUB Business Zone
HUBZone	Historically Underutilized Business Zone
IAT	Integration, Assembly, and Test
ICD	Interface Control Document
IRD	Interface Requirements Document
ITAR	International Traffic in Arms Regulations
IV&V	Independent Verification and Validation
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
KDP	Key Decision Point
MEL	Master Equipment List
MEP	Mars Exploration Program
MMRTG	Multiple Mission Radioisotope Thermoelectric Generator

MO&DA	Mission Operations and Data Analysis
MOS	Mission Operations Services
MOU	Memorandum of Understanding
NASA	National Aeronautics and Space Administration
NASA-STD	NASA-Standard
NEN	Near-Earth Network
NEPA	National Environmental Policy Act
NFS	NASA FAR Supplement
NISN	NASA Integrated Services Network
NLS	NASA Launch Services
NLSA	Nuclear Launch Safety Approval
NODIS	NASA Online Directives Information System
NOI	Notice of Intent
NPD	NASA Policy Directive
NPR	NASA Procedural Requirements
NRA	NASA Research Announcement
NRC	National Research Council
NRP	NASA Routine Payload
NSPIRES	NASA Solicitation and Proposal Integrated Review and Evaluation System
NSS	NASA Safety Standard
OCFO	Office of the Chief Financial Officer
OMI	Other Minority Institution
OSTP	Office of Science and Technology Policy
PDF	Portable Data Format
PDR	Preliminary Design Review
PI	Principal Investigator
PIC	Procurement Information Circular
PM	Project Manager
POC	Point of Contact
PS	Project Scientist
PSE	Project Systems Engineer
RHU	Radioisotope Heater Unit
ROD	Record of Decision
ROM	Rough Order-of-Magnitude
ROSES	Research Opportunities in Space and Earth Sciences
RPS	Radioisotope Power System
RTG	Radioisotope Thermoelectric Generator
RY	Real Year
SALMON	Stand Alone Missions of Opportunity Notice
SB	Small Business
SC	Student Collaboration
SCaN	Space Communication and Navigation
SDB	Small Disadvantaged Business
SDVOSB	Service Disabled Veteran Owned Small Business
SE	System Engineer(ing)
SEO	Science Enhancement Option

SMD	Science Mission Directorate
SN	Space Network
SOW	Statement of Work
SPD	SMD Policy Document
SPG	Strategic Planning Guidance
TA	Technical Authority
TDO	Technology Demonstration Opportunity
TMC	Technical, Management, and Cost
TRL	Technical Readiness Level
UARC	University Affiliated Research Center
URL	Uniform Resource Locator
U.S.	United States
U.S.C.	United States Code
VOSB	Veteran Owned Small Business
WBS	Work Breakdown Structure
WOSB	Women Owned Small Business

APPENDIX D

PROGRAM LIBRARY

<<PROGRAM NAME>> Acquisition Homepage: <<SOMA AHP>>
<<PROGRAM NAME>> AO Library: <<PROG LIB>>

Strategic Documents

1. NPD 1001.0C, *NASA 2018 Strategic Plan*
2. *2014 Science Plan*

Program Specific Documents

1. *<<PROGRAM NAME>> Roadmap*
2. [Program Plan recommended, if available]
3. <<PROGRAM NAME>> safety, reliability, and quality assurance requirements document
4. *Guidelines and Criteria for the Phase A Concept Study*
5. *ELV Launch Services Information Summary*
6. *NASA Launch Services Program (LSP) Advisory Services Plan*
7. *Information on International Space Station Resources*
   a. *International Space Station Capabilities and Payload Accommodations*
   b. *Earth and Space Science Accommodations on ISS*
8. *Space Communications and Navigation (SCaN) Mission Operations and Communications Services (MOCS)*
9. *The Explanatory Guide to the NASA Science Mission Directorate Educational Merit Evaluation Factors for Student Collaboration Elements*
10. *TRL 6 Examples*
11. *SMD Mission Extension Paradigm*
12. *Microsoft Excel version of the template tables in the AO:*
    Table B1: Example Science Traceability Matrix
    Table B2: Example Mission Traceability Matrix
    [AO OPTION for single-step opportunities] *Table B3a: Total Mission Cost RY$ Profile Template* [END OPTION]
    Table B3b: Total Mission Cost FY$ Profile Template
    Table B5: Master Equipment List
13. *SPD-19, Meeting the 70% JCL Requirement in PI-led Missions*
14. *Draft Model Contract for Phases B/C/D/E*

NASA and Federal Documents

1. NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*
2. NPR 7123.1B, *NASA Systems Engineering Processes and Requirements*
3. NID 8020.109, *Planetary Protection Provisions for Robotic Extraterrestrial Missions*
4. NPD 8020.7G, *Biological Contamination Control for Outbound and Inbound Planetary Spacecraft*
5. NPD 7100.10F, *Curation of Institutional Scientific Collections*

6. NASA-HDBK-6022, *NASA Handbook for the Microbiological Examination of Space Hardware*
7. NASA/CP-2002-211842, *A Draft Test Protocol for Detecting Possible Biohazards in Martian Samples Returned to Earth*
8. NASA/SP-2010-3404, *NASA WBS Handbook*
9. NPR 8715.6B, *NASA Procedural Requirements for Limiting Orbital Debris*
10. NASA-STD-8719.14A, *NASA Process for Limiting Orbital Debris*
11. NPR 8715.3D, *NASA General Safety Program Requirements*NPR 8705.4, *Risk Classification for NASA Payloads*
12. NPD 2521.1B, *Communications and Material Review*
13. NPR 2200.2D, *Requirements for Documentation, Approval and Dissemination of Scientific and Technical Information*
14. *NASA Plan for Increasing Access to the Results of Scientific Research*
15. Presidential Policy Directive PPD-26, National Space Transportation Policy, dated November 21, 2013

Additional NASA and Federal Documents

All NASA Policy Directives (NPD) and NASA Procedural Requirements (NPR) documents referenced in this AO may be found in the NASA Online Directives Information System (NODIS) Library (http://nodis3.gsfc.nasa.gov/)

NPR 1600.1A, *NASA Security Program Procedural Requirements*
NPD 1360.2B, *Initiation and Development of International Cooperation in Space and Aeronautics Programs*
NPR 7150.2B, *NASA Software Engineering Requirements*
NPD 5101.32E, *Procurement, Financial Assistance*
NPR 8580.1A, *Implementing the National Environmental Policy Act and Executive Order 12114*
NPD 8610.7D, *Launch Services Risk Mitigation Policy for NASA-Owned and/or NASA-Sponsored Payloads/Missions*
NPD8610.12H, Orbital Transportation Services

NASA technical standards documents may be found in the public access portion of the NASA Standards and Technical Assistance Resource Tool (START) (http://standards.nasa.gov/)

NASA-STD-8739.8, *Standard for Software Assurance*

NASA technical reports may be found on the NASA Technical Reports Server (NTRS) (http://ntrs.nasa.gov/search.jsp)

NASA/SP-2016-6105 Rev 2, *NASA Systems Engineering Handbook*

The Federal Acquisition Regulations (FAR) may be accessed at https://www.acquisition.gov/?q=browsefar. The following parts of the Federal Acquisition Regulations are referenced in this AO.

FAR 15.403-4, “Requiring certified cost or pricing data (10 U.S.C. 2306a and 41 U.S.C. 254b)”
FAR 15.403-5, “Instructions for submission of certified cost or pricing data and data other than certified cost or pricing data”
FAR 33.101, “Definitions”
FAR 52.219-8, “Utilization of Small Business Concerns”
FAR 52.219-9, “Small Business Subcontracting Plan”
FAR 52.222-26, “Equal Opportunity”
FAR 52.226-2, “Historically Black College or University and Minority Institution Representation”
FAR 52.227-11, “Patent Rights – Ownership by the Contractor”
FAR 52.227-14, “Rights in Data – General”
FAR 52.233-2, “Service of Protest”

The NASA FAR Supplement (NFS) may be accessed at http://www.hq.nasa.gov/office/procurement/regs/NFS.pdf. The following parts of the NASA FAR Supplement are referenced in this AO.

NFS 1815.208, “Submission, modification, revision, and withdrawal of proposals”
NFS 1835.016-70, “Foreign participation under broad agency announcements (BAAs)”
NFS 1852.227-11, “Patent Rights--Retention by the Contractor (Short Form)”
NFS 1852.227-70, “New Technology”
NFS 1852.227-71, “Requests for Waiver of Rights to Inventions”
NFS 1852.233-70, “Protests to NASA”
NFS 1852.234-2, “Earned Value Management System”
NFS 1872.304, “Categorization”
NFS 1872.306, "Proposals submitted by NASA investigators”

NASA Procurement Information Circulars (PICs) may be accessed at http://www.hq.nasa.gov/office/procurement/regs/pic.pdf.

The Code of Federal regulations (CFR) may be accessed at http://www.gpo.gov/fdsys/. The following parts of the Code of Federal Regulations are referenced in this AO.

2 CFR 200.466, “Scholarships and student aid costs”
15 CFR Parts 730-774, “Export Administration Regulations”
22 CFR Parts120-130, “International Traffic in Arms Regulations”
48 CFR 15.408, “Solicitation provisions and contract clauses”

The United States Code (USC) may be accessed at http://www.gpo.gov/fdsys/. The following parts of the United States Code are referenced in this AO.

42 USC 4321 *et seq.*, "National Environmental Policy Act (NEPA) of 1969, as amended"

Executive Orders may be accessed at http://www.archives.gov/federal-register/executive-orders/. The following Executive Orders are referenced in this AO.

Executive Order 12114, “Environmental effects abroad of major Federal actions” (see http://www.archives.gov/federal-register/codification/executive-order/12114.html)

Homeland Security Presidential Directive HSPD-12 (see http://www.dhs.gov/homeland-security-presidential-directive-12)

APPENDIX E

REQUIREMENTS FOR SUBSEQUENT PHASES

This appendix provides references to documents that govern subsequent phases of mission development for selected investigations. These documents may contain requirements on selected missions; however, they do not place requirements on proposals submitted in response to this AO. Proposed investigations should be implementable within the program and project management environment that these documents describe. These documents may be found in the Program Library (Appendix D).

E.1 Phase A Concept Study Reports and Confirmation of Investigation(s) for Phase B, as applicable

Guidelines and Criteria for the Phase A Concept Study

E.2 Confirmation of Investigation(s) for Subsequent Phases

NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*
<<PROGRAM NAME>> safety, reliability, and quality assurance requirements document
NPR 7123.1B, *NASA Systems Engineering Processes and Requirements*
NPR 8705.4, *Risk Classification for NASA Payloads*
NPR 8715.3D, *NASA General Safety Program Requirements*
SPD-19, *Meeting the 70% JCL Requirement in PI-led Missions*

APPENDIX F

COMPLIANCE CHECKLIST

This appendix contains a checklist with the list of items that NASA will check for compliance before releasing a proposal for evaluation. All other requirements will be checked during evaluation.

Administrative	
1. Electronic proposal received on time	Requirement 1
2. Proposal on CD-ROM received on time	Requirement 2
3. Original signatures of PI and of authorizing official included	Requirement B-12
4. Meets page limits	Requirement B-4
5. Meets general requirements for format and completeness (maximum 55 lines text/page, maximum 15 characters/inch --approximately 12 pt font)	Requirement 127 Requirement B-1 Requirement B-2 Requirement B-3
6. Required appendices included; no additional appendices	Requirement B-59
7. Budgets are submitted in required formats	Requirement B-54
8. All individual team members who are named on the cover page indicate their commitment through NSPIRES	Requirement 101
9. All export-controlled information has been identified	Requirement 102
10. Restrictions Involving China acknowledged on Electronic Cover Page	Requirement 5
Scientific	
11. Addresses solicited science research programs	Requirement 11
12. Requirements traceable from science to instruments to mission	Requirement 13
13. Appropriate data archiving plan	Requirement 14
14. Baseline science mission and threshold science mission defined	Requirement 17
Technical	
15. Complete spaceflight mission (Phases A-F) proposed	Requirement 27
16. Team led by a single PI	Requirement 54
17. [AO OPTION]Phase A-D portion of [END AO OPTION] PI-Managed Mission Cost within AO Cost Cap or Adjusted AO Cost Cap, as applicable	Requirement 74
18. Phase A costs within Phase A cost limit	Requirement 76
19. Contributions within contribution limit	Requirement 88
20. Co-investigator costs in budget	Requirement 68
21. Launch readiness prior to launch readiness date	Requirement 111
22. Includes table describing non-U.S. participation	Requirement 96
23. Includes letters of commitment from funding agencies for non-U.S. participating institutions	Requirement 93
24. Includes letters of commitment from all U.S. organizations offering contributions	Requirement 99
25. Includes letters of commitment from all major partners and non-U.S. institutions providing contribution of efforts of anyone on the Proposal Team.	Requirement 100

APPENDIX G

REQUIREMENTS CROSSWALK

This appendix contains an approximate crosswalk between proposal requirements in the AO and proposal requirements in Appendix B. Proposal requirements in Appendix B provide further definition of the proposal requirements in the AO and provide specific requirements for the format and content of the proposal. Some AO requirements do not require further definition by an Appendix B requirement, however they must be addressed in the proposal. Not all possible crosswalk relations are shown.

[NOTE TO AO AUTHORS: This crosswalk does not automatically update when requirements are added or deleted from the AO or Appendix B. This crosswalk must be adjusted by hand for each AO.]

[NOTE TO AO READERS: This crosswalk is not updated for each release of the Standard AO Template.]

AO Reqmt	**AO Section**	**AO Reqmt Topic**	**Appendix B Reqmt**
1	3	Proposal submission	
2	3	Electronic submission	
3	5.1.1	Science scope	B-15
4	5.1.2	Science traceability	B-16
5	5.1.2	Data [AO OPTION FOR TWO STEPS]analysis [END OPTION]plan	B-21, B-22, B-23
6	5.1.3	Measurement traceability	B-17, B-21
7	5.1.3	Instrumentation rational	B-19, B-20, B-26
8	5.1.4	Baseline and threshold mission	B-18, B-26
9	5.1.4	Threshold mission	B-18
10	5.1.5.1	Planetary protection (encounters)	B-63
11	5.1.5.1	Planetary protection (samples)	B-63
12	5.1.5.2	Sample curation	AO OPTION
13	5.1.5.3	Sample allocation	AO OPTION
14	5.1.6	SEO Description	B-25
15	5.1.6	SEO Separable	B-25
16	5.1.6	Extended mission	B-25

17	5.2.1	Complete Missions	B-26, B-27, B-28, B-45
18	5.2.1	Mission architecture	B-26, B-27, B-28, B-29
19	5.2.1	Mission design and operations	B-26, B-27, B-28, B-30, B-31, B-32, B-33, B-34, B-35
20	5.2.1	Flight systems design	B-26, B-27, B-28, B-31, B-32, B-33, B-34
21	5.2.1	Development approach	B-26, B-27, B-28, B-32, B-34, B-36, B-38, B-39, B-40
22	5.2.2	Management approach	B-26, B-27, B-28, B-34, B-41, B-42, B-43, B-44, B-45
23	5.2.3	New technologies	B-28, B-37
24	5.2.4	Environmental review	B-28
25	5.2.5.1	Radioactive material	B-28
26	5.2.6	Space communications and tracking	B-28
27	5.2.6	NASA standard space communications	B-28
28	5.2.6	NASA non-standard space communications	B-28, B-57
29	5.2.7	Critical events	B-28
30	5.2.8	End-of-mission spacecraft disposal	B-28, B-64, B-65
31	5.2.9	Deviations from payload requirements	B-28
32	5.3.1	Principal Investigator (PI)	B-28, B-42, B-58
33	5.3.2	Project manager	B-28, B-42, B-58
34	5.3.2	PI and PM roles	B-28, B-41, B-42
35	5.3.3	Qualifications of individuals	B-28, B-41, B-42
36	5.3.3	Qualifications of institutions	B-28, B-41, B-42
37	5.3.4	Risk identification	B-28, B-43
38	5.3.4	Risk mitigation	B-28, B-43
39	5.3.4	Descopes	B-28, B-43
40	5.3.5	NASA PI proposals	B-28, B-66
41	5.4.1	Science team	B-24, B-58
42	5.4.2	Co-investigator roles	B-24, B-58
43	5.4.2	Co-investigator funding	B-46, B-49

44	5.4.3	Collaborators	B-58
49	5.5.3	Student Collaboration separable	B-54
50	5.5.3	Student Collaboration funding	B-46, B-49
51	5.6.1	Cost table [ALTERNATIVE AO OPTION FOR SINGLE STEPS] tables [END OPTION]	B-49
52	5.6.1	PI-Managed Mission Cost	B-46, B-49
53	5.6.1	Limit on pre-Confirmation spending	B-46, B-49
54	5.6.2	Phase A cost	B-46, B-49
55	5.6.2	Phase A teaming	B-41, B-42
56	5.6.3	Cost methodologies	B-46, B-47, B-48, B-49, B-51, B-69
57	5.6.3	Cost control	B-46, B-47, B-48, B-49, B-51
58	5.6.3	Cost reserves	B-46, B-47, B-48, B-49, B-51
59	5.6.4	Work Breakdown Structure	B-49
60	5.6.5	Master Equipment List	B-67, B-68
61	5.6.6	Full cost accounting	B-46
62	5.6.6	NASA contributions	B-46, B-49
63	5.6.6	Applicable accounting standards	B-46
64	5.6.7	Contribution identification	B-59
65	5.6.7	Contribution value	B-60
66	5.6.7	Contribution risk management	B-44, B-59
67	5.7.2	Non-US cost plan	
68	5.7.2	Non-US letters of commitment	B-57
69	5.7.2	Non-US contribution risk management	B-44, B-59
70	5.7.2	Non-US contribution detail	B-19, B-20, B-26
71	5.7.2	Non-US participation table	B-60
72	5.7.3	International agreements	B-40
73	5.7.4	ITAR and EAR requirements	B-61, B-62

74	5.8.1.1	US contribution letters of commitment	B-57
75	5.8.1.2	Major partner letters of commitment	B-56, B-57
76	5.8.2	NSPIRES commitment for team members	B-12
77	5.8.2	Export-controlled proposal material	B-4
78	5.9.1	Launch by date	B-40
79	5.9.2	Launch vehicle compatibility	B-31
80	5.9.2	Costs for non-standard launch services	B-46, B-49
81	5.9.2	Contributed launch services	B-31
82	5.9.2	Compatibility with multiple launch vehicles	B-31
83	6.2.1	Proposal format	B-1, B-2, B-3, B-4, B-5, B-6, B-7, B-8, B-9, B-11, B-13, B-14, B-55, B-70
84	6.2.3	Proposal submission	B-5, B-6, B-53
85	6.2.4	NSPIRES registration	
86	6.2.4	Electronic cover page	B-9, B-10, B-11
87	6.2.4	Electronic submission	B-10

APPENDIX H

REPRESENTATIONS AND CERTIFICATIONS

Submission of the signed proposal including Section V of the Proposal Summary Information indicates the prospective awardee's agreement with the requirement to submit and maintain representations and certifications, as mandated by the Federal Acquisition Regulation (FAR).

Prior to award of a contract or agreement, prospective awardees must (1) be registered in the System for Award Management (SAM) in accordance with FAR 4.1102, and (2) ensure that the representations and certifications submitted to SAM that are applicable to the AO, and are current, accurate, and complete. The SAM is accessible at https://www.sam.gov.

Prospective awardees will be contacted by a Contracting Officer to discuss any additional information required for award. Any additional NASA FAR Supplement or contract-specific certification packages will be provided to the prospective awardee for completion prior to award. This may include representations and certifications, revised budgets or budget explanations, certificate of current cost or pricing data, subcontracting plan for small businesses, or other information as applicable to the proposed award. The anticipated award start date will be determined at this time. The appropriate award document, when signed by the Contracting Officer, is the authorizing award document.

National Aeronautics and Space Administration

[NOTE TO AO AUTHORS: Delete from this page on, prior to release.]
List of Variables in the Standard AO Template

The Standard AO Template was created to make the writing of AOs easier and more consistent. It is structured around optional sections or paragraphs and contains a number of variables that should be set by the AO author. AO options are contained within [AO OPTION]…[END OPTION] pairs. If no [END OPTION] exists, the AO option extends to the end of the end of the section. Variables are enclosed in <<…>>. The current variables and their definitions are shown below in the order in which they appear in the Template. Note that although not flagged within the Standard AO Template, all documents that drive AO requirements (e.g., NPRs, NPD, and NASA Science Plans) should be checked and their version verified by AO Authors.

Section *4.4.3 Delivery of Data to Archive* has [AO OPTIONs] for the Earth Science Division and the Planetary Science Division, which should be reviewed for applicability outside of each specified division.

PROGRAM NAME	**Name of the mission program for which the AO is issued**
CAP	AO Cost Cap in millions
CAP YEAR	Fiscal year of the AO Cost Cap and Adjusted AO Cost Cap
NUM PH A	Number of Step-1 selections
NUM FLT	Number of missions selected for flight (Phases B-F)
LRD	Latest launch readiness date
DRAFT DATE	Release date of draft AO
PST 1	SMD's goal in the Agency Strategic Plan
PST 2	How SMD addresses this goal
PST 3	Research objectives of this goal
AO R DATE	Date of release of final AO
STP 2 DATE	Due date for Step 2 CSRs
CENTER NAME	Name of the NASA Center hosting the <<PROGRAM NAME>> Program Office
CENTER ABBRV	Acronym for Center (e.g., ARC for Ames Research Center)
PH A DUR	Duration of Phase A Concept Studies, in months
PH A CAP	Cost cap on Phase A Concept Studies
MISSION CATEGORY	Category 1, 2, or 3
MISSION CLASS	Class A, B, C, or D
DEV YEARS	Number of development years
CHECK	Flag for AO author to verify preceding information (typically an individual's name and contact information)
PI-DEV TDO CAP	PI-Team-Developed Enhancing Technology Demonstration Opportunity Cost Cap, separate from the AO Cost Cap.
PI-DEV TDO INCENTIVE	PI-Team-Developed Enhancing Technology Demonstration Opportunity incentive, structured like that for Student

	Collaboration
NASA-DEV TDO	List of available NASA-Developed Enhancing Technology Demonstration Opportunities
NASA-DEV TDO INCENTIVE	List NASA-Developed Enhancing Technology Demonstration Opportunity incentives, which if offered will increase the AO Cost Cap
FAR 19.708(B) TSHLD	Small Business Subcontracting Plan threshold in the Federal Acquisition Regulation
KDP-C LIMIT	Percentage of PI-Managed Mission Cost that may be expended prior to KDP-C
NUKE REF	Reference to the Launch Approval Engineering costs document in the acquisition library
ELV COST	Reduction in AO Cost Cap for NASA-provided launch services
ISS COST	Reduction in AO Cost Cap for ISS accommodation and transport
PROG LIB	URL of program acquisition library
PARENT DELAY	Required minimum funded schedule reserve for secondary, co-manifested, or hosted payloads
PPC LOC	Location of Preproposal Conference
POC NAME DETAILS	Full name of AO POC
POC DIV DETAILS	Name of the HQ division of the AO POC.
POC AUID DETAILS	Email user id of AO POC (part to the left of the @ symbol in NASA email address)
POC PHN DETAILS	AO POC HQ phone extension
FAR 15.403-4 TSHLD	Certified cost and pricing threshold in the Federal Acquisition Regulation
COPIES	Number of paper copies of Step-1 proposals to submit
DIVISION DIRECTOR NAME	Full name of Division Director
DIVISION NAME	Name of the Division issuing AO
AA NAME	Name of Assoc. Admin. for SMD
INSTR XTRA	Number of extra pages allowed per instrument
SEO XTRA	Number of extra pages allowed for Science Enhancement Opportunities
TDO XTRA	Number of extra pages allowed for Enhancing Technology Demonstration Opportunities
FLT EL XTRA	Number of extra pages allowed per non-identical flight element
MAX XTRA	Maximum number of extra pages allowed due to instruments and flight elements
SOMA AHP	URL of Acquisition Home Page

STANDARD PI-LED MISSION AO TEMPLATE

REVISION HISTORY

The latest revision of the Standard AO Template is posted at http://soma.larc.nasa.gov/StandardAO/.

August 9, 2008 Initial release

December 3, 2008 Revision incorporating lessons learned from development of the Draft New Frontiers AO

- Change in policy, Section 5.6.6 Full Cost Accounting for NASA Facilities and Personnel: For the purpose of calculating the full cost of NASA provided services for proposals submitted in response to this AO, the CM&O burden should be applied only to NASA provided labor including Center civil servants and on-site contractors; this cost must be included in the PI-Managed Mission Cost.
- Addition of new standard language, Appendix B Section J Part 6 Planetary Protection and/or Sample Curation Plan: Added requirements for planetary protection plans and curation plans.
- Clarification of language with minor impact on policy or requirement: Section 4.1.2 NASA Program Management, Section 4.5.1 Independent Verification and Validation, Section 5.1.5.2 Curation of Returned Samples, Section 5.2.5.2 Program Requirements for the Use of Radioactive Material, Section 5.9.2 Launch Services, Appendix B General Requirements, Appendix B Section E Science Implementation.
- Clarification of language without change in policy or requirement: Section 4.1.1 NASA Flight Program and Project Requirements, Section 5.5.2 Core E/PO Program, Section 7.2.1 Overview of Evaluation Criteria, Section 7.4.4 Downselection of Investigations.
- Correction of many dozens of typographical and formatting errors.

March 24, 2009 Revision incorporating clarifications made during development and approval of the Final New Frontiers AO

- Addition of new standard language, Section 4.2.1 Eligibility to Participate in this AO: Stated constraint's on The Aerospace Corporation's ability to respond to this AO and to participate in supporting analysis studies.
- Clarification of language with minor impact on policy or requirement: Section 4.1.2 NASA Program Management, Section 4.1.4 Remediation, Termination, or Cancellation, Section 4.5.1 Independent Verification and Validation, Section 5.5.2 Core E/PO Program, Section 5.6.7 Contributions, Section 7.2.4 Feasibility of the Mission Implementation Including Cost Risk, Appendix B General Requirements, Appendix B Section G Management.
- Clarification of language without change in policy or requirement: Section 4.1 NASA Management Policies, Section 4.1.1 NASA Flight Program and Project Requirements, Section 4.1.2 NASA Program Management, Section 4.3.1 PI-Managed Mission Cost, Section 4.3.2 Total Mission Cost, Section 4.3.3 Enhanced PI-Managed Mission Cost, Section 4.4.1 Data Analysis, Section 4.4.3 Delivery of Data to Archive, Section 5.2.2 Accepted Management Processes and Practices, Section 5.3.1 Principal Investigator, Section 5.5.1

Small Business Participation, Section 5.5.3 Student Collaborations (optional), Section 5.6.6 Full Cost Accounting for NASA Facilities and Personnel, Section 6.2.1 Structure of the Proposal, Section 7.4.2 Award Administration and Funding, Section 7.4.4 Downselection of Investigations, Appendix C.1 Glossary of Terms, Appendix F Compliance Checklist.

- Correction of fewer typographical and formatting errors.

June 30, 2009 Revision incorporating corrections and clarifications made during editing of the Final New Frontiers AO and during the AO/Procurement Conversation on April 7, 2009

- Correction/clarification of language describing the contracting of selected and downselected investigations, Section 7.4 Implementation of Selected Proposals.
- Appendix B Section A.1 updated to better match NSPIRES output for Proposal Summary Information.
- Correction of even fewer typographical and formatting errors.
- Use of revised NASA brand, as required by the NASA Style Guide

October 6, 2009 Revision incorporating lessons learned from development of the Draft Discovery 2010 AO

- Addition of new standard language, Section 4.1.3 Mission Category and Payload Risk Classification. Option for proposer to propose mission categorization and risk classification.
- Addition of new standard language, Section 4.2.1 Eligibility to Participate in this AO. Clearly lays out options for limitations, if any, for Aerospace.
- Addition of new standard language, Section 5.1.5.4 Curation of Space Exposed Hardware. Lays out policy for curation of returned space exposed hardware.
- Addition of new standard language, Section 5.2.4 Environmental Review and Launch Approval. Complete revision of requirements for environmental review and launch approval.
- Addition of new standard language, Section 5.2.5 Telecommunications, Tracking, and Navigation. Restrictions on the use of DSN assets.
- Clarification of language with minor impact on policy or requirement: Section 4.4.3 Delivery of Data to Archive, Section 5.1.5.1 Planetary Protection, Section 5.3.2 Project Manager, Section 5.3.3 Management and Organization Experience and Expertise, Section 5.3.4 Risk Management, Section 5.5.2 Core E/PO Program, Section 5.6.2 Cost of the Phase A Concept Study, Section 5.6.3 Cost Estimating Methodologies and Cost Reserve Management, Section 5.9.2 Launch Services, Section 7.4.3 Conduct of the Phase A Study, Appendix B General Requirements, Appendix B Section A.3 Proposal team Member Commitment through NSPIRES, Appendix B Section F.2 Mission Concept Descriptions, Appendix B Section F.6 Schedule, Appendix B Section J.7 Discussion of End-of-Mission Spacecraft Disposal Requirements.
- Clarification of language without change in policy or requirement: Section 1.1, Section 3 Proposal Opportunity Period, Section 4.1.1 NASA Flight Program and Project Requirements, Section 4.1.4 Remediation, Termination, or Cancellation, Section 4.3.1 PI-Managed Mission Cost, Section 5.1.5.2 Curation of Returned Samples, Section 5.1.3 New Technologies/Advanced Development, Section 5.2.6 Critical Event Coverage, Section 5.2.7 End-of-Mission Spacecraft Disposal Requirements, Section 5.3.5 Compliance with Procurement Regulations by NASA PI Proposals, Section 5.5.1 Small Business Participation, Section 6.1.1 Preproposal Conference, Section 6.1.2 Notice of Intent to Propose, Section

7.2.3 Scientific Implementation Merit and Feasibility of the Investigation, Section 7.2.4 Feasibility of the Mission Implementation feasibility, Including Cost Risk.
- Correction of ever present typographical and formatting errors.

June 7, 2010 Revision incorporating lessons learned from development of the Discovery 2010 AO and the Draft Explorer 2010 AO

- NM 7120-81 is the NASA Interim Directive (NID) for NASA Procedural Requirements (NPR) 7120.5D. Effective September 22, 2009, NM 7120-81 is the governing NPR until HPR 1725.D is formally revised.
- Addition of new standard language, Section 4.1.2 NASA Program Management. Explicitly describe role of Program Office in AO process.
- Addition on new standard language, Section 4.1.3 NASA Center Role in Public Affairs and Outreach. Explicitly describe role of NASA Centers in public affairs and outreach.
- Recognition that the support contracts for both TMC (Section 4.2.1 Eligibility to Participate in this AO) and science panels (Section 6.2.3 Submission of Proposals) are being competed at this time.
- Addition of new standard language and a new requirement regarding systems engineering in Section 5.2.2 Accepted Management Practices and Processes.
- Addition of new standard language, Section 5.2.4 Environmental Review and Launch Approval. Addition of option for radioisotope calibration sources only.
- Revised language in Section 5.6.6 Full Cost Accounting for NASA Facilities and Personnel to be consistent with Agency's unified labor accounting practice.
- Recasting of evaluation factors in Section 7.2.4 Feasibility of the Mission Implementation, including Cost Risk, to align the AO language with the established practices of the Technical/Management/Cost evaluation managed by the Science Office for Mission Assurance (SOMA) at Langley Research Center. Also addition of standard language for evaluation of infused NASA-provided technology.
- Clarification in Section 7.4.1 Notification of Selection that proposal summary (abstract) information may be used in the Selection Statement whether or not the proposal is selected.
- Clarification of Bridge Phase in Section 7.4.2 Award Administration and Funding.
- Clarification of language with minor impact on policy or requirement: Section 4.4.1 Data Analysis, Section 4.4.3 Delivery of Data to Archive, Section 5.2.1 Complete Spaceflight Missions, Section 5.2.4.1 Environmental Review, Section 5.2.4.4 Accommodating Environmental Review and Launch Approval Requirements, Section 5.2.5 Telecommunications, Tracking, and Navigation, Section 5.2.6 Critical Event Coverage.
- Clarification of language without change in policy or requirement: Section 4.3.2 Total Mission Cost, Section 4.5.2 Earned Value Management Plan, Section 5.1.2 Traceability of Proposed Investigation, Section 5.1.5.1 Planetary Protection, Section 5.2.5 Telecommunications, Tracking, and Navigation, Section 5.6.3 Cost Estimating Methodologies and Cost Reserve Management, Section 6.1.1 Preproposal Conference.
- Correction of ever present typographical and formatting errors.

October 18, 2010 Revision incorporating lessons learned from development of the Explorer 2011 AO

- Revision of Section 4.5.2 Earned Value Management Plan to reflect changes between NPR 7120.5D and NM 7120-81 (will review again when NPR 7120.5E is released).

- New evaluation contractor in Section 4.2.1 Eligibility to Participate in this AO.
- New peer review contractor mailing address in Section 6.2.3 Submission of Proposals.
- Addition of SMD policy document SPD-18 to Section 5.5.2 Core E/PO Program.
- Table B4 NASA New Start Inflation Index has been updated to the FY10 Index.
- Clarification of language with minor impact on policy or requirement: Section 4.1.4 Mission Category and Payload Risk Classification, Section 4.2.1 Eligibility to Participate in this AO, Section 5.1.4 Baseline and Threshold Science Mission, Section 5.2.4 Environmental Review and Launch Approval, Section 5.2.5 Telecommunications, Tracking, and Navigation, Section 5.2.6 Critical Event Coverage, Section 5.3.3 Management and Organization Experience and Expertise, Section 5.9.2 Launch Services, Section 7.2.3 Scientific Implementation Merit and Feasibility of the Investigation, Section 8 Conclusion, Appendix B General Requirements, Appendix B Section A.1 Hardcopy Proposal, Appendix C.1 Glossary of Terms, Table B1, Table B2, Appendix D Program Library, Appendix F Compliance Checklist.
- Clarification of language without change in policy or requirement: Section 4.1.1 NASA Flight Program and Project Requirements, Section 4.1.2 NASA Program Management, Section 4.1.3 NASA Center Role in Public Affairs and Outreach, Section 4.1.4 Mission Category and Payload Risk Classification, Section 4.1.5 Remediation, Termination, or Cancelation, Section 4.2.1 Eligibility to Participate in this AO, Section 4.2.3 Responsibility of Principal Investigator for Implementation, Section 4.3.3 Enhanced PI-Managed Mission Cost, Section 4.4.3 Delivery of Data to Archive, Section 5.6.3 Cost Estimating Methodologies and Cost Reserve Management, Section 5.6.6 Full Cost Accounting for NASA Facilities and Personnel, Section 5.7.3 Agreements with Selected Non-U.S. Participants, Section 5.7.4 Export Control Guidelines, Section 6.1.4 Program Library and Acquisition Home Page, Section 7.4.4 Downselection of Investigations.

June 6, 2011 — Revision incorporating lessons learned from development of the unreleased Jupiter Europa Orbiter AO, the Draft Earth Venture-2 AO, and the final Earth Venture-2 AO

- Revision of Section 4.2.1 to distinguish between language for Draft AOs and language for Final AOs; also revised conditions for use of Aerospace Corporation to conduct supporting analysis.
- Revision of Section 5.1.1 to require proposals to demonstrate that the investigation will achieve its objectives.
- Revision to Section 5.6.7 Contributions, Section 5.7.2 General Guidelines Applicable to Non-U.S. Proposals and Proposals including Non-U.S. Participation, and Section 7.2.4 Feasibility of the Mission Implementation, including Cost Risk to clarify the evaluation of proposals without mitigation plans for coping with potential failures of proposed cooperative arrangements.
- Addition of Section 4.3.4 Mission Funding Profile to state NASA's limits on meeting funding profile requirements for the selected mission.
- Addition of Section 4.3.5 Availability of Appropriated Funds to state dependence of awards on NASA's budget process.
- Addition of Section 7.4.2 Principal Investigator-led Team Masters Forum to state requirement to attend a PI Forum after selection.
- Addition to Appendix B, Section A.2 Electronic Cover Page, of requirement to identify all participants not listed on the proposal cover page.

- Addition to Appendix B, Section G Management, and Appendix B, Section J.3 Resumes, of requirement to include PSE as a key management team member.
- Changed reference from NID NM1720-81 to NPR 7120.5E per direction from OCE.
- Clarification of language with minor impact on policy or requirement: Section 2.1 NASA Strategic Goals; Section 5.2.6 Critical Event Coverage; Section 5.3.3 Management and Organization Experience and Expertise; Section 5.5.1 Small Business Participation; Section 5.5.3 Student Collaborations (optional); Section 5.7.1 Overview of Non-U.S. Participation; Section 5.7.3 Agreements with Selected Non-U.S. Participants; Section 7.3 Selection Factors; Appendix B Section F.1 General Requirements and Mission Traceability; Appendix B Section J.9 Master Equipment List.

June 13, 2013 Revision incorporating lessons learned from amendments to the EV-2 AO and development of the SALMON-2 AO.

- Section 4.1.1, NASA Space Flight Project Management, the governing revision of NPR 7120.5 has been changed to reference NPR 7120.5E.
- Section 4.1.5, Remediation, Termination, or Cancellation, added new paragraph about PI commitment.
- Section 4.2.1, Eligibility to Participate in this AO, added new paragraph on lack of restrictions on number of proposals submitted or teaming arrangements; revised language for Aerospace in the draft and final AO. Changed Earth Resources Technology Inc. to Cornell Technical Services.
- Section 4.4.3, Delivery of Data to Archive, clarification of data archive assignment for Earth science.
- Section 4.5.1, Independent Verification and Validation of Software, restatement of policies governing IV&V for selected projects.
- Section 5.2.7, Orbital Constellations, new section for Earth Science.
- Section 4.5.5, End-of-Mission Plan and End-of-Prime-Mission Review, new section for Earth Science.
- Section 5.2.3, New Technologies/Advanced Development, changed reference to TRL definitions to NPR 7123.1B
- Section 5.2.2 Accepted Management Processes and Practices, added new requirement to describe deviations and waivers.
- Section 5.2.4.1, Environmental Review and Launch Approval, made complete for non-nuclear material AOs.
- Section 5.5.1, Small Business Participation, removed the requirement for a small business subcontracting plan from the proposal.
- Section 5.6.6 Full Cost Accounting for NASA Facilities and Personnel, added guidance for determining applicable CM&O rate.
- Section 5.8.3 Classified Proposal Appendix regarding Heritage, new section describing option to submit a classified appendix regarding heritage.
- Section 5.9.4, Investigations aboard the International Space Station, AO OPTION from the EV-2 AO.
- Section 5.9.5, Alternative Access to Space, AO OPTION from the EV-2 AO.
- Section 7.4.3, Award Administration and Funding, requires small business subcontracting plan after selection.

- Clarification of language with minor or no impact on policy and requirements: Section 5.3.3 Management and Organization Experience and Expertise, Section 5.6.6 Full Cost Accounting for NASA Facilities and Personnel, Appendix C.3 Abbreviations and Acronyms, Appendix D Program Library

June 13, 2014 — Revision incorporating lessons learned from development of the Mars 2020 Investigations AO and responses to the Lessons Learned from Recent Planetary Science Division Announcements of Opportunity Request For Information.

- Clarification, beginning in the Foreword and throughout the Template, of variables enclosed in <<…>>. Variables are defined in a table at the end of the Template.
- Clarification of "cost cap" to be "AO cost cap" in the Foreword, Section 4.3, Section 4.3.4, Section 7.3, Section 7.4.4, Requirement B-28, Requirement B-45, and Appendix F; or "PI-Mission Managed Cost" in Section 5.1.6, Section 5.2.4.4, Requirement 38, Section 5.5.3, Requirement 66, and Section 5.8.3.
- Addition, to Table of Contents, of Appendix B Sections.
- Update of references to the *2014 NASA Strategic Plan* and the *2014 Science Mission Directorate Science Plan* in Section 2.1 and Appendix D.
- Change from hardcopy to electronic proposals with associated CD-ROM submissions in Section 3.
- Addition of NASA Center Firewall AO OPTION in Section 4.1.2.
- Addition of Section 4.2.2, which prohibits bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity.
- Clarification of Section 4.2.5 to apply to Key Management Team members, who are to be specified per Section 5.3.6.
- Update of reference for Earned Value Management Plan requirements in Section 4.5.2.
- Move of *Orbital Constellations* Section 4.5.5 to Section 5.2.7.
- Update of reference to *2013 Call Letter for ESD Senior Review* in Section 4.5.5.
- Clarification of the definition of "descope" in Section 5.1.4 and the Glossary in Appendix C.
- Prohibition on flight hardware Science Enhancement Options added to Section 5.1.6.
- Update of reference to NPR 7123.1B *NASA Systems Engineering Processes and Requirements* in Section 5.2.2.
- Clarification in Section 5.2.3 of TRL 6 by PDR requirements, including application to systems defined as level 3 Work Breakdown Structure elements. Clarification flowed to Section 5.3.6, Section 7.2.4, Requirement B-19, and Requirement B-37.
- Change from "radioisotope calibration sources" to "radiological sources" in Section 5.2.4. Also change from "non-nuclear" to "nonradioactive". Clarification that AO OPTION 2 includes RHUs.
- Change from instances of "Advanced Stirling Radioisotope Generator" to "Radioisotope Power System".
- Change *End-of-Mission Spacecraft Disposal Requirement* Section 5.2.8 to AO OPTION FOR EARTH AND MOON ORBITERS.
- Alignment in Section 5.3.2 of requirement for the designation of the PM with that specified for the PI.

- Addition as an AO OPTION FOR FULL MISSIONS of Section 5.3.3 *Project Systems Engineer.* Existing instances of PSE modified to be AO OPTIONs.
- Addition as an AO OPTION FOR 1 STEPS in Requirement 51 and Requirement B-42 provision of time commitments of Key Management Team members by mission phase.
- Addition to Requirement 55 and Requirement B-43 of discussion of "scientific impact of individual, as well as combined, descopes".
- Clarification of Section 5.5.1.
- Change of Section 5.5.2 to allow for the imposition of Education and Public Outreach requirements during or subsequent to the Phase A concept study phase, in lieu of specific guidance for proposals. Balance of Template adjusted accordingly.
- Clarification of Requirement 66 to apply to the PI-Managed Mission Cost. Also, addition of AO OPTION to increase the percentage of the PI-Managed Mission Cost that may be expended prior to Confirmation. Addition of flow down AO OPTION to Section 7.4.6.
- Clarification in Section 5.6.3 of calculation of unencumbered cost reserve percentages.
- Removal of cost increase restriction in Requirement 71.
- Addition of power estimates and contingencies to Master Equipment List Requirement 74 and associated Requirement B-66, to make both consistent with existing Table B5.
- Addition of AO OPTION FOR 1 STEPS to clarify milestone at which contributed costs become part of the Total Mission Cost.
- Elimination of exemption from requirement for Institutional Letters of Commitment for contributed Co-I services in Section 5.6.7, Section 5.8.1, and Appendix B, Section J.2. Exemption applied to collaborator services in Section 5.6.7.
- Addition of rationale statement, to Section 5.6.7 and Requirement 80, in cases where no mitigation is available for a contributed item. Also, deletion of reference to Appendix B, Section H.
- Clarification in Section 5.8.1.3 of Letters of Commitment requirements. Proposal Team defined in Section 5.8.1.3 and the Glossary in Appendix C to include the Key Management Team and any Co-I who is not part of the Key Management Team. Proposal Team members are required to indicate their commitment through NSPIRES. Definition of Team Member removed from Glossary.
- Change of Section 5.8.3 to an AO OPTION, removal of trial language, and addition of notification option.
- Change of Section 5.9.5 to an AO OPTION.
- Addition to Section 6.1.2 of AO OPTION to require Notice of Intent (NOI) submission. Clarification of when NOI is due. Clarification of NOI submission to include entire Proposal Team. Addition of request for communication of changes between NOI and proposal submission.
- Changes to Requirements 109 and 110 in Section 6.2.3 to facilitate electronic proposal submissions; hardcopies no longer required.
- Clarification of Section 7.1.2.
- Clarification of Section 7.2.1., including adjustment of definition of MEDIUM Risk.
- Addition to Factor B-2 of "or demonstration of a clear path to achieve necessary maturity" and to Factor B-3 of "the professional literature (e.g., [refereed journals])" in Section 7.2.3.
- Addition of statement "Programmatic risks may be assessed but are not included in the TMC risk rating." to Section 7.2.4.

- Clarification of Section 7.4.1.
- Update of cost and pricing data provision threshold in Section 7.4.3 OPTION 2.
- Addition of AO OPTION in Section 7.5 to notify nonselected proposers by telephone.
- Update of document number and title in Section 7.6.1.
- Update of FAR reference and threshold for provision of cost and pricing data in Appendix A, Section VI.
- Changes to Requirement B-3, the Proposal Structure and Page Limits table, Requirement B-5, Requirement B-6, and Requirement B-9 to facilitate electronic proposal submissions. Addition of 1 STEP AO OPTION in table for PI Commitment. Division in table of Table B3 into B3a (real year dollars) and B3b (FY dollars) in table. Removal in table of page allocation for Small Business Subcontracting Plan, which is no longer required in proposals.
- Addition of Requirement B-11, with an introductory paragraph, to provide institutions that are not addressed by other requirements, to assist in conflict of interest checks.
- Addition to Requirement B-17 of functional requirements, with associated clarifications.
- Addition to Requirement B-20 of instrument diagrams and component characteristics.
- Addition to Requirement B-32 of AO OPTION FOR LARGE MISSIONS AND 1 STEPS for flight software details.
- Clarification of Requirement B-47.
- Clarification of Appendix B, Section J to apply to PROPOSAL APPENDICES, with each appendix explicitly numbered (e.g., J.1).
- Addition of engineering models to prototypes, with fidelities for both, to Master Equipment List breakouts in Appendix B, Section J, Sub-Section J.9. Addition of AO OPTION FOR LARGE MISSIONS AND 1 STEPS for electronic board details.
- Update to 2013 values in Table B4 NASA FY 2013 NEW START INFLATION INDEX.
- Addition of definition of Planetary Protection to Glossary in Appendix C. Removal of definition of Education and Public Outreach.
- Addition of ASIC, CBE, CSCI, and FPGA to ABBREVIATIONS AND ACRONYMS. Removal of ASRG.
- Update of document names and numbers in Program Library in Appendix D.
- Update to Compliance Checklist in Appendix F.
- Update to Requirements Crosswalk in Appendix G.

October 23, 2018 Revision incorporating changes resulting from SMD Request for Information (RFI) NNH15ZDA013L “Community Input on Standard Announcement of Opportunity” and policy changes since the June 13, 2014 version.

- Change of cover page font to Times New Roman.
- Capitalization of proper noun “AO Cost Cap” in Foreword and balance of document; specification of NASA’s Fiscal Year; introduction of proposal-specific “Adjusted AO Cost Cap”; addition of AO OPTION to exclude cost of standard launch vehicle and launch services; addition of AO OPTIONs for two-step and single-step opportunities; clarification of necessity to be ready for launch, rather than launch by the specified Launch Readiness Date (LRD).
- Correction of Appendix B Section A title to “NSPIRES Cover Pages and Graphic Cover Page" and Section I title to “Optional Student Collaboration Plan” in Table of Contents.

- Addition of AO OPTION 2 FOR SINGLE STEPS in Section 1.1 that summarizes single-step processes; addition of statement regarding applicability of Program Library documents, even when superseded elsewhere; division into the fourth and fifth paragraph, of language that had been in a single paragraph, to clarify which requirements are only applicable after a Step-1 or single-step selection; addition of a summary of requirements that have been deferred until Step 2 of two-step opportunities; initial instance of AO OPTION to cap only Phase A-D portion of mission; addition of statement regarding diverse and inclusive communities; addition of statement regarding equal opportunity employment and anti-harassment; addition of statement regarding technology and technological progress.
- Change of "must" to "shall" in Requirement 2, to be consistent with NPR 1400.1G; analogous changes throughout the document.
- Removal of Step-1 constraint in Section 4.1 and the balance of the document as applicable, to additionally encompass single-step opportunities.
- Specification in Section 4.1.1 of KDP-B for single-step opportunities, consistent with NPR 7120.5E; alignment of KDP-E with NPR 7120.5E.
- Generalization, in Section 4.1.2 and the balance of the document, of name of safety, reliability, and quality assurance requirements document, due to different naming conventions among Programs; update of NODIS URL.
- Update of Section 4.1.3, with change in title from *NASA Center Role in Public Affairs* to *Roles and Responsibilities in Communications and Outreach*.
- Update of Section 4.1.3.2, to replace requirement for mission websites to follow those for the Agency's primary website to application of NPD 2521.1B *Communications and Material Review* and NPR 2200.2D *Requirements for Documentation, Approval and Dissemination of Scientific and Technical Information.*
- Specification of "life-cycle cost" rather than "total mission cost" for NASA mission categorization in Section 4.1.4, consistent with NPR 7120.5E; addition of processes for proposing and commenting on tailorable NPR 7120.5E requirements.
- Addition of AO OPTIONs for PI commitment consistent with the type of opportunity in Section 4.1.5.
- Correction of reference to AO rather than Program Element Appendix in draft Aerospace Corporation language in Section 4.2.1; update of submission instructions for Partial Limitation memorandum.; imposition of Full Limitation to ASRC and affiliates
- Updates to Section 4.2.2 and Requirement 5.
- Addition of NASA concurrence for changes of Co-Is in Section 4.2.5; alignment of required named Key Management Team members with balance of document; addition of AO OPTION for possible Factor C-4 weaknesses being assigned to proposals from institutions with a recent history of replacing named Key Management Team members.
- Clarification of definition of PI-Managed Mission Cost in Section 4.3.1; addition of AO OPTION for opportunities that do not include the Phase E-F portion of the PI-Managed Mission Cost under the AO Cost Cap or Adjusted AO Cost Cap; addition of PI-Team-Developed Enhancing TDO.
- Addition of PI-Team-Developed Enhancing TDO in Section 4.3.2; exclusion of DSN Aperture Fees; addition of costs for exclusion of standard launch vehicle and launch services.
- Addition of PI-Team-Developed Enhancing TDO in Section 4.3.3.
- Clarification of funding profile limitations in Section 4.3.4.

- Update of Section 4.4, including addition of "and Sample Return" and "Requirements" to the title; addition of Sections 4.4.2; inclusion as Sections 4.4.4 to 4.4.6 of what had previously been Sections 5.1.5.2 to 5.1.5.4; update of NPD 7100.10E to NPD 7100.10F—including the title—in Section 4.4.4 and the balance of the document; update of Astromaterials Acquisition and Curation Office name; change of name of Astromaterials Curator; imposition on to Step 2, in Requirement 6, of two elements deleted from Requirement B-64; notice of imposition on to Step 2, in Requirement 9 of Section 4.4.6, of two elements deleted from Requirement B-68.
- Addition of Section 4.5 Intellectual Property Rights; restatement in Section 4.5.2 of what was previously Section 4.4.2, with addition of language regarding sensitive Government information, but without option for exclusive data rights period.
- Addition of AO OPTIONs to defer contacting the NASA IV&V Program until Step 2 in Section 4.6.1; addition of <<CHECK>> document variable to trigger AO Author review in Section 4.6.1 and balance of document; change of contact phone number for The Office of the Director at the NASA IV&V Program.
- Update of applicable NFS clause in Section 4.6.2.
- Correction of Cost Analysis Data Requirement (CADRe) reference in NPR 7120.5E in Section 4.6.3.
- Update of Section 4.6.4 language to reflect changes from NPR 8715.6A to the referenced NPR 8715.6B; addition of AO OPTION to defer conjunction assessment risk analysis budgeting until Step 2.
- Update of reference to *2017 Call Letter for ESD Senior Review* in Section 4.6.5; removal of specification of biennial calls. Addition of advancement of knowledge to Section 5.1.2 Traceability of Proposed Investigation; update of Requirement 14 to be consistent with Section 4.4.2.
- Clarification of Requirement 15 to indicate that data is necessary and sufficient to achieve—rather than will permit achievement of—science objectives.
- Update of Threshold Science Mission description in Section 5.1.4.
- Addition of Section *5.1.5 Level 1 and 2 Requirements* as an AO OPTION for single steps.
- Update of Section *5.1.6 Planetary Protection*, including the addition of questions to be addressed in Requirement 21; update from NPR 8020.12C to NID 8020.109 in the section and the balance of the document; update of contact information for Planetary Protection Officer.
- Addition of AO OPTIONs and adjustment of associated language to allow deferral of SEO definition and/or costing until Step 2 in Section 5.1.7; update of NASA SEO assumptions; addition of prohibition on SEOs being necessary to achieve proposed investigation objectives.
- Addition of calibration and validation plans to Section 5.2.1 and as Requirement 31.
- Update of *NASA Systems Engineering Handbook* to Rev 2 in Section 5.2.3 and the balance of the document; addition of condition for exemption from requirement to provide technology maturation plans for NASA-developed technologies; addition of AO OPTIONs referencing Enhancing TDOs and providing for associated exemptions from TRL 6 by PDR requirement; addition of summary table of TDO options as an AO OPTION.
- Renaming of and renumbering of Section *5.9.6 Technology Infusion Opportunity* to Section 5.2.3.1 NASA-Developed Enabling Technology Demonstration Opportunity; addition of global introductory language that will be expanded upon as required.

- Addition of Section 5.2.3.2 for Enhancing TDOs.
- Update of Section 5.2.4, including promotion of language that had been in Section 5.2.4.1; change in methodology for addressing costs for nonstandard launch services—for use of radioisotope power systems or radioisotope heater units—to reductions in the Adjusted AO Cost Cap.
- Update of organization that the Space Studies Board is part of, in Section 5.2.4.2; clarification of guidance provided in the *Sample Return Primer and Handbook*.
- Clarification and correction of NEPA and NLSA costing in Section 5.2.4.3, including change in methodology for addressing costs, to reductions in the Adjusted AO Cost Cap; update of associated Table 1; deletion of paragraph that preceded Requirement 43 due to redundancy.
- Deletion of 2016 transition to Ka-band reference in Section 5.2.5; exclusion of DSN Aperture Fees from the PI-Managed Mission Cost; imposition in Requirement 43 of required—rather than recommended—estimate of additional costs for NASA's network services; elimination of redundancy between Requirement 47 and Requirement 49; specification of maximum channel bandwidth limits for all NASA space missions with the addition of Requirement 48 to address conformance for any applicable limit(s).
- Clarification of Section 5.2.7, including Requirement 51, to limit applicability to *existing* orbital constellations.
- Change of Section 5.2.8 AO OPTION to defer end-of-mission spacecraft disposal requirement to Step 2; clarification of requirement, including deletion of statement regarding preference for powered disposal.
- Update of Section 5.2.10 language and addition of associated requirement to reflect expected use of applicable AMMOS tools.
- Clarification in Section 5.3.5 to allow partial PI delegation of responsibility to the implementing organization for ensuring mission success; change of instance of "implementing institution" to "implementing organization" here, and in the balance of the document; addition of AO OPTION FOR STREAMLINED CLASS D that removes PI spaceflight experience from the evaluation criteria; specification of prior working relationships of the implementing organization and all partners as an evaluation sub-factor; imposition of requirement to specify time commitment for named Key Management Team members in restructured Requirement 58 and Requirement B-46; clarification of Requirement 59 that provides for *named* Key Management Team members as a subset of the Key Management Team.
- Deletion of reference to Procurement Information Circular (PIC) 05-15 from Section 5.3.7 and Appendix B Section J.8.
- Clarification of Co-I funding to be included in the PI-Managed Mission Cost in Requirement 68.
- Addition of requirement language in Section 5.4.3—as well as a second requirement—to reflect expectations for collaborators that are similar to those for Co-Is.
- Replacement of FAR threshold for Small Business Subcontracting Plan with a document variable in Section 5.5.1 and balance of the document.
- Update of "Education and Public Outreach" to "Education Program Plan, and Communications and Outreach Program" in Section 5.5.2, as well as Section 5.5; addition of acknowledgement that any new requirements will entail additional funding; specification of Communications and Outreach Plan funding directly through a NASA Center and Phase B development; removal of previously associated acronym from Appendix.

- Update of Section 5.5.3.
- Addition of AO OPTIONs for cost table(s) in Requirement 73 of Section 5.6.1; correction of applicable cost cap in Requirement 74.
- Change of Section 5.6.2 to an AO OPTION FOR TWO STEPS; change of specification of Phase A concept study costs in applicable Fiscal Year dollars rather than Real Year dollars.
- Addition of language in Section 5.6.3 to better align the section to related Appendix B Section H; separation of Phases E/F from Phases A/B/C/D; update of KDP-E timing per NPR 7120.5E; shift of minimum unencumbered reserve percentage from paragraph preceding Requirement 80 to the requirement itself; removal of operations from Requirement 80, as Requirement 81 addresses Phases E and F; addition of identification of proposed cost reserves to Requirement 80.
- Update of Section 5.6.6 to reflect current SMD policy on full cost accounting for NASA facilities and personnel.
- Addition of AO OPTION for contributed alternative access to space in Section 5.6.7; addition of statement on PI accountability; clarification of Requirement 87 to separately identify costs; addition to Requirement 88 of AO OPTION addressing caps on contributed instruments.
- Addition of AO OPTION to Section 5.7.1 that limits contributions to the science payload.
- Clarification of cost plan requirements for proposals from U.S. institutions with non-U.S. participation in Section 5.7.2; addition of weighting option for encumbered cost reserves; Clarification of element iv of Requirement 96.
- Addition as an AO OPTION FOR TWO STEPS of statement to Section 5.7.3 about the impossibility of NASA concluding international agreements before the completion of concept study reports; change of "Phase A concept study" to "formulation" in Requirement 97 to accommodate both single-step and two-step opportunities.
- Distribution of required elements of Letters of Commitments from Section 5.8.1 to Section 5.8.1.1 and Section 5.8.1.2.
- Update of definition of major partners in Section 5.8.1.2, as well as for Appendix B Section J.1.
- Promotion of Section 5.8.2 Personal Letters of Commitment from a subsection of Section 5.8.1; imposition of requirement for collaborator commitment in NSPIRES; addition to Requirement 101 of certification of correct NSPIRES linked organization.
- Addition of consideration of EAR, in addition to ITAR, for export-controlled material in Section 5.8.3 and balance of document; clarification of use of non-U.S. persons as evaluators; addition to Requirement 102 of direction to identify in red font and red-bordered boxes, information (data) subject to U.S. export laws and regulations.
- Restructuring of Section 5.8.4 to apply Requirement 103 to all proposals; elimination of AO OPTION for provision of classified materials; addition of option to provide Bases of Estimate; addition of option to request clarifications on classified materials; update of AO POC notification, including option to request secure electronic submission; application of same, but independent, page limit as for unclassified appendix regarding heritage; clarification of deadline for receipt; addition of "delivery in place" and sponsor verification options.
- Restructuring of Sections *5.9.3 Launch Services, 5.9.4 Investigations aboard the International Space Station,* and *5.9.5 Alternative Access to Space* into Sections *5.9.3 AO-Provided Access to Space* and *5.9.4 Alternative Access*.

- Addition to Section 5.9.3.1 of AO OPTIONs for NASA-provided expendable launch vehicles (ELVs) to be Government Furnished Equipment (GFE) *or* costed as reductions to the Adjusted AO Cost Cap; update of existing AO OPTION to credit/cost capabilities that differ from the standard service as increases/decreases to the Adjusted AO Cost Cap; addition of AO OPTIONs for use, as a standard launch service, of a domestic launch vehicle certified as category 2 or 1; update of existing AO OPTION for treating costs associated with radioactive materials as reductions to the Adjusted AO Cost Cap; clarification and addition of AO OPTIONs regarding launch vehicle compatibility.
- Addition to Section 5.9.3.3 of AO OPTIONs for NASA-provided accommodation and transportation to the International Space Station (ISS) to be Government Furnished Equipment (GFE) *or* costed as reduction to the Adjusted AO Cost Cap; update of assumed ISS operations end date; update of NASA Directorate providing flight commitment to the ISS; update of POC information.
- Update of Section 5.9.4, its sub-sections, and associated requirements to reflect changes from the *U.S. Space Transportation Policy* to the *National Space Transportation Policy*, clarify SMD policy, and update proposal requirements; specification of formal coordination with NASA per NPD 8610.12H for use of ballistic missile or foreign launch vehicles; change in costing of $2.0M for NASA launch vehicle monitoring to be a reduction in the Adjusted AO Cost Cap, as well as narrowing its application; specification in Requirements 122 and 126 of a minimum AO-specified funded schedule reserve requirement for proposed secondary, co-manifested, and hosted payloads.
- Update of Section 6.1.1 to provide AO OPTIONs for in-person or web/teleconference Preproposal Conferences and to specify a final date for provision of answers to questions.
- Elimination of fax number and launch vehicle performance class *from*, as well as the addition of general design or architecture of the mission and instruments envisioned to be proposed *to*, NOI request in Section 6.1.2; replacement of 150 word per item limit with total 4000-character limit.
- Addition of email notification process for AO amendments in Section 6.1.4.
- Imposition of document variables in Section 6.1.5.
- Deletion of ambiguous reference to "different criteria" in Section 7.1.1; establishment of intent to release Proposal Evaluation Plans with final AOs, coupled with removal of reference to proposal evaluation plan template; addition of AO OPTIONs for clarification of potential major weaknesses in scientific merit and/or scientific implementation merit.
- Specification of Categorization Committee rather than a categorization subcommittee in Section 7.1.2; removal of terminology that implied a standing Steering Committee; provision of Steering Committee details.
- Change from "scores" to "rating" in Section 7.2.1 to be consistent with the balance of Section 7.2; removal of reference to proposer as a proper noun from Low Risk definition.
- Addition of Factors A-5 and A-6 for SEOs and PI-Team-Developed Enhancing TDOs respectively to Section 7.2.2.
- Addition of "of the investigation" to Factor B-3 in Section 7.2.3; rewrite of—including deletion of "proposal's" from—Factor B-6 to align the factor to its Step-2 counterpart; addition of Factor and B-7 for PI-Team-Developed Enhancing TDOs; addition of Factor B-8 for Level 1 and 2 Requirements.
- Removal of ", Including Cost Risk" from the title of Criterion C in Section 7.2.4 and elsewhere; addition of AO OPTIONs to Factor C-3 for the evaluation of plans for NASA-

Developed Enabling TDOs; addition of "prior working relationships of the implementing organization and known partners" to Factor C-3.

- Clarification *of*, alignment to Step-2 of counterpart *of*, and removal of subcontracting plan *from* Factor C-4 in Section 7.2.4.
- Clarification and alignment to Step-2 counterpart of Factor C-5 in Section 7.2.4; clarification of estimates generated by the evaluation team being the basis of the assessment of the proposed cost.
- Clarification/addition of how TDOs will be evaluated in Section 7.2.4; provision of examples of programmatic risks not included in TMC risk ratings.
- Clarification of consideration of prior experience of PI, PM, PSE (as applicable), and institutions in selection in Section 7.3; removal of "final" from proposal selection discussion.
- Addition of written debriefing material provision in Section 7.4.1; addition of language regarding costs.
- Change of PI-led Team Masters Forum duration and required attendee list in Section 7.4.2; addition of language regarding costs.
- Clarification of post-selection provision of cost and pricing data in Section 7.4.3; update of associated required format; specification of Advance Agreement on Pre-contract Costs AO OPTIONs; clarification of post-selection provision of small business subcontracting plans; clarification of Bridge Phase timing; addition of AO OPTION for single-step opportunities.
- Removal of term "Initial Confirmation Review" in Section 7.4.5; correction of criteria evaluated for Step 2: only the first criterion is subject to conditional re-evaluation; addition of option to request specific information for inclusion in Concept Study Reports; specification of appropriate decision authority for KDP-B.
- Specification of appropriate decision authority for KDP-C in Section 7.4.6; clarification of prohibition on rephrasing of costs after Confirmation.
- Update of title of NPR 5101.32E and the applicable division in the Office of Procurement, in Section 7.6.1.
- Removal APPENDIX A materials, as NASA FAR Supplement no longer mandates inclusion of specific language in all AOs; references to specific sections of APPPENDIX A replaced with in-line quotes from applicable NASA FAR Supplement sections.
- Addition of precautionary language on following instructions in APPENDIX B INTRODUCTION.
- Removal from Requirement B-2 of instructions associated with proposal hardcopies.
- Clarification of allocation of extra pages for additional instruments in Proposal Structure and Page Limits table and Requirement B-4.
- Clarification of allocation of extra pages for additional flight elements in Proposal Structure and Page Limits table and Requirement B-4.
- Addition of allocation of three extra pages for proposals utilizing alternative access to space in Proposal Structure and Page Limits table and Requirement B-4.
- Addition of allocation of extra pages for Enhancing TDOs in Proposal Structure and Page Limits table and Requirement B-4.
- Limitation of Schedule Foldouts that do not contribute to page-limited count to three in Proposal Structure and Page Limits table.
- Addition of ALTERNATIVE AO OPTION FOR LARGE MISSION to page limit for Sections D+E, F+G, and H.

- Addition of AO OPTION FOR SINGLE STEPS for real year cost TABLE B3a in Proposal Structure and Page Limits table; specification of cost tables as foldouts consistent with Requirements B-53 and B-54.
- Addition of AO OPTION to Appendix B Section J.6 Planetary Protection Plan in Proposal Structure and Page Limits table.
- Renumbering of all Proposal Appendices from J.6 (was J.6A) on in Proposal Structure and Page Limits table.
- Addition of AO OPTION to Appendix B Section J.7 Draft Sample and Space-Exposed Hardware Curation Plan in Proposal Structure and Page Limits table.
- Addition of AO OPTION FOR SINGLE STEPS to Appendix B Section J.8 Discussion of End-of-Mission Spacecraft Disposal Requirements in Proposal Structure and Page Limits table.
- Addition of Proposal Appendix J.9 Infusion Plan for NASA-Developed Enabling TDO as an AO OPTION in Proposal Structure and Page Limits table.
- Addition of Proposal Appendix J.11 Certifications Amendments (optional) in Proposal Structure and Page Limits table.
- Limitation of Proposal Appendix J.12 Heritage to 30 pages in Proposal Structure and Page Limits table.
- Removal from Requirement B-4 of instruction associated with proposals hardcopies; clarification of extra page allotment for constellations.
- Requirement for submission of unlocked documents in Requirement B-5; imposition of requirement to perform optical character recognition of images; increase in electronic proposal limit to 25 MB; addition of allowance and prohibition of document links; specification of NSPIRES upload as official proposal submission.
- Addition of AO OPTIONS for Microsoft Project and trajectory files in Requirement B-6; clarification of nature of 100 MB proposal option.
- Prohibition of proprietary or confidential information in the Proposal Summary (abstract) added to Requirement B-7.
- Removal of NSPIRES usage tutorial from Section A.1 of APPENDIX B.
- Removal of real year dollar component of Requirement B-10.
- Removal of option to forego physical or images of signatures in Requirement B-12, due to transition to fully electronic proposals.
- Deferral until Step 2 of real year requirement from Requirement B-13.
- Addition to Requirement B-19 of option to provide sample collection and preservation system descriptions in Section E of proposals; clarification of and addition to required environmental effect discussion.
- Narrowing of data sufficiency discussion specified in Requirements B-21.
- Addition of AO OPTIONs in renamed APPENDIX B Section E.4 Data Plans to defer full Data Plans until Step 2; specification of compliance or not necessary justification for requirements and the guidelines in the *NASA Plan for Increasing Access to the Results of Scientific Research*.
- Removal from Requirement B-25 of sentence that required nonfunded members of the science team to be identified as collaborators, since contributed Co-Is are also not funded out of the PI-Managed Mission Cost.

- Separation of launch readiness date and launch date flexibility in Requirement B-32; addition of allowable dispersions to orbit information.
- Addition of AO OPTION for Trajectory data as Requirement B-34.
- Imposition of the first solar power option on all mission types, with the addition of "(i) expected power requirements for each mission phase" and "phased" to (ix) for based battery Depth of Discharge in Requirement B-35—concurrent removal of solar power option for "Earth and Lunar Orbiter Missions, and Earth-sun L1/L2"; removal of LARGE MISSIONS from AO OPTION for flight software.
- Establishment of distinction between dry mass margin and launch mass margin in Requirement B-37; addition of Flight Project Practices requirement that was part of optional Appendix B Section J.14.
- Refocusing of items required for description of development approach in Requirement B-39; last two bullets moved from Requirement B-46.
- Changes to Requirement B-40 to reflect corrections to TRL 6 definition in NPR 7123.1B.
- Specification in Requirement B-43 of WBS level requirements for schedule foldout(s) and limitation of their number that do not contribute to page-limited count to three.
- Addition of AO OPTION for Microsoft Project files as Requirement B-44.
- Clarification of teaming arrangement discussion in Requirement B-45.
- Narrowing of Requirement B-47 focus, by way of movement of elements of the second bullet to Requirement B-39; addition of requirements to minimally specify top five risks and to explicitly budget for known risks.
- Clarification of constraints on PI-Managed Mission Costs in Requirement B-49.
- Addition of Basis of Estimate ALTERNATIVE AO OPTION FOR LARGE MISSIONS as Requirement B-52.
- Addition of AO OPTIONs that specify cost table foldout requirements for two- and single-step opportunities in Requirements B-54 and B-55 respectively; change—from suggestion to requirement—to use of NASA inflation/deflation indices for organizations without approved forward pricing rates.
- Addition of AO OPTION to limit TABLE B3a on real year costs to single-step opportunities in Requirement B-56; requirement deferred until Step 2 in two-step opportunities; removal of language associated with hardcopy proposals.
- Addition of AO OPTION to limit statement on proposer's approved forward pricing rates to single-step opportunities in Requirement B-57; requirement deferred until Step 2 in two-step opportunities.
- Clarification, by way of the addition of the second and third sentences, of Requirement B-59.
- Removal of real year dollar language from Requirement B-60.
- Clarification of Requirement B-62.
- Change of recommendations of listed items to requirements in Requirement B-63.
- Removal of two elements of curation plans—now specified as draft—from Requirement B-68; addition of example for clarification.
- Addition of AO OPTION to limit Appendix B Section J.8 to single-step opportunities—associated requirements deferred until Step 2 in two-step opportunities; restructuring of requirements; update to NPR 7815.6B.
- Addition of Appendix B Section J.9 Infusion Plan for NASA-Developed Enabling TDOs.
- Exclusion of fully contributed instruments from MEL in Requirement B-76.

- Clarification of conditions that impose requirements for additional detail in Requirement B-77; removal of LARGE MISSIONS from AO OPTION for electronic boards; addition of Radio Frequency Integrated Circuits (RFICs) to AO OPTION.
- Limitation of Proposal Appendix J.12 Heritage to number of pages specified in Proposal Structure and Page Limits table; removal of options for evaluation teams to use more than the three heritage levels defined in the table.
- Clarification that bottom two rows of Example Mission Traceability Matrix are example entries.
- Updates to Tables B3a and B3b for an FY17 start.
- Update of values in Table B4 to reflect the *2017 NASA NEW START INFLATION INDEX FOR FY18 USE* and an FY18 start.
- Addition of definitions of "Adjusted AO Cost Cap", "AO Cost Cap", "Communications", "Cost plan", "Data buy", "Data product latency", "Education", "Enhanced PI-Managed Mission Cost ", "Flight worthiness", "Life-Cycle Cost", "Major partners", "Project Scientist (PS)", "Project Systems Engineer (PSE)", "Science Data", "Technology Demonstration Opportunity (TDO)" to Glossary in Appendix C; update of definition of "AO Steering Committee" to be consistent with Section 7.1.2; change of "Categorization Subcommittee" to "Categorization Committee" to be consistent with Section 7.1.2; change of definition of "Hosted Payload" to be consistent with NPD 8610.12H; change of "Key Management Team" to "Key Management Team members" with associated update to be consistent with Section 5.3.5; clarification of definition of "PI-Managed Mission Cost" consistent with Section 4.3.1; update of definition of "Proposal Team" to be consistent with Section 5.8.2; correction of "Total Mission Cost" to be consistent with Section 4.3.2.
- Update to Program Library template in Appendix D to effect, among other things, reflection of current document numbers and names, inclusion of all AO referenced documents, and document numbering by section.
- Appendix H CERTIFICATIONS changed to Appendix H REPRESENTATIONS AND CERTIFICATIONS, and rewritten.
- Addition of note to AO Authors to check documents that drive AO requirements in the introduction to document variables; addition of note to AO Authors to review Section 4.4.3 AO OPTIONs for applicable clauses; addition of new and updates to document variables as documented above.

Questions about this Standard PI-led Mission AO Template may be addressed to:

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