



**NNH10ZDA007O**

**Release Date June 7, 2010**

**Amended August 16, 2010**

# **Announcement of Opportunity**

## **DISCOVERY 2010**

**Notices of Intent Due Date:**  
**Proposal Due Date**

**August 3, 2010**  
**September 10, 2010**

**ANNOUNCEMENT OF OPPORTUNITY**  
**DISCOVERY PROGRAM**  
**NNH10ZDA007O**

**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 planetary science investigations for the Discovery Program.

NASA expects to select one Discovery mission to proceed into Phase B (or an extended Phase A) and subsequent mission phases. The selected mission's launch readiness date shall be no later than the end of calendar year 2017.

The cap on the PI-Managed Mission Cost for a Discovery mission is \$425M in Fiscal Year (FY) 2010 dollars, not including the cost of the standard launch vehicle (LV) or any contributions (Section 4.3.1 and Section 5.6.1). The cap may be increased through the optional use of specific NASA-developed technologies (Section 5.9.3).

Proposers should be aware of the following major changes in this AO from the Draft Discovery Program AO (NNH10ZDA003J) released for public comment on December 7, 2009.

- The role of NASA Marshall Space Flight Center in the AO process is explicitly described (Section 4.1.2) as is the role of NASA Centers in public affairs for selected missions (Section 4.1.3).
- The costs associated with National Environmental Protection Act (NEPA) compliance, Nuclear Launch Safety Approval (NLSA) compliance, and nuclear launch services for missions proposing to use ASRGs are reduced to a firm, fixed cost of \$20M (FY10) (Section 5.2.4.4).
- The requirement for justifying the use of a frequency other than Ka-band for science data return is clarified (Section 5.2.5).
- The latest allowable Launch Readiness Date (LRD) is December 31, 2017 (Section 5.9.1).
- Launch vehicles in the “medium” and “high” performance classes with 4m fairings have been added as options (Section 5.9.2).
- Proposed missions are required to be compatible with three families of launch vehicles: Atlas V, Delta IV, and Falcon 9 (Section 5.9.2).
- The minimum requirements for taking advantage of technology-infusion cost cap incentives are detailed in a new document in the Program Library entitled *In-Space Propulsion Technologies Minimum Demonstration Requirements* (Section 5.9.3).
- Missions to the Martian surface are not required to carry the *Electra-lite* UHF radio package (Section 5.9.4).

Proposers should be aware of the following major changes in this AO from the previous Discovery Program AO in 2006 (NNH06ZDA001O).

- The cost of standard launch services is not included within the cap on the PI-Managed Mission Cost (Section 4.3.1), but mission-unique launch services and the differential cost of more capable LVs than the standard LV will be included in the PI-Managed Cost (Section 5.9.2).
- The Discovery Program requirement that returned space-exposed hardware be curated and that the costs for such curation be included in the PI-Managed Mission Cost has been added (Section 5.1.5.4)
- Proposals may designate a Project Manager Alternate. At selection and subject to the approval of NASA, the Alternate may be named as the Project Manager (Section 5.3.2).
- The minimum reserve level of 25% is now assessed against the Phase A-E cost (Section 5.6.3) rather than the Phase A-D cost.
- Proposal of investigations enabled by the use of Advanced Stirling Radioisotope Generators (ASRGs) is allowed (Section 5.9.3). ASRGs are provided as Government Furnished Equipment (GFE).
- New propulsion technology has been developed by NASA and is available for infusion into Discovery missions (Section 5.9.3).
- Investigations focused on Mars are allowed (Section 2.2).
- Missions of Opportunity investigations are no longer solicited through the Discovery AO. Missions of Opportunity investigations may be solicited through the Stand Alone Mission of Opportunity Notice (SALMON) AO at a future date.
- Letters of Commitment are not required from Co-investigators. However, all proposal team members must commit to the proposal through NSPIRES (Section 5.8.1.3).

In addition to the listed major changes, this AO incorporates a large number of additional changes relative to previous Discovery Program AOs and to the Draft Discovery Program AO 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.

**Amended July 13, 2010. New text is bold. Deleted text is struck through. [Amendment 1]**

- **Requirement 89 has been amended to require, if applicable, that proposals describe how the proposed use of NEXT, AMBR, or aerocapture meets the minimum demonstration guidelines for the chosen technology.**
- **Section 5.9.3, *Infusion of NASA-developed technology*, has been amended to revise the date for availability of ASRG units.**
- **Requirement B-9 has been amended to reflect the Discovery-specific information that is required for the Electronic Cover Page in NSPIRES.**

**Amended August 2, 2010. New text is bold. [Amendment 2]**

- **Requirement 89 and Requirement 90 have been amended to explicitly apply to proposals that use ASRGs (this was implied but not explicit).**

**Updated August 10, 2010, with new mailing address for proposal submission in Section 6.2.3. New text is bold. Deleted text is struck through.**

Amended August 16, 2010. New text is bold. [Amendment 3]

- Requirement B-30A has been added to require provision of sufficient data to permit an independent assessment of the proposed mission design and trajectory. Recognizing the late date of this additional requirement, this additional data may be provided in a file or files on the CD containing the electronic version of the proposal. There is no requirement that this data also be included in the hardcopy proposal.
- To accommodate the late date of this additional requirement, the proposal due date has been extended by one week. Proposals are due on September 10, 2010.

**ANNOUNCEMENT OF OPPORTUNITY**  
**DISCOVERY PROGRAM**  
**NNH10ZDA007O**

**TABLE OF CONTENTS**

<b>1. Description of Opportunity .....</b>	<b>1</b>
1.1 Introduction .....	1
1.2 NASA Safety Priorities .....	1
<b>2. AO Objectives.....</b>	<b>2</b>
2.1 NASA Strategic Goals .....	2
2.2 Discovery Program Goals and Objectives .....	2
2.3 Discovery Program Background.....	3
<b>3. Proposal Opportunity Period.....</b>	<b>4</b>
<b>4. Policies Applicable to this AO.....</b>	<b>4</b>
4.1 NASA Management Policies .....	4
4.1.1 NASA Flight Program and Project Requirements .....	4
4.1.2 NASA Program Management .....	5
4.1.3 NASA Center Role in Public Affairs and Outreach .....	6
4.1.4 Mission Category and Payload Risk Classification .....	7
4.1.5 Remediation, Termination, or Cancellation .....	7
4.2 Participation Policies .....	8
4.2.1 Eligibility to Participate in this AO .....	8
4.2.2 Constraints on Investigations that are Candidates for Selection.....	9
4.2.3 Responsibility of Principal Investigator for Implementation.....	9
4.2.4 NASA Concurrence for Replacement(s) of Key Management Team Members .....	9
4.3 Cost Policies.....	10
4.3.1 PI-Managed Mission Cost.....	10
4.3.2 Total Mission Cost.....	10
4.3.3 Enhanced PI-Managed Mission Cost.....	10
4.4 Data Policies .....	10
4.4.1 Data Analysis .....	10
4.4.2 Data Rights.....	11
4.4.3 Delivery of Data to Archive.....	11
4.5 Project Management Policies.....	11
4.5.1 Independent Verification and Validation of Software .....	11
4.5.2 Earned Value Management Plan.....	12
4.5.3 Cost Analysis Data Requirement (CADRe) .....	12
<b>5. Requirements and Constraints .....</b>	<b>12</b>
5.1 Science Requirements .....	12
5.1.1 Scope of Proposed Investigation.....	12
5.1.2 Traceability of Proposed Investigation .....	12
5.1.3 Mission Science Objectives and Requirements .....	13
5.1.4 Baseline and Threshold Science Missions .....	13

5.1.5 Planetary Protection and Sample Return Policies.....	14
5.1.6 Science Enhancement Options.....	16
5.2 Technical Requirements.....	17
5.2.1 Complete Spaceflight Missions .....	17
5.2.2 Accepted Management Processes and Practices.....	17
5.2.3 New Technologies/Advanced Developments .....	17
5.2.4 Environmental Review and Launch Approval.....	18
5.2.5 Telecommunications, Tracking, and Navigation .....	21
5.2.6 Critical Event Coverage .....	23
5.2.7 End-of-Mission Spacecraft Disposal Requirement.....	23
5.2.8 Deviations from Recommended Payload Requirements .....	24
5.2.9 Mission Operations Tools and Services.....	24
5.3 Management Requirements .....	24
5.3.1 Principal Investigator .....	24
5.3.2 Project Manager .....	24
5.3.3 Management and Organization Experience and Expertise .....	25
5.3.4 Risk Management .....	25
5.3.5 Compliance with Procurement Regulations by NASA PI Proposals.....	26
5.4 Science Team, Co-Investigators, and Collaborators.....	26
5.4.1 Science Team .....	26
5.4.2 Co-Investigators .....	26
5.4.3 Collaborators.....	27
5.5 Small Business Participation and Education and Public Outreach.....	27
5.5.1 Small Business Participation.....	27
5.5.2 Core E/PO Program .....	28
5.5.3 Student Collaborations (optional) .....	29
5.6 Cost Requirements .....	30
5.6.1 PI-Managed Mission Cost and Total Mission Cost .....	30
5.6.2 Cost of the Phase A Concept Study .....	30
5.6.3 Cost Estimating Methodologies and Cost Reserve Management .....	31
5.6.4 Work Breakdown Structure .....	31
5.6.5 Master Equipment List.....	32
5.6.6 Full Cost Accounting for NASA Facilities and Personnel .....	32
5.6.7 Contributions.....	34
5.7 Non-U.S. Participation Requirements.....	35
5.7.1 Overview of Non-U.S. Participation.....	35
5.7.2 General Guidelines Applicable to Non-U.S. Proposals and Proposals including Non-U.S. Participation .....	35
5.7.3 Agreements with Selected Non-U.S. Participants .....	37
5.7.4 Export Control Guidelines Applicable to Non-U.S. Proposals and Proposals including Non-U.S. Participation.....	37
5.8 Additional Proposal Requirements .....	37
5.8.1 Letters of Commitment .....	37
5.8.2 Export Controlled Material in Proposals .....	39
5.9 Program Specific Requirements and Constraints .....	39
5.9.1 Schedule Requirements.....	39

5.9.2 Launch Services .....	39
5.9.3 Infusion of NASA-developed Technology .....	41
5.9.4 Program Infrastructure Requirements for Mars Missions .....	44
<b>6. Proposal Submission Information .....</b>	<b>45</b>
6.1 Preproposal Activities .....	45
6.1.1 Preproposal Conference and Questions .....	45
6.1.2 Notice of Intent to Propose .....	46
6.1.3 Teaming Interest .....	47
6.1.4 Program Library and Acquisition Home Page .....	47
6.1.5 Point of Contact for Further Information .....	47
6.2 Proposal Preparation and Submission .....	47
6.2.1 Structure of the Proposal .....	47
6.2.2 Certifications .....	48
6.2.3 Submission of Proposals .....	48
6.2.4 Electronic Submission of Proposal Summary Information .....	48
<b>7. Proposal Evaluation, Selection, and Implementation .....</b>	<b>50</b>
7.1 Overview of the Proposal Evaluation and Selection Process .....	50
7.1.1 Evaluation Process .....	50
7.1.2 Categorization and Steering Process .....	50
7.1.3 Selection Process .....	51
7.2 Evaluation Criteria .....	51
7.2.1 Overview of Evaluation Criteria .....	51
7.2.2 Scientific Merit of the Proposed Investigation .....	52
7.2.3 Scientific Implementation Merit and Feasibility of the Investigation .....	53
7.2.4 Feasibility of the Mission Implementation, Including Cost Risk .....	55
7.3 Selection Factors .....	57
7.4 Implementation of Selected Proposals .....	58
7.4.1 Notification of Selection .....	58
7.4.2 Award Administration and Funding .....	58
7.4.3 Conduct of the Phase A Concept Study .....	59
7.4.4 Downselection of Investigations .....	60
7.4.5 Confirmation of Investigations .....	61
7.5 Opportunity for Debriefing of Nonselected Proposers .....	61
7.6 Process for Appeals .....	61
7.6.1 Agency Procurement Ombudsman .....	61
7.6.2 Protests .....	62
<b>8. Conclusion .....</b>	<b>62</b>

## **APPENDICES**

Appendix A: General Instructions and Provisions.....	A-1
Appendix B: Requirements for Proposal Preparation.....	B-1
Appendix C: Glossary of Terms and Abbreviations.....	C-1
Appendix D: Program Library .....	D-1
Appendix E: Requirements for Subsequent Phases .....	E-1
Appendix F: Compliance Checklist .....	F-1
Appendix G: Requirements Crosswalk.....	G-1
Appendix H: Certifications .....	H-1



**ANNOUNCEMENT OF OPPORTUNITY**  
**DISCOVERY PROGRAM**  
**NNH10ZDA007O**

## **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 Discovery Program. All investigations proposed in response to this solicitation must support the goals and objectives of the Discovery 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).

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 three 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 (downselection) of the Concept Study Reports. As the outcome of Step 2, NASA intends to continue a single investigation into the subsequent phases of mission development for flight and operations.

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 Step 1 proposal. Appendix D lists the contents of the Program Library while Appendix E.1 lists the Program Library documents that specify requirements for Phase A concept studies, and Appendix E.2 lists the Program Library documents that specify requirements that will apply to subsequent phases of investigations that are selected for implementation. These documents are intended to provide guidance for investigations selected in Step 1 and Step 2, respectively; they are specifically not intended to impose requirements on Step 1 proposals.

### **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 NASA employees working under NASA instruments), and (4) high-value equipment and property.

## 2. AO Objectives

### 2.1 NASA Strategic Goals

One of NASA's strategic goals is to "Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space." Further information on NASA's strategic goals may be found in NASA Policy Directive (NPD) 1001.0, *The 2006 NASA Strategic Plan*, available through the Program Library (Appendix D).

The NASA Science Mission Directorate (SMD) is addressing this strategic goal by conducting a program of planetary science designed to answer the following science questions:

- How did the Sun's family of planets and minor bodies originate?
- How did the Solar System evolve to its current diverse state?
- What are the characteristics of the solar system that lead to the origin of life?
- How did life begin and evolve on Earth and has it evolved elsewhere in the solar system?
- What are the hazards and resources in the solar system environment that will affect the extension of human presence in space?

In answering these questions, the following research objectives are addressed:

- Understand the processes that determine the history and future of habitability in the solar system, including the origin and evolution of Earth's biosphere and the character and extent of prebiotic chemistry on Mars and other worlds.
- Identify and investigate past or present habitable environments on Mars and other worlds, and determine if there is or ever has been life elsewhere in the solar system.
- Explore the space environment to discover potential hazards to humans and to search for resources that would enable human presence.

Further information on the goals and objectives of NASA's planetary science program may be found in *The Science Plan for NASA's Science Mission Directorate (2007-2016)* and in the *2006 Solar System Exploration Roadmap*, available through the Program Library.

### 2.2 Discovery Program Goals and Objectives

The goal of NASA's Discovery Program is to provide frequent flight opportunities for high quality, high value, focused, planetary science investigations that can be accomplished under a not-to-exceed cost cap.

By conducting a series of planetary science investigations, NASA will provide a mechanism by which pressing questions in planetary science may be addressed, permitting a steady improvement in our understanding of planetary systems and the processes that affect them. The frequent, steady nature of the investigations will ensure a continuing stream of fresh scientific data to the planetary science community, thus helping to maintain the excellence of the U.S. planetary science program and to inspire the next generation of investigators.

The Discovery Program strives to:

- advance scientific knowledge and exploration of the elements of our Solar System;
- add scientific data, maps, and other products to the Planetary Data System archive for all scientists to access;
- announce scientific progress and results in the peer-reviewed literature, popular media, scholastic curricula, and materials that can be used to inspire and motivate students to pursue careers in science, technology, engineering, and mathematics;
- expand the pool of well-qualified Principal Investigators and Program Managers for implementation of future missions in Discovery and other programs, through current involvement as Co-Investigators and other team members; and
- implement technology advancements proven in related programs.

These goals and objectives are also articulated in the *Discovery Program Plan*, which can be found in the Program Library.

Investigations may target any body in the Solar System, including Mars and Earth's Moon, but excluding the Earth and Sun, in order to advance the objectives outlined in Section 2.1. Investigations of extra-solar planets are not solicited in this AO.

### 2.3 Discovery Program Background

The Discovery Program was initiated in 1992 as a way to ensure frequent access to space for planetary science investigations. Previous Discovery Program AOs were released in 1994, 1996, 1998, 2000, 2004, and 2006. The completed missions in the Discovery Program are NEAR, Mars Pathfinder, Lunar Prospector, Genesis, Deep Impact, and Stardust. CONTOUR was lost shortly after its launch in 2002. The four missions currently in development, operation, or analysis phase are MESSENGER, Dawn, Kepler, and GRAIL. Three missions of opportunity, Aspera-3, Netlander, and the Moon Mineralogy Mapper, have been selected. Netlander was terminated before launch. Aspera-3 is currently operating on ESA's Mars Express. The Moon Mineralogy Mapper has completed operations on ISRO's Chandrayaan-1. Two missions of opportunity have been selected under the Stand-Alone Mission of Opportunity Notice (SALMON) AO and incorporated into the Discovery Program: LaRa and Strofio. Additionally, three investigations reusing existing spacecraft are in operation: EPOCH and DIXI are hosted by the Deep Impact spacecraft and have been joined to produce the EPOXI mission, and Stardust-NExT is hosted on the Stardust spacecraft. Information about all previous and current Discovery missions may be found at <http://discovery.nasa.gov/missions.html>.

### 3. Proposal Opportunity Period

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

AO Release Date.....	June 7, 2010
Preproposal Conference .....	See Section 6.1.1
Notice of Intent to Propose Deadline.....	August 3, 2010
<b>[Amended August 16, 2010. Due date changed to September 10, 2010.]</b>	
<b>Proposal Submittal Deadline at 4:30 p.m. Eastern Time</b>	<b>September 10, 2010</b>
<b>Letters of Commitment due (with proposal) .....</b>	<b>September 10, 2010</b>
<del>Proposal Submittal Deadline at 4:30 p.m. Eastern Time .....</del>	<del>September 3, 2010</del>
<del>Letters of Commitment due (with proposal) .....</del>	<del>September 3, 2010</del>
Step 1 Selections announced (target) .....	April 2011
Initiate Phase A Concept Studies (target) .....	May 2011
Phase A Concept Study Reports due (target) .....	February 2012
Downselection of investigation(s) for flight (target) .....	June 2012
Launch Readiness Date .....	NLT December 31, 2017

All proposals, U.S. and non-U.S., must be received before the proposal submittal deadline. Those received after the deadline will be treated in accordance with Appendix A, Section VII.

Requirement 1. Proposals submitted in response to this solicitation shall be delivered no later than the Proposal Submittal Deadline. Proposals shall be delivered to the Address for Submittal of Proposals given in Section 6.2.3.

Requirement 2. Proposal submission shall be accompanied by electronic submission of proposal summary data no later than the Proposal Submittal Deadline following the instructions for submission of proposal summary data provided in Section 6.2.4.

### 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 process. These requirements are not levied on Step 1 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 Interim Directive (NID) NM 7120-81<sup>1</sup>, *NASA Space Flight Program and Project Management Requirements*, are Formulation, Approval, Implementation, and Evaluation. The NASA mission management processes are subdivided as follows:

---

<sup>1</sup> 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 NPR 7120.5 is formally revised.

*Formulation* is divided into:

- Phase A – Concept Study 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-orbit 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 NM 7120-81, 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 NM 7120-81. For missions selected as a result of this AO, KDP-A is the selection of a Step-1 proposal for a Phase A concept study, KDP-B is the downselection of a mission to enter Phase B following evaluation of Concept Study Reports, KDP-C is the culmination of the Confirmation process, KDP-D is a soft transition that occurs after the Systems Integration Review, KDP-E is the handoff from development to operations following in-orbit checkout (generally 30 to 90 days after launch), and KDP-F is the decision to terminate operations after completion of the mission. Scientific and other analyses, including data analysis and preliminary analysis of returned samples, may continue under project funding in Phase F. If the decision at downselection 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 NM 7120-81, the *Discovery Program Safety and Mission Assurance Guidelines and Requirements* document, and other NASA requirements documents available in the NASA Online Directives Information System (NODIS, <http://nodis.hq.nasa.gov/>) and in the Program Library. To that end, the Associate Administrator for SMD has established a Discovery Program Office at the NASA Marshall Space Flight Center to be responsible for project oversight. The Discovery Program Manager at Marshall Space Flight Center reports to the Discovery Program Director at NASA Headquarters. Additional details about the program office staffing, structure, and goals can be found in the *Discovery Program Plan*, available through the Program Library.

NM 7120-81 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 NM 7120-81 will be assigned to the implementing project management organization. That organization must be prepared to carry out these responsibilities. In such cases, the Discovery Program Office at the NASA Marshall Space Flight Center will retain the Independent Technical Authority (ITA) that would otherwise be invested in an implementing Center or JPL.

The *Discovery Program Safety and Mission Assurance Guidelines and Requirements* document, available through 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 utilize their own 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 Step-1 proposals.

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

#### *4.1.3 NASA Center Role in Public Affairs and Outreach*

Successful media relations activities require close cooperation between NASA and the selected investigations. NASA Centers and JPL have specific expertise in media relations and/or public affairs, especially as they pertain to Earth and space science missions. All selected investigations will coordinate media relations and/or public affairs with a NASA Center or JPL. If a selected investigation does not include a NASA Center or JPL as part of their investigation team, the investigation will utilize the public affairs guidance and resources of the Discovery Program Office at NASA Marshall Space Flight Center.

NASA is to be informed in a timely manner of any newsworthy mission event or issue before public release of information. Strategies for using new and social media also will be developed collaboratively to ensure common and consistent messaging will occur in a timely manner. NASA and the selected investigation will establish and maintain a detailed coordination media relations plan and communications process.

Selected investigations also must work with NASA to ensure their mission website follows NASA requirements for incorporating content for the agency's primary public website at <http://www.nasa.gov/>. NASA, and through NASA the selected investigation, is required under the Information Quality Act and associated guidelines to maximize the quality, objectivity, utility, and integrity of information and services provided to the public.

#### *4.1.4 Mission Category and Payload Risk Classification*

NM 7120-81, *NASA Space Flight Program and Project Management Requirements*, establishes guidelines for categorizing NASA missions based on the estimated total mission cost and mission priority level. The mission categorization guidelines are given in Section 2.1.5 and Table 2-1 of NM 7120-81.

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 B of NPR 8705.4.

Historically, Discovery missions have been determined to be Category 2 missions (per NM 7120-81) with Class B or Class C payloads (per NPR 8705.4). Investigations using nuclear power sources, however, are Category 1 missions by regulation (see NM 7120-81).

Requirement 3. Based on the criteria for mission categorization in NM 7120-81 and risk classification in NPR 8705.4, proposers shall propose a mission categorization and risk classification for their proposed mission and incorporate appropriate work effort and support in their proposals accordingly.

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 5.1.4 of this AO). A descope made necessary by the PI's inability to remain within budget or schedule, or failure at any time during development 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.

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.

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, may be 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.

## 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., 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.

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.

The NASA contract with Science Applications International Corporation (SAIC) for evaluation support under this AO creates an unmitigatable organizational conflict of interest for SAIC in the event that any business unit of SAIC has a proposed role as prime contractor, subcontractor, or participating organization. Because of this organizational conflict of interest, SAIC is precluded from participating in any capacity in support of a respondent under this AO.

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 shall 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 shall not be bound into the proposal itself, but must be a separate document. 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.

#### *4.2.2 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.

#### *4.2.3 Responsibility of Principal Investigator for Implementation*

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

#### *4.2.4 NASA Concurrence for Replacement(s) of Key Management Team Members*

Any replacement of key management team members (including, but not limited to, the PI and the Project Manager (PM)) requires concurrence by NASA.

## 4.3 Cost Policies

### 4.3.1 *PI-Managed Mission Cost*

*PI-Managed Mission Cost* is defined as the funding that the Discovery Program will be expected to provide to the PI's implementation team 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 counted against the PI-Managed Mission Cost, even though the PI is not directly responsible for those costs (*e.g.*, NASA-provided telecom and network services described in Section 5.2.5). The PI-Managed Mission Cost is capped (see Section 5.6.1).

Examples of costs to be included in the PI-Managed Mission Cost, unless contributed, are: development activities (*e.g.*, instrument development, spacecraft development, management, software, testing); launch services outside of the standard services provided by NASA; Education/Public Outreach, including Student Collaborations in excess of the student collaboration incentive (see Section 5.5.3); 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; any 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 student collaboration incentive (see Section 5.5.3), plus any additional costs that are contributed or provided in any way other than through the Discovery Program (see Section 5.6.7). The Total Mission Cost will define the total value of the baseline investigation, not including the cost of standard launch vehicle and launch services.

### 4.3.3 *Enhanced PI-Managed Mission Cost*

*Enhanced PI-Managed Mission Cost* is defined as the funding that the Discovery Program will be expected to provide to the PI's implementation team for the development and execution of the proposed project, including optional components such as any Student Collaboration or Science Enhancement option (see Section 5.1.6). The Enhanced PI-Managed Mission Cost is the PI-Managed Mission Cost (see Section 4.3.1), plus any Student Collaboration costs up to the student collaboration incentive (see Section 5.5.3), plus any Science Enhancement Options (see Section 5.1.6).

## 4.4 Data Policies

### 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) or post-mission (Phase F) activities. Data analysis and preliminary analysis of returned samples may be continued during Phase F.

#### *4.4.2 Data Rights*

By NASA policy, all science data returned from NASA missions are immediately in the public domain. A short period of exclusive access may be proposed for data calibration and validation, but a compelling justification for it must be demonstrated. Any period of exclusive access should be the minimum that is consistent with optimizing science return from the mission. Barring exceptional circumstances, it may not exceed six months.

#### *4.4.3 Delivery of Data to Archive*

Mission data will be made fully available to the public through a NASA-approved data archive (e.g., the Planetary Data System, Atmospheric Data Center, High Energy Astrophysics Science Archive Research Center, etc.), in 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 delivery to the archive.

Archival data products will include low-level (raw) data, high-level (processed) data, and derived data products such as maps, ancillary data (including valid SPICE (spacecraft, planet, instrument, C-matrix, events) kernels related to spacecraft, instrument, and body information), calibration data (ground and in flight), 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. 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, proposers should contact the archive directly to obtain information regarding the appropriate policies and practices. 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 capped PI-Managed Mission Cost.

### **4.5 Project Management Policies**

#### *4.5.1 Independent Verification and Validation of Software*

The NASA Chief Safety and Mission Assurance Officer has the authority to select software projects to which Independent Verification and Validation (IV&V) is to be applied, as outlined in NPD 2820.1, *NASA Software Policy*. The selection of projects is based on prioritized recommendations from the Agency's IV&V Board of Directors. Proposal teams are encouraged to contact the Chief for Plans and Programs at the NASA IV&V Facility to gain a preliminary understanding of the potential level of safety and mission critical software that their project will contain and the associated project system software risks. If the project is selected to receive IV&V services, the costs for these services will be covered within the allocation to the NASA IV&V Program and need not be included in the proposed PI-Managed Mission Cost. Selected

investigations will have to spend project funds only to provide required data and information to the IV&V facility. The Chief for Plans and Programs at the NASA IV&V Facility is Christina Moats (Telephone: 304-367-8340; E-mail: [christina.d.moats@nasa.gov](mailto:christina.d.moats@nasa.gov)).

#### *4.5.2 Earned Value Management Plan*

NM 7120-81, Sections 4.6.2.c(1) and 4.7.2.c(1), requires projects to implement earned value management (EVM) in Phase C through Phase E. The requirements for EVM implementation are given in NM 7120-81, Appendix F.3, Section 3.1). One requirement is that, for contracts and subcontracts valued at \$50M or more, the contractor EVM system must be formally validated by the cognizant Federal management agency.

#### *4.5.3 Cost Analysis Data Requirement (CADRe)*

NASA has established a Cost Analysis Data Requirement (CADRe) in NM 7120-81, Section 4.5.2.c(3), that will apply to investigations selected through this AO. Support contractors funded directly by NASA Headquarters 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.

## **5. Requirements and Constraints**

This section provides general requirements on Step 1 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), 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).

Investigations may target any body in the Solar System, including Mars and Earth's Moon, but excluding the Earth and Sun, in order to advance the objectives outlined in Section 2. Investigations of extra-solar planets are not solicited in this AO.

**Requirement 4.** Proposals shall describe a science investigation with goals and objectives that address NASA's and the Discovery Program's science objectives as described in Section 2.

#### *5.1.2 Traceability of Proposed Investigation*

The Discovery Program is intended to perform focused science investigations that conclude with papers published in peer-reviewed archival journals, as well as deposition of appropriately reduced and calibrated data in designated data archives (see Section 4.4.3)

Requirement 5. 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 6. Proposals shall include a plan to calibrate (both pre-flight 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 that plan within the proposed mission cost. The data plan shall discuss and justify any period of exclusive access to data (see Appendix B, Section E, for additional detail).

#### *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 crisp, 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. The proposed mission is evaluated against the standard of successfully delivering the required measurements.

Requirement 7. 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 will permit achievement of these objectives (see Appendix B, Sections D and E, for additional detail).

Requirement 8. Proposals shall describe the proposed instrumentation, including a discussion of each instrument and the rationale for its selection.

#### *5.1.4 Baseline and Threshold Science Missions*

The Baseline Science Mission and the Threshold Science Mission are defined in NM 7120-81 as follows:

The “Baseline Science Mission” is the mission that, if fully implemented, would achieve the full science objectives proposed for the investigation.

The “Threshold Science Mission” is the mission that would accomplish the minimum subset of Baseline Science Mission science objectives sufficient to justify the proposed cost of the mission. The threshold science requirements set the science floor for the proposed mission.

The differences between the Baseline Science Mission and the Threshold Science Mission provide resiliency to potential cost and schedule growth in the proposed development and implementation plan. A descope is any alteration of a mission that renders it unable to accomplish one or more of the Baseline Science Mission science objectives, but allows accomplishment of all Threshold Science Mission science objectives.

NASA recognizes that, in some circumstances, the Threshold Science Mission may be identical to the Baseline Science Mission.

Requirement 9. Proposals shall specify only one Baseline Science Mission and only one Threshold Science Mission.

Requirement 10. Proposals shall not include any descopes or other risk mitigation actions that result in the mission being unable to achieve the Threshold Science Mission objectives.

#### *5.1.5 Planetary Protection and Sample Return Policies*

##### *5.1.5.1 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*; NPR 8020.12C, *Planetary Protection Provisions for Robotic Extraterrestrial Missions*; and NASA-HDBK-6022, *NASA Handbook for the Microbiological Examination of Space Hardware (DRAFT)*, in the Program Library). Note that forward contamination is of particular concern for Mars and for possible liquid water bodies within icy satellites.

Return of samples from certain target bodies may be subjected to rigorous containment and biohazard testing protocols in accordance with NASA planetary protection policy (see NPR 8020.12C, *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).

Although not formally a part of planetary protection requirements, it is suggested that proposers request a preliminary planetary protection categorization of their mission from the Planetary Protection Officer (PPO) during the early stages of planning — even before proposal submission. Prior to a written request, the project is encouraged to communicate informally with the PPO.

For additional information, proposers may contact the NASA Planetary Protection Officer, Dr. Catharine A. Conley (Telephone: 202-358-3912; E-mail: [cassie.conley@nasa.gov](mailto:cassie.conley@nasa.gov)).

Requirement 11. Proposals that include an encounter with another solar system body, via flyby, orbiter, lander, or end of mission impact shall address plans for contamination control, as required by NPD 8020.7G and NPR 8020.12C; such investigations shall bear all additional costs generated by any special planetary protection requirements.

Requirement 12. Proposals that include the return of extraterrestrial samples shall address plans to comply with planetary protection requirements as required by NPD 8020.7G and NPR 8020.12C; such investigations shall bear all additional costs generated by any special planetary protection requirements.

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

#### 5.1.5.2 Curation of Returned Samples

All samples of extraterrestrial planetary materials returned by NASA missions are NASA property (see NPD 7100.10E, *Curation of Extraterrestrial Materials*, in the Program Library). They shall be delivered to, and processed by, the NASA Astromaterials Curatorial Facility located at NASA's Johnson Space Center (JSC); contact Dr. Carlton Allen, Astromaterials Curator (Telephone: 281-483-5126; E-mail: [jsc-astromaterials-curator@mail.nasa.gov](mailto:jsc-astromaterials-curator@mail.nasa.gov); <http://curator.jsc.nasa.gov/>). The Curator will assist proposers in designing a curation plan that meets their mission's requirements for sample preservation and use (see the *NASA Policy on Curation of Extraterrestrial Materials* document in the Program Library.) The actual costs for all aspects of curation, from planning through distribution and storage, including all required laboratory construction or modification, shall be borne by the mission from inception to two years following sample return.

Requirement 13. Proposals that include the return of extraterrestrial samples shall provide a Sample Curation Plan. See Appendix B, Section J.6.B, for details.

Requirement 14. Proposals that include the return of extraterrestrial samples shall allocate funding for use of the JSC Curatorial Facility, including all aspects of curation.

#### 5.1.5.3 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 Curatorial Facility. 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 15. 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.

#### 5.1.5.4 Curation of Space-Exposed Hardware

It is the policy of the Discovery 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 Curatorial Facility located at NASA's 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 Curatorial Facility. 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, shall be borne by the mission from inception to two years following sample return.

Requirement 16. Proposals that include the return of space-exposed hardware shall include the curation of this hardware in their Sample Curation Plan. See Appendix B, Section J.6.B, for details.

Requirement 17. Proposals that include the return of space-exposed hardware shall allocate funding for use of the JSC Curatorial Facility to document, store and distribute hardware samples, including all aspects of curation.

#### *5.1.6 Science Enhancement Options*

Activities such as extended missions, guest investigator programs, general observer programs, participating scientist programs, interdisciplinary scientist programs, and/or archival data analysis programs, where appropriate, have the potential to broaden the scientific impact of investigations. Such optional activities may be proposed as Science Enhancement Options (SEOs).

NASA considers any proposed SEO activities as optional. Inclusion of such optional activities in a proposal does not imply a commitment from NASA to fund them, even if the baseline investigation is selected. 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 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 must be defined, but will not count against the PI-Managed Mission Cost cap. Funding requested for SEO activities prior to Phase E should be minimized. As these proposed activities are optional and are not included within the cost capped baseline investigation, the science enabled by SEO activities is not considered as part of the scientific merit of the proposed investigation.

Requirement 18. If SEO activities are proposed, the proposal shall define and describe the proposed activities and their costs.

Requirement 19. If SEO activities are proposed, they shall be clearly separable from the Baseline Science Mission and Threshold Science Mission investigations.

Requirement 20. 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) 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, preliminary analysis of returned samples, and, if applicable, extended mission operations or other science enhancements (see Section 5.1.6), and closeout (Phase F). The term “spaceflight missions” is defined as Earth orbital and deep-space missions; it specifically excludes suborbital missions (*e.g.*, via sounding rockets, balloons, and aircraft).

Requirement 21. Proposals submitted in response to this AO shall be for complete science investigations requiring a spaceflight mission.

Requirement 22. Proposals shall describe the proposed mission architecture and the rationale for each mission element.

Requirement 23. Proposals shall describe the proposed mission design and mission operations concept.

Requirement 24. Proposals shall describe the proposed flight system concept including the spacecraft bus and its major subsystems.

Requirement 25. Proposals shall describe the development approach for implementing the proposed mission within schedule and cost constraints, including a project schedule.

See Appendix B, Section F, for additional detail.

### 5.2.2 Accepted Management Processes and Practices

The document NM 7120-81, *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. The implementing organizations are free to propose their own processes, procedures, and methods for managing their missions; however, they must be consistent with the principles of NM 7120-81. Any deviations from NM 7120-81 will require a waiver during formulation.

Requirement 26. 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).

### 5.2.3 New Technologies/Advanced Developments

This AO solicits flight missions, not technology development projects. Proposed investigations are generally expected to have mature technologies, specifically all technologies at a Technology Readiness Level (TRL) of 6 or higher (TRLs are defined in NPR 7120.8, *NASA Research and*

*Technology Program and Project Management Requirements*, Appendix J, which can be found in the NASA Online Directives Information System (NODIS) at <http://nodis3.gsfc.nasa.gov/>). Proposals with a limited number of less mature technologies are permitted, as long as they contain a plan for maturing all technologies to TRL 6 no later than KDP-C (Confirmation) and adequate backup plans in the event that the technologies cannot be matured as planned.

Section 5.9.3 of this AO provides guidelines for infusion of NASA-developed technologies. NASA SMD assumes the responsibility for maturing these technologies to TRL-6. Therefore, proposals that include utilization of one of these NASA-developed technologies 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 technologies (see Appendix B, Section J.13).

Requirement 27. Proposals that use technologies (other than the NASA-developed technologies described in Section 5.9.3) currently at less than TRL 6 shall include a plan for technology maturation and a backup plan (see Appendix B, Section F, for additional detail).

#### *5.2.4 Environmental Review and Launch Approval*

The process by which the environmental review and launch approval (if applicable) requirements are satisfied is referred to as “launch approval engineering.” Multiple organizations within NASA, and possibly outside of NASA, participate in this process. Although it is the responsibility of NASA to ensure that all such requirements are satisfied, missions will have to allocate resources to provide inputs into the process, participate in the development and implementation of any contingency plans or risk communication plans, and participate in launch approval reviews. Additionally, spacecraft and mission designs will have to take into account risk reduction and range safety issues.

##### *5.2.4.1 Environmental Review*

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 decision-makers to take environmental factors into account during the decision-making process. NASA is required to comply with NEPA for activities involving research and development, space flight activities, and program management. NASA implements NEPA using 14 CFR Part 1216.3, *Procedures for Implementing the National Environmental Policy Act*, NPR 8580.1, *Implementing the National Environmental Policy Act and Executive Order 12114*, and the Council on Environmental Quality (CEQ) *Regulations for Implementing the Procedural Provisions of NEPA* (40 CFR Parts 1500-1508).

NASA is responsible for determining the proper level of NEPA and related documentation required for a mission and ensuring that the process is completed during the preliminary design and technology development phase of a mission (per NM 7120-81, Section 4.5.2.a(2)). Depending on the potential environmental impacts of a selected mission, one of three levels of NEPA documentation will be required:

- Record of Environmental Consideration and a NASA Routine Payload (NRP) Checklist;
- Preparation of a mission unique Environmental Assessment (EA); or
- Preparation of a mission unique Environmental Impact Statement (EIS).

Questions concerning environmental review requirements or NEPA may be addressed to Ms. Tina Norwood, the NASA NEPA Program Manager, at (202) 358-7324 or by E-mail at [nepa@hq.nasa.gov](mailto:nepa@hq.nasa.gov).

#### 5.2.4.2 Use of Radioactive Material

The proposed use of radioactive materials of any quantity and any isotope, including radioisotope power sources, radioisotope heater units, or radioactive calibration sources for science instruments, will require review for environmental impact and nuclear launch safety approval (NLSA). The NLSA requirements are specified in NPR 8715.3, *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 8715.3, 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 28. If use of radioactive materials is proposed (including radioisotope power systems and radioisotope heater units), 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.

This AO allows for missions to baseline use of minor radiological sources for science instrumentation and 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 charged against the PI-Managed Mission Cost; missions will have to reimburse the Department of Energy for the cost of the RHUs (see Requirement 29) and fund the environmental and nuclear launch safety review processes (see Sections 5.2.4.1, 5.2.4.2, and 5.2.4.4).

Requirement 29. The costs of RHUs and their associated services and any minor sources shall be included within the PI-Managed Mission Cost (for pricing information, see the *Radioisotope Heater Unit Information Summary* document in the Program Library).

Launch processing of a mission that uses radioisotope power systems or radioisotope heater units is a nonstandard launch service that carries an additional cost against the PI-Managed Mission Cost (see Section 5.9.2).

Questions concerning the NLSA process may be addressed to Mr. Mark Dahl, at (202) 358-0306 or at [mark.r.dahl@nasa.gov](mailto:mark.r.dahl@nasa.gov).

#### 5.2.4.3 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 NPR 8020.12C). Specific planetary

protection requirements for each planned mission will be determined by the NASA Planetary Protection Officer, in accordance NPR 8020.12C, and consistent with the policy and guidelines of the Committee on Space Research (COSPAR), recommendations of the Space Studies Board of the National Research Council (NRC), and advice from the NASA Advisory Council. 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.

#### 5.2.4.4 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 an Advanced Stirling Radioisotope Generator (ASRG) 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 must be included in the PI-Managed Mission Cost for missions not using ASRGs (see Section 5.9.2). The costs for the development of some NEPA and NLSA documents will be considered part of the PI-Managed Mission Cost. These last costs vary depending on the attributes of the proposed mission, as shown in Table 1; the costs in Table 1 are to be used for proposal preparation and are firm, fixed costs; proposals should not add margin onto them. For proposal purposes, these costs should be treated as decrements to the PI-Managed Mission Cost Cap; there is no need to identify which year the costs will be expended nor to convert the costs into real year dollars.

Also shown in Table 1 are the key milestones that missions will have to accommodate in their scheduling. Only portions of the documents required to meet these milestones must be provided by the proposed mission; 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.

**Table 1: Key milestones and costs for launch approval processes in FY10 dollars.**

<b>Mission Attributes</b>	<b>Cost</b>	<b>Key Milestones</b>
ASRG ASRG + RHUs ASRG + minor sources ASRG + RHUs + minor sources	\$20M	NEPA Notice of Intent: 21 months before CDR NEPA Databook: 16 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 Risk communication Plan: 21 months before CDR
RHU RHU + minor sources	\$20M	NEPA Notice of Intent: 21 months before CDR NEPA Databook: 16 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 Risk communication Plan: 21 months before CDR
Restricted Sample Return (ASRG outbound only)	\$20M	NEPA Notice of Intent: 21 months before CDR NEPA Databook: 16 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 Risk communication Plan: 21 months before CDR
Restricted Sample Return (minor sources only)	\$14M	Final NEPA Document: PDR Nuclear Safety Review/Request Document: 5 months before launch
Restricted Sample Return (no ASRG or minor sources)	\$13M	Final NEPA Document: PDR
Minor sources with A2 mission multiple between 10 and 500.	\$800K	NEPA Notice of Intent: 21 months before CDR NEPA Databook: 16 months before CDR Final NEPA Document: 1 month before CDR LV Data for Nuclear Safety Review Document: 17 months before launch Nuclear Safety Review/Request Document: 5 months before launch Risk communication Plan: 21 months before CDR
Out of scope with NASA Routine Payload Environmental Assessment	\$500K	Final NEPA Document: PDR
Within scope of NASA Routine Payload Environmental Assessment	\$100K	Final NEPA Document: PDR

\*SAR = Safety Analysis Report

**Requirement 30.** The costs of environmental review and launch approval shall be included in the PI-Managed Mission Cost. 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.

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 31.** Proposals shall include mission requirements for telecommunications, tracking, and navigation; proposals shall also include a plan for meeting those requirements, including a cost plan, where the cost of development and use of telecommunications, tracking, and navigation services must be included within the PI-Managed Mission Cost cap whether or not NASA networks are used.

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 Point of Contact (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 Discovery mission. It is SMD policy that none of the DSN 70 meter antennas may be proposed to support normal operations of the selected Discovery 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 deep-space missions launched after 2016 to the use Ka-band for science data return (telemetry, tracking, and commanding (TT&C) data may still be transmitted using X-band). In order to better manage the Agency's transition to Ka-band service, proposed investigations shall baseline the use of Ka-band for science data return. The Space Frequency Coordination Group (SFCG) has recommended (Recommendation 23-1, available at <https://www.sfcgonline.org/>) that X-band users be limited to using 12 MHz of spectrum in deep space and 8 MHz at Mars (where there are multiple missions). Where appropriate, these limits will be imposed on missions proposed to this AO.

**Requirement 32.** If use of NASA's network services is proposed, costs for services, as described in the *NASA's Mission Operations and Communications Services* document, must be included in the proposal's cost plan.

Requirement 33. 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 should include an estimate of the additional costs for these capabilities and capacities.

Requirement 34. Proposals shall baseline the use of only one DSN 34 meter at any time for normal operations (not including periods of station hand-off).

Requirement 35. Proposals shall baseline the use of Ka-band for science data return. If the use of Ka-band is inappropriate for the proposed investigation (based on the SFCG recommendations), then the proposal shall contain a justification for the use of an alternative communications approach.

#### *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. Critical event telemetry must be transmitted from the spacecraft in real-time, in case the RF link is lost, but is not required to be displayed or analyzed in real time. 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 36. 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 End-of-Mission Spacecraft Disposal Requirement*

NPR 8715.6, *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. Please note that NASA prefers powered controlled reentries for disposal.

Requirement 37. As applicable for Earth and Moon orbiters, proposals shall demonstrate satisfaction of the orbit disposal requirement by providing a mission lifetime analysis and indicating whether disposal is in orbit or with a reentry, either controlled or uncontrolled (see Appendix B, Section J.7, for additional detail).

#### *5.2.8 Deviations from Recommended Payload Requirements*

Discovery missions are required to meet the requirements for safety, reliability, and mission assurance in the *Discovery Program Safety and Mission Assurance Guidelines and Requirements* document (available in the Program Library).

Requirement 38. Proposals shall indicate any expected deviations from the recommended requirements in the *Discovery Program Safety and Mission Assurance Guidelines and Requirements* document and in Appendix B of NPR 8705.4 for the payload class specified in Section 4.1.4.

#### *5.2.9 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/>). Use of AMMOS may be proposed, as appropriate. Points of contact and cost information for these services may be found in the Advanced Multi-Mission Operating System Services document in the Program Library.

### **5.3 Management Requirements**

See Appendix B, Section G, for additional detail.

#### *5.3.1 Principal Investigator*

The 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, but 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 39. Proposals 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 the approval of NASA, the Alternate may be named as the Project Manager. 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 40. Proposals shall identify a single Project Manager 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.

Requirement 41. Proposals shall clearly define the respective roles of the PI and PM.

#### *5.3.3 Management and Organization Experience and Expertise*

The qualifications and experience of the PI, PM, Project Scientist (PS), Project Systems Engineer (PSE), and other key members of the PI-led Investigation Team must be commensurate with the technical and managerial needs of the proposed investigation.

The implementing institutions, selected and overseen by the PI, have the responsibility to ensure that the mission meets schedule and cost constraints. It is the PM and the implementing institutions' responsibility to provide the quality personnel and resources necessary to meet the technical and managerial needs of the mission. The commitment, spaceflight experience, and past performance of the PI and of the implementing institutions will be assessed against the needs of the investigation.

Requirement 42. Proposals shall identify the management positions that will be filled by key management team members. These positions shall include, as a minimum, the PI, PM, PSE, and, where appropriate, the PS and partner leads. For management positions for which key management team members are named (including the PI and PM per Requirement 39 and Requirement 40), proposals shall describe the qualifications and experience of those team members who occupy those positions. For management positions for which key management team members are not named, proposals shall describe the qualifications and experience required of any candidate to occupy those positions. For all positions that will be filled by key management team members, proposals shall demonstrate that the described qualifications and experience are commensurate with the technical and managerial needs of the proposed investigation.

Requirement 43. Proposals shall describe the qualifications and experience of the primary implementing institutions and demonstrate that they are commensurate with the technical and managerial needs of the proposed investigation.

#### *5.3.4 Risk Management*

Proposers must demonstrate clear understanding of specific risks inherent in the development 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, or any nontrivial modifications or upgrades of existing technologies, proposed for the investigation; 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; and any contributions that are critical to the success of the mission.

Requirement 44. Proposals shall define and discuss the major risks to the development and implementation of the proposed investigation.

Requirement 45. 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 development 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 46. 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, and the decision milestone(s) for implementing descopes.

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

#### *5.3.5 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) 1872.308). Additional instructions may be found in Procurement Information Circular (PIC) 05-15 (see Program Library).

Requirement 47. Proposals submitted by NASA Centers shall contain any descriptions, justifications, representations, indications, statements, and/or explanations that are required by the regulations in NFS 1872.308 (see Appendix B, Section J.8, for additional detail).

### 5.4 Science Team, Co-Investigators, and Collaborators

#### *5.4.1 Science Team*

Requirement 48. 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 and whose services are either funded by NASA or are contributed by his/her employer.

Every Co-I must have a role that is required for the successful development 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 49. 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 50. Proposals shall identify the funding source for each Co-I. If funded by NASA, 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 through the proposal. A collaborator may be committed to provide a focused contribution to the project for a specific task, such as data analysis. If 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 team member.

Requirement 51. Proposals shall identify and designate all collaborators.

### 5.5 Small Business Participation and Education and Public Outreach

#### *5.5.1 Small Business Participation*

It is the policy of the Government when contracts are issued to emphasize subcontracting opportunities for small businesses. Offerors 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. Offerors 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.

Offerors are advised that, by law, for NASA prime contracts resulting from this solicitation which offer subcontracting possibilities, exceed \$500,000, and are with organizations other than small business concerns, the clause at FAR 52.219-9 will apply. Offerors 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), HBCU, and OMI entities to the maximum practicable extent.

If offerors are able to demonstrate that subcontracting opportunities are not reasonably available in the performance of the Phase A concept studies, then subcontracting plans are not required for evaluation of Step 1 proposals leading to Phase A awards for project formulation.

Requirement 52. Proposals shall include a small business subcontracting plan for the Phase A concept study or demonstrate that one is not required (see Appendix B, Section I.1 for additional detail).

At the time the Phase A concept study report is delivered, regardless of whether subcontracting plans are submitted with the Step 1 proposal, offerors 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 offeror ineligible for subsequent implementation and operation phases. As part of the Step 2 continuation (downselect) 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, except for SDBs. Offerors will separately identify and will be evaluated on participation targets of SDBs in North American Industry Classification System (NAICS) codes determined by the Department of Commerce to be underrepresented industry sectors.

#### *5.5.2 Core E/PO 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. All selected investigations will be required to implement a core Education and Public Outreach (E/PO) program consistent with SMD policy (see the *Explanatory Guide to the NASA Science Mission Directorate Educational and Public Outreach Evaluation Factors* document in the Program Library). However the quality of E/PO plans is not a consideration in the selection of Step 1 proposals for Phase A concept studies. Therefore, E/PO plans are not needed at this time. Detailed plans for E/PO programs are neither required nor permitted in proposals.

A plan for a core E/PO program will be developed during the Phase A concept study and will be included in the Concept Study Report. The quality of the E/PO plan contained in the Concept Study Report will be evaluated and will be a factor in the downselection for flight following Phase A; see *The Explanatory Guide to the NASA Science Mission Directorate Educational and Public Outreach Evaluation Factors* in the Program Library.

The minimum allowable core E/PO program cost is defined to be 1% of the PI-Managed Mission Cost Cap but excluding any additions to the cost cap owing to technology infusions (see Section 5.9.3). Missions must designate at least the minimum allowable core E/PO program cost for implementation of the core E/PO program. There is no maximum allowable cost for the core E/PO program; however, the funding for the core E/PO program must be included in the PI-Managed Mission Cost.

Core E/PO activities may continue for one year following end-of-prime-mission to allow for the incorporation of the results of the mission investigation into the core E/PO program.

Requirement 53. Proposals shall not designate an E/PO lead and proposals shall not include a plan for a core E/PO program.

Requirement 54. Proposals shall identify the funding set aside for the implementation of a core E/PO program; this funding shall be at least the minimum allowable core E/PO program cost and shall be included in the PI-Managed Mission Cost.

Requirement 55. Proposals shall include the following statement of commitment from the PI (see Appendix B, Section I.2, for additional detail):

“I understand the NASA SMD requirements for E/PO and I am committed to carrying out a core E/PO program that meets the goals described in the *Explanatory Guide to the NASA Science Mission Directorate Educational and Public Outreach Evaluation Factors* document. I will submit an E/PO plan with my Concept Study Report if this proposal is selected.”

#### *5.5.3 Student Collaborations (optional)*

Proposals may define a Student Collaboration (SC) that is a separate part of the proposed investigation. A SC can take the form of an instrument development, an investigation of scientific questions, analysis and display of data, development of supporting hardware or software, or other aspects of the investigation. The SC must be incorporated into the mission on a nonimpact basis. That is, the SC may not increase the mission development risk or impact the development or performance of the baseline science investigation in any way that would cause the baseline mission to be compromised in the event that the SC component is not funded; encounters technical, schedule, or cost problems; or fails in flight. A SC must be dependent upon the proposed mission being implemented, *e.g.*, require the provision of flight elements and/or access to science/engineering data generated by the mission. SC elements that involve only analysis of archival data may not be proposed. A SC may, but is not required to, have the potential to add value to the science or engineering of the mission. A SC must include appropriate plans for the mentoring and oversight of students to maximize the opportunity for teaching, learning, and success in contributing to the mission.

Although any proposed SC is an E/PO element, a SC may not be used as a component of the core E/PO program. If a proposed investigation is selected, NASA retains the option to fund or not to fund any proposed SC.

There is no minimum and no maximum allowable cost for a SC. NASA is providing a student collaboration incentive that is defined to be 1% of the PI-Managed Mission Cost Cap, but excluding any additions to the cost cap owing to technology infusions (see Section 5.9.3). The proposed cost of the SC, up to the student collaboration incentive, may be outside of the PI-Managed Mission Cost. If the SC costs more than the student collaboration incentive, then the rest of the cost of the SC must be within the PI-Managed Mission Cost.

In the Step 1 evaluation, a proposed SC will be evaluated only for its impact on mission feasibility. The merit of the proposed SC will not be evaluated in the Step 1 evaluation; the merit of the proposed SC will be evaluated as part of the evaluation of the Step 2 Concept Study Report; see *The Explanatory Guide to the NASA Science Mission Directorate Educational Merit Evaluation Factors for Student Collaboration Elements* in the Program Library.

Requirement 56. If a proposal contains a SC, the proposal shall demonstrate that the proposed SC is clearly separable from the proposed Baseline and Threshold Science Mission investigations, to the extent that the SC will not impact the science investigation in the event that the SC is not funded; that the SC fails during flight operations; or that the SC encounters

technical, schedule, or cost problems during development (see Appendix B, Section I.3, for additional detail).

Requirement 57. 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 PI-Managed Mission Cost, including all mission phases, before any adjustments, is capped at \$425M FY 2010 dollars. The PI-Managed Mission Cost excludes the cost of launch vehicles (Section 5.9.2). The PI-Managed Mission Cost cap is adjusted by costs for the launch approval process (Section 5.2.4.4), costs for nonstandard launch vehicles and fairings (Section 5.9.2), costs for nonstandard launch services associated with the launch of radioactive material (Section 5.9.2), and incentives for the infusion of NASA-developed technology (Section 5.9.3).

Charges for nonstandard launch vehicles and services must be counted against the PI-Managed Mission Cost (see Section 5.9.2).

Investigations selected to proceed to Phase B (or an extended Phase A) will have their PI-Managed Mission Cost capped at the cost proposed in the Concept Study Report and approved by NASA at downselect (see Section 7.4.3).

Requirement 58. Proposals shall include the proposed PI-Managed Mission Cost and the proposed Total Mission Cost in all required AO cost tables (see Appendix B, Section H, for required AO cost tables).

Requirement 59. The proposed costs shall comply with the specified PI-Managed Mission Cost cap.

Requirement 60. No more than 25% of the proposed costs may be spent prior to KDP-C (Confirmation).

### *5.6.2 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 nine months following the establishment of initial contracts. The cost of the Phase A concept study is capped at \$3.0M Real Year (RY) dollars. See Sections 7.4.2 and 7.4.3 for additional information on the Phase A concept study.

Requirement 61. Proposals shall include the cost of the Phase A concept study, which shall be included within the PI-Managed Mission Cost, and the proposed cost shall comply with the Phase A concept study cost cap.

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

Requirement 62. 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).

Requirement 63. Proposals shall identify the methodologies (cost models, cost estimating relationships of analogous missions, etc.) and rationale used to develop the proposed cost.

Requirement 64. 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 cost 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/E. The numerator is the amount of unencumbered cost reserves, not including funded schedule reserve. The denominator is the PI-managed mission cost to complete Phases A-E, including the cost of technical design margin, including funded schedule reserve, not including cost reserve.

Adequate unencumbered cost reserves are defined to be a minimum of 25%. 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), KDP-D (at the end of Phase C), and KDP-E (at the start of Phase E, generally 30 to 90 days after launch).

Requirement 65. Proposals shall justify the adequacy of the proposed cost reserves, given that the proposed cost is not allowed to increase beyond the cost cap during Phase A or at any later time. Proposals shall comply with the requirement for unencumbered cost reserves against the cost to complete and shall demonstrate an approach to maintaining required unencumbered cost reserves through subsequent development and operations phases.

#### *5.6.4 Work Breakdown Structure*

Requirement 66. Proposals shall provide a Work Breakdown Structure (WBS) that conforms to the standard prescribed in Appendix G of NM 7120-81. Costs for most elements shall be specified to WBS Level-2. Exceptions are the costs of elements which 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 67. Proposals shall include a Master Equipment List (MEL) summarizing all major components of each flight element subsystem and each instrument element components to support validation of proposed mass estimates, design heritage, and cost (see Appendix B, Section J.9, 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 for proposals submitted in response to this AO, 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 required for the performance of the research effort. Since the NASA civil servant labor and benefits costs will be covered by the unified labor account within the Agency's Cross-Agency Support Program (CASP), these costs will not be paid from the resulting award but still must be accounted for within the PI-Managed Mission Cost.

All NASA civil servant labor costs, including salary and benefit costs, must be clearly identified by year within the budget justification section of the proposal.

Estimated NASA Center Management and Operations (CM&O) costs must be included to enable a level playing field for proposers. 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.

Do not include within the cost proposal, nor within the PI-Managed Mission Cost, other costs not paid with Discovery Program funds such as allocated service pools, Agency Management and Operations (AM&O, a.k.a. NASA Headquarters overhead), and any CM&O burden attributed to off-site contracts (pass-through dollars) and other cost elements.

Proposal budgets from NASA Centers, whether as the proposing organization or as a supporting organization, must include within the PI-Managed Mission Cost the following cost elements as appropriate and must separately identify them by element and by year:

- NASA civil servant direct labor including benefits;
- NASA civil servant travel;
- Other direct costs including non-civil servant demand service pools and procurements as identified in the NASA N-2 database; and
- The CM&O burden on NASA provided labor, including Center civil servants and on-site contractors.



**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	CASP	includes benefits
Civil Service Travel	Yes	Yes	SMD Program	
Other Direct	Yes	Yes	SMD Program	includes non-civil servant demand service pools and procurements as identified in the NASA N-2 database
CM&O	Yes	Yes	CASP	applied to NASA provided labor, including Center civil servants and on-site contractors
AM&O	No	No	CASP	includes NASA provided independent technical authority
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 68.** Proposals including costs for NASA Centers shall conform to the full cost policy stated in Section 5.6.6. Each of the elements of the NASA Center costs (direct labor, travel, other direct costs (procurements and demand service pools), CM&O) 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 69.** 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 70.** Proposals including costs for non-NASA Federal Government agencies shall follow the applicable accounting standards.

#### 5.6.7 Contributions

Contributions from sources other than the Discovery Program and other SMD programs, U.S. or non-U.S., are welcome. These may include, but are not limited to, labor, services, 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).

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

Requirement 72. 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.

Letters of Commitment are required from each organization responsible for a contribution (for U.S. organizations, see Section 5.8.1.1 and Requirement 81; for non-U.S. contributing organizations, see Section 5.7.2 and Requirement 75).

The requirement for institutional Letters of Commitment for contributions does not apply to contributed support for Co-Investigators; no institutional Letters of Commitment are required with the Step 1 proposal for contributed Co-Investigator support. The requirement for personal statements of commitment from contributed Co-investigators is given in Section 5.8.1.3 and Requirement 83.

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 (see Appendix B, Section H, for additional detail).

Requirement 73. 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.

## 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).

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*. 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, are expected to arrange for non-U.S. financing for their portion of the research.

### *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, U.S. and non-U.S., must be typewritten in English and must comply with all submission requirements stated in this AO and in Appendix B of this AO.

Requirement 74. 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.

Requirement 75. 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 in a Letter of Commitment for a contribution are given in Section 5.8.1. 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 must sign these Letters of Commitment.

Contributions from non-U.S. sources offer benefits but also represent complexity and risk to a project.

Requirement 76. Proposals from U.S. proposers shall include a discussion of mitigation plans, where possible, for 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. Note that reserves held for this purpose will be considered by NASA to be encumbered. When no mitigation is possible, this must be explicitly acknowledged. 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 downselect decision is made at the conclusion of Phase A.

Any proposed non-U.S. participation must be described at the same level of detail as that of U.S. partners, including the provision of technical, schedule, and management data. 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 77. Any proposed non-U.S. contribution essential to the success of the proposed investigation shall be described at the same level of detail as those of U.S. partners (with the exception of the cost plan).

Requirement 78. 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 contribution and method for estimating value, and (v) cross-reference to any Letters of Commitment in the proposal appendix. Proposals with non-U.S. participation must 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 a flowchart. 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 selected, 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. 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. Additionally, in some cases, interim agreements may be put in place until a more permanent arrangement is reached.

Requirement 79. If applicable, proposals shall show how the Phase A concept study 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 80. Non-U.S. proposals and domestic 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 Letters of Commitment*

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., but excluding Co-I services) on a no-exchange-of-funds basis, including all non-U.S. organizations providing hardware or software to the investigation (see Section 5.6.7), and (ii) all major organizational partners in the proposal regardless of source of funding. See Appendix B, Section J.2, for additional detail.

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).

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.

#### 5.8.1.1 Letters of Commitment for Contributions

An institutional Letter of Commitment for a contribution must contain the required elements described in Section 5.8.1.

Requirement 81. 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.

The requirement for Letters of Commitment from non-U.S. organizations offering contributions is given in Section 5.7.2 and Requirement 75.

#### 5.8.1.2 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, major hardware elements, science instruments, integration and test, mission operations, and other major products or services as defined by the proposer. 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).

An institutional Letter of Commitment for a major partner must contain the required elements described in Section 5.8.1.

Requirement 82. Unless otherwise explicitly exempted elsewhere in this AO (*e.g.*, Section 5.2.5), proposals shall include a 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.

#### 5.8.1.3 Personal Letters of Commitment

No personal or institutional Letters of Commitment are required for co-investigators or other proposal team members in the Step 1 proposal. A proposal team member is defined to be any individual identified on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) proposal cover page. Proposal team members indicate their commitment to the proposed investigation through NSPIRES (see Appendix B, Section A.3, for instructions). 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).

Requirement 83. 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.

### *5.8.2 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.

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. citizens, who are not 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 must be marked with a notice to that effect.

Requirement 84. If the proposal contains export controlled material, 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."

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

## **5.9 Program Specific Requirements and Constraints**

### *5.9.1 Schedule Requirements*

Requirement 85. Proposals shall propose a launch readiness date no later than December 31, 2017.

### *5.9.2 Launch Services*

A Discovery investigation will be launched as the primary payload on an expendable launch vehicle (ELV) that NASA will provide as Government Furnished Equipment (GFE). Standard launch services utilizing a domestic launch vehicle certified as category 3 per NPD 8610.7, *NASA Launch Services Risk Mitigation Policy for NASA-Owned or NASA-Sponsored Payloads/Missions*, regardless of the payload classification, will be provided at no charge to the PI-Managed Mission Cost. There will be a charge against the PI-Managed Mission Cost for any launch services beyond the standard launch services offered. Detailed information on launch vehicle options, including a description of standard launch services, is provided in the *ELV Launch Services Information Summary* document in the Program Library.

The *ELV Launch Services Information Summary* describes six categories of launch vehicles in the intermediate performance class. The standard service will provide the least capable launch

vehicle (standard performance class with a 4m fairing). A charge will be counted against the PI-Managed Mission Cost for investigations that require the use of more capable launch vehicles as shown in Table 2. The costs in Table 2 are firm, fixed costs; proposals should not add margin onto them. For proposal purposes, these costs should be treated as decrements to the PI-Managed Mission Cost Cap; there is no need to identify which year the costs will be expended nor to convert the costs into real year dollars.

**Table 2: Charges against the PI-Managed Mission Cost for nonstandard launch vehicles and fairings in FY 2010 dollars.**

		FAIRING SIZE	
		4m	5m
PERFORMANCE CLASS	Standard	none	\$14M
	Medium	\$22M	\$25M
	High	\$32M	\$68M

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. Co-manifested or secondary payloads on a U.S. or non-U.S. launch vehicle may not be proposed or considered under this AO. Contributed launch services may not be proposed or considered under this AO.

**Requirement 86.** Proposals shall define the required launch vehicle capability and demonstrate that it is compatible with the standard launch services offered.

**Requirement 87.** If services beyond the standard launch services offered are required, the proposal shall include the cost of such services in the PI-Managed Mission Cost.

Launch delay costs as a result of spacecraft or payload delays are not a standard launch service. Any such launch-delay costs must be funded out of the PI-Managed Mission Cost and, therefore, represent a cost risk to the PI-Managed Mission Cost.

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 included in the PI-Managed Mission Cost for missions *not* using ASRGs. Costs associated with the launch of radioactive materials are shown in Table 3. These are firm, fixed costs; proposals should not add margin to them. For proposal purposes, these costs should be treated as decrements to the PI-Managed Mission Cost Cap; there is no need to identify which year the costs will be expended nor to convert the costs into real year dollars.



**Table 3: Costs of nonstandard launch services associated with the launch of radioactive material in FY 2010 dollars.**

MISSION ATTRIBUTES	COST
ASRG ASRG + RHUs ASRG + minor sources ASRG + RHUs + minor sources	\$0
RHU RHU + minor sources	\$20M
Minor sources with A2 mission multiple between 10 and 500.	\$18M

Due to the volatility of the launch services market, NASA cannot ensure which launch vehicles will be available at the time of the launch deadline specified in Section 5.9.1. Accordingly, proposers are advised to plan for compatibility with vehicle families that provide the required performance and are expected to be available through spacecraft 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.

**Requirement 88.** Proposals shall discuss flexibility to be accommodated on multiple launch vehicle families (*i.e.*, Atlas V, Delta IV, and Falcon 9).

### 5.9.3 Infusion of NASA-developed Technology

NASA recognizes that it would be desirable to fly new technologies in order to enable scientific investigations or to enhance an investigation's science return. Discovery missions potentially provide opportunities to infuse advanced technologies developed by NASA and thereby advance NASA's technology base and enable a broader set of future missions. The *2006 Solar System Exploration Roadmap* (available in the Program Library) identifies technology development needs for solar system exploration and states that NASA will strive to maximize the payoff from its technology investments, either by enabling individual missions or by enhancing classes of missions with creative solutions. The Roadmap identifies transportation technologies as a "highest priority" and notes that solar electric propulsion could be "strongly enhancing" for most missions.

SMD's In-Space Propulsion Technology (ISPT) program has developed several technologies that are nearing TRL 6 and that are, therefore, potentially applicable to Discovery missions. Three of these technologies are: 1) the NASA's Evolutionary Xenon Thruster (NEXT) ion propulsion system, 2) the Advanced Material Bi-propellant Rocket (AMBR), and 3) aerocapture. ISPT investments in electric propulsion technologies have included completing NEXT, a 0.6-7kW throttleable gridded ion propulsion system. ISPT investments in chemical propulsion have included a high-temperature storable bi-propellant rocket engine providing higher performance for lower cost than current state-of-the-art high performance rocket engines. ISPT investments in aerocapture have completed the development of a family of efficient thermal protection system (TPS) materials and structures; models for aerothermal effects; engineering atmospheric models which include Titan, Neptune, Mars, and Venus; guidance, navigation, and control (GN&C)

algorithms for blunt-body rigid aeroshells; and will complete ground testing of GN&C hardware in the loop by the end of 2009.

The Program Library contains a description of the ISPT program and the three ISPT propulsion technologies, as well as other propulsion related references:

- 1) The *NASA's In-Space Propulsion Technology Project Overview, Near-Term Products, and Mission Applicability* document provides an overview of the ISPT program.
- 2) In-depth reference documents and briefing packages of the NEXT ion propulsion system, the AMBR rocket engine, and aerocapture are provided in the following documents:
  - a. The *NASA's Evolutionary Xenon Thruster (NEXT) Ion Propulsion System Information Summary for Discovery Missions* document provides an in-depth description of the technology.
  - b. *The NEXT Ion Propulsion System for Solar System Exploration* is a standard briefing package.
  - c. The *Advanced Materials Bi-propellant Rocket (AMBR) Information Summary* document provides an in-depth description of the technology.
  - d. The *AMBR Engine for Science Missions* is a standard briefing package.
  - e. *Aerocapture Information Summary for Discovery Missions* document provides an in-depth description of the technology.
  - f. *Aerocapture for Discovery Missions* is a standard briefing package.
- 3) The *In-Space Propulsion Technology Project Low-Thrust Trajectory Tool Suite* document describes trajectory tools developed by the ISPT program that would be useful for determining mission trajectories if NEXT is utilized.
- 4) The *Electric Propulsion Thruster Lifetime Qualification Standard Recommendation* document describes the ISPT project's recommendation regarding a standard approach for electric propulsion thruster lifetime qualification.
- 5) The *In-Space Propulsion Technologies Minimum Demonstration Requirements* document describes the minimum hardware and activities required by missions that propose to demonstrate ISPT-developed technologies.

In order to maximize the payoff from its technology investments, NASA will provide an incentive to encourage the infusion of the NEXT or the AMBR engine or aerocapture into Discovery mission proposals in response to this AO. Proposers are offered the option of selecting one (or none) of these specific technologies for insertion into their missions. NASA will share in the flight development costs of the proposed advanced technology, up to a maximum amount depending on which technology is proposed:

- For missions that utilize NEXT, the cap on the PI-Managed Mission Cost will be raised by \$19M (FY 2010);
- For missions that utilize AMBR, the cap on the PI-Managed Mission Cost will be raised by \$5M (FY 2010);
- For lander missions that propose to use aerocapture, the cap on the PI-Managed Mission Cost will be raised by \$10M (FY 2010).
- For orbiter missions that propose to use aerocapture, the cap will be raised by \$20M (FY 2010).

To qualify for an incentive infusion, a proposed mission must meet minimum demonstration requirements for its chosen technology. These requirements are contained in the document *In-Space Propulsion Technologies Minimum Demonstration Requirements* located in the Program Library.

Proposers will be responsible for the required NEXT, AMBR, or aerocapture flight hardware development and integration, including the flight hardware development schedule.

The application and development of flight hardware from the applicable technology will be evaluated as described in Section 7.2.4.

In order to continue improving its product development approach and ensure its future products are ready to transition to flight development, the ISPT program would like to monitor the NEXT, AMBR, or aerocapture flight hardware development; receive IV&V test results; flight development lessons learned, and performance data during flight. Any PI considering the use of either of these technologies, and requiring further information, should contact David J. Anderson, ISTP Program Manager (Acting), at NASA's Glenn Research Center (Telephone: 216-433-8709; E-mail: [david.j.anderson@nasa.gov](mailto:david.j.anderson@nasa.gov)).

**[Amended July 13, 2010. New text is bold. Deleted text is struck through.]**

**[Amended August 2, 2010. New text is in bold.]**

SMD's Radioisotope Power Systems (RPS) program, in collaboration with the Department of Energy (DOE), is developing the Advanced Stirling Radioisotope Generator (ASRG). DOE has contracted with Lockheed Martin Space Systems Company and Orbital Sciences Corporation for the development, fabrication, and testing of the ASRG. The specifications, qualification schedule, and interface control document describing the ASRG can be found in the Program Library. Proposers may elect to use up to two ASRGs only if use of a radioisotope power system *enables* their investigation (both Baseline and Threshold Science Missions). Satisfying this enabling attribute means that the science goals to be achieved by the proposed mission cannot be accomplished reasonably with a nonnuclear power system. NASA will provide two fueled and fully qualified ASRGs (valued at \$54M FY 2010) as Government Furnished equipment at no cost to the proposer. The units will be available for integration at NASA's Kennedy Space Center no earlier than ~~March~~ **September/November** 2014. Investigations may choose to use one ASRG as a flight unit and the other as a flight spare or to use both ASRGs as flight units. The ASRG qualification unit may not be used as a flight spare. The use of radioisotope power systems will entail considerations of range and nuclear launch safety requirements in spacecraft and mission design.

Requirement 89. If applicable, proposals shall clearly describe the application of **ASRG**, NEXT, AMBR, or aerocapture in the proposed investigation (**including how the proposed use meets the minimum demonstration guidelines for the chosen technology**). See Appendix B, Section J.13, for additional details.

Requirement 90. If applicable, the costs associated with **ASRG**, NEXT, AMBR, or aerocapture shall be called out as a separate WBS element in the proposal budget (Table B3).

Requirement 91. Proposals using ASRGs shall describe how their investigation (both Baseline and Threshold Science Missions) is enabled by the use of radioisotope power systems and the science and mission impacts of not using such systems in a separate appendix. See Appendix B, Section J.14, for additional details

Any PI considering the use of ASRGs, and requiring further information, should contact Robert Cataldo, at NASA's Glenn Research Center (Telephone: 216.977.7082; E-mail: [Robert.L.Cataldo@nasa.gov](mailto:Robert.L.Cataldo@nasa.gov)).

Requirement 92. Proposals may include the use of no more than one of the above-described NASA-developed technologies.

NASA has the responsibility of developing these technologies to TRL-6. As these are technology development projects, NASA cannot guarantee the anticipated performance under conditions different than those for which they have been designed and tested. It is the responsibility of selected proposers to assess any risk inherent in application of these technologies beyond the design envelope. The application and scope of any proposed use of NASA-developed technology will be evaluated for appropriateness and conformance to the guidelines presented in this section.

Additional information regarding questions about NASA developed technologies is provided in Section 6.1.1.

#### *5.9.4 Program Infrastructure Requirements for Mars Missions*

Investigations proposing the development of a Mars mission are subject to the telecommunication and navigation policies of the Mars Exploration Program (MEP). The MEP has developed an integrated telecom and navigation strategy based on an evolving orbital infrastructure, standardized, interoperable communications/navigation services, and time-phased capabilities matched to the scientific and engineering needs of the Program. The strategy involves evolving a Mars Network by implementing a standardized proximity link communications/navigation payload (see the *Mars Relay Description for Discovery Proposals* and *Electra Mars Proximity Link Communications and Navigation Payload Description* documents in the Program Library) deployed on every long-lived (greater than one Mars year) Mars science orbiter mission. This combined strategy will put in place an initial Mars Network infrastructure with gradually increasing capability and with redundant on-orbit assets.

Requirement 93. Although MEP expects to support the Odyssey, Mars Reconnaissance Orbiter (MRO), Mars Atmosphere and Volatile Evolution (MAVEN), and ExoMars/Trace Gas Orbiter missions as Mars relay communication assets as described in the *Mars Relay Description for Discovery Proposals*, proposers to this AO shall provide sufficient information so that the planned use of such infrastructure resources can be evaluated (see Appendix B, especially Requirement B-35).

As a matter of policy, the MEP requires that missions with more than one Mars year of expected life in Mars orbit must carry a UHF communications package (see the *Electra Mars Proximity Link Communications and Navigation Payload Description* document in the Program Library) to

provide telecommunications support for data relay for future missions and to provide support during critical events (see further details in Section 6.5 below). Orbiter missions required to carry such a UHF relay will have it provided as GFE at no cost to the proposer, although the cost of its integration into the payload shall be included in the PI-Managed Mission Cost. Relay operations should not significantly impact the nominal orbiter mission; the UHF relay will be used to support missions launched in the 2018 launch opportunity or later. Furthermore, the operations of the orbiter UHF relay payload for other Mars missions will be paid for by the MEP.

Requirement 94. Proposals for a Mars orbiter with more than one Mars year of expected life in Mars orbit shall include a UHF communications package provided as GFE. Proposals for such qualifying missions shall discuss the technical approach, including schedule and cost, for implementing the UHF relay in the event of selection.

NASA has developed a smaller version of the Electra payload specially tailored to the mass, volume, and power constraints of Mars landers, for flight on the 2011 Mars Science Laboratory mission. Known as Electra-Lite, this standardized UHF relay subsystem provides inherent interoperability with existing Mars relay infrastructure. Proposed landed missions planning to utilize MEP-provided relay services are encouraged to use this payload to fit into the existing Mars telecommunications network. The Electra-Lite payload is described in the *Electra-Lite Mars Proximity Link Communications and Navigation Payload Description* document in the Program Library. If instead a non-Electra-Lite relay payload is selected, it is incumbent on the proposed mission to ensure interoperability with the MEP relay payloads, as described in the *Mars Relay Description for Discovery Proposals* document in the Program Library.

Requirement 95. Proposals for a Mars lander utilizing a UHF-relay system other than the *Electra-Lite* shall be interoperable with MEP relay payloads as described in the *Mars Relay Description for Discovery Proposals* document in the Program Library.

## **6. Proposal Submission Information**

### **6.1 Preproposal Activities**

#### *6.1.1 Preproposal Conference and Questions*

A Preproposal Conference will be held in (Location TBD), in accordance with the schedule in Section 3. Further information, including logistics, will be available at the Discovery Acquisition Homepage (see Section 6.1.4) prior to the Preproposal Conference.

All interested parties may attend. All expenses and arrangements for attending this meeting are the responsibility of the attendees. Note that travel and associated costs of attendance 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.

The purpose of this conference will be to address questions about the proposal process for this AO. Questions should be sent to the Discovery 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 Discovery Acquisition Homepage (see Section 6.1.4) approximately 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 to the Discovery Program Scientist at the address given in Section 6.1.5 until 14 days before the proposal due date given in Section 3. It is expected that all questions and answers will be posted in the FAQ at Discovery Acquisition Homepage (see Section 6.1.4).

For questions about NASA developed technology including ASRGs, NASA will endeavor to provide as complete answers as available resources (e.g., time, funding, technical capabilities such as models and other analysis tools) permit. However responses based solely on analysis and not on testing carry with them inherent uncertainty that NASA may not be able to quantify and cannot eliminate; proposers assume any risk related to these uncertainties. NASA may provide the proposer's questions or otherwise consult with NASA contractors, DOE, or DOE's contractors in order to respond to questions; under these circumstances, the contractors will be bound by appropriate non-disclosure agreements and/or conflict of interest avoidance plans.

#### *6.1.2 Notice of Intent to Propose*

To assist the planning of the proposal evaluation process, NASA strongly encourages all prospective proposers to submit a Notice of Intent (NOI) to propose, before the NOI submittal deadline specified in Section 3. Material in a NOI is deemed confidential and will be used for NASA planning purposes only. Submission of a NOI is not required for the submission of a proposal to this solicitation. Those who submit NOIs will receive any Discovery Program updates or AO amendments that may occur, up to the time of the proposal submittal deadline (see also Section 6.1.4).

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 E-mail at [nspires-help@nasaprs.com](mailto: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, fax number, E-mail address, and institutional affiliation of the PI.
- (b) Full names and institutional affiliations of each known Co-I. If any Co-Is or other 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) Anticipated launch vehicle performance class.
- (d) A brief statement (150 words or less) for each of the following:
  - (i) science objectives of the proposed mission;
  - (ii) identification of new technologies that may be employed as part of the mission, including but not limited to NASA-developed technologies.

- (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.

#### *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 Discovery Teaming Interest page of the Discovery Acquisition Homepage (see address given in Section 6.1.4) have expressed interest in teaming with other organizations on Discovery 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 Program Library and Acquisition Home Page*

The Discovery Program Library provides additional regulations, policies, and background information on the Discovery Program. Information on the Program Library is contained in Appendix D. The Program Library is accessible at <http://discovery.larc.nasa.gov/dpl.html>.

A Discovery Acquisition Homepage, available at <http://discovery.larc.nasa.gov/>, will provide updates and any AO addenda during the Discovery 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.

Updates to the AO and any amendments will be posted on the NSPIRES website. A link will be provided on the Discovery 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 Discovery Program Scientist:

Dr. Michael H. New  
Planetary Science Division  
Science Mission Directorate  
National Aeronautics and Space Administration  
Washington, DC 20546-0001  
Telephone: 202-358-1766  
E-mail: [michael.h.new@nasa.gov](mailto:michael.h.new@nasa.gov)

### **6.2 Proposal Preparation and Submission**

#### *6.2.1 Structure of the Proposal*

General NASA guidance for proposals is given in Appendix A of this AO, which is considered binding unless specifically amended in this AO. 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 96. 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 three required certifications printed in full 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 97. The original signed proposal and 65 paper copies, each of which contains an attached, clearly labeled CD-ROM that contains electronic proposal files (see Appendix B), shall be delivered to the following address by the proposal submittal deadline specified in Section 3. [Partially repeats Requirement 1]

**[Updated on August 10, 2010, with new mailing address.]**

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

**Phone for commercial delivery: 202-479-9030**

~~NOTICE TO PROPOSERS: At the time of AO release, the location of NASA's peer review support services is being moved. The new mailing address is not known at this time. No later than August 1, 2010, the AO will be clarified to include the shipping address for proposals in Section 6.2.3, and the new address will be posted on the Discovery Acquisition Homepage (see Section 6.1.4).~~

NASA will notify proposers that their proposals have been received. Proposers who have not received this confirmation within two weeks after submittal of their proposals should contact the Discovery Program Scientist at the address given in Section 6.1.5.

Proposals received after the submittal deadline will be treated in accordance with Appendix A, Section VII.

#### *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 to 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 Central Contractor Registry (CCR).

Requirement 98. 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 shall indicate their commitment to the proposed investigation through NSPIRES (see Requirement 83).

The same proposal summary information must be submitted on the Electronic Cover Page as is in Section A of the proposal. The Electronic Cover Page may be submitted either before or after the proposal is submitted, as long as the Electronic Cover Page is submitted no later than the proposal due date given in Section 3. This means that the Electronic Cover Page may be finalized after the proposal is completed to ensure that the Electronic Cover Page has identical information as Section A of the proposal. Alternatively the Electronic Cover Page may be submitted first and a printout of the Electronic Cover Page may be included in Section A of the proposal.

Requirement 99. The Electronic Cover Page shall contain information that is identical to the information contained in Section A of the proposal.

Requirement 100. The Electronic Cover Page shall be submitted in NSPIRES by an authorized organizational representative (AOR) of the proposing organization, and it shall be submitted by the proposal submittal deadline specified in Section 3. [Partially repeats Requirement 2]

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 submitting 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 to 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); each panel will evaluate proposals against different criteria. 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.

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 the feasibility of the mission implementation (see Section 7.2.4), NASA will request clarification on specific, potential major weaknesses in the feasibility of mission implementation that have been identified in the proposal. NASA will request such clarification uniformly from all proposers. The ability of proposers to provide clarification to NASA is extremely 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*

An *ad hoc* categorization subcommittee of the SMD AO Steering 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, will convene to consider the peer review results and, based on the evaluations, categorize the proposals in accordance with procedures required by NFS 1872.403-1(e). The categories are defined as follows:

Category I. Well conceived and scientifically and technically sound 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 data that 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 and scientifically or technically sound investigations which are recommended for acceptance, but at a lower priority than Category I.

Category III. Scientifically or technically sound investigations which require further development. Category III investigations may be funded for 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.

A sitting panel of the SMD AO Steering Committee will then review the results of the evaluations and categorizations. The AO 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 AO 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 decision, 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:

- The scientific merit of the proposed investigation;
- The scientific implementation merit and feasibility of the proposed investigation; and
- The technical, management, and cost (TMC) feasibility of the proposed approach for mission implementation, including cost risk.

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, including cost risk, 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 score. The adjectival

summary scores 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.

<b>Summary Evaluation</b>	<b>Basis for Summary Evaluation</b>
<u>Excellent</u>	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.
<u>Very Good</u>	A fully competent proposal of very high merit that fully responds to the objectives of the AO, whose strengths fully outbalance any weaknesses.
<u>Good</u>	A competent proposal that represents a credible response to the AO, having neither significant strengths nor weakness and/or whose strengths and weaknesses essentially balance.
<u>Fair</u>	A proposal that provides a nominal response to the AO, but whose weaknesses outweigh any perceived strengths.
<u>Poor</u>	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, technical merit and feasibility, including cost risk, will be reported as Low Risk, Medium Risk, or High Risk, as defined in the table below.

<b>Summary Evaluation</b>	<b>Basis for Summary Evaluation</b>
<u>Low Risk</u>	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.
<u>Medium Risk</u>	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. Mission design may be complex and resources tight.
<u>High Risk</u>	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 enhancements 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.

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 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, including details on data collection strategy and plans; 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; 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 and/or sample analysis plan. This factor includes the merit of plans for data and/or sample analysis, data archiving, and/or sample curation to meet the goals and objectives; to result in the publication of science discoveries in the professional literature; and to preserve data and samples 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; an assessment of the planning and budget adequacy and evidence of plans for the preliminary evaluation and curation of any returned samples; reporting scientific results in 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 of the proposal.
- Factor B-6. Merit of any science enhancement options (SEOs), if proposed. This factor includes assessing the appropriateness of activities selected to enlarge the science impact of the mission; the potential of the selected activities to enlarge the science impact of the mission; and the appropriate costing of the selected activities. The peer review panel will inform NASA whether the evaluation of the proposed SEO(s) impacted the overall rating for scientific implementation merit and feasibility. Lack of an SEO will have no impact on the proposal's overall rating for scientific implementation merit and feasibility.

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 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. The intrinsic merit of student collaborations will not be evaluated at this time.

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 Feasibility of the Mission Implementation, Including Cost Risk*

The technical and management approaches of all submitted investigations 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 and the adequacy of backup plans to mature systems within the proposed cost and schedule when technologies 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 – hardware and software – and facilities), and the plans for launch services. 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 and the adequacy of backup plans to ensure success of the mission when technologies 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, and 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 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 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 adequacy of contingency plans for coping with the failure of a proposed cooperative arrangement or contribution. This factor also includes assessment of proposal 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 launching by the proposed launch date. Also evaluated under this factor are the proposed project and schedule management tools to be used on the project along with the subcontracting plan including small and small disadvantaged businesses.
- Factor C-5. Adequacy and robustness of the cost plan, including cost feasibility and cost risk. This factor includes proposal 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). Proposals will be evaluated for the adequacy of the cost reserves and whether proposals with inadequate cost reserves demonstrate a thorough understanding of the cost risks. This factor also includes an assessment of the proposed cost relative to estimates generated using parametric models and analogies. Also evaluated under this factor are the proposed cost management tools to be used on the project.

The application and scope of any proposed use of NASA-developed technology will be evaluated for appropriateness and conformance to the guidelines in Section 5.9.3. The implementation feasibility and risk of the proposed use of NASA-developed technology will be evaluated against the factors in this section. All proposers will receive feedback, if applicable, on their proposed use of NASA-developed technology.



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.

Student Collaboration proposals, if any, will be evaluated only for the impact they have on overall 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 mission. The intrinsic merit of student collaborations will not be evaluated at this time.

This evaluation will result in narrative text, including specific major and minor strengths and weaknesses, as well as an appropriate risk rating for the feasibility of 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, and their institutions, past performance (especially in meeting cost and schedule constraints) will be an important risk 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, 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, the SMD program is an evolving activity that ultimately depends 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 final 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 PI-Managed Mission Cost cap for this AO, one or more investigations significantly below the PI-Managed Mission 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 PI-Managed Mission 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.*, partial selections, see Section II of Appendix A) and any special instructions for the concept study. The formal notification will also include instructions for scheduling a debriefing at which 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.

The Selection Statement for this solicitation, which is signed by the Selection Official, may include information from the proposal summary (abstract) for any proposal, whether or not it is selected. Since the Selection Statement is a releasable document, the proposal summary (abstract) shall not contain proprietary or confidential information that the submitters wish to protect from public disclosure.

### 7.4.2 Award Administration and Funding

Oversight management responsibilities have been assigned to the Discovery Program Office at the Marshall Space Flight 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.

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) and cost and pricing data. If more than one contractual arrangement between NASA and the proposing team is required, a separate SOW and budget breakout is required for each organization. For Phase A contracts that exceed \$650K, the contractor will be required to provide cost and pricing data to support the Phase A cost estimate and to certify the cost proposed for the Phase A contract in accordance with FAR 15.406-2. The contractor will also be required to provide cost and pricing data, 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 and cost and pricing data in as timely a manner as possible. The process of awarding contracts cannot begin until SOWs and cost and pricing data have been received, and funds cannot be provided to the implementing organizations 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 contain 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 downselection 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 that is chosen during the Step-2 downselection process to continue beyond the Phase A concept study. Additional phases will be added to the contract after each Phase has been approved through the program review process.

#### *7.4.3 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 an appropriate education and public outreach program and an optional student collaboration, before final selection for implementation. The product of the concept studies is a Phase A Concept Study Report to be delivered by each selected investigation team approximately 9 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 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 PI-Managed Mission Cost cap. The NASA review of the completed Concept Study Report will include all mission facets, including E/PO. 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 cap will be set at the Concept Study Report's proposed cost.

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

#### 7.4.4 Downselection of Investigations

The SMD Associate Administrator will make downselection 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, including cost risk, of the proposed investigation; and
- Merit of plans for E/PO, including any student collaboration proposed.

The evaluation criteria and downselection factors are described in the *Guidelines and Criteria for the Phase A Concept Study* document in the Program Library. Any changes to science and science implementation contained in the Phase A Concept Study Report will be carefully evaluated. Assuming no changes to the first two criteria, the emphasis during downselection will be on the latter two.

At the conclusion of Phase A, it is anticipated that the Selecting Official will continue a single investigation 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.

An investigation may be downselected to enter Phase B or may be downselected for a funded Extended Phase A so they can retire one or more risks before they are allowed to proceed to Phase B. For investigations selected to enter Phase B immediately, the downselect serves as the Initial Confirmation Review gate (KDP-B); an investigation downselected for an Extended Phase A must subsequently pass an Initial Confirmation Review gate (KDP-B) with the SMD Program Management Council (PMC) before entering Phase B. There is no guarantee that an investigation downselected for an Extended Phase A will be approved to enter Phase B, even if all risks have been retired during the Extended Phase A.

Upon a continuation decision, 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.

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. 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. proposal or a U.S. proposal with non-U.S. participation be selected, NASA's Office of External 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, which includes the clause, “Advanced Agreement to Add Additional Phases,” is available in the Program Library.

#### *7.4.5 Confirmation of Investigations*

Per NM 7120-81, 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% of the proposed PI-Managed Mission Cost. The results of the independent review and the project status will be presented to the SMD Program Management Council (PMC) at the Confirmation Review (KDP-C) for Confirmation to enter Phase C. If the project is classified Category 1 according to NM 7120-81, the Confirmation results will need subsequent approval from the Agency PMC. Following Confirmation, no rephasing between fiscal years of Phase E costs 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 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 Headquarters 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 5101.32, *Procurement*, will take action to resolve concerns, disagreements, and recommendations submitted by interested parties that cannot be resolved at the Center level, or those having Agencywide implications, refer Center-specific issues to the appropriate Center Procurement Ombudsman for action, and periodically communicate with Center Procurement Ombudsmen on common Agencywide issues and refer those issues to the appropriate office for action. Under NPD 5101.32, the designated Agency Procurement Ombudsman is:

Director of the Contract Management Division  
Office of Procurement  
NASA Headquarters  
Washington, DC 20546  
USA

#### *7.6.2 Protests*

Only prospective offerors 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:

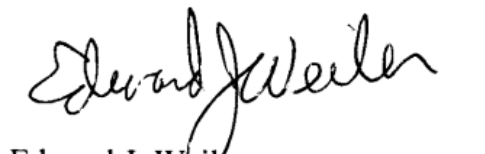
Assistant Administrator for Procurement  
Office of Procurement  
NASA Headquarters  
Washington, DC 20546  
USA

### **8. Conclusion**

The Discovery Program represents a challenging way for NASA 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 Discovery investigations in response to this Announcement.



James L. Green  
Director  
Planetary Science Division



Edward J. Weiler  
Associate Administrator  
for Science Mission Directorate

## APPENDIX A

### GENERAL INSTRUCTIONS AND PROVISIONS

*NASA FAR Supplement, Part 1872.705-1*

#### I. INSTRUMENTATION AND/OR GROUND EQUIPMENT

By submitting a proposal, the investigator and institution agree that NASA has the option to accept all or part of the offeror's plan to provide the instrumentation or ground support equipment required for the investigation, or NASA may furnish or obtain such instrumentation or equipment from any other source as determined by the selecting official. In addition, NASA reserves the right to require use of Government instrumentation or property that subsequently becomes available, with or without modification, that meets the investigative objectives.

#### II. TENTATIVE SELECTIONS, PHASED DEVELOPMENT, PARTIAL SELECTIONS, AND PARTICIPATION WITH OTHERS

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.

#### III. SELECTION WITHOUT DISCUSSION

The Government intends to evaluate proposals and award contracts without discussions with offerors. Therefore, each initial offer should contain the offeror's best terms from a cost or price and technical standpoint. However, the Government reserves the right to conduct discussions, if later determined by the Contracting Officer to be necessary.

#### IV. NONDOMESTIC PROPOSALS

The guidelines for proposals originating outside of the United States are the same as those for proposals originating within the United States, except that the additional conditions described in AO Section 5.7 shall also apply.

#### V. TREATMENT OF PROPOSAL DATA

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.

#### VI. STATUS OF COST PROPOSALS

Submission of cost or pricing data, as defined in FAR 15.401, is required if the combined Phase A and Bridge Phase costs exceed \$650,000. Cost or pricing data will also be required for proposals for subsequent mission phases. The investigator's institution agrees that the cost proposal submitted in response to the Announcement is for proposal evaluation and selection purposes, and that, following selection and during negotiations leading to a definitive contract, the institution may be required to resubmit or execute all certifications and representations required by law and regulation.

#### VII. LATE PROPOSALS

The Government reserves the right to consider proposals or modifications thereof received after the date indicated for such purpose, if the selecting official deems it to offer NASA a significant technical advantage or cost reduction. (See NFS 18-15.208.)

#### VIII. SOURCE OF SPACE INVESTIGATIONS

Investigators are advised that candidate investigations for space missions can come from many sources. These sources include those selected through this AO, those generated by NASA in-house research and development, and those derived from contracts and other agreements between NASA and external entities.



## IX. DISCLOSURE OF PROPOSALS OUTSIDE THE GOVERNMENT

NASA may find it necessary to obtain proposal evaluation assistance outside the Government. Where NASA determines it is necessary to disclose a proposal outside the Government for evaluation purposes, arrangements will be made with the evaluator for appropriate handling of the proposal information. Therefore, by submitting a proposal, the investigator and institution agree that NASA may have the proposal evaluated outside the Government. If the investigator or institution desires to preclude NASA from using an outside evaluation, the investigator or institution should so indicate on the cover. However, notice is given that if NASA is precluded from using outside evaluation, it may be unable to consider the proposal.

## X. EQUAL OPPORTUNITY

For any NASA contract resulting from this solicitation, the clause at FAR 52.222-26, "Equal Opportunity," shall apply.

## XI. PATENT RIGHTS

- a. For any NASA contract resulting from this solicitation awarded to other than a small business firm or nonprofit organization, the clause at NFS 18-52.227-70, New Technology, shall apply. Such contractors may, in advance of a contract, request waiver of rights as set forth in the provision at NFS 18-52.227-71, Requests for Waiver of Rights to Inventions.
- b. For any NASA contract resulting from this solicitation awarded to a small business firm or nonprofit organization, the clause at FAR 52.227-11, Patent Rights -- Retention by the Contractor (Short Form), (as modified by NFS 18-52.227-11) shall apply.

## XII. RIGHTS IN DATA

Any contract resulting from this solicitation will contain the Rights in Data – General clause: FAR 52.227-14.

## XIII. SMALL AND SMALL DISADVANTAGED BUSINESS SUBCONTRACTING

- a. Offerors are advised that NASA is subject to statutory goals to allocate a fair portion of its contract dollars to SDB concerns, HBCUs, and OMIs, as these entities are defined in 52.219-8 and 52.226-2 of the FAR. Offerors 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.
- b. Offerors are advised that, by law, NASA prime contracts resulting from this solicitation which offer subcontracting possibilities, exceed \$500,000, and are with organizations other than small business concerns, the clause at FAR 52.219-9 shall apply. Accordingly, offerors awarded contracts for Phase A concept studies that exceed \$500,000 are 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. Failure to do so will make the offeror ineligible for award. These plans should be submitted for negotiation after selection in conjunction with contract execution.

- c. As part of the down selection of investigations, offerors, other than small business concerns, are required to submit small business subcontracting plans, covering implementation and operation Phases B/C/D/E/F, at the time the Phase A concept study reports are delivered. Failure to submit a subcontracting plan will make the offeror ineligible for award. As part of the down select decision, 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, except for SDBs. Offerors shall separately identify and will be evaluated on participation targets of SDBs in North American Industry Classification System (NAICS) codes determined by the Department of Commerce to be underrepresented industry sectors.

#### XIV. WITHDRAWAL OF PROPOSALS

Proposals may be withdrawn by the proposer at any time before award. Proposers are requested to notify NASA if the proposal is funded by another organization or of other changed circumstances that dictate termination of evaluation.

## APPENDIX B

### REQUIREMENTS FOR PROPOSAL PREPARATION

#### INTRODUCTION

The following requirements apply to preparation of proposals in response to this Announcement of Opportunity (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 contains the specific requirements for the format and content of Step 1 proposals. 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 96.*

Requirement B-1. A proposal shall consist of one volume divided into readily identifiable sections that correspond and conform to Sections A through J of this appendix. It shall be typewritten 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. All parts of a proposal, including photographs and/or colored graphics, shall be printed on recyclable white paper. 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). Cardboard stock and loose-leaf binders are prohibited; plastic covers and spiral bindings are acceptable.

Requirement B-3. Text shall not exceed 55 lines per page. Margins at the top, both sides, and bottom of each page shall be no less than 1 inch if printed on 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 printed on 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	Graphic Cover Page Proposal Summary Information Export controlled material statement (Section 5.8.2) Optional Restriction on Use statement (see Appendix A, Section V)	1 None 0.5 0.5
B	Fact Sheet	2
C	Table of Contents	None
D	Science Investigation	25 + 2 pages / instrument
E	Science Implementation, including optional SEO	+ 2 pages for SEO **
F	Mission Implementation	25 + 2 pages/flight element **
G	Schedule Foldout(s) Management	(Schedule foldout(s) do(es) not count against page limit)
H	Cost and Cost Estimating Methodology Cost Table B3	8 (Table B3 does not count against page limit)
I	Small Business Subcontracting Plan Acknowledgement of E/PO requirements Optional Student Collaboration plan	2 + 2 for optional student collaboration
J	Appendices (no others permitted):	
J.1	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.6A	Planetary Protection Plan	None
J.6B	Sample and Space-Exposed Hardware Curation Plan	None
J.7	Discussion of End-of-Mission Spacecraft Disposal Requirements	None
J.8	Compliance with Procurement Regulations by NASA PI Proposals	None
J.9	Master Equipment List (MEL)	None
J.10	Heritage	None
J.11	List of Abbreviations and Acronyms	None
J.12	List of References (optional)	None
J.13	NASA-Developed Technology Infusion Plan	5
J.14	Description of Enabling Nature of ASRG (if ASRG use is proposed)	3

\*\* Total extra pages limited to 10 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. Two extra pages each may be allotted for each separate science instrument in the Science Section (Sections D and E), two extra pages each may be allotted for each separate flight element (*e.g.*, cruise element, landed element, sample return element, additional spacecraft) in the Mission Implementation and Management Sections (Sections F and G), and two extra pages are allotted for all science enhancement options (SEOs) combined, if they are permitted by the AO, in the Science Implementation Section (Section E). The total number of such extra pages in the Science and Mission Implementation sections combined shall not exceed a maximum of ten extra pages regardless of the number of science instruments and flight elements. Every side of a page upon which printing appears will count against the page limits and, unless specifically exempted (*e.g.*, Requirement B-40 and Requirement B-49), 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. One copy of every proposal shall bear on its cover sheet the original signatures of the Principal Investigator and an official of the PI's institution who is authorized to commit its resources (see Section A of this appendix). This "original" copy shall be printed on a single side of each page, and it shall be bound in a manner (*e.g.*, with a binder clip, with a rubber band, in an accordion folder, *etc.*) that allows it to be disassembled easily for reproduction in the event that NASA needs additional copies. The number of printed "review" copies specified in Section 6.2.3 of this AO shall be submitted with the original copy; two-sided printing is required for the review copies.

Requirement B-6. A CD-ROM containing up to three searchable PDF files of the proposal, limited to the main proposal, all tables, and all applicable appendices (see Section J of this appendix), as well as EXCEL files of tables (see Requirement B-50 and Requirement B-69) shall be attached to the original and to each review copy.

## A. GRAPHIC COVER PAGE AND PROPOSAL SUMMARY INFORMATION

### A.1 HARDCOPY PROPOSAL

*The following expands requirements in the AO, in particular Requirement 96.*

Requirement B-7. A Graphic Cover Page and Proposal Summary Information, prepared as directed below, shall preface every proposal. The Proposal Summary Information will not be counted against the page limits.

Requirement B-8. 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 signature of the PI and the authorizing official (unless these signatures appear on the Proposal Summary Information), and
- A 0.5 inch (13 mm) high by 2 inch (51 mm) long space in the upper right corner of the page for NASA to place the proposal number and the copy number.

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).

**[Amended July 13, 2010. New text is bold. Deleted text is struck through.]**

Requirement B-9. The Proposal Summary Information shall include the following information and only the following information. This information shall be identical to the information entered into the Electronic Cover Page in NSPIRES (see Requirement B-10). Including a printed copy of the completed NSPIRES Electronic Cover Page in the proposal will satisfy this requirement. These pages will not be counted against the page limits.

- The signature of the PI and the authorizing official (unless these signatures appear on the Graphic Cover Page);
- Section I:
  - The Principal Investigator's (PI's) full name, E-mail address, phone number, and mailing address;
  - The proposal's full title, proposed start date, and proposed end date (if the proposed end date is later than December 31, 2020, please enter an end date that is one day after your start date to indicate that the true end date is within the body of your proposal.);
- Section II:
  - The date submitted;
- Section III:
  - The legal name of the proposing organization;
  - The common name ("doing business as" name) of the proposing organization;
  - The Division/Department/Center of the proposing organization;
  - The mailing address of the proposing organization;
- Section IV:
  - The proposal point-of-contact's (POC's) name, E-mail address, and telephone number (proposal POC may be the PI);
- Section V:
  - The following text, verbatim:

Certification of Compliance with Applicable Executive Orders and U.S. Code

By submitting the proposal identified in the Cover Sheet/Proposal Summary Information in response to this Research Announcement, the Authorizing Official of the proposing organization (or the individual proposer if there is no proposing organization) as identified below:

- certifies that the statements made in this proposal are true and complete to the best of his/her knowledge;
- agrees to accept the obligations to comply with NASA award terms and conditions if an award is made as a result of this proposal; and

• confirms compliance with all provisions, rules, and stipulations set forth in the two Certifications and one Assurance contained in this NRA (namely, (i) the Assurance of Compliance with the NASA Regulations Pursuant to Nondiscrimination in Federally Assisted Programs, and (ii) Certifications, Disclosures, and Assurances Regarding Lobbying and Debarment and Suspension).

Willful provision of false information in this proposal and/or its supporting documents, or in reports required under an ensuing award, is a criminal offense (U.S. Code, Title 18, Section 1001).

- The name, E-mail address, and phone number of the authorized official who signed the proposal's cover page;
- Section VI:
  - For every proposal team member, their name; E-mail address; phone number; organization name; indication if participation is from an international organization or a U.S. Government agency; if yes to the latter, a statement of total funds requested by that U.S. agency; and team member role (exactly one role per team member) chosen from the following list (note that these are the only roles permitted by NSPIRES; other named key personnel, such as project scientist or project systems engineer, should use the most appropriate role from this list):

---

List of Team Member Roles

Principal Investigator  
Co-investigator  
Co-I/Institutional PI  
Collaborator  
Project Manager  
Industry Partner  
International Partner  
Other Professional  
Postdoctoral Associate  
Graduate/Undergraduate Student

---

- Section VII:
  - Proposal summary (not to exceed 300 words); NASA intends to enter the summaries of all investigation proposals selected for its various programs into a publicly accessible database; proposal summaries shall not contain proprietary or confidential information that the submitters wish to protect from public disclosure;
- Section VIII:
  - Answers to the following questions:
    - Is proprietary/privileged information included in this application? – Answer Yes or No;
    - Does this project involve activities outside the U.S. or partnership with non-U.S. collaborators? – Answer Yes or No for the following types of foreign participation and include an explanation if “Yes” : Principal Investigator, Co-Investigator, Collaborator, Equipment, Facilities;
    - Are NASA civil servant personnel participating as team members on this project (include funded and unfunded)? – Answer Yes or No;

- Does this project have an actual or potential impact on the environment? – Answer Yes or No and include an explanation if “Yes”;
- Has an exemption been authorized on an environmental assessment (EA) or an environmental impact statement (EIS) been performed? Answer Yes or No and include an explanation if “Yes”;
- Does this project have the potential to affect historic, archeological, or traditional cultural sites (such as Native American burial or ceremonial grounds) or historic objects (such as an historic aircraft or spacecraft)? – Answer Yes or No and include an explanation if “Yes”;
- Section IX:
  - Short title of proposal (the mission’s acronym or short nickname);
  - Type of institution;
  - List all science team members, key institutional representatives, and other science participants in this investigation, both requesting funding and not requesting funding, who do not appear in Section VI or on the proposal's electronic cover page as a proposal team member. 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). (*N.b.*, this is requested to aid NASA in avoiding conflicts of interest for proposal reviewers.)
  - Identification of target of investigation;
  - Which launch vehicle performance class is proposed? — Answer “Standard with 4m fairing”, “Standard with 5m fairing”, “Medium with 4m fairing”, “Medium with 5m fairing”, “High with 4m fairing”, or “High with 5m fairing”;
  - Is the use of NEXT proposed? — Answer Yes or No;
  - Is the use of AMBR proposed? — Answer Yes or No;
  - Is the use of aerocapture proposed? — Answer “Yes (lander)”, “Yes (orbiter)” or “No”;
  - Is the use of ASRG proposed? — Answer “Yes (1 ASRG)”, “Yes (2 ASRGs)” or “No”;
  - **If the use of ASRG is proposed:**
    - **Could the mission involve more than two Earth swingbys? — Answer Yes, No, Possibly. [*If the mission could not have at least one Earth swingby, please skip the next 3 questions.*]**
    - **Could any of the mission’s Earth swingbys be at an altitude lower than 300km? — Answer Yes, No, Possibly**
    - **Could the highest velocity (relative to Earth) of any Earth swingby maneuver exceed ~16 km/sec? — Answer Yes, No, Possibly**
    - **Could the mission’s last planned trajectory change maneuver (TCM) prior to any Earth swingby occur less than 5 days prior to the swingby? — Answer Yes, No, Possibly**
    - **Could the nominal mission involve planned residence times in low Earth orbit exceeding two hours? — Answer Yes, No, Possibly.**
    - **Would the primary planned application for the RPS and, if applicable, any RHUs involve anything other than Spacecraft power and/or heating? — Answer Yes, No, Possibly.**
    - **Could the mission have payload liquid propellants (fuel plus oxidizer) in excess of 3,000 kg? — Answer Yes, No, Possibly**
    - **Could the mission have payload solid propellants in excess of 2,000 kg? — Answer Yes, No, Possibly.**



- **Could the mission have a payload pressurant tank exceeding a stored energy (nominal operating pressure x internal volume) of  $1.2 \times 10^5$  Nm?** — Answer Yes, No, Possibly
- **Could the mission involve returning the ASRG to the Earth-Moon system?** — Answer Yes, No, Possibly.
- Is use of radioisotope heater units, or radioactive material sources for science instruments proposed? – Answer Yes or No and include an explanation if “Yes”.
- **If the use of radioisotope heater units, or radioactive material sources for science instruments, is proposed, could the mission involve returning them to the Earth-Moon system?** — Answer Yes, No, Possibly.
- Is a student collaboration (SC) proposed? — Answer Yes or No;
- Is a science enhancement option (SEO) proposed? — Answer Yes or No;
- Statement of contributions to development or operations (but not science) by any non-U.S. partner. Identify the non-U.S. partner(s), the non-U.S. funding agency/agencies, and the approximate value of the non-U.S. contributions, if any;
- PI-Managed Mission Cost in real year dollars (RY\$) and in FY 2010 dollars from Table B3;
- Total Mission Cost in real year dollars (RY\$) and in FY 2010 dollars from Table B3;
- Provide NASA Personnel FTE Information; enter FTE totals by budget year in the following format: Year 1, FTE Total for Year 1, Year 2, FTE Total for Year 2, Year 3, FTE Total for Year 3, etc. (Example: FY07, 3.2, FY08 2.40, FY09, 1.3)
- Answers to the following questions:
  - i. This proposal contains information and/or data that are subject to U.S. export control laws and regulations, including Export Administration Regulations (EAR) and International Traffic in Arms Regulations (ITAR). – Answer Yes or No;
  - ii. The export-controlled material (EAR and/or ITAR) has been identified in this proposal. – Answer Yes or No or N/A;
  - iii. The proposer acknowledges that the inclusion of such material in this proposal may complicate the Government's ability to evaluate the proposal. – Answer Yes or No or N/A;

## A.2 ELECTRONIC COVER PAGE (NSPIRES Submission)

*The following expands requirements in the AO, in particular Requirement 99 and Requirement 100*

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

**Requirement B-10.** This AO requires that proposal summary information, referred to as the Electronic Cover Page, shall be submitted electronically. The forms for the Electronic Cover Page are found in NSPIRES at <http://nspires.nasaprs.com/>. The Electronic Cover Page shall be completed and submitted online. The electronic submission of the Electronic Cover Page alone does not satisfy the deadline for proposal submission. Electronic submission of the Electronic Cover Page in NSPIRES need not be completed until after the proposal is finalized, but must be completed before the proposal submittal deadline specified in Section 3 of this AO.

Requirement B-11. The same proposal summary information shall be submitted on the Electronic Cover Page as is in Section A of the proposal. In particular, the list of proposal team members and the proposed costs must be identical.

Note that proposers have several options for meeting Requirement B-10 and Requirement B-11: (i) proposers may first finalize, copy, and submit the hardcopy proposal, including the Proposal Summary Information, and then complete and submit the Electronic Cover Page in NSPIRES; (ii) proposers may first complete and submit the Electronic Cover Page in NSPIRES and then print it out for inclusion in the hardcopy proposal; or (iii) any other order for completing and submitting both the Proposal Summary Information in the hardcopy proposal and the Electronic Cover Page via NSPIRES. Both Requirement B-10 and Requirement B-11 require that the Proposal Summary Information and the Electronic Cover Page contain identical data and that both are received by NASA prior to the proposal deadline no matter what order they are completed and submitted.

### A.3 PROPOSAL TEAM MEMBER COMMITMENT THROUGH NSPIRES

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

Every proposal team member (*i.e.*, every individual identified on the NSPIRES proposal cover page) 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 98.

A proposal team member will receive an E-mail from NSPIRES indicating that he/she has been added to the proposal by the PI. The proposal team member should log in to NSPIRES. Once logged in, the proposal team member should follow the link in the “Reminders and Notifications” section of his/her NSPIRES home page, titled “Need <role> confirmation for proposal <title> for Solicitation <<solicitation number>>.” On the “Team Member Participation Confirmation” page, the proposal team member should read language about the Organizational Relationship, then click the “Continue” button.

If the contact information then displayed on the “Team Member Profile” screen is out of date, the proposal team member should update this information **later** using the “Account Mgmt” link in the NSPIRES navigation bar across the top. Prior to making that update, however, the team member should follow the on-screen prompts to identify the organization through which he/she is participating on this proposal. Click the “Link Relationship” button to the right side of the “Organizational Relationship” banner. Select the organization from the “Link Proposal to an Association” part of the page. If the correct organization is not displayed here, try using the “Add Association” button to add the organization to this list. Then click the “Save” button at the bottom of the page. If the team member cannot find the organization when searching in the “Add Association” area (*i.e.*, the organization is not registered), type in the formal name in the space provided (or select “Self” if appropriate). Once the organization is selected and the “Save”

button is clicked, there is a confirmation page that allows the team member to edit that relationship if it was chosen incorrectly. Click “Continue”.

Note that 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. If the address information is accurate (or once it has been edited to be accurate), the proposal team member may log out of NSPIRES.

NSPIRES will send an email to both the team member and the PI confirming that the commitment was made and the organization was identified. The PI may additionally monitor the status of proposal team member commitments by examining the “Relationship Confirmed” column on the Team Member page of the NSPIRES proposal cover page record. Note that the proposal cover page cannot be submitted until all identified team members have confirmed their participating organization.

Requirement B-12. 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.

## B. FACT SHEET

*The following expands requirements in the AO, in particular Requirement 96.*

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;
- The proposed PI-Managed Mission Cost in real year dollars (RY\$) and in FY 2010 dollars from Table B3; and
- The proposed Total Cost, including a breakdown of any contributed costs by contributing organization, in real year dollars (RY\$) and in FY 2010 dollars from Table B3.

## C. TABLE OF CONTENTS

*The following expands requirements in the AO, in particular Requirement 96.*

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 4 through Requirement 21.*

### 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.

### 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 that must 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, sample returns, witness samples, 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 objectives to measurement requirements to instrument performance requirements, 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.

### 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 NM 7120-81. 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 5 through Requirement 21 and Requirement 48 through Requirement 51.*

### 1. Instrumentation.

Requirement B-19. This section shall describe the instrumentation and the rationale for its selection. It shall identify the individual instruments and instrument systems, 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 systems to technology readiness level (TRL) 6 at 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 systems 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 effects, such as radiation 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; and
- Instrument thermal control capability.

## 2. Data Sufficiency.

Requirement B-21. This section shall discuss the quality and quantity of data to be generated by each instrument and a detailed data collection strategy in support of the proposed science investigation goals and objectives. The flow-down from science investigation goals to measurement objectives and instrument performance shall be stated clearly and supported by quantitative analysis. Potential data processing complexities shall be acknowledged and described, including discussion of addressing such issues during mission operations and/or afterwards.

## 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 should be apparent from this discussion.

## 4. Data Plan.

Requirement B-23. A schedule-based end-to-end data management plan, including approaches for data retrieval, validation, preliminary analysis, and archiving, shall be described. The science products (*e.g.*, flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, sample returns, witness samples, laboratory data, etc.) shall be identified, including a list of the specific data products and the individual team members responsible for the data products as well as sufficient demonstration that software and/or hardware technologies required to work with the data sets (and create the proposed science products) are either available or will be developed as part of the mission. The 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 and a schedule for the submission to the data archive of raw and reduced data in physical units accessible to the science community.

## 5. Science Team.

Requirement B-24. This section shall identify each key member (*i.e.*, one whose participation is essential to the success of the investigation) 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 each co-investigator (Co-I) shall be explicitly defined, the necessity of that role shall be justified, and the funding source (NASA or contributed) for the PI and each Co-I shall be noted. Non-funded members of the science team shall be identified in the proposal as collaborators (see Section 5.4 of this AO). The role of collaborators may be defined and justified.

## 6. Plan for Science Enhancement Options (SEO).

Requirement B-25. If an SEO is proposed, this section shall define and describe the proposed activities (see Section 5.1.6 of this AO).

## F. MISSION IMPLEMENTATION

*The following expands requirements in the AO, in particular AO Requirement 21 through Requirement 27.*

### 1. General Requirements and Mission Traceability.

Requirement B-26. 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-27. 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-28. NASA recognizes that the full depth of information requested in Requirement B-29 through Requirement B-40 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 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 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-28 will apply to all cases where the required information cannot, for whatever reason, be provided.

## 2. Mission Concept Descriptions.

Requirement B-29. 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 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-30. 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 (including 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), 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).

**[Amended August 16, 2010. New text is in bold.]**

**Requirement B-30A. Additionally, the following information shall be provided. Recognizing the late date of this additional requirement, this additional data may be provided in a file or files on the CD containing the electronic version of the proposal. There is no requirement that this data also be included in the hardcopy proposal.**

- **Checkout Duration:** The minimum duration allocated after launch before the primary propulsion system will be commanded to provide required  $\Delta V$ .
- **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 time of the proposed launch window.



- **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 should 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.

Requirement B-31. Launch Vehicle Compatibility: Compatibility with the proposed launch vehicle shall be demonstrated by providing in the appropriate proposal section the launch site, launch loads and margin, fairing size, packaged payload dimensions, spacecraft mass, and mission orbit characteristics such as altitude (km – circular or apogee/perigee), inclination, C3. Describe any known nonstandard requirements such as additional fairing doors, cleanliness and purge requirements, planetary protection, etc.

Requirement B-32. 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 in-flight, 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
- Deep Space, including Heliocentric Orbit, Missions (non-ASRG):
- (i) identify type of array structure (rigid, flexible, body mounted); (ii) solar array axes of rotation (vector projected in spacecraft coordinates); (iii) array size; (iv) solar cell type and efficiency; (v) expected power generation at Beginning of Life and End of Life; (vi) worst case Sun incidence angle to solar panels during science mission; (vii) battery type and storage capacity; (viii) worst case battery Depth of Discharge (DOD); and (ix) spacecraft bus voltage.
- Deep Space, including Heliocentric Orbit, Missions (ASRG):
- (i) number of ASRGs; (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.
- Earth and Lunar Orbiter Missions, and Earth-Sun L1/L2:
- (i) expected power requirement for each mission phase; (ii) minimum power capability needed to meet all requirements; and (iii) associated battery Depth of Discharge (DOD).
- (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 postprocessing 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, (ii) temperature control approach (*i.e.* passive *vs.* active), and (iii) special thermal design considerations (*e.g.*, cryogenic instrument requirements, ASRG use).

**Requirement B-33. 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-34. 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 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:

- Mass;
- Propellants;
- Power;
- Data Storage; and
- Attitude Control System.

For any other driving mission element requirements derived from the Mission Requirements, provide estimates of implementation performance and design margins with respect to the required performance.

Definitions:
<p><u>Contingency</u>, 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.</p> <p><u>Margin</u> 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.</p> <p><u>Example:</u> 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 <math>15/100 = 15\%</math> and the mass margin is 85 kg or <math>85/115 = 74\%</math>.</p> <p><u>Example:</u> The end-of-life (EOL) capability of a spacecraft power system is 200 Watts, of which 75 Watts has be allocated to the instrument and 100 Watts has been allocated to the spacecraft bus. The power margin is the unallocated 25 Watts or <math>25/175 = 14.3\%</math>. The current best estimate for the instrument power is 60 Watts, leaving 15 Watts or <math>15/60 = 25\%</math> contingency to the 75 Watt maximum expected value.</p>

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-35. 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 data volume, (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, operations center development.

### 3. Development Approach.

Requirement B-36. This section shall describe the development approach. This description shall include, at a minimum, the following items:

- Systems engineering approach (*e.g.*, plans, tools, processes for requirements, interfaces, and configuration management);
- Mission assurance approach, including (i) fault tolerance and fault management, (ii) product assurance, and (iii) reliability (*e.g.*, use or non-use of redundancy, requirements for burn-in of parts, requirements for total operating time without failure prior to flight, *etc.*);
- Identification of instrument to spacecraft interfaces;

- Design maturity and heritage of mission elements (instruments, spacecraft, ground systems, and mission design, etc.) by reference to Appendix 10, Heritage, of the proposal (see Section J of this appendix);
- Essential trade studies that are to be conducted;
- Approach to management and closure of action items, hardware discrepancies, test anomalies, etc.; and
- Approach for handling special processes (*e.g.*, if radioactive sources are proposed, the approach to supporting the development, submittal, and approval of the necessary NEPA process and the Nuclear Safety Launch Approval process).

#### 4. New Technologies/Advanced Developments.

This section does not apply for the use of NEXT, AMBR, aerocapture, or ASRG.

Requirement B-37. This section shall describe any proposed new technologies and/or advanced developments and the approaches that will be taken to reduce their associated risks. If no advanced development is required, the justification for TRL 6 or above shall be clearly demonstrated. These descriptions shall address, at a minimum, the following topics:

- Identification and justification of the TRL for each proposed new development and/or advanced development at the time the proposal is submitted (for *TRL definitions*, see NPR 7120.8, *NASA Research and Technology Program and Project Management Requirements*, Appendix J, in the Program Library);
- Rationale for combining the TRL values of subsystems to derive the full system TRL as proposed;
- Rationale for the stated TRL value of a system that is an adaptation of an existing system of known TRL;
- The proposed approach for maturing each of the identified items to a minimum of TRL 6, defined as “system/subsystem model or prototype demonstration in a relevant environment, space, or ground” by the end of Phase B (include discussion of simulations, prototyping, systems testing, life testing, etc., as appropriate);
- An estimate of the resources (manpower, cost, and schedule) required to complete the technology 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.

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

Requirement B-38. 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-39. 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 must be developed and how they will be validated, critical path items, etc.) shall be highlighted. 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.

## 6. Schedule.

Requirement B-40. A project schedule foldout(s) covering all phases of the investigation shall be provided. This foldout(s) 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 NM 7120-81. The schedule chart and accompanying narrative, which is 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 NEPA and Nuclear Safety Launch 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.

Multiple foldouts are permitted and will not count against the page count for this section.

## G. MANAGEMENT

*The following expands requirements in the AO, in particular Requirement 26, Requirement 39 through Requirement 46, Requirement 62, and Requirement 76.*

Requirement B-41. This section shall describe the investigator's proposed management approach. The management organization (including an organization chart) and decision-making process shall be described, and the teaming arrangement and team communications 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 in the program shall be provided.

Requirement B-42. This section shall describe the specific roles and responsibilities of the PI, PM, and other named key management team members. It shall describe the qualifications and experience, especially any 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. It shall also describe the qualifications and experience of the primary implementing institutions and demonstrate that they are commensurate with the technical and managerial needs of the proposed investigation.

Requirement B-43. This section shall describe the top 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. If cost risks are in this list, they should be described here and then discussed in Section H (see Requirement B-48). The management strategies for control, allocation, and release of technical margins, cost reserves, and schedule reserves shall be described. The approach to any potential descopes, including savings of resources (mass, power, dollars, schedule, etc.) by implementing descopes, and the decision milestone(s) for implementing descopes shall be discussed. Specifically, this description shall identify 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 them. When contracts are required, the acquisition strategy, including any incentive strategy, shall be described.

Requirement B-44. 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-45. 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, and (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 the proposed cost is not allowed to increase beyond the cost cap during Phase A or at any later time. 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 58 through Requirement 61 and Requirement 63 through Requirement 72.*

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-46. 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, flight systems, ground systems, ground

network fees, contributions, core E/PO program, 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-47. This section shall include a description of the methodologies used to develop the estimate. The cost estimating methodology discussion in this section shall provide an overview of the cost estimate development process. Any 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.

Requirement B-48. This section shall include a discussion of cost risks.

Requirement B-49. This section shall provide a foldout cost table, Table B3, which will not be counted against the page limit. Table B3 shall identify the proposed cost required in each mission phase and in each fiscal year; the costs shall be in real year dollars (RY\$). The top portion of Table B3 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 B3 shall be the NASA standard WBS elements as defined in NM 7120-81. The costs for most elements shall be provided to WBS level 2, as shown in Table B3. Exceptions are the costs of individual instruments, any unique flight system elements such as landers or sample return capsules, DSN, and non-standard elements such as sample facilities, which shall be explicitly shown. The columns in Table B3 shall be grouped and subtotaled by mission phase and shall be labeled with the appropriate fiscal years. Fiscal years that span more than one mission phase shall be split into two columns by mission phase. The final two columns are totals in real year dollars (RY\$) and totals in fiscal year 2010 dollars (FY10\$). Proposers shall use their own forward pricing rates to translate between real year dollars (RY\$) and fiscal year 2010 dollars (FY10\$). For organizations that are without approved forward pricing rates, proposers may use the NASA inflation/deflation indices in Table B4 to translate between real year dollars (RY\$) and fiscal year 2010 dollars (FY10\$).

Requirement B-50. Table B3 shall be provided additionally in EXCEL format on each CD submitted with the proposal.

Requirement B-51. 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 an explanation for how the forward pricing rates were derived to translate between real year dollars (RY\$) and fiscal year 2010 dollars (FY10\$) in Table B3.



## I. SMALL BUSINESS SUBCONTRACTING PLAN, ACKNOWLEDGEMENT OF EDUCATION AND PUBLIC OUTREACH, AND OPTIONAL STUDENT COLLABORATION

*The following expands requirements in the AO, in particular Requirement 52 through Requirement 57.*

### 1. Small Business Subcontracting Plan

Requirement B-52. This section shall include one of the following, as applicable: (i) demonstration that the offeror is a small business concern, (ii) demonstration that subcontracting opportunities are not reasonably available in the performance of the Phase A concept study, or (iii) small business subcontracting plans meeting the requirements in Section 5.5.1, Appendix A, and referenced parts of the FAR.

### 2. Education and Public Outreach

Requirement B-53. This section shall include the required statement of commitment from the PI (see Section 5.5.2 of this AO).

### 3. Student Collaboration

Requirement B-54. 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. APPENDICES

Requirement B-55. 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. No other appendices are permitted.

### 1. Table of Proposal Participants

*The following expands requirements in the AO, in particular Requirement 82.*

Requirement B-56. 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 (real year dollars 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, non-hardware partners, and (iii) minor partners, vendors, and

suppliers, as known at the time of the proposal. Major partners are defined to be organizations responsible for providing project management, system engineering, major hardware elements, science instruments, integration and test, mission operations, and other major elements of the proposed investigation, as defined by the proposer.

## 2. Letters of Commitment.

*The following expands requirements in the AO, in particular Requirement 33, Requirement 75, Requirement 81, and Requirement 82.*

Requirement B-57. 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. but excluding Co-I services) on a no-exchange-of-funds basis, including all non-U.S. organizations providing hardware or software to the investigation, 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.

## 3. Resumes.

*The following expands requirements in the AO, in particular Requirement 39, Requirement 40, Requirement 48, and Requirement 49.*

Requirement B-58. This section shall include resumes or curriculum vitae for the PI, PM, all Co-Is identified in the science section, and for any key project personnel who are named in the proposal. 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 PI, PM, and Project SE (if named). 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, by surname after that of the PI.

## 4. Summary of Proposed Program Cooperative Contributions.

*The following expands requirements in the AO, in particular Requirement 71 through Requirement 73 and Requirement 78.*

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 shall include (a) an "exploded diagram" of the investigation and (b) a supporting table.

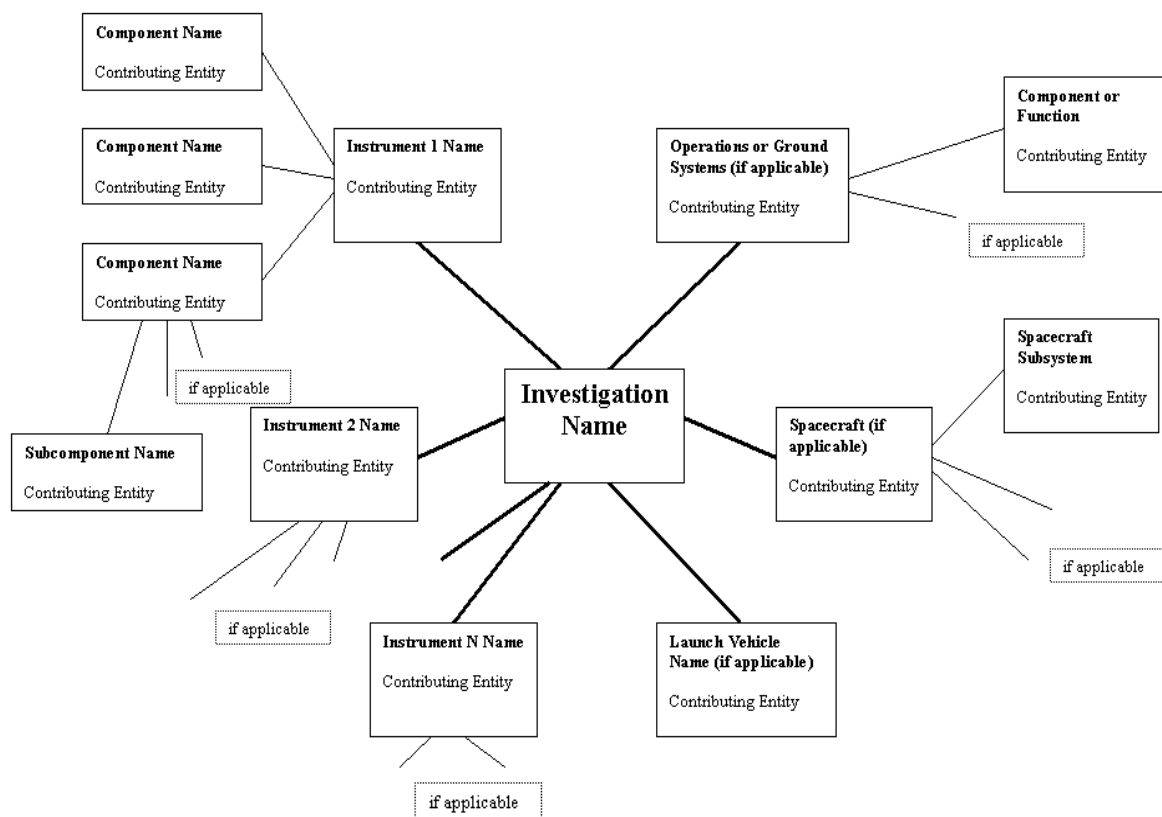
### a. An "exploded diagram" of the investigation.

Requirement B-59. 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 should not be shown:

- i. If there are no cooperative contributions of spacecraft, launch vehicle or services, or ground operations or facilities, these boxes should 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, should not be shown.
- iii. U.S. or non-U.S. goods and services obtained by contract using NASA funds are not cooperative contributions and are also not to be shown.

SAMPLE EXPLODED DIAGRAM



b. A supporting table of collaborative contributions

Requirement B-60. 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.

#### 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 80.*

Requirement B-61. 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 120-130, *et seq.* and 15 CFR 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.pmdtc.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 120-130, *et seq.*

Requirement B-62. Foreign nationals requiring access to NASA facilities and information systems will be required to comply with Homeland Security Presidential Directive HSPD-12 (see <http://hspd12.nasa.gov/>), 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.

#### 6. Planetary Protection and/or Sample Curation Plan.

##### 6a. Planetary Protection Plan

*The following expands requirements in the AO, in particular Requirement 11 and Requirement 12.*

Requirement B-63. If applicable, this section shall describe the plan for compliance with the planetary protection requirements described in Section 5.1.5.1 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(s) responsible for implementing those steps.

#### 6b. Sample and Space-Exposed Hardware Curation Plan

*The following expands requirements in the AO, in particular Requirement 13, Requirement 14, Requirement 16, and Requirement 17.*

Requirement B-64. If applicable, this section shall describe the plan for sample and space-exposed hardware curation at the NASA JSC Astromaterials Curatorial Facility in accordance with the requirements in Section 5.1.5.2. At a minimum, this plan shall describe (i) the nature of samples expected to be returned, (ii) the methods used to prevent sample contamination or degradation during collection and return to Earth, (iii) the methods used to prevent sample contamination or degradation during post-return curation, (iv) the general procedures for storage, subsampling, documentation, distribution, and security, (v) the preliminary examination of the samples, (vi) the method(s) chosen for reporting the results of the preliminary examination, and (vii) the preparation (within 6 months of return) of a sample catalog sufficient for other scientists to request samples. The plan shall demonstrate that at least 75% of the returned sample shall be preserved for future studies by members of the science community.

#### 7. Discussion of End of Mission Spacecraft Disposal Requirements.

*The following expands requirements in the AO, in particular Requirement 37.*

This appendix is required only for proposed missions to Low Earth Orbit (LEO) (<2000 km perigee), near Geosynchronous orbit (GEO) ( $\text{GEO} \pm 300 \text{ km}$ ), or the Moon (orbiters and landers).

Requirement B-65. This section shall discuss briefly how the mission meets the orbit disposal requirement applicable to its proposed orbit. For LEO missions, this section shall briefly discuss the lifetime of the mission and whether it meets the 25-year post-mission (or 30-year from launch – whichever comes first) requirement for LEO missions.

This section shall include a mission lifetime analysis demonstrating satisfaction of the above requirement, addressing all assumptions and inputs contributing to the analysis. These assumptions and inputs shall include, 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.

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-66. 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 8715.6, *NASA Procedural Requirements for Limiting Orbital Debris*; and
- NASA-STD-8719.14, *NASA Process for Limiting Orbital Debris*.

8. Compliance with Procurement Regulations by NASA PI Proposals.

*The following expands requirements in the AO, in particular Requirement 47.*

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 1872.308). Additional instructions may be found in Procurement Information Circular (PIC) 05-15, which is available in the Program Library.

Requirement B-67. For NASA Center proposals, this section shall include any descriptions, justifications, representations, indications, statements, and/or explanations that are required by the regulations.

9. Master Equipment List.

*The following expands requirements in the AO, in particular Requirement 67.*

Requirement B-68. 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, design heritage, and cost. A template for this MEL is included as Table B5.

Requirement B-69. The MEL shall be additionally provided in EXCEL format on each CD submitted with the proposal.

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 and prototypes, required deliveries for simulators and testing, contingency allocations for individual

components, and other component description/characteristics. Certain items (like electronic boxes and solar arrays) should include additional details, as applicable, to identify and separate individual elements.

#### 10. Heritage.

*The following expands requirements in the AO, in particular Requirement 63.*

Requirement B-70. 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.

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.

The evaluation team will use a scale with at least three levels (full, partial, or none) as illustrated in the table below.

	<b>Full heritage</b>	<b>Partial heritage</b>	<b>No heritage</b>
<b>Design</b>	Identical	Minimal modifications	Major modifications
<b>Manufacture</b>	Identical	Limited update of parts and processes necessary	Many updates of parts or processes necessary
<b>Software</b>	Identical	Identical functionality with limited update of software modules (<50%)	Major modifications (>=50%)
<b>Provider</b>	Identical provider and development team	Different however with substantial involvement of original team	Different and minimal or no involvement of original team
<b>Use</b>	Identical	Same interfaces and similar use within a novel overall context	Significantly different from original
<b>Operating Environment</b>	Identical	Within margins of original	Significantly different from original
<b>Referenced Prior Use</b>	In operation	Built and successfully ground tested	Not yet successfully ground tested

#### 11. List of Abbreviations and Acronyms.

*The following expands requirements in the AO, in particular Requirement 96.*

Requirement B-71. This section shall provide a list of abbreviations and acronyms.

#### 12. List of References (optional).

In addition to the above items, this section 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. If internal documents such as Flight Project Practices are referenced, an externally accessible URL shall be provided to download them.

#### 13. Infusion Plan for NASA-Developed Technology

*The following expands requirements in the AO, in particular Requirement 89 and Requirement 90.*



Requirement B-72. If applicable, this section, which shall not exceed 5 pages in length, shall describe any proposed utilization of NASA-developed technology. 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 offerors' 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 would enhance (or in the case of ASRG enable) the proposed investigation's science return.
- 4) Description of how the offeror 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 technology in the body of the proposal should be referenced from this section.

#### 14. Description of Enabling Nature of ASRG

*The following expands requirements in the AO, in particular Requirement 91.*

Requirement B-73. If applicable, this section, which shall not exceed 3 pages in length, shall describe how the proposed investigation is enabled by the use of the ASRG. This discussion shall include descriptions of any trade studies performed as well as estimates of the impact to the investigation's science return and mission design should ASRGs not be employed. If an Earth or Venus gravity-assist is proposed, then this section should also contain a description of the enabling nature of this trajectory.

TABLE B1  
EXAMPLE SCIENCE TRACEABILITY MATRIX

Science Goals	Science Objectives	Scientific Measurement Requirements		Instrument Performance Requirements		Projected Instrument Performance	Mission Requirements (Top Level)
		Observables	Physical parameters				
Goal 1	Objective 1	Absorption line	Column density of absorber	Alt. Range	XX km	ZZ km	Observing strategies: requires yaw and elevation maneuvers
Goal 2		Emission line	Density and temperature of emitter				Launch window: to meet nadir and limb overlap requirement. Window applies day to day
Etc.		Morphological feature	Size of features	Vert. Resol.	XX km	ZZ km	Need AA seasons to trace evolution of phenomena
				Horiz. Resol.	XX deg x XX lat x XX long	ZZ deg x ZZ lat x ZZ long	
				Temp. Resol.	XX min	ZZ min.	
		Rate of change of observable phenomenon	Rise time of eruptive phenomenon	Precision	XX K	ZZ K	
Accuracy				XX K	ZZ K		
	Objective 2 to N			Repeat above categories			

An EXCEL version of this template is available in the Program Library.

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
Msn Functional Req or Instrument Accommodation (from Table B1)	Mission	Spacecraft	Ground System	Operations
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

An EXCEL version of this template is available in the Program Library.

TABLE B3  
TOTAL MISSION COST FUNDING PROFILE TEMPLATE

Total Mission Cost Funding Profile Template

(FY costs in Real Year Dollars, Totals in Real Year and 2010 Dollars)

WBS#	WBS Element	Phase A/B			Phase C/D			Phase E			Phase F			TOTAL	
		FY1	FY n	RY Tot	FY10 Tot	FY1	FY2	FY n	RY Tot	FY10 Tot	FY1	FY n	RY Tot	FY10 Tot	RY Tot
01	Phase A														
02	Project Management														
03	Systems Engineering														
04	Safety & Mission Assurance														
05	Science / Technology														
06	Payload(s)														
07	List each instrument separately														
08	Spacecraft														
09	List each separate flight system element														
10	Mission Operations														
11	Launch Vehicle / Services														
12	Ground System(s)														
13	Systems Integration & Testing														
14	Education and Public Outreach														
15	Reserves														
16	PI-Managed Mission Cost														
17	Contributions														
18	Student Collaboration Incentive (if applicable)														
19	List by organization and WBS element														
20	Total Contributions														
21	Total Mission Cost														
22	Other AO-specific Activities														
23	List by activity and WBS element														
24	Enhanced PI-Managed Mission Cost														
25	Phase B Bridge Phase Funding (included above)														
26															

Label columns with actual fiscal years. Add or remove FY columns as necessary.

An EXCEL version of this template is available in the Program Library.

TABLE B4  
NASA FY09 NEW START INFLATION INDEX  
for use in FY10

Fiscal Year	2010	2011	2012	2013	2014	2015	2016	2017
Inflation Rate		2.4%	2.9%	3.0%	2.9%	2.8%	2.8%	2.9%
Cumulative Inflation Index	1.000	1.024	1.054	1.085	1.117	1.148	1.180	1.214

Use an inflation rate of 2.9% for years beyond 2017.

Note: Proposers shall use their own forward pricing rates. For organizations that are without forward pricing rates, proposers may use the NASA new start inflation index in Table B4 (see Appendix B, Section H).

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 <i>n</i>		# 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 <i>n</i>		# 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												

An EXCEL version of this template is available in the Program Library.

## APPENDIX C

### GLOSSARY OF TERMS AND ABBREVIATIONS

#### Part C.1: GLOSSARY OF TERMS

**Announcement of Opportunity (AO)** — A document used to announce opportunities to participate in NASA programs.

**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 full-time Federal Government employees that provides advice to the Mission Directorate Associate Administrator and 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 accomplish the entire set of scientific objectives proposed for the investigation.

**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 immediate 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 Subcommittee** — An ad hoc subcommittee of the AO Steering 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, that categorizes proposals for investigations submitted in response to an AO based on the evaluations.

**Co-Investigator (Co-I)** — An investigator who plays a necessary role in the proposed investigation and whose services are either funded by NASA or are contributed by his/her employer. 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 through the proposal. A collaborator may be committed to provide a focused contribution to the project for a specific task, such as data analysis. If funding support is requested in the proposal for an individual, that individual shall not be identified as a collaborator but shall be identified as a Co-Investigator or another category of 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 spacecraft disposal (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, preliminary analysis of returned samples, and, if applicable, extended mission operations or other science enhancements.

**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.

**Descscope** — Any alteration of a mission that renders it unable to accomplish one or more of the Baseline Science Mission scientific objectives.

**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.

**Federal Acquisition Regulation (FAR)** — The regulations governing the conduct of acquisition.

**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.

**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. Key management team members are the PI, PM, PSE, and, where appropriate, PS and partner leads, and other roles as identified in the proposal.

**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.

**Minimum science mission** — The mission that would accomplish the minimum subset of Baseline Science Mission scientific objectives sufficient to justify the proposed cost of the mission.

**Mission** — Used interchangeably with investigation.

**Mission Architecture** — The summary level description of the over all 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 Announcement of Opportunity.

**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 funding that the Program sponsoring the AO will be expected to provide to the PI's implementation team 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 PI-Managed Mission Cost is capped.

**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.

**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 Minimum 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 Enhancement Option (SEO)** — An activity, such as extended missions, guest investigator programs, general observer programs, participating scientist programs, interdisciplinary scientist programs, or archival data analysis programs that have 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.

**Team** — A group of investigators responsible for carrying out and reporting the results of an investigation or group of investigations.

**Team Member** — A participant in an investigation, including the Principal Investigator, a Co-Investigator, or any member of an investigation team. Team members are identified by role on the proposal's Electronic Cover Page.

**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.

**Total Mission Cost** — The PI-Managed Mission Cost plus any additional costs that are contributed or provided in any way other than through the Program sponsoring the AO.

**Unencumbered reserve** — Unexpended reserves that are not being held for an identified, but not yet realized, risk.

**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.

**Education and Public Outreach** — Includes all costs associated with developing and implementing the proposed investigation's programs for education and public outreach.

**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** — 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, postflight 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 Phase E (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 post-launch science team support costs. It does not include costs of any Science Enhancement Option (SEO) activities.

**NASA Center Costs (all categories)** — Additional costs born 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 below for postlaunch component.)

**Prelaunch 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
AM&O	Agency Management and Operations
AO	Announcement of Opportunity
AOR	Authorized Organizational Representative
ASRG	Advanced Stirling Radioisotope Generator
CADRe	Cost Analysis Data Requirement
CASP	Cross-Agency Support Program
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
DOE	Department of Energy
DOR	Differential One-way Ranging
DSN	Deep Space Network
EA	Environmental Assessment
EAR	Export Administration Regulations
E/PO	Education and Public Outreach
EBPOC	Electronic Business Point of Contact
EIS	Environmental Impact Statement
ELV	Expendable Launch Vehicle
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
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
HQ	NASA Headquarters
HUBZone	Historically Underutilized Business Zone
IAT	Integration, Assembly, and Test
ICD	Interface Control Document
IRD	Interface Requirements Document
ITA	Independent Technical Authority
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

NAICS	North American Industry Classification System
NAIF	Navigation and Ancillary Information Facility
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
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
OCIAP	Organizational Conflict of Interest Avoidance Plan
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
P.L.	Public Law
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
RPS	Radioisotope Power System
RTG	Radioisotope Thermoelectric Generator
RY	Real Year
SAIC	Science Applications International Corporation
SALMON	Stand Alone Mission 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
SPICE	Spacecraft, Planet, Instrument, C-matrix, Events
TMC	Technical, Management, and Cost
TRL	Technical Readiness Level
TT&C	Telemetry, Tracking, and Commanding
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

Acquisition home page URL <http://discovery.larc.nasa.gov>

Program Library URL <http://discovery.larc.nasa.gov/dpl.html>

#### Strategic Documents

- NPD 1001.0, *The 2006 NASA Strategic Plan*
- *The Science Plan for NASA's Science Mission Directorate (2007-2016)*
- *New Frontiers in the Solar System: An Integrated Exploration Strategy*
- *Grading NASA's Solar System Exploration Program: A Midterm Review*

#### Program Specific Documents

- DISC-PLAN-001B, *Discovery Program Plan*
- *Lightweight Radioisotope Heater Unit (LWRHU) Information Summary*
- *NASA's In-Space Propulsion Technology Project Overview, Near-Term Products, and Mission Applicability*
- *In-Space Propulsion Technologies Minimum Demonstration Requirements*
- *NASA's Evolutionary Xenon Thruster (NEXT) Ion Propulsion System Information Summary for Discovery Missions*
- *The NEXT Ion Propulsion System for Solar System Exploration*
- *Electric Propulsion Thruster Lifetime Qualification Standard Recommendation*
- *In-Space Propulsion Technology Project Low-Thrust Trajectory Tool Suite*
- *AMBR Engine for Science Missions*
- *Advanced Materials Bi-propellant Rocket (AMBR) Information Summary*
- *Aerocapture Information Summary for Discovery Missions*
- *Aerocapture for Discovery Missions*
- *Advanced Stirling Radioisotope Generator Information Summary*
- *ASRG Functional Description*
- *Electromagnetic Interference Data from ASRG Engineering Unit*
- *Low-Frequency Magnetic Fields Near the ASRG Engineering Unit*
- *Draft Model Contract for Phases B/C/D/E*
- DISC-RQMT-002B, *Discovery Program Safety and Mission Assurance Guidelines and Requirements*
- *Guidelines and Criteria for the Phase A Concept Study*
- *Launch Services Information Summary*
- *NASA's Mission Operations and Communications Services*
- *Policy and Requirements for the Education and Public Outreach Programs of SMD Missions*
- *The Explanatory Guide to the NASA Science Mission Directorate Educational and Public Outreach Evaluation Factors*
- *The Explanatory Guide to the NASA Science Mission Directorate Educational Merit Evaluation Factors for Student Collaboration Elements*

- *SMD Mission Extension Paradigm*
- *Sample Return Primer and Handbook*
- *Mars Relay Description for Discovery 2010 Proposals*
- *Electra Mars Proximity-Link Communications and Navigation Payload Description*
- *Electra-Lite Mars Proximity Link Communications and Navigation Payload Description*
- *Table B1: Example Science Traceability Matrix*
- *Table B2: Example Mission Traceability Matrix*
- *Table B3: Total Mission Cost Funding Profile Template*
- *Table B5: Master Equipment List*
- *Draft Procedural Guidelines for Flight Projects: Communications with the Planetary Protection Officer*
- *Final Report of the Life Cycle Cost Growth Study for the Discovery and New Frontiers Program Office*

The following NASA Directives may be found in the NASA Online Directives Information System (NODIS) Library (<http://nodis.hq.nasa.gov/>)

- NPD 1001.0, *The 2006 NASA Strategic Plan*
- NPD 1360.2A, *Initiation and Development of International Cooperation in Space and Aeronautics Programs*
- NPD 2820.1, *NASA Software Policy*
- NPD 5101.32, *Procurement*
- NPR 5800.1, *Grant and Cooperative Agreement Handbook*
- NPD 7100.10E, *Curation of Extraterrestrial Materials*
- NM 7120-81, *NASA Space Flight Program and Project Management Requirements*
- NPR 7120.8, *NASA Research and Technology Program and Project Management Requirements*
- NPR 8020.12C, *Planetary Protection Provisions for Robotic Extraterrestrial Missions*
- NPD 8020.7G, *Biological Contamination Control for Outbound and Inbound Planetary Spacecraft*
- NPR 8580.1, *Implementing the National Environmental Policy Act and Executive Order 12114*
- NPD 8610.7D, *NASA Launch Services Risk Mitigation Policy for NASA-Owned or NASA-Sponsored Payloads/Missions*
- NPR 8705.4, *Risk Classification for NASA Payloads*
- NPR 8715.3, *NASA General Safety Program Requirements,*
- NPR 8715.6, *NASA Procedural Requirements for Limiting Orbital Debris*

The following 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-HDBK-6022, *NASA Handbook for the Microbiological Examination of Space Hardware (DRAFT)*
- NASA-STD-8719.14, *NASA Process for Limiting Orbital Debris*

The following NASA technical reports may be found on the NASA Technical Reports Server (NTRS) (<http://ntrs.nasa.gov/search.jsp>)

- NASA/CP-2002-211842, *A Draft Test Protocol for Detecting Possible Biohazards in Martian Samples Returned to Earth*

The Federal Acquisition Regulations (FAR) may be accessed at <http://www.acquisition.gov/far/index.html>. The following parts of the Federal Acquisition Regulations are referenced in this AO.

- FAR 15.401, “Contract Pricing Definitions”
- FAR 15.406-2, “Certificate of Current Cost or Pricing Data”
- FAR 33.101, “Protests 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/nfstoc.htm>. 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”
- NFS 1852.227-11, “Patent Rights--Retention by the Contractor”
- 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 1872.308, “Proposals submitted by NASA investigators”
- NFS 1872.403-1, “Advisory subcommittee evaluation process”
- NFS 1872.705-1, “Appendix A: General instructions and provisions”

NASA Procurement Information Circulars (PICs) may be accessed at <http://www.hq.nasa.gov/office/procurement/regs/pic.html>. The following NASA Procurement Information Circulars are referenced in this AO.

- PIC 05-15, “Guidance On Competitive Procedures For Broad Agency Announcements”

The Code of Federal Regulations (CFR) may be accessed at <http://www.gpoaccess.gov/cfr/>. The following parts of the Code of Federal Regulations are referenced in this AO.

- 14 CFR Part 1216.3, “Procedures for Implementing the National Environmental Policy Act (NEPA)”
- 15 CFR Parts 730-774, “Export Administration Regulations”
- 22 CFR Parts 120-130, “International Traffic in Arms Regulations”
- 40 CFR Parts 1500-1508, “Regulations for Implementing the Procedural Provisions of NEPA”

The United States Code (USC) may be accessed at <http://www.gpoaccess.gov/uscode/>. The following parts of the United States Code are referenced in this AO.

- 42 USC 4321 *et seq.*, “National Environmental Policy Act of 1969, as amended (NEPA)”

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”

The *Managerial Cost Accounting Concepts and Standards for the Federal Government* as recommended by the Federal Accounting Standards Advisory Board may be accessed at <http://www.fasab.gov/pdffiles/sffas-4.pdf>.

- *Step-One Proposal Evaluation Plan Template*

## 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.

#### E.1 Phase A Concept Study Reports and Confirmation of Investigation(s) for Phase B

*Guidelines and Criteria for the Phase A Concept Study*

#### E.2 Confirmation of Investigation(s) for Phases Subsequent to Phase B

NM 7120-81, *NASA Space Flight Program and Project Management Requirements*

DISC-PLAN-001B, *Discovery Program Plan*

DISC-RQMT-002B, *Discovery Program Safety and Mission Assurance Guidelines and Requirements*

## APPENDIX F

### COMPLIANCE CHECKLIST

This Appendix contains the list of items that NASA will check for compliance before releasing a proposal for evaluation. All other requirements will be checked during evaluation.

<b>Administrative</b>	
1. Proposal received on time	Requirement 1
2. Original signature of authorizing official included	Requirement B-5
3. Electronic cover page and summary (NSPIRES submission) received on time	Requirement 2
4. Proposal includes proposal summary information with content identical to electronic cover page	Requirement B-7 Requirement B-9
5. Correct number of copies each including a CD	Requirement 97
6. Meets page limits	Requirement B-4
7. Meets general guidelines (one volume original easy to disassemble, maximum 55 lines text/page, maximum 15 characters/inch -- approximately 12 pt font)	Requirement B-1 Requirement B-2 Requirement B-3
8. Meets general requirements for format and completeness	Requirement 96
9. Required appendices included; no additional appendices	Requirement B-55
10. Budgets are submitted in required formats	Requirement B-49
11. All individual team members named on cover page indicate commitment through NSPIRES	Requirement 83
12. All export-controlled information has been identified.	Requirement 84
<b>Scientific</b>	
13. Addresses solicited science research programs	Requirement 4
14. Requirements traceable from science to instruments to mission	Requirement 5
15. Appropriate data archiving plan	Requirement 6
16. Baseline science mission and threshold science mission defined	Requirement 9
<b>Technical</b>	
17. Complete spaceflight mission (Phases A-F) proposed	Requirement 21
18. Team led by a single PI	Requirement 39
19. Includes commitment for E/PO program	Requirement 55
20. PI-Managed Mission Cost within cost cap	Requirement 59
21. Phase A costs within Phase A cost limit	Requirement 61
22. Contributions within contribution limit	Requirement 72
23. Co-investigator costs in budget	Requirement 50
24. Launch readiness date prior to launch deadline	Requirement 85
25. Includes table describing non-U.S. participation	Requirement 78
26. Includes letters of commitment from funding agencies for non-U.S. participating institutions	Requirement 75
27. Includes letters of commitment from all U.S. organizations offering contributions	Requirement 81
28. Includes letters of commitment from all major partners	Requirement 82

## 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 expand upon the proposal requirements in the AO and provide further definition on the structure and content of the proposal. Some AO requirements do not require further definition by an Appendix B requirement. Not all possible crosswalk relations are shown.

<b>AO Reqmt</b>	<b>AO Section</b>	<b>AO Reqmt Topic</b>	<b>Appendix B Reqmt</b>
1	3	Proposal submission	
2	3	Electronic submission	
3	4.1.3	Mission category and payload risk class	
4	5.1.1	Science scope	B-15
5	5.1.2	Science traceability	B-16
6	5.1.2	Data plan	B-21, B-22, B-23
7	5.1.3	Measurement traceability	B-17, B-21
8	5.1.3	Instrumentation rationale	B-19, B-20, B-26
9	5.1.4	Baseline and threshold missions	B-18, B-26
10	5.1.4	Threshold mission	B-18
11	5.1.5.1	Planetary Protection (encounters)	B-63
12	5.1.5.1	Planetary Protection (samples)	B-63
13	5.1.5.2	Sample curation plan	B-64
14	5.1.5.2	Sample curation funding	B-64
15	5.1.5.3	Sample allocation to foreign partner	B-64
16	5.1.5.4	Space-exposed hardware curation plan	B-64
17	5.1.5.4	Space-exposed hardware curation funding	B-64
18	5.1.6	SEO description	B-25
19	5.1.6	SEO separability	B-25
20	5.1.6	Extended missions	B-25
21	5.2.1	Complete missions	B-26, B-27, B-28, B-45
22	5.2.1	Mission architecture	B-26, B-27, B-28, B-29
23	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, B-63, B-64, B-65, B-66

<b>AO Reqmt</b>	<b>AO Section</b>	<b>AO Reqmt Topic</b>	<b>Appendix B Reqmt</b>
24	5.2.1	Flight systems design	B-26, B-27, B-28, B-31, B-32, B-33, B-34
25	5.2.1	Development approach	B-26, B-27, B-28, B-32, B-34, B-36, B-38, B-39, B-40, B-63
26	5.2.2	Management approach	B-26, B-27, B-28, B-34, B-41, B-42, B-43, B-44, B-45
27	5.2.3	New technologies	B-28, B-37
28	5.2.4.2	Radioactive material	B-28, B-40
29	5.2.4.2	RHU use cost	B-28, B-40
30	5.2.4.4	NEPA and Launch Approval Costs	
31	5.2.6	Space communications and tracking	B-28
32	5.2.6	Standard space comm. service costs	B-28
33	5.2.6	Nonstandard space comm. service costs	B-28, B-57
34	5.2.6	Use of single 34m antenna for normal operations	B-28, B-35
35	5.2.6	Use of Ka-band high data-rate telemetry	B-28, B-35
36	5.2.7	Critical events	B-28
37	5.2.8	End-of-mission spacecraft disposal	B-28, B-64, B-65, B-66
38	5.2.9	Deviations from payload requirements	B-28
39	5.3.1	Principal Investigator	B-28, B-41, B-42, B-58
40	5.3.2	Project manager	B-28, B-41, B-42, B-58
41	5.3.2	PI and PM roles	B-28, B-41, B-42
42	5.3.3	Qualifications of individuals	B-28, B-41, B-42
43	5.3.3	Qualifications of institutions	B-28, B-41, B-42
44	5.3.4	Risk identification	B-28, B-43
45	5.3.4	Risk mitigation	B-28, B-43
46	5.3.4	Descope	B-28, B-43
47	5.3.5	NASA-PI proposals	B-67
48	5.4.1	Science team	B-23, B-24, B-58
49	5.4.2	Co-investigator roles	B-24, B-58
50	5.4.2	Co-investigator funding	B-46, B-49
51	5.4.3	Collaborators	B-24, B-58
52	5.5.1	Small business contracting plan	B-52
53	5.5.2	E/PO plan	



<b>AO Reqmt</b>	<b>AO Section</b>	<b>AO Reqmt Topic</b>	<b>Appendix B Reqmt</b>
54	5.5.2	E/PO funding	B-46, B-49
55	5.5.2	E/PO commitment	B-53
56	5.5.3	Student collaboration separability	B-54
57	5.5.3	Student collaboration funding	B-46, B-49
58	5.6.1	Cost tables	B-49
59	5.6.1	Cost cap	B-46, B-49
60	5.6.1	Limit on pre-Confirmation spending	B-46, B-49
61	5.6.2	Phase A cost	B-46, B-49
62	5.6.2	Phase A teaming	B-41, B-42
63	5.6.3	Cost methodologies	B-46, B-47, B-48, B-49, B-51
64	5.6.3	Cost control	B-46, B-47, B-48, B-49, B-51
65	5.6.3	Cost reserves	B-46, B-47, B-48, B-49, B-51
66	5.6.4	Work Breakdown Structure	B-49
67	5.6.5	Master Equipment List	B-68, B-69
68	5.6.6	Full-cost accounting	B-46
69	5.6.6	NASA contributions	B-46, B-49, B-70
70	5.6.6	Applicable accounting standards	B-46
71	5.6.7	Contribution identification	B-59
72	5.6.7	Contribution value	B-60
73	5.6.7	Contribution risk management	B-44, B-59
74	5.7.2	Non-US cost plan	
75	5.7.2	Non-US letters of commitment	B-57
76	5.7.2	Non-US contribution risk management	B-44, B-59
77	5.7.2	Non-US contribution detail	B-19, B-20, B-26
78	5.7.2	Non-US participation table	B-60
79	5.7.3	International agreements	B-40
80	5.7.4	Export-control requirements	B-61, B-62
81	5.8.1.1	US contribution letters of commitment	B-57
82	5.8.1.2	Major partners letters of commitment	B-56, B-57
83	5.8.1.3	NSPIRES commitment for team members	B-12
84	5.8.2	Export-controlled proposal material	B-9
85	5.9.1	Latest launch readiness date	B-40
86	5.9.2	Launch vehicle capability	B-31
87	5.9.2	Costs for nonstandard launch services	B-46, B-49
88	5.9.2	Compatibility with multiple launch vehicles	B-31
89	5.9.3	Use of NASA-developed technology	B-72
90	5.9.3	Costs for use of NASA-developed technology	B-72

<b>AO Reqmt</b>	<b>AO Section</b>	<b>AO Reqmt Topic</b>	<b>Appendix B Reqmt</b>
91	5.9.3	Enabling nature of ASRG	B-73
92	5.9.3	Limit on NASA-developed technologies	
93	5.9.4	Use of Mars communication assets	
94	5.9.4	Inclusion of Mars communications package	
95	5.9.4	Interoperability of Mars UHF relay equipment	
96	6.2.1	Proposal format	B-1, B-2, B-3, B-4, B-5, B-6, B-7, B-8, B-9, B-13, B-14, B-55, B-70, B-71
97	6.2.3	Proposal submission (number of copies)	B-5, B-6, B-50, B-53, B-69
98	6.2.4	NSPIRES registration	B-12
99	6.2.4	Electronic cover page	B-10, B-11
100	6.2.4	Electronic submission of cover page	B-10, B-11

## APPENDIX H

### CERTIFICATIONS

**Included for reference only. Submission of the signed proposal including Section V of the Proposal Summary Information certifies compliance with these certifications.**

---

#### **Assurance of Compliance with the National Aeronautics and Space Administration Regulations Pursuant to Nondiscrimination in Federally Assisted Programs**

---

The (*Institution or organization on whose behalf this assurance is signed, hereinafter called "Applicant."*)

HEREBY AGREES THAT it will comply with Title VI of the Civil Rights Act of 1964 (P.L. 88-352), Title IX of the Education Amendments of 1972 (20 U.S.C. 1680 *et seq.*), Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794), and the Age Discrimination Act of 1975 (42 U.S.C. 16101 *et seq.*), and all requirements imposed by or pursuant to the Regulation of the National Aeronautics and Space Administration (14 CFR Part 1250) (hereinafter called "NASA") issued pursuant to these laws, to the end that in accordance with these laws and regulations, no person in the United States shall, on the basis of race, color, national origin, sex, handicapped condition, or age be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the Applicant receives Federal financial assistance from NASA; and HEREBY GIVES ASSURANCE THAT it will immediately take any measure necessary to effectuate this agreement.

If any real property or structure thereon is provided or improved with the aid of Federal financial assistance extended to the Applicant by NASA, this assurance shall obligate the Applicant, or in the case of any transfer of which the Federal financial assistance is extended or for another purpose involving the provision of similar services or benefits. If any personal property is so provided, this assurance shall obligate the Applicant for the period during which it retains ownership or possession of the property. In all other cases, this assurance shall obligate the Applicant for the period during which the Federal financial assistance is extended to it by NASA.

THIS ASSURANCE is given in consideration of and for the purpose of obtaining any and all Federal grants, loans, contract, property, discounts or other Federal financial assistance extended after the date hereof to the Applicant by NASA, including installment payments after such date on account of applications for Federal financial assistance which were approved before such date. The Applicant recognizes and agrees that such Federal financial assistance will be extended in reliance on the representations and agreements made in this assurance, and that the United States shall have the right to seek judicial enforcement of this assurance. This assurance is binding on the Applicant, its successors, transferees, and assignees, and the person or persons whose signatures appear below are authorized to sign on behalf of the Applicant.

---

**Certification Regarding Debarment, Suspension, and Other Responsibility Matters**  
**Primary Covered Transactions**

---

This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 14 CFR Part 1265.

A. The applicant certifies that it and its principals:

1. Are not presently debarred, suspended, proposed for debarment, declare ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
2. Have not within a three-year period preceding this application been convicted or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or Local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
3. Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or Local) with commission of any of the offenses enumerated in paragraph A.(b) of this certification;
4. Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or Local) terminated for cause or default; and

B. Where the applicant is unable to certify to any of the statements in this certification, he or she shall attach an explanation to this application.

C. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion -- Lowered Tier Covered Transactions (Subgrants or Subcontracts)

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principles is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department of agency.
2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

---

**Certification Regarding Lobbying**

---

As required by S 1352 Title 31 of the U.S. Code for persons entering into a grant over \$100,000, the applicant certifies that:

1. No Federal appropriated funds have been paid or will be paid by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, in connection with making of any Federal grant, the entering into of any cooperative, and the extension, continuation, renewal, amendment, or modification of any Federal grant;
2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting an officer or employee of any agency, Member of Congress, or an employee of a Member of Congress in connection with this Federal grant, the undersigned shall complete Standard Form -- LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
3. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subgrants, contracts under grants, and subcontracts), and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by S1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

National Aeronautics and Space Administration

