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# **Announcement of Opportunity**

## **Mars 2020 Investigations**

Revision Date: December 4, 2013

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<b>Notices of Intent Due Date:</b>	<del>October 15, 2013</del> November 4, 2013 [amended 10/21/2013]
<b>Proposal Due Date:</b>	<del>December 23, 2013</del> January 15, 2014 [amended 10/21/2013]

OMB Approval Number 2700-0085

## ANNOUNCEMENT OF OPPORTUNITY

### MARS 2020 INVESTIGATIONS

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#### FOREWORD

The National Aeronautics and Space Administration (NASA) Science Mission Directorate (SMD) is releasing this Announcement of Opportunity (AO) to solicit Principal Investigator (PI)-led space science and exploration technology investigations for the Mars 2020 rover mission.

Although individual PI-managed instrument science investigations do not have a predetermined cost cap, the total allocated cost for all the SMD-funded investigations selected is approximately \$100M in Real Year (RY) dollars for Phases A through D. Additional funding of approximately \$60M RY is allocated for investigation in Phase E. Additionally, exploration technology investigations, jointly funded by the Human Exploration and Operations Mission Directorate (HEOMD) and Space Technology Mission Directorate (STMD) may be selected at a total cost of approximately \$30M in RY dollars, including Phase E costs. NASA expects to select a complete suite of Mars 2020 investigations to proceed into Phase A and subsequent investigation phases. The selected investigations will be launched to Mars no later than August 2020.

This AO is based on SMD's Standard PI-Led Mission AO. Proposers should be aware that changes have been made in this AO to address the unique requirements of instrument investigations that differ from those of full mission investigations. The following major changes in this AO have been implemented.

- Proposals must address the Mars 2020 Proposal Information Package (PIP), which contains preliminary descriptions of the Mars 2020 mission, rover, the environments in which instruments are expected to survive and operate, as well as Principal Investigator (PI) responsibilities and deliverables, the capabilities of the Mars 2020 ground data system and mission operations system, and the details of funding allocations and profiles. In case of a conflict between this AO and the PIP, the AO takes precedence.
- Notices of Intent (NOIs) are **mandatory** and due within three weeks of the AO release.
- Unencumbered cost reserves for Phases A/B/C/D should be a minimum of 20%. A proposed reserve posture is required as part of the cost plan and will be evaluated in terms of risk for selection.
- Instruments will be managed within a framework corresponding to the Mars 2020 Project's expected overall Category 1 mission (per NPR 7120.5E) and risk class A (per NPR 8705.4) designation.
- The contribution limit for U.S. PI proposals has been increased to one-half of the Total Investigation Cost.
- The maximum percentage of NASA funds that may be proposed to be spent prior to investigation Confirmation is 40% for SMD investigations, where adequate justification of funding required to support heritage or other risk reduction can be provided. The maximum percentage is 20% for HEOMD/STMD investigations.
- Proposals that address an exploration technology investigation are permitted to include an advanced technology option that offers a parallel path for advancing promising, lower TRL technologies (Section 5.3.1).

- Education and Public Outreach (E/PO), Student Collaboration (SC), and Science-Exploration-Technology Enhancement Options (SEOs) are not being solicited at this time.
- A Work Breakdown Structure (WBS) that conforms to the standard prescribed in Appendix B must be provided.
- Phase A Task Plans are **required**.
- Statements of Work (SOWs), cost and pricing data, and small business subcontracting plans are **required** attachments to proposals, where applicable.
- An Instrument Accommodation Requirements Summary is **required** (Appendix B, Section J.13).
- An accommodation assessment will be performed after Categorization, on possible instrument sets, by the Mars 2020 Project Office at NASA's Jet Propulsion Laboratory (JPL).
- Proposals must not include bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds arrangement (Section 4.2.2, Restrictions Involving China).

In addition to the listed major changes, this AO incorporates a large number of additional changes relative to SMD's Standard PI-Led Mission AO, including both policy changes and changes to proposal submission requirements. All proposers should read this AO carefully, and all proposals must comply with the requirements, constraints, and guidelines contained within this AO.

**Notice: This AO was corrected on September 27, 2013 to replace duplicated text in Section 2.2. Mars Exploration Program Goal III objectives are now correct. In addition, language in Section 5.4 about the Radioisotope Power System was clarified.**

**This AO was updated on October 4, 2013. The Preproposal Conference (PPC) has been postponed. The date in Section 3 has been changed to TBD. When the Government shutdown ends, a new date and time, as well as information about accessing the PPC, will be provided.**

**Amended on October 8, 2013. Due to the continuing Government shutdown, the Notice of Intent (NOI) due date has been changed to "TBD".**

**Amended on October 21, 2013. The following dates have been changed (see Section 3): the Preproposal Conference (PPC) date has been changed to October 28, 2013; the Notice of Intent (NOI) due date has been changed to November 4, 2013; the deadline for electronic proposal submittal has been changed to January 15, 2014; the due date for letters of commitment (with Electronic Proposal) has been changed to January 15, 2014; the deadline for receipt of proposal on CD-ROM has been changed to January 21, 2014.**

**Amended on December 4, 2013. All instances of Phase F and closeout have been deleted from this AO (Section 2.7, Section 4.1.1, Section 5.4.2, Section 7.4.2 and Appendices C and F). Requirement 1 has been clarified to indicate that proposed investigations can be for instrument science and/or exploration technology in the same proposal. The wording in Section 4.3.1 was clarified to indicate that PI-Managed Investigation Cost and Total Investigation Cost should cover Phase A-E, not Phase A-D. The WBS has been**

**restructured to align better with the NASA Standard WBS in NPR 7120.5E (Appendix B). All instances referring to "Instrument Scientist" and its abbreviation "IS" have been deleted (Section 5.5.3 and Appendix C). Appendix B, Section J.6 has been amended to allow proposers to provide one page addressing approaches to planetary protection to support the Project planetary program protection implementation. Appendix B was updated to indicate that the Commitment by the PI should be the final element of proposal Section A, on one additionally allocated page. Requirement 43a has been added to Section 5.7.1 on small business subcontracting plans. Section 5.8.4 was clarified to indicate that adequate unencumbered cost reserves for Phases A/B/C/D is defined to be a minimum of 20% of the Phase A-D portion of the PI-Managed Investigation Cost. The first sentence of the sixth bullet of Requirement B-33 has been replaced with new wording to clarify the requirement. Section 6.2.5 was added to provide instructions for submission of proposals by non-U.S. Organizations.**

**ANNOUNCEMENT OF OPPORTUNITY**  
**MARS 2020 INVESTIGATIONS**  
**NNH13ZDA018O**

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## **1. Description of Opportunity**

### **1.1 Introduction**

The National Aeronautics and Space Administration (NASA) Science Mission Directorate (SMD) is releasing this Mars Exploration Program (MEP) Announcement of Opportunity (AO) to solicit proposals for Mars 2020 surface-science investigations and exploration technology investigations. All investigations proposed in response to this solicitation must support the goals and objectives of the MEP (Section 2.2) and/or NASA's human Mars exploration goals (Section 2.3). Investigations must be implemented by Principal Investigator (PI) led investigation teams (Section 5.5.1), and must be implemented through the provision of complete instrument investigations (Section 5.4.2).

Proposed investigations will respond to: a) the overall Mars 2020 science objectives to characterize the geologic context and history of a landing site and, using the acquired geologic information, determine the habitability of an ancient environment, assess the biosignature preservation potential within that environment, and seek signs of ancient Martian life within the geologic record; and/or b) the exploration technology objectives to assess *in situ* resources, identify hazards, and characterize the environment. In addition, scientific investigations will enable future Mars exploration by identifying and rigorously selecting a suite of samples for placement into a cache for potential future return to Earth. Proposed exploration technology investigations will address Strategic Knowledge Gaps (SKGs) that pose risks or limit technology options for future human exploration of Mars.

The Mars 2020 mission will use a variety of instruments carried on a rover platform that will operate on the Martian surface for one Mars year. Proposals in response to this AO will be due 90 days after its release (see Schedule, Section 8.0). For the purpose of this AO, an investigation includes the design, build, assembly and test of the proposed instrument(s), and delivery to NASA with appropriate postdelivery support; establishment and preparations of the investigation team, mission operations and data collection, calibration, validation; and analysis with timely delivery of appropriate data to the NASA Planetary Data System (PDS).

Proposed investigations will be evaluated and selected through a single-step competitive process (Section 7.1).

This AO, particularly Section 5, presents the requirements and constraints that apply to proposals that are to be submitted in response to this AO. Section 5.3 includes additional requirements and constraints that apply to proposals that are to be submitted specifically in response to the exploration technology investigation. Appendix B contains additional requirements on the format and content of proposals, as well as elements that will enable the Mars 2020 Project Office at NASA's Jet Propulsion Laboratory (JPL) to provide initial funds to selected investigations as soon as possible. Appendix D lists Program Library documents that specify requirements that will apply to proposed and selected investigations.

Proposals may be submitted for investigations that involve a single instrument or a suite of instruments. NASA reserves the right to add instruments to a selected proposed suite and/or not to select instruments proposed as part of an instrument suite. In the case of a NASA-defined suite comprised of individually proposed instruments, one of the PIs may be designated as the suite Team Leader by NASA and given additional integration and operations responsibilities.

This AO does not solicit investigations for Mars 2020 rover interdisciplinary scientists or participating scientists. Interdisciplinary Scientists may be solicited by a later competition during the development phase. Participating Scientists may be solicited closer to the time of launch. Because these additional investigations will be competed, proposers to this AO should constrain the number of Co-Investigators to only those who have a substantial role in development, operations, and data analysis for the investigation.

## 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 understand the content, origin, and evolution of the solar system and the potential for life beyond Earth. Further information on NASA's strategic goals may be found in NASA Policy Directive (NPD) 1001.0A, *The 2011 NASA Strategic Plan*, available through the Program Library (Appendix D).

The NASA Science Mission Directorate (SMD) is pursuing this strategic goal by seeking answers to fundamental science questions that guide NASA's solar system exploration:

- What is the inventory of solar system objects and what processes are active in and among them?
- How did the Sun's family of planets, satellites, and minor bodies originate and evolve?
- What are the characteristics of the solar system that lead to habitable environments?
- How and where could life begin and evolve in the solar system?
- What are the characteristics of small bodies and planetary environments that pose hazards and/or provide resources?

SMD's Planetary Science Division is addressing those questions through the following research objectives:

- Inventory solar system objects and identify the processes active in and among them.
- Understand how the Sun's family of planets, satellites, and minor bodies originated and evolved.
- Understand the processes that determine the history and future of habitability of environments on Mars and other solar system bodies.
- Understand the origin and evolution of Earth life and the biosphere to determine if there is or ever has been life elsewhere in the universe.
- Identify and characterize small bodies and the properties of planetary environments that pose a threat to terrestrial life or exploration or provide potentially exploitable resources.

Further information on NASA's strategic goals in planetary science may be found in the *2010 Science Plan for NASA's Science Mission Directorate*, and information on NASA's strategic goals may be found in the most recent version of the NASA Strategic Plan. Both are available through the Program Library.

## 2.2 Mars Exploration Program Goals

In response to the recommendations by its advisory and analysis groups, NASA's Mars Exploration Program is a long-term systematic program of Mars exploration. The overarching goal of the Program is to answer the question, "Did life ever exist on Mars?" The scientific objectives established by the Program to address this goal are to search for evidence of past or present life, to characterize the climate and volatile history of Mars, to understand the surface and subsurface geology (including the nature of the interior), and to characterize the Martian environment quantitatively in preparation for human exploration.

The broad goals of the MEP and the specifics of where it fits relative to the strategic plan for NASA in general may be found in the "2011 NASA Strategic Plan" and the "2010 Science Plan for NASA's Science Mission Directorate." The MEP is fundamentally a science-driven program whose focus is on understanding and characterizing Mars as a dynamic "system" and ultimately addressing whether life is or was ever a part of that system. The MEP further embraces the challenges associated with the development of a predictive capability for Martian climate and how the role of water, obliquity variations, and other factors may have influenced the environmental history of Mars. Two of the foundation elements of the scientific strategy for the MEP are also referred to as "assessing potential habitability" and "seeking signs of life." This strategy connects fundamental program goals pertaining to biological potential, climate, the evolution of the planet, and the development of knowledge and technologies applicable to the eventual exploration of Mars by humans.

The MEP addresses the highest priority scientific investigations directly related to the Program goals and objectives. These planned investigations were derived by means of a highly inclusive process involving a large segment of the broad Mars/planetary exploration community. Mars 2020 investigations are a means of addressing high-priority scientific investigations recommended to NASA by the science community (*e.g.*, Vision and Voyages for Planetary

Science in the Decade 2013-2022; and the Mars Exploration Program Analysis Group (MEPAG) report entitled Mars Science Goals, Objectives, Investigations, and Priorities of September 2010; see the Mars 2020 Program Library).

The goals and objectives of the MEP are outlined below. Mars 2020 rover investigations are also governed by these overall goals.

#### Scientific Goals and Objectives of the NASA Mars Exploration Program

- Goal I. Determine if life ever arose on Mars:
  - Objective A: Characterize past habitability and search for evidence of ancient life
  - Objective B: Characterize present habitability and search for evidence of extant life
  - Objective C: Determine how the long-term evolution of Mars affected the physical and chemical environment critical to habitability and the possible emergence of life
  
- Goal II. Understand the processes and history of climate on Mars:
  - Objective A: Characterize Mars' atmosphere, present climate, and climate processes under current orbital configuration
  - Objective B: Characterize Mars' recent climate and climate processes under different orbital configurations
  - Objective C: Characterize Mars' ancient climate and climate processes
  
- Goal III. Determine the evolution of the surface and interior of Mars:
  - ~~Objective A: Characterize Mars' atmosphere, present climate, and climate processes under current orbital configuration~~
  - ~~Objective B: Characterize Mars' recent climate and climate processes under different orbital configurations~~
  - ~~Objective C: Characterize Mars' ancient climate and climate processes~~
  - Objective A: Determine the nature and evolution of the geologic processes that have created and modified the Martian crust**
  - Objective B: Characterize the structure, composition, dynamics, and evolution of Mars' interior**
  - Objective C: Understand the origin, evolution, composition and structure of Phobos and Deimos [corrected September 27, 2013 to replace duplicated objectives with Goal III's actual objectives.]**
  
- Goal IV. Prepare for human exploration:
  - Objective A: Obtain knowledge of Mars sufficient to design and implement a human mission with acceptable cost, risk and performance

### 2.3 NASA Human Exploration Goals

#### *2.3.1 Overview*

The goal of NASA's human exploration program is to sustainably expand human activity beyond low Earth orbit, with an objective of sending human explorers to Mars (or its vicinity) in the 2030s. NASA is pursuing this goal by developing capabilities such as the Orion Crew Vehicle and the Space Launch System and by addressing Strategic Knowledge Gaps (SKGs) that pose

risks or limit technology options available to future human explorers. NASA's Human Exploration and Operations Mission Directorate (HEOMD) develops new capabilities for human spaceflight to enable missions to cis-lunar space, near-Earth asteroids, and Mars and its moons. NASA's Space Technology Mission Directorate (STMD) develops and demonstrates critical technologies that will enable both human and robotic exploration. Together, HEOMD and STMD are jointly sponsoring investigations for the Mars 2020 mission to address the highest priority human exploration knowledge gaps and technology development objectives.

### 2.3.2 Strategic Knowledge Gaps

An evaluation of mission architectures and potential human exploration missions yielded a set of Strategic Knowledge Gaps (SKGs) that represent the unknown environments, hazards, and the availability of resources at potential destinations that, if not addressed, increase complexity and risk to mission plans. Science-focused missions such as Mars 2020 provide valuable measurement opportunities to close high priority SKGs.

The SKGs for Mars were defined and prioritized by the Mars Exploration Program Analysis Group (MEPAG). The full list of Mars SKGs is available in the Program Library. The Mars SKGs fall into three categories:

- **Architecture Drivers:** measurements and technology demonstrations that allow missions and systems to be designed more efficiently. These include identification of resources for *in-situ* resource utilization (ISRU) to reduce the mass of propellants and other consumables that must be launched from Earth, as well as knowledge of atmospheric density and winds to design human-scale entry, descent, and landing systems.
- **Crew Safety:** measurements of environments and hazards must be well understood, in order to keep the crew safe. These include knowledge of the interplanetary and surface radiation environment, biohazards from possible extant life, and toxicity of materials such as dust that could affect human health.
- **Operational:** measurements to ensure safe and reliable operations of systems. These include surface hazards at the landing site, the effects of dust on rover mobility and space suits, forward planetary protection to avoid contamination of special regions on Mars by organisms from Earth, and electrical properties of the atmosphere and the surface that may cause electrostatic discharges that could damage electronics.

Of particular interest to this solicitation are technology concepts that include advanced technologies that have the potential to reduce the mass, volume, and power associated with an oxygen-production plant on the surface of Mars.

## 2.4 Mars Exploration Program Implementation

The MEP is presently implemented as a series of flight missions to Mars, each of which provide important, focused scientific return. Taking advantage of launch opportunities available approximately every 26 months, the MEP is undertaking a set of missions that will ultimately provide for a discovery-driven set of flight mission options in the next decade, including possible return of samples to Earth.

Management of NASA's Mars program is the responsibility of the Mars Exploration Program located at NASA Headquarters, Washington, DC. The Mars Program Office (MPO) at NASA's Jet Propulsion Laboratory, Pasadena, California, is responsible for implementation of the MEP missions and projects. The Mars 2020 Project is managed by the MPO. It is the JPL Mars 2020 Project's responsibility to provide the spacecraft, landing systems, payload accommodations, and the rover and its sample acquisition, processing and handling capabilities. The Project also provides mission systems engineering, assurance, and management. JPL will award subcontracts for selected investigations under their prime contract. NASA or other Government organizations selected for funding under this AO will be funded directly via Bypass Funding Requests managed by the Mars 2020 Project Payload Office.

## 2.5 Mars 2020 Mission Goals and Objectives

In order to advance our scientific understanding of Mars, the Mars 2020 mission will build upon the accomplishments of NASA's prior Mars missions. A Science Definition Team (SDT) was convened to formulate a detailed mission concept that is traceable to the highest priority, community-vetted scientific goals and objectives for Mars exploration (as described in the National Research Council's Planetary Decadal Survey, *Vision and Voyages*, and related Mars Exploration Program Analysis Group goals and objectives) and would support NASA's long-term priority objectives for human exploration of Mars. The Mars 2020 Acquisition Website includes the report of the SDT and SDT Frequently Asked Questions (FAQs) for the Mars 2020 mission. The SDT defined strawman payloads of instruments that could achieve the scientific knowledge and technology objectives. The list of candidate instrument types is a "proof-of-concept"—examples of potentially viable instruments that could meet the mission objectives. The list does not in any way restrict the possible approaches, nor is the list intended to preclude consideration of investigations that propose other instruments or combinations of instruments that can provide the necessary observations.

In addition to addressing high priority *in situ* science goals, scientific investigations will enable future Mars exploration by identifying and rigorously selecting materials that could be placed carefully into a returnable sample cache, thus achieving significant technical progress toward the future return of samples to Earth. Exploration technology investigations enable future human exploration of Mars by addressing Strategic Knowledge Gaps while being compatible with, and ideally synergistic with, the science investigations.

Proposals to this AO must be responsive to one or more of the following objectives, with A through C representing the threshold objectives of the Mars 2020 mission:

- A. Characterize the processes that formed and modified the geologic record within a field exploration area on Mars selected for evidence of an astrobiologically-relevant ancient environment and geologic diversity.
- B. Perform the following astrobiologically-relevant investigations on the geologic materials at the landing site:
  - 1. Determine the habitability of an ancient environment.
  - 2. For ancient environments interpreted to have been habitable, search for materials with high biosignature preservation potential.

3. Search for potential evidence of past life using the observations regarding habitability and preservation as a guide.
- C. Assemble a returnable cache of samples for possible future return to Earth.
1. Obtain samples that are scientifically selected, for which the field context is documented, that contain the most promising samples identified in Objective B and that represent the geologic diversity of the field site.
  2. Ensure compliance with future needs in the areas of planetary protection and engineering so that the cache could be returned in the future if NASA chooses to do so.
- D. Contribute to the preparation for human exploration of Mars by making significant progress towards filling at least one major Strategic Knowledge Gap. The highest priority SKG measurements that are synergistic with Mars 2020 science objectives and compatible with the mission concept are (in priority order):
1. Demonstration of *In-Situ* Resource Utilization (ISRU) technologies to enable propellant and consumable oxygen production from the Martian atmosphere for future exploration missions.
  2. Characterization of atmospheric dust size and morphology to understand its effects on the operation of surface systems and human health.
  3. Surface weather measurements to validate global atmospheric models.

NOTE: Technology advancements that are not part of the rover investigation payload (*e.g.*, advancements in entry, descent, and landing capabilities) are not solicited as part of this AO.

## 2.6 Mars 2020 Mission Design

The current mission implementation concept, which addresses the goals and objectives in Section 2.5, is described below.

### 2.6.1 Mars 2020 Surface Mission Outline

The Mars 2020 mission will use a variety of instruments carried on a rover platform that will operate on the Martian surface for one Mars year. A candidate set of measurements were identified by the SDT as being the highest priority to achieve the objectives of the mission, and other measurement types were identified as being highly desirable. Proposers should consult the report of the SDT for further details.

The solicited Mars 2020 investigations (both scientific and exploration technology) will be accommodated in multiple locations on the Mars 2020 rover:

1. Mast mounted: remote sensing instruments to be mounted on the Mars 2020 rover mast;
2. Arm mounted: contact or remote sensing instruments to be mounted on a provided robotic arm;
3. Other payload: instruments mounted elsewhere on the Mars 2020 rover.

Given the submission of proposals of merit, NASA intends to select and fund investigations for Phase A and then Phase B design activities. Investigations that successfully complete Phase A/B, including a Preliminary Design Review/Confirmation Review, may then be confirmed and

funded for Phase C/D, detailed design and development. NASA reserves the right to deselect investigations at PDR/Confirmation even if they have successfully completed Phase A/B should resource limitations present a problem.

The Mars 2020 mission emphasizes the use of rover mobility to provide multiple opportunities for making *in situ* measurements and caching samples. Investigations have multiple roles and are expected to be used to identify and select suitable samples for caching, as well as conduct their associated scientific investigations. Instrument science investigations and the associated flight hardware proposed for the Mars 2020 mission must address the scientific objectives given in Section 2.5.

#### *2.6.2 Mars 2020 Project Science Group*

The Mars 2020 Project Science Group (PSG) will provide scientific guidance for the Mars 2020 mission. The PSG will contribute to the development of the Level 1 science requirements for the Mars 2020 project. The PSG will work with the Mars 2020 Project and MPO during the formulation and development phases to maximize the effectiveness of engineering trades and to ensure that the proposed science investigations meet Level 1 science requirements. The PSG will be co-chaired by the Mars 2020 Program and Project Scientists, and the membership will include the PIs of the selected Mars 2020 investigations, and any other scientists that NASA may appoint.

#### 2.7 Scope of this Mars 2020 Investigations AO

This Mars 2020 Investigations AO solicits proposals for Mars 2020 instrument investigations that are consistent with the Mars 2020 mission described herein and in the Proposal Information Package (PIP). Investigation proposals may involve one or more instruments.

This AO solicits complete instrument investigations. The term “complete” encompasses all appropriate mission phases (see Section 4.1.1) from definition (Phase A) through mission operations ~~and closeout~~ (Phase ~~F-E~~) **[amended December 4, 2013]**, which includes analysis and publication of data in the peer-reviewed literature, delivery of the data to the community during the mission, and delivery of the data to an appropriate NASA data archive. “Instrument science investigation” refers to investigations funded by SMD. “Exploration technology investigation” refers to investigations primarily addressing SKGs and funded by HEOMD and STMD. The requirements in Section 5.3 are specific to exploration technology investigations. The requirements in the balance of Section 5 are applicable to all investigations.

**Requirement 1.** Proposals submitted in response to this solicitation shall be for ~~either~~ an instrument science investigation **and/or** for an exploration technology investigation for flight on the Mars 2020 mission. **[amended December 4, 2013]**

### 3. Proposal Opportunity Period and Schedule

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

AO Release Date	September 24, 2013
Preproposal Conference	<del>October 8, 2013</del> <b>October 28, 2013</b> <b>[amended 10/21/2013]</b>
Notice of Intent to Propose Due Date	<del>October 15, 2013</del> <b>November 4, 2013</b> <b>[amended 10/21/2013]</b>
Electronic Proposal Submittal Deadline at 11:59 p.m. Eastern Time	<del>December 23, 2013</del> <b>January 15, 2014</b> <b>[amended 10/21/2013]</b>
Letters of Commitment Due (with Electronic Proposal)	<del>December 23, 2013</del> <b>January 15, 2014</b> <b>[amended 10/21/2013]</b>
Deadline for Receipt of Proposal on CD-ROMs at 5:00 p.m. Eastern Time	<del>December 27, 2013</del> <b>January 21, 2014</b> <b>[amended 10/21/2013]</b>
Selections Announced (target)	March 2014
Instrument Phase A (Accommodation and Definition Phase) Contract (target)	April 2014

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

Requirement 3. In addition to electronic submission, CD-ROMs containing the proposal and relevant files described in Section 6.2.3 must be submitted. Proposals on CD-ROMs submitted in response to this solicitation shall be delivered no later than the Deadline for Receipt of Proposal on CD-ROMs. Proposals shall be delivered to the Addresses for Submittal of Proposals given in Section 6.2.3.

### 4. Policies Applicable to this AO

#### 4.1 NASA Management Policies

The following policies will impose requirements on the Mars 2020 mission, for which planning may need to be considered and described as part of the proposal process.

##### *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 to be flowed down through the Mars 2020 Project requirements defined in the Proposal Information Package (PIP) and referenced documents (including Subcontract Data Requirements List/Data Requirement Description (SDRL/DRD) listing), available in the Mars 2020 Program Library. NASA mission management processes, as defined by NASA Procedural Requirements (NPR) 7120.5E, *NASA Space Flight Program and Project Management Requirements*, NPR 7123.1B, *NASA Systems Engineering Processes and*

*Requirements*, and D-79808, *Mars 2020 Mission Assurance Plan (MAP)* provide additional reference information.

The project management processes are Formulation, Confirmation, and Implementation. The processes are subdivided as follows:

*Formulation* is divided into:

- Phase A – Investigation Accommodation and Definition.
  - Duration: 5 months, starting from time of Selection/Initial Funding (target: April 2014 – September 2014).
  - Phase ends at Instrument Accommodation Review with payload accommodation - requirements baselined.
- Phase B – Instrument Preliminary Design.
  - Duration: 10 months, from End of Phase A (target: September 2014 – June 2015).
  - Phase ends with Instrument Preliminary Design Review/Confirmation Review

*Confirmation* is the approval process for transitioning into *Implementation*.

*Implementation Phase* is divided into:

- Phase C/D – Instrument Detailed Design, Build, Test, and Integration.
  - Duration: From End of Phase B through Launch plus 30 days (target: July 2015 – August 2020)
- Phase E – Instrument Operations and Data Analysis.
  - Duration: Launch plus 30 days through start of Surface Phase (February 2021 to end of Primary Surface Mission (Feb 2023) followed by a 6-month period for data analysis and archiving (target: September 2020 – August 2023).
- ~~Phase F – Closeout~~ **[amended December 4, 2013]**

#### *4.1.2 NASA Program Management*

Because of the significant expenditure of Government funds on space flight investigations, as well as their expected complexity, NASA intends to maintain an essential degree of insight into investigation development; NASA will exercise oversight to ensure that the implementation is responsive to NASA requirements and constraints. NASA requirements and constraints are spelled out in D-79808, *Mars 2020 Mission Assurance Plan (MAP)*, in NPR 7120.5E, and in other NASA requirements documents available in the NASA Online Directives Information System and in the Program Library. NASA oversight of investigations selected by this AO will be provided by the Mars 2020 Project at JPL, which reports through the Mars Program Office, also at JPL, to NASA HQ.

The *Mars 2020 Mission Assurance Plan (MAP)* document will apply to investigations that are selected for Phase A. Selected investigations that reside at institutions that have NASA-approved safety and mission assurance (S&MA) programs may use their own appropriate institutional practices in lieu of the guidelines and requirements in this document. These practices must be described in the proposal and accepted by NASA upon selection.

In addition to its role in implementation of the Mars 2020 Project, JPL is eligible to submit and participate in proposals in response to this AO. The Mars 2020 Project Office will have access to the AO before it is released. The Science Mission Directorate at NASA Headquarters will manage the evaluation and selection process. In order to manage JPL's two roles, SMD has established functional and organizational firewalls between selected individuals in the Mars 2020 Project Office and those parts of JPL that might participate in proposals. These firewalls ensure that personnel identified as supporting the Mars 2020 AO process will protect all nonpublic information from all proposers, including those at JPL, and will be free of financial and other conflicts of interest with proposers.

Similarly, firewalls have been put in place for other NASA Centers in which selected personnel are supporting the development of this AO and the evaluation of proposed investigations.

#### *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 Mars Exploration Program Office at JPL.

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 that 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 PIs also must work with NASA to ensure their investigation 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 (44 U.S.C. 3504(d)(1) and 3516) and associated guidelines to maximize the quality, objectivity, utility, and integrity of information and services provided to the public.

#### *4.1.4 Flowdown of Mission Category and Payload Risk Classification to Investigations*

NPR 7120.5E, *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 2.1.4 and Table 2-1 of NPR 7120.5E.

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

NASA expects to designate the Mars 2020 Project as a Category 1 mission (per NPR 7120.5E) and risk class A (per NPR 8705.4). Proposers are advised that instruments will be managed within a corresponding framework, and that requirements will be flowed down via SDRL/DRDs, as defined in the PIP. Proposers shall incorporate appropriate work effort and support in their proposals accordingly.

#### *4.1.5 Remediation, Termination, or Cancellation*

Any alteration of an investigation that renders it unable to accomplish one or more of its baseline objectives will be regarded as a descope of the investigation. NASA will review any such descope set of achievable objectives to ensure that the investigation remains at or above the Threshold Investigation (see Section 5.2.4 of this AO). A descope made necessary by the PI's inability to remain within budget or schedule, or failure at any time during formulation and implementation to maintain a level of return at or above the Threshold Investigation, can result in investigation cancellation accompanied by appropriate contract action, which may involve termination.

The proposal must include a commitment by the PI for the PI-Managed Investigation Cost, schedule, and performance of the investigation. If, at any time, the cost, schedule, or performance commitments made in the proposal appear to be in peril, the investigation will be subject to termination or cancellation.

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 investigation cost in Phase A 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 investigation cancellation and/or contract termination. NASA may cancel an investigation and/or terminate a contract notwithstanding any international or domestic partnerships established to enable the investigation.

## **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.

There is no restriction on the number of proposals that an organization may submit to this solicitation or on the teaming arrangements for any one proposal, including teaming with NASA

Centers and JPL. However, each proposal must be a separate, stand-alone, complete document for evaluation purposes.

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

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

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

#### *4.2.2 Restrictions Involving China*

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

In accordance with Public Law 112-55, Section 539(a), NASA is restricted from funding any NASA contract, grant, or cooperative agreement action that involves bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds arrangement.

#### *4.2.3 Constraints on Investigations that are Candidates for Selection*

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

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

Mars 2020 investigations must be headed by a single Principal Investigator (PI) who is responsible to NASA for all aspects of the investigation, including instrument design, development, test, and delivery to JPL per the Mars 2020 project schedules found in the PIP in the Mars 2020 Program Library. This responsibility includes not only the scientific or exploration technology integrity of the investigation, but also the complete investigation (development and operation), including provision of the experiment hardware, software, ground support equipment, including any necessary simulators, and support of mission operations planning and execution, data analysis, planning and implementation of any applicable education

and public outreach program, and timely archiving of calibrated data into the PDS archive and publication of results. All Co-Investigators (Co-Is) named to an investigation must have a substantial, well-defined role in the investigation. This responsibility, however, will be exercised with essential NASA oversight to ensure that the implementation is responsive to the requirements and constraints of the Mars 2020 Project.

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

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

### 4.3 Cost Policies

#### *4.3.1 PI-Managed Investigation Cost*

*PI-Managed Investigation Cost* is defined as the funding that the Mars 2020 Project will be expected to provide to the PI's implementation team for the development and execution of the proposed project, Phases A through ~~D~~-E. It includes any reserves applied to the development of the investigation. It also includes any costs that are required to be counted against the PI-Managed Investigation Cost, even though the PI is not directly responsible for those costs (*e.g.*, NASA-provided telecom and network services). **[amended December 4, 2013]**

Examples of costs to be included in the PI-Managed Investigation Cost are: development activities (*e.g.*, instrument development, management, software, testing); subcontracting costs, including fees; Co-Is and all other personnel required to conduct the investigation, analyze data and publish results, and deliver data in an acceptable format to the PDS; insurance; any program/project-specific costs (*e.g.*, special test equipment or facilities mods); and all labor, including contractor and Civil Servant (NASA and non-NASA).

There is no predetermined cost cap per suite or instrument in this AO; however, the budget resources for all SMD-funded investigations are limited to approximately \$100M RY for Phases A through D and approximately \$60M RY for Phase E. HEOMD and STMD will sponsor exploration technology investigations up to approximately \$30M RY including costs for Phase E. Cost will be a significant driver in the payload selection. The level of funding available for each selected proposal will be decided on a case-by-case basis and will be capped at that level. NASA must be able to select multiple Mars 2020 investigations within the available budget.

#### *4.3.2 Total Investigation Cost*

Total Investigation Cost is defined as the PI-Managed Investigation Cost (see Section 4.3.1), plus any additional costs that are contributed or provided in any way other than through the Mars 2020 Project (see Section 5.8.8). The Total Investigation Cost will define the total value of the baseline investigation.

### 4.4 Data Policies

The Mars 2020 Project requires that raw data, calibration records, and processed data be maintained in an updated form throughout the period of investigation. Specifically, each selected Instrument PI must plan:

- To maintain a continually updated record of the "best version" of the data until meaningful changes in data calibration no longer occur;
- To release data in an appropriate manner for public access as soon as feasible;
- To make appropriate data records available to other investigators and project personnel during the mission for shared analysis;
- To support the timely interpretation of all instrument data (science, exploration technology, or engineering) in support of tactical operations; and
- To support the timely processing and distribution of data, including their deposition in the Planetary Data System (PDS) as soon as feasible but no later than six months after data acquisition.

#### *4.4.1 Data Analysis*

Mars 2020 PIs will be responsible for initial calibration, validation, and analysis of the data, its subsequent delivery to the NASA Planetary Data System (PDS) in calibrated format (*i.e.*, with adequate documentation), and the timely publication of initial scientific or exploration technology results. (Note that information on the PDS, its formats, and its requirements is included in the Mars 2020 Program Library.)

Proposals to this AO must also include an adequately budgeted data analysis period, independent of PDS archiving activities, as a part of the Phase E activities that is understood to include publication of scientific or exploration technology results of the investigation in refereed journals. Failure to do so shall be reason for declaring a proposal as being nonresponsive to this AO and its return without further review.

PIs selected for instrument investigations must plan to archive their Data Products in the Planetary Data System (PDS) in a PDS-compatible data format. Plans must conform to policy and requirements for the validation and archiving of data presented in the document, "Mars Exploration Program Data Management Plan" (see Mars 2020 Program Library). After a short period for verification and validation, not to exceed six months, the PI must deposit the validated data in the PDS; analysis, preparation, distribution, and archiving of all instrument team data products are to be completed within six months of data acquisition. Exceptions to this guideline are to be identified and appropriate justification given. Data Products will be archived in the PDS as soon as they are available, on a time scale commensurate with the level of data processing to be identified in the jointly developed Science Data Management and Archive Plan. Image data is to be made available publicly shortly after reception on the ground.

Initial data analyses for the investigations solicited here will be accomplished by the PIs and their teams. Therefore, proposers are expected to include, as part of their proposed investigation Operations and Data Analysis activities, a clear definition of the roles of all the investigation team members and a data analysis plan that is consistent with PDS archiving activities. Cost estimates for PI investigation instrument team activities will cover all phases, including investigation operations and data analysis.

In addition, because of the requirement for deposition of data in the PDS, all PI instrument investigation proposals in response to this AO must specifically include the costs of calibration, verification, and preparation of data for transfer to the archive.

Level 0 (raw data) will be archived by the Mars 2020 Project.

#### *4.4.2 Data Rights*

It is NASA policy that PIs do not have exclusive use of data taken during the course of their investigation (see Section XII of Appendix A). All data from Mars 2020 investigations will be nonproprietary and must be made available to the science or exploration technology community and public as soon as possible. In order to engage the public more fully, investigators are strongly encouraged to release subsets of particularly interesting initial data on a daily to weekly basis (plans for, and actual release of, data for public engagement will be coordinated through the Mars 2020 Project Science Group). Therefore, as part of a proposer's data release plan, discussion of the volume and timing of data for early release must be addressed, and the necessary preparations costed accordingly. NASA, through the Mars 2020 Project, reserves the right to direct or conduct processing and release of data needed for mission or program planning and also to support public engagement. Imaging investigations will be expected to support Mars 2020 project outreach activities by providing for public release of JPEG versions of the raw images within 24 hours of receipt of data. All investigations will be expected to support preparation of press releases, including captioned imagery and data representations on a routine basis.

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

Mars 2020 PIs will be responsible for collecting the engineering and ancillary information necessary to validate and calibrate the scientific or exploration technology data prior to delivery to the PDS. Data products delivered to the PDS shall be documented, validated, and calibrated in physical units useable by the scientific or exploration technology community at large. The time required to complete this process and make the data available to the scientific or exploration technology community and the general public must be six months or less.

### 4.5 Project Management Policies

#### *4.5.1 Earned Value Management Plan*

For Government entities, the earned value management (EVM) requirements are listed in NPR 7120.5E. For entities receiving contracts, the EVM requirements are listed in NFS 1834.201N.

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

NASA has established a Cost Analysis Data Requirement (CADRe) in NPR 7120.5E, 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 Investigation 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 proposals. Supplemental requirements on standard proposal content and format are provided in Appendix B.

### 5.1 General Requirements

#### *5.1.1 Deliverables and Hardware Complement*

The instrument deliveries must be accompanied by all support equipment needed to support handling and system test. Support equipment includes, but is not limited to, the following: shipping containers, stand-alone handling fixtures, optical/thermal targets, test sources, protective remove-before flight covers, electrical ground-support equipment (EGSE) cabling, standalone health-check equipment. An End Item Data Package (EIDP) must accompany the flight hardware. The deliverables schedule is shown in Section 5.11.2 and the PIP.

##### 5.1.1.1 Flight-like Payload Bus Interface

A short-term loan of hardware to support early electrical and protocol tests and a preliminary electrical interface checkout test against a representative system-level interface will be required; for example, a plug-compatible breadboard, prior to EM delivery. The duration of the loan is expected to be on the order of several days. This unit may be used with the payload checkout bench (PCB) or developmental surface system hardware. The interface must be functionally identical to the flight model.

##### 5.1.1.2 Engineering Model (EM)

The EM is nonflight hardware that must be form, fit, and interface equivalent to the FM hardware. The EM is planned to be integrated into the Mars 2020 testbed. Specific details will be negotiated with the Mars 2020 Project and documented in the ICD.

##### 5.1.1.3 Flight Model (FM)

The flight model, or FM, will be integrated with the flight system. The accompanying ground-support equipment (GSE) must contain all hardware and software required for maintaining the health of the flight model and for providing stimulation and testing. Requirements for purges, etc. included in the ICD will be provided by the flight system subsequent to integration. Preintegration instrument-level purge carts, etc., will be the responsibility of the PI. Prior to the FM payload instrument integration, all instrument-level GSE will be the responsibility of the PI. Any anticipated instrument-unique accommodation elements should be described in the proposal.

##### 5.1.1.4 Flight Spares Strategy

Selected flight-level parts, subassemblies, and long-lead items must be deliverable as spares to be used in the event of a postdelivery failure of a flight instrument. PIs must propose a sparing strategy; a final sparing plan will be negotiated with each instrument after selection.

#### *5.1.2 Planetary Protection*

Planetary protection requirements and the scientifically driven desire for organic cleanliness will place constraints on instrument development, integration, and operations. The spacecraft, rover,

and instruments will require surface bioburden reduction and limits will be placed on background organic contamination. The Mars 2020 mission will, in particular, be subject to the established protocols that address forward contamination with respect to Mars. Specifically, it should be noted that the Mars 2020 mission will be subjected to rigorous cleanliness and bioprotection protocols that may require, among other procedures, surface cleaning by alcohol wiping or other process, dry heat microbial reduction, or other treatments as discussed in the PIP (see Mars 2020 Program Library and Appendix D under Additional NASA and Federal Documents). The Mars 2020 Project is responsible for the mission meeting the planetary protection requirements. However, it will be the responsibility of the proposer to have a planetary protection plan that would enable their instrument to meet planetary protection requirements.

Requirement 4. Proposals shall include plans for planetary protection and contamination control, as required by the PIP Sections 3.5 and 3.6.

## 5.2 Research Requirements

### *5.2.1 Scope of Proposed Investigation*

The overall mission objective of Mars 2020 is to explore and perform a detailed investigation of a site on Mars that was likely once habitable. Proposed investigations preferably will employ *in situ* scientific instrumentation capable of seeking signs of past life (had it been there) and selecting samples to be collected in a returnable cache. Additionally, instrumentation that makes measurements that address Strategic Knowledge Gaps and are synergistic with science goals will be considered.

Requirement 5. Proposals shall describe an investigation with goals and objectives that address the program objectives described in Section 2.

Requirement 6. Proposals shall demonstrate how the proposed investigation will fully achieve the proposed objectives.

### *5.2.2 Traceability of Proposed Investigation*

The Mars 2020 rover is intended to perform focused investigations that conclude with papers published in peer-reviewed archival journals, as well as deposition of appropriately reduced and calibrated data and derived products in the NASA PDS (see Section 4.4.1).

Requirement 7. Proposals shall clearly state the relationship between the 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 8. Proposals shall include a plan to calibrate (both preflight and inflight), 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 investigation cost.

### 5.2.3 Investigation Objectives and Requirements

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

Key requirements include:

- Broad and rigorous *in situ* science to characterize the geology, to identify and characterize ancient habitable environments, to identify sites with the highest preservation potential of ancient Martian life, and seek the signs of life within those environments.
- Acquiring a diverse set of samples intended to address a range of Mars science questions and storing them in a cache for potential return to Earth at a later time.
- Collection of critical data needed to plan for eventual human missions to the Martian surface that fit within the following defined SKG categories: (1) architecture drivers, (2) crew safety, and (3) operational.

Requirement 9. Proposals shall state the specific objectives and their required measurements at a level of detail sufficient to allow an assessment of the capability of the proposed investigation 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).

### 5.2.4 Baseline and Threshold Investigations

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

The “Baseline Investigation” is the investigation that, if fully implemented, would fulfill the Baseline Science or Exploration Technology Requirements, which are the performance requirements necessary to achieve the full science or exploration technology objectives of the investigation.

The “Threshold Investigation” is a descoped Baseline Investigation that would fulfill the Threshold Science or Exploration Technology Requirements, which are the performance requirements necessary to achieve the minimum science or exploration technology acceptable for the investment.

The differences between the Baseline Investigation and the Threshold Investigation provide resiliency to potential cost and schedule growth in the proposed formulation and implementation plan. An acceptable descope is any alteration of an investigation that renders it unable to accomplish one or more of the Baseline Investigation objectives, but allows accomplishment of all Threshold Investigation objectives.

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

Requirement 10. Proposals shall specify only one Baseline Investigation and only one Threshold Investigation.

Requirement 11. Proposals shall not identify any descopes or other risk mitigation actions that result in the investigation being unable to achieve the Threshold Investigation objectives.

### 5.3 Exploration Technology Requirements

#### *5.3.1 Scope of Proposed Investigations*

The capability to produce consumable and propellant oxygen from the Martian atmosphere is enabling for future human exploration mission architectures. The *in situ* production of oxygen significantly reduces the mass of oxygen that must be launched from Earth for the ascent from Mars and human consumption on Mars. NASA mission studies show that *in situ* oxygen production results in a 60% reduction in landed mass for human Mars missions. The mass savings introduced by the use of *in situ* resource utilization (ISRU) technologies may enable mission design options not presently available to mission designers, such as the elimination of Mars-orbit rendezvous, reduced Entry, Descent and Landing (EDL) system performance, and options for alternate ascent propellants. Expanding the design envelope has the potential to reduce the overall architecture cost and complexity.

A successful precursor mission is both prudent and required before incorporating ISRU into a mission-critical role for either crewed or robotic exploration missions. NASA's Mars 2020 mission presents an ideal opportunity to validate critical ISRU technologies in an extraterrestrial environment.

The PI must propose a primary exploration technology investigation payload option that is expected to reach TRL 6 maturity no later than PDR/Confirmation. To encourage innovation in technology development offerors are also highly encouraged to propose an advanced technology option with the potential to further minimize the mass, volume, and/or power as compared to the primary investigation payload. This technology development option should be performed in parallel with the design and development of the primary investigation. The details for the proposed advanced technology development option shall be presented, along with the primary design, at the payload PDR/Confirmation. If demonstrated to be of sufficient maturity (*e.g.*, TRL 6), the advanced technology development option could be inserted, in place of the primary investigation design, no later than the payload CDR. The PI will present the final investigation design at the payload CDR.

#### *5.3.2 Exploration Technology Investigation Requirements*

Because liquid oxygen is the greatest contributor to overall propellant mass for a human exploration class Mars ascent vehicle, the primary objective of this investigation is to collect carbon dioxide and use it to produce oxygen. The target purity for propellant-grade oxygen is greater than 99.6% by volume. An ideal investigation would validate the ability of an ISRU system to operate efficiently in varying Martian atmospheric conditions, including both diurnal and seasonal variations. Furthermore, exploration technology investigations should incorporate technologies that are scalable to support future human missions.

Requirement 12. Specific requirements for an ISRU payload are:

- The payload shall process the Martian atmosphere to produce oxygen.
- The generated oxygen shall be stored and its purity shall be measured.
- The payload shall be capable of intermittent operation.
- The payload shall not interfere with the operations of the science instruments.

Optional measurements:

- The size distribution of dust particles ingested in the inlet stream may be measured.
- The temperature, pressure, and relative humidity of the inlet stream may be measured.

Requirement 13. A Mars 2020 ISRU investigation shall meet or exceed the capabilities listed in the “Mars 2020” column in the table below. In addition, it is highly desirable that the payload demonstrate extensibility to capabilities for subscale validation and future human mission needs as shown in the table.

ISRU Plant Capabilities for Mars 2020 and Future Exploration Missions.

	Mars 2020	Subscale Validation Class Missions	Future Human Missions
Minimum Oxygen Production Rate	0.02 kg/hr	0.44 kg/hr	2.2 kg/hr
Minimum Operational Life	50 sols	500 sols	1,200 sols

### 5.3.3 Exploration Proposal Content

Requirement 14. The following specific requirements for ISRU investigation proposals are in addition to requirements outlined elsewhere in this AO:

- Describe the proposed ISRU payload, its concept of operations, and how it is relevant to solicitation objectives.
- Specify the ISRU payload performance objectives and critical figures of merit. Provide estimates of payload mass, volume, and power.
- Describe the overall development plan for the ISRU payload ensuring that the plan achieves the required level of maturity at the appropriate mission milestones.
- Identify any low-TRL technologies included in the ISRU payload concept (both the primary and the technology option), and describe the technology maturation approach.
- Provide analytical or experimental proof-of-concept that the proposed ISRU payload is feasible.
- Address the potential of the proposed solution to be scalable to NASA’s future exploration missions.
- Describe any optional measurements of atmospheric dust size and surface weather conditions that are included in the ISRU payload concept and how they are synergistic with mission science objectives.
- Describe the equipment, laboratories, and test facilities required to develop the proposed payload.
- Identify the critical risks and development challenges. Describe the risk mitigation plan.

## 5.4 Technical Requirements

A proposal in response to this AO must address all technical aspects of its investigation from the beginning of funding through delivery of the data for archiving and the publication of results in the peer-reviewed literature. The document, NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*, describes the activities, milestones, and products typically associated with Formulation and Implementation of projects and may be used as a reference in defining a team's approach (available through the Mars 2020 Program Library). Proposers are encouraged to propose innovative processes, techniques, and activities to accomplish these objectives and to demonstrate cost, schedule, and technical efficiencies.

Each Mars 2020 investigation shall have a cost-effective mission assurance program that is consistent with the PIP and PIP-related documents. Investigation specific requirements for mission assurance in particular are included in Section 8 of the PIP.

**A Radioisotope Power Supplies System (RPSs) are is** being considered for use as the primary rover power source on the Mars 2020 mission. The final decision on this implementation will not occur until Phase B for the Flight System. Thus, investigations chosen must meet design and verification requirements that allow for the radiation environments and extended lifetime afforded by this option. Environmental requirements information is available in the Mars 2020 Program Library. **[clarified September 27, 2013]**

The proposer is responsible for the success of his/her investigation. The proposal must describe the technical approach for every element of the investigation to ensure that the investigation does not exceed the bounds of the available spacecraft or financial resources. Investigators must recommend reserves for mass, power, and other technical resources based on the maturity of the proposed design and the technologies incorporated in the design approach.

### 5.4.1 Mission Overview

The Mars 2020 rover will be launched from the NASA Kennedy Space Center Eastern Test Range, on an intermediate-class (*e.g.*, Atlas V) launch vehicle, with a 20-day launch period, opening as early as July and as late as August 2020. Payload instruments will be in a power-off state during the launch and injection phase. The cruise phase begins when the spacecraft separates from the launch vehicle and ends prior to Mars entry, descent, and landing (EDL). The cruise phase lasts approximately 6 to 8 months, depending on the launch date, trajectory, and landing site selection. The rover will remain enclosed inside an aeroshell during the entire cruise. The landing date ranges from January to March 2021.

The EDL phase begins at entry vehicle separation from the cruise stage and ends with the soft touchdown of the rover on the surface and Descent Stage flyaway. Unless specifically required to meet investigation objectives, payload instruments will be in a power-off state during EDL. If operation during EDL is required, a significant level of additional fault containment and accommodation complexity will be incurred to allow operation during this mission critical event.

Primary landed mission operations are to continue for one Mars year, 669 sols (687 days). The landed mission begins after touchdown, with the mobility system already deployed. Initial landed operations include critical rover deployments, rover health checks, and establishment of

communication with Earth. Critical deployments include high gain antenna, remote sensing mast (RSM) and release of launch lock constraints on arms. After the remote sensing mast has been deployed, the rover will image the landing site. These data, along with rover health telemetry, will have priority for data return. Instrument health checks will be included in the early surface ops activities.

Five different Sol Templates describe the expected building blocks of the mission operations plan: Traverse, Context Measurement (Remote Sensing Science), Arm Manipulation and Contact Science, Coring/Caching, and Recharge/Telecom. The five Sol Templates are discussed in detail in Section 4.4.1 of the PIP.

At the end of the primary mission, an extended mission may continue until the end of the rover's useful life or the end of operations funding, whichever comes first.

NASA's commitment to cost efficiency in the Mars 2020 mission development will require an emphasis on use of MSL heritage in the Mars 2020 Flight System designs. This requires that the payload development also be accomplished with an emphasis on maintaining the validity of the heritage assumptions in its interfaces and accommodations requirements.

The payload will be allocated available resources for mass, energy, volume, data rate, duty cycle, and other key resources as specified in the PIP. Therefore, proposed instruments must demonstrate adequate reserves and margins consistent with their design maturity vs. contemporary design principles and engineering practice so that growth of the instrument resource requirements beyond identified and allocated margins is avoided.

#### *5.4.2 Complete Payload Investigation*

The term "complete" encompasses all appropriate mission phases (see Section 4.1.1) from project initiation (Phase A) through mission operations (Phase E), which must include analysis and publication of data in the peer-reviewed scientific or exploration technology literature, and delivery of the data to an appropriate NASA PDS archive, ~~and closeout (Phase F).~~ **[amended December 4, 2013]**

Requirement 15. Proposals submitted in response to this AO shall be for complete science or exploration technology investigations to be flown on the Mars 2020 mission.

Requirement 16. Proposals shall describe the proposed instrument(s) and the rationale for each instrument.

Requirement 17. Proposals of multiple instruments (suites) shall describe the rationale for the suite of instruments.

Requirement 18. Proposals shall describe the proposed instrument operations concept, assuming the Mars 2020 design described in the PIP.

Requirement 19. Proposals shall describe the instrument(s) accommodation requirements within the planned rover described in Section 5.4.3 and as described in the PIP.

Requirement 20. Proposals of multiple instruments in a suite proposal shall provide science or exploration technology, technical, and cost information for each instrument sufficient to allow for separate evaluation and selection.

See Appendix B, Sections E and F, for additional detail.

#### *5.4.3 Payload Resource and Accommodation Constraints*

For all investigations proposed in response to this AO, innovative design approaches that incorporate technological advances in low-cost, lightweight, high-performance instruments are encouraged. The most tightly controlled resources to Mars 2020 payload elements will be available funds and mass, with volume being significantly constrained for specific instrument placement locations (*e.g.*, arm and RSM mounted instrument hardware) based on the heritage design of the rover system. Other accommodation resources will be allocated and managed as well, but are largely dependent on the operational scenarios and duty cycles required to perform the various investigations. Interested proposers are encouraged to read and understand the PIP thoroughly to better plan for all payload accommodation and resource limitations and constraints. Instrument designs are expected to be compliant with the PIP.

Requirement 21. Proposals shall describe the instrument design and describe compliance with the PIP. Proposals shall describe any additional accommodation requirements or deviations from the PIP that would be required for instrument accommodation.

The current best estimate of the total mass allocation for the investigations solicited by this AO is 28 kg, including mass reserves to be recommended by the proposers. Although selection will be made against this total mass allocation, the PIP (see Mars 2020 Program Library) includes further details as to carrying capacity of the various anticipated instrument locations that will also be taken into account. Mass and requirements for reserve are discussed in the PIP in Section 3.2.3.

As part of the accommodation and integration of an instrument on the Mars 2020 spacecraft, the Project will provide suitably designed mounting brackets and/or platforms as defined in the PIP. However, the cost and development of any instrument-unique deployable masts and other mechanisms required by an instrument will be the responsibility of the proposer. The proposer must also ensure that any such masts or mechanisms do not interfere with the operation of the vehicle.

The current best estimates of the total payload volume allocations for various anticipated instrument locations are discussed in Section 3.2.2 of the PIP.

The current best estimate of total power/energy allocations for the investigations are based on a strawman mission scenario and representative Sol Templates. Allocations are described in the PIP. While Mars 2020 power will primarily be allocated based on per sol energy consumption limits and the strawman mission scenario, peak power will also be limited by the system's power switching capabilities. Power and energy allocation is further discussed in Section 3.2.4 of the PIP.

Approximately 2 GB of onboard memory will be allocated for storage of instrument data prior to downlink. Total data return capability will be limited (and variable) by the actual downlink opportunities and will likely range from ~100 to ~600 Mbits per sol presuming Mars relay orbiter UHF communication. Note that considering the age of the current orbiters, large data return capability cannot be guaranteed. A modest data volume (~ 15 to 30 Mbits/sol) will be accommodated for low-latency (same-sol) data return from the payload to enable critical operations planning cycles. Data volume allocations and constraints are further discussed in Section 3.2.5 of the PIP.

The achievement of an efficient and operable flight system requires an integrated approach to the management of the technical resources, as well as an integrated architectural approach to the operation of the instruments, spacecraft avionics, and spacecraft flight software. Each instrument team is expected to participate in the system engineering processes that are required to achieve this goal. This is discussed further in Sections 3 and 6 of the PIP.

Requirement 22. Proposals shall describe the resources, strategy and approach for instrument team participation in the spacecraft system development.

#### *5.4.4 Payload Operations Requirements*

It is expected that each PI of an instrument investigation selected through this AO will provide personnel to support flight operations specific to their instrument and maintain an investigation operations facility at their own institution.

Each PI provides personnel to support flight operations specific to their instrument. These personnel will be members of the project operations team and participate in both the tactical and strategic operations processes. The project operations team is a virtual team whose members will primarily not be collocated with JPL and other instrument teams except for specific prelanding tests and during the first ~90 sols after landing.

Each instrument team is expected to participate in the strategic planning process (which nominally has a time horizon of 5 to 7 sols). In addition, whenever an instrument's data is involved in the tactical decision-making, or whenever an instrument is requesting interactive commanding, instrument team participation will be required. This includes the generation of instrument specific command sequences for inclusion in the tactical uplink process, daily science and exploration technology data processing, and instrument health assessment. For very interactive instruments, this could be every sol. Costing should take into account the required frequency and complexity of instrument support to the operations process. More details can be found in Section 5.2.1.6 of the PIP.

The primary Mars 2020 Mission Support Area (MSA) will be provided at JPL. The JPL MSA will be sized to accommodate key instrument team members for selected periods, including the early surface operations for characterization of the spacecraft and instruments. After the first ~90 days on the surface, instrument team members will return to their home institutions and support operations remotely. It is expected that each PI of an instrument investigation selected through this AO will develop and maintain an instrument operations facility at his or her own

institution. This facility should provide for instrument command sequence generation and transmission to the Mars 2020 Project at JPL, be able to retrieve essential instrument telemetry data for instrument performance assessment and health and welfare assessment, retrieve instrument science or exploration technology data, allow remote participation in the operations science or exploration technology decision process, and provide a means for validating science or exploration technology data and preparing science or exploration technology data for archiving. The PI operations facility and network configuration must meet Project-specified security requirements. The plans and budget for the design and staffing of these individual PI investigation operations facilities must be provided in the proposals.

As discussed in PIP Section 7.4.2.5, the Mars 2020 Project will specify a Science Operations and Planning Computer (SOPC) environment and provide operations compatible software tools, connections to an acceptable network, and software maintenance. Implementation of investigation operations facilities and capability in time to support spacecraft/instrument testing and operations will be monitored by the Mars 2020 Project by means of schedules, peer reviews, formal reviews, meetings, documentation, and configuration control.

#### *5.4.5 Accepted Management Processes and Practices*

The document NPR 7120.5E, *NASA Space Flight Program and Project Management Processes and Requirements*, delineates activities, milestones, and products typically associated with Formulation and Implementation of projects; it should be used *as a reference* in defining an investigation team's management approach. The implementing organizations are free to propose their own processes, procedures, and methods for managing their investigations; however, they must be consistent with the principles of NPR 7120.5E.

Requirement 23. Proposals shall describe the investigation's proposed management approach, including the management organization and decision-making process, the teaming arrangement, the responsibilities of the PI and other team members, and the risk management and risk mitigation plans (see Appendix B, Section G, for additional detail).

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

Requirement 24. Proposals shall describe the investigation's proposed systems engineering approach, including plans, tools, and processes for requirements, interfaces, and configuration management. (see Appendix B, Section F, for additional detail).

#### *5.4.6 New Technologies/Advanced Developments*

This AO solicits flight investigations, 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 7123.1B *NASA Systems Engineering Processes and Requirements*, Appendix E, which can be found in the NASA Online Directives Information System (NODIS) or the Program Library. 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 PDR/Confirmation and adequate backup plans in the event that the technologies cannot be matured as planned.

Requirement 25. Proposals that use technologies currently at less than TRL 6 shall include a plan for technology maturation to TRL 6 no later than PDR/Confirmation and a backup plan that shall be at TRL 6 well beforehand, in the event that the proposed technologies cannot be matured as planned (see Appendix B, Section F, for additional detail).

#### *5.4.7 Use of Radioactive Material*

This AO allows for investigations to baseline use of low level radiological calibration or signal sources for instrumentation.

The proposed use of radioactive materials of any quantity and any isotope, including radioactive calibration sources for science or exploration technology instruments, will require review for environmental impact and nuclear launch safety approval (NLSA). The environmental review requirements flow from the *National Environmental Policy Act* (NEPA) and are specified in NPR 8580.1, *Implementing the National Environmental Policy Act and Executive Order 12114*. The NLSA requirements are specified in NPR 8715.3, *NASA General Safety Program Requirements*, Chapter 6: “Nuclear Safety for Launching of Radioactive Materials.” The effort required for NLSA consists of 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). The Mars 2020 Project is responsible for NLSA and NEPA compliance.

Requirement 26. If use of radioactive materials is proposed (*e.g.*, for calibration sources or other instrument operational purposes), the proposal shall include a listing of the estimated radioactive materials to be used (isotope, form, quantity, and estimate of A2 mission multiple as determined by Chapter 6 and Appendix D of NPR 8715.3). The proposal shall provide a rationale for the use of radioactive materials and reasonable, nonradioactive alternatives if possible.

Requirement 27. The cost impacts of any instrument-related radioactive materials on the Mars 2020 mission’s environmental review and launch approval process will be included by the Mars 2020 Project as an estimated accommodation cost for the proposed investigation.

#### *5.4.8 Deviations from Recommended Payload Requirements*

Mars 2020 investigations are required to meet the requirements for safety, reliability, and mission assurance in D-79808, *Mars 2020 Mission Assurance Plan (MAP)* (see Program Library).

Requirement 28. Proposals shall indicate any expected deviations from the recommended requirements in D-79808, *Mars 2020 Mission Assurance Plan (MAP)*.

#### *5.4.9 Mission Operations Tools and Services*

The Mission Operations System (MOS) is the collection of team structure, planning strategies, tools, services, and supporting infrastructure working together to support efficient flight operations. The Mars 2020 mission will capitalize on the mission system tools and services that have provided the foundation for previous NASA Mars rover operations. The Mission Operations System is described in detail in Section 5 of the PIP.

The Ground Data System (GDS) element of the MOS provides the tools and services necessary to conduct flight operations. This includes the basic tools and services necessary for the creation of commands and command sequences and the tools and services necessary to acquire and analyze instrument data. It is expected that each PI of an instrument investigation selected through this AO will supply the instrument-unique elements necessary for adaptation of the GDS for Mars 2020 as described in Section 6 of the PIP.

### **5.5 Management Requirements**

With appropriate NASA/JPL oversight, NASA intends to give the PI and his/her team the ability to use their own management processes, procedures, and methods to the fullest extent possible. Therefore, each proposing PI instrument investigation team is encouraged to define the management approach best suited for their particular investigation and teaming arrangement. This approach should be commensurate with the investigation's implementation approach, while retaining a simple and effective management structure that ensures adequate control of the investigations' design and development within the cost and schedule constraints. The proposal must contain a Work Breakdown Structure (WBS) that best fits its organizational approach and the overall investigation design. Section 7 of the PIP provides guidance on Project imposed requirements for: reviews; deliverables; and other science, exploration technology, and payload management related items.

Requirement 29. Proposals shall define management and teaming approaches in an implementation plan that is commensurate with the investigation's implementation approach.

See Appendix B, Section G, for additional detail.

#### *5.5.1 Principal Investigator*

The Principal Investigator (PI) is accountable to NASA for the success of the investigation, with full responsibility for its science or exploration technology integrity and for its execution within committed cost and schedule. A deputy PI may be designated, where a clear division of responsibility can be established.

Regardless of the number of instruments proposed, each instrument investigation must be led by a single PI who is responsible for managing the selected investigation and interfacing with the Mars 2020 Project Office.

The PI must be prepared to recommend project termination when, in her/his judgment, the minimum subset of investigation objectives identified in the proposal as the Threshold Investigation (Section 5.2.4) is not likely to be achieved within the committed cost and schedule.

Requirement 30. A proposal shall identify and designate one, and only one, PI as the individual in charge of the proposed investigation.

#### *5.5.2 Instrument Project Manager*

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

Requirement 31. A proposal shall identify a single Instrument Project Manager as the individual charged with the responsibility for overseeing the technical and programmatic implementation of the proposed investigation.

Requirement 32. Proposals shall clearly define the respective roles of the PI and IPM.

#### *5.5.3 Management and Organization Experience and Expertise*

The qualifications and experience of the PI, IPM, ~~Instrument Scientist (IS)~~, and other key members of the PI-led investigation team must be commensurate with the technical and managerial needs of the proposed investigation. **[amended December 4, 2013]**

The implementing institutions, selected and overseen by the PI, have the responsibility to ensure that the investigation meets schedule and cost constraints. It is the IPM and the implementing institutions' responsibility to provide the quality personnel and resources necessary to meet the technical and managerial needs of the investigation. The commitment, spaceflight experience, and prior experience of the key members of the PI-led investigation team and of the implementing institutions will be assessed against the needs of the investigation.

Requirement 33. Proposals shall identify key management positions. These positions shall include, as a minimum, the PI, IPM, and, where appropriate, the ~~IS and~~ partner leads for substantial efforts. For management positions for which key management team members are named (including the PI and IPM per Requirement 30 and Requirement 31), proposals shall describe the qualifications and experience of those team members. 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. **[amended December 4, 2013]**

Requirement 34. 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.

#### *5.5.4 Risk Management*

Proposers must demonstrate clear understanding of specific risks inherent in the formulation and implementation of their proposed investigation and must discuss their approaches to mitigating these risks. Examples of such risks that must be discussed in the proposal are: any new

technologies, or any nontrivial modifications or upgrades of existing technologies proposed for the investigation; increased planetary protection requirements, which may be as stringent as Category IVb; any validation of heritage technology for the investigation 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 investigation.

Requirement 35. Proposals shall define and discuss the major risks to the formulation and implementation of the proposed investigation.

Requirement 36. 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 Investigation and the Threshold Investigation (see Section 5.2.4) may provide some resiliency to potential cost and/or schedule growth in the proposed formulation and implementation of the investigation. One method of responding to such growth is to descope the investigation. Any set of descopes, which still allows the investigation to satisfy the objectives of the Threshold Investigation, may be proposed.

Requirement 37. If the proposed risk management approach includes potential descoping of investigation capabilities, the proposal shall include a discussion of the approach to such descopes, including savings of resources (mass, power, dollars, schedule, etc.) by implementing descopes, the decision milestone(s) for implementing descopes, and the scientific or exploration technology impact of individual, as well as combined, descopes.

Requirement 38. Proposals that include international participation shall address the risk resulting from any international contributions to the proposed investigation (see Section 5.8.8 and Section 5.9).

#### *5.5.5 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, available in the Program Library.

Requirement 39. 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).

### **5.6 Investigation Team, Co-Investigators, and Collaborators**

#### *5.6.1 Investigation Team*

Requirement 40. Proposals shall clearly define the investigation team necessary to successfully conduct the investigation.

### *5.6.2 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 implementation of the investigation, 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 41. Proposals shall designate all Co-Is, describe the role of each Co-I in the development of the investigation, and justify the necessary nature of the role.

Requirement 42. Proposals shall identify the funding source for each Co-I. If funded by NASA, costs shall be included in the PI-Managed Investigation Cost. If contributed, the costs shall be included in the Total Investigation Cost.

### *5.6.3 Collaborators*

A collaborator is an individual who is less critical to the successful development of the investigation 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 43. Proposals shall identify and designate all collaborators.

## **5.7 Small Business Participation and Education and Public Outreach**

### *5.7.1 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 investigation contracts resulting from this solicitation that offer subcontracting possibilities, exceed \$550,000 (\$650,000 if the offeror is a U.S. Government organization), 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. Failure to submit a required subcontracting plan will make the offeror ineligible for selection. The subcontracting plans will be evaluated on the participation goals and quality and level of work performed by small business concerns overall, as well as that performed by the various categories of small business concerns listed in FAR 52.219-9.

During Phase A of each selected investigation, regardless of whether subcontracting plans were submitted with the associated proposal, offerors other than small business concerns are required to submit small business subcontracting plans covering later Phases. Failure to submit a subcontracting plan will make the offeror ineligible for subsequent implementation and operation phases.

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.

**Requirement 43a. A small business subcontracting plan, covering Phase A, including the proposed goals and targets and the quality and level of work that will be performed by various categories of small business concerns, as described in Appendix A, Section XIII, of the AO, shall be provided as proposal Section I. This plan will be negotiated prior to any Phase A contract award. If not applicable, indicate so. [amended December 4, 2013]**

#### *5.7.2 Core Education and Public Outreach (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. Core E/PO programs have facilitated this communication. The Mars Exploration Program and the Mars 2020 mission will follow SMD guidelines for Education and Public Outreach. Since the E/PO plans of individual investigations are not a consideration in the selection of proposals to this AO, they need not be included in proposals at this time.

### **5.8 Cost Requirements**

#### *5.8.1 PI-Managed Investigation Cost and Total Investigation Cost*

It is the intent of NASA to select a combined payload that best satisfies the Mars 2020 science and exploration technology requirements within the most favorable combination of payload mass and combined instrument cost. Presently, the Mars 2020 Project is budgeting SMD guidelines of approximately \$100M RY for the development of the science instrument payload. Additionally, exploration technology investigations are budgeted at approximately \$30M RY, including operations. These guidelines include all investigation reserves and cover all phases of development activity through Launch plus 30 days. In addition, approximately \$60M has been budgeted for the SMD funded investigations' operations and data analysis phase (cruise, one Martian year baseline, plus six months nominal data analysis, validation, and archive close out period), including reserves. Note that the Mars 2020 Project's current plan for cost reserve management requires commitment of any proposed cost reserves be reviewed and approved by a

process led by the Mars 2020 Payload Manager and involving the PI and the Mars 2020 Project Scientist as appropriate.

Cost realism and overall cost effectiveness are important criteria in the selection of the investigations. Therefore, a realistic schedule and budget for development are required, including the identification and proposed acquisition/development of long-lead items.

Requirement 44. Proposals shall include the proposed PI-Managed Investigation Cost and the proposed Total Investigation Cost in all required AO cost tables (see Appendix B, Section H, for required AO cost tables).

Requirement 45. For science instrument investigations, 25% of the Phase A-D PI-Managed Investigation Cost may nominally be proposed to be spent prior to an investigation's PDR/Confirmation. With proper justification based on heritage and/or risk reduction, up to 40% may be proposed. For exploration technology investigations, 10% of the Phase A-E PI-Managed Investigation Cost may nominally be proposed to be spent prior to an investigation's PDR/Confirmation. With proper justification up to 20% may be proposed.

#### *5.8.2 Funding Profile Constraints*

The Mars 2020 funding profile is constrained during the first part of the Mars 2020 development, with the bulk of funding to come after FY 2014 (see Appendix E of this AO for investigation planning budget profile), which should be reflected in the funding profiles for each proposal. For the Phase A/B period (running from start of the Phase A contract until successful Preliminary Design Review/Confirmation of the investigation), the funds available for instrument development are constrained (including reserve) to approximately \$25M RY for SMD and approximately \$3M RY for HEOMD/STMD. These limits include all financial obligations, including any contracts for long lead items needing to be placed during this Phase A/B period. Investigations that successfully complete Phase A/B may be confirmed (at a Preliminary Design Review/Confirmation Review) and will then be funded from a combined allocation of approximately \$75M RY for SMD, for Phase C/D covering all investigations. Proposed HEOMD/STMD funding profiles for Phase C/D are to be provided in the cost plan.

#### *5.8.3 Investigation Unique Teaming and Funding Requirements*

The unique investigation management approaches and organizational arrangements in the selected proposals may require the Mars 2020 Project to implement diverse contract administration and funding arrangements.

Requirement 46. Proposals shall specify the proposed teaming arrangements, including any special contracting mechanisms that are advantageous for specific partners in the team. If more than one contractual arrangement between Mars 2020 Project and the proposing team is required, proposals shall identify how funds are to be allocated among the partnering organizations.

#### *5.8.4 Cost Estimating Methodologies and Cost Reserve Management*

Proposals may use estimates derived from models or cost estimating relationships from analogous investigations (see Appendix B, Section H, for additional detail).

Requirement 47. Proposals shall identify the methodologies (cost models, cost estimating relationships of analogous investigations, etc.) and rationale used to develop the proposed cost.

Requirement 48. Proposals shall include a discussion of sources of estimate error and uncertainty in the proposed cost and management approaches for controlling cost growth.

Investigators must recommend cost reserves within the overall allocation based on the maturity of the proposed design and the technologies incorporated in the design approach. The cost reserves will be evaluated and the findings factored into the best value assessment.

Adequate unencumbered cost reserves for Phases A/B/C/D is defined to be a minimum of 20% **of the Phase A-D portion** of the PI-Managed Investigation Cost. Proposals that are unable to show adequate unencumbered cost reserves are likely to be judged a high cost risk. Cost reserves are considered separately for Phases A-D and Phase E. For the purpose of this AO, the unencumbered cost reserves on the PI-Managed Investigation Cost are measured as a percentage against the cost to complete through Phases A/B/C/D or E. The numerator is the amount of unencumbered cost reserves for Phases A/B/C/D or E respectively, not including funded schedule reserve. The denominator is the PI-Managed Investigation Cost to complete Phases A/B/C/D or E respectively, including the cost of technical design margin, funded schedule reserve, and encumbered cost reserve, but not including unencumbered cost reserve. **[amended December 4, 2013]**

Adequate unencumbered cost reserves must be demonstrated at each of the following milestones: Accommodation and Definition Phase initiation (demonstrated in the proposal), Preliminary Design Phase initiation (demonstrated in the Phase A Accommodation Review), Detailed Design and Implementation phase (the independent cost estimate for Confirmation and at PDR, and updated at CDR), and prior to flight (at the start of Phase E/Mission Flight Readiness Review, generally 30 to 90 days after launch).

Requirement 49. Proposals shall justify the adequacy of the proposed cost reserves, given that the investigation will be cost-capped at the proposed PI-Managed Investigation Cost when selected. Any increase in the cost-cap (e.g., due to accommodation adjustments) must be negotiated with the Mars 2020 Project. Proposals shall demonstrate an approach to maintaining adequate unencumbered cost reserves through subsequent development and operations phases. A proposed unencumbered cost reserve burn-down curve based on retirement of significant risks shall be included in the cost plan.

#### *5.8.5 Work Breakdown Structure*

Requirement 50. Proposals shall provide a Work Breakdown Structure (WBS) that conforms to the standard prescribed in Appendix B. Proposals should also provide a WBS dictionary further describing the elements of their cost. Costs for most elements shall be specified to WBS Level-2. Exceptions are the costs of key elements that explicitly appear only at a level below WBS Level-2; these exceptions include individual instruments subsystems, unique procured flight hardware elements, and data analysis/archiving (see Appendix B, Section G, for additional detail). The WBS must provide adequate insight into each individual instrument in a suite proposal.

#### *5.8.6 Master Equipment List*

Requirement 51. Proposals shall include a Master Equipment List (MEL) summarizing individual instrument element components to support validation of proposed mass estimates, design heritage, and cost (see Appendix B, Section J.9, for additional detail).

#### *5.8.7 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 Investigation Cost all costs required for the performance of the research effort. Even if the NASA civil servant labor and benefits costs will be covered by a civil service labor and expense account so that these costs will not be paid from the resulting award, they still must be accounted for within the PI-Managed Investigation Cost.

For the purpose of calculating the full cost of NASA provided services for proposals submitted in response to this AO, the Center Management and Operations (CM&O) burden should be applied only to NASA provided labor, including Center civil servants and on-site contractors; this cost must be included in the PI-Managed Investigation Cost.

Do not include within the cost proposal, nor within the PI-Managed Investigation Cost, other costs not paid with Mars 2020 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 Investigation 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.

NASA Centers should use the CM&O rate specified in the most recent Agency Strategic Programming Guidance (SPG) issued by the Office of the Chief Financial Officer (OCFO).

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

	Identify in proposal	Include in PI-managed investigation cost	Funding source	Comments
Civil Service Labor	Yes	Yes	Mission Directorate (MD) Programs	includes benefits
Civil Service Travel	Yes	Yes	MD Programs	
Other Direct	Yes	Yes	MD Programs	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-MD
Non-NASA Federal Government (funding requested from NASA)	Yes	Yes	MD Programs	if NASA funding is requested for the non-NASA Federal Government agency
Contributions	Yes	No	Identify	includes all non-NASA contributions

**Requirement 52.** Proposals including costs for NASA Centers shall conform to the full cost policy stated in Section 5.8.7. 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 53.** 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 54. Proposals including costs for non-NASA Federal Government agencies shall follow the applicable accounting standards.

#### *5.8.8 Contributions*

U.S. or non-U.S. contributions from sources other than the Mars Exploration Program, other SMD programs, HEOMD, or STMD 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 investigation, as well as to ensure that investigations 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 the proposed PI-Managed Investigation Cost. Such contributions will not be counted against the PI-Managed Investigation Cost, but they must be included in the calculation and discussion of the Total Investigation Cost (Section 4.3.2).

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 selection of the investigation. 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 55. If a proposal includes one or more contributions, the proposal shall separately identify all contributions, the organizations providing the contributions, and the organizations providing the funding for the contributions; the costs for the contributions shall be clearly identified within the Total Investigation Cost.

Requirement 56. 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 5.10.1.1 and Requirement 64; for non-U.S. contributing organizations, see Section 5.9.2 and Requirement 59).

The requirement for institutional Letters of Commitment for contributions does not apply to contributed support for Co-Investigators or collaborators; no institutional Letters of Commitment are required with the proposal for contributed Co-Investigator or collaborator support. The requirement for personal statements of commitment from contributed Co-investigators and collaborators is given in Section 5.10.1.3 and Requirement 66.

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 57. 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 or exploration technology, and technical capabilities, and (iii) contingency plans for coping with potential failures of proposed cooperative arrangements or, where no mitigation is possible, an explicit acknowledgement to that effect.

## 5.9 Non-U.S. Participation Requirements

### *5.9.1 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.

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

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

### *5.9.2 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 58. 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 59. 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 5.10.1. Officials who are authorized to commit the resources of the non-U.S. funding agencies must sign these Letters of Commitment.

Requirement 60. 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. When no mitigation is possible, this should be explicitly acknowledged.

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 selection.

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 61. 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.

Requirement 62. 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 (detailed budget not required), 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.

### *5.9.3 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 investigations. It is usually not possible for NASA to conclude an international agreement prior to conclusion of Phase A activities. Although, in some cases, interim agreements may be put in place until a more permanent arrangement is reached, proposers should be prepared to accomplish Accommodation and Definition tasks without requiring a final international agreement to be in place.

### *5.9.4 Export Control Guidelines Applicable to Non-U.S. Proposals and Proposals including Non-U.S. Participation*

Requirement 63. Non-U.S. proposals and U.S. proposals that include non-U.S. participation shall describe plans for compliance with U.S. export laws and regulations, *e.g.*, 22 CFR Parts 120-130 and 15 CFR Parts 730-774, as applicable to the circumstances surrounding the particular non-U.S. participation (see Appendix B, Section J.5, for additional detail).

## 5.10 Additional Proposal Requirements

### *5.10.1 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 and collaborator services) on a no-exchange-of-funds basis, including all non-U.S. organizations providing hardware or software to the investigation (see Section 5.8.8) 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.

#### 5.10.1.1 Letters of Commitment for Contributions

An institutional Letter of Commitment for a contribution must contain the required elements described in Section 5.10.1.

Requirement 64. 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 5.9.2 and Requirement 59.

#### 5.10.1.2 Letters of Commitment for Major Partners

Major partners are the organizations, other than the proposing organization, responsible for providing science leadership, exploration technology leadership, project management, system engineering, major hardware elements, science or exploration technology 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 5.10.1.

Requirement 65. 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.

#### 5.10.1.3 Personal Letters of Commitment

No personal or institutional Letters of Commitment are required for Co-investigators, collaborators, or other proposal team members in the 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).

Requirement 66. 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.

#### *5.10.2 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 67. 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/>.

## 5.11 Program Specific Requirements and Constraints

### *5.11.1 Commitment for a Single-Step Selection*

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

Requirement 68. Each proposal must include a commitment by the PI for the cost, schedule, and scientific or exploration technology performance of the investigation.

### *5.11.2 Schedule Requirements*

In order to meet the launch window in July/August 2020, adherence to the following nominal program schedule is anticipated:

Phase A/Payload Accommodation Phase Complete	September 2014
Instrument Preliminary Design Review (PDR) and Confirmation Review for Phase C/D	May/June 2015
Project PDR	July 2015
Instrument Critical Design Review (CDR)	August 2016
Project CDR	September 2016
Delivery of Instrument Engineering Model hardware to JPL	March 2017
Delivery of Instrument flight hardware to JPL	December 2018
Mission launch	July/August 2020

## 6. Proposal Submission Information

### 6.1 Preproposal Activities

#### *6.1.1 Preproposal Conference*

A Preproposal Conference will be held in via web/teleconference, in accordance with the schedule in Section 3. Further information, including logistics, will be available at the Mars 2020 Acquisition Homepage (see Section 6.1.5) prior to the Preproposal Conference.

All interested parties may participate. All expenses for attending this meeting are the responsibility of the attendees. Note that 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 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 Mars 2020 Program Scientist at the address given in Section 6.1.6. 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 Mars 2020 Acquisition Homepage at the address given in Section 6.1.5 two weeks after this event. Additional questions and answers subsequent to the conference will also appear in this location, if necessary. Questions may be submitted until 14 days before the proposal due date given in Section 3. It is expected that all questions and answers will be posted on the Mars 2020 Acquisition Homepage at the address given in Section 6.1.5.

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

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

A NOI is submitted electronically by entering the requested information at <http://nspires.nasaprs.com/>. Registration on the NSPIRES website is required to submit NOIs and proposals. Proposers who experience difficulty in using the NSPIRES site should contact the Help Desk by 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 and collaborator. 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) A brief statement (150 words or less) for each of the following:
  - (i) objectives of the proposed investigation;
  - (ii) identification of new technologies that may be employed as part of the investigation.
- (d) The name of the organizational lead from each organization (industrial, academic, nonprofit, and/or Federal) included in the proposing team and the organization's role in the proposed investigation, as may be known at the time of the NOI.

SMD requests that proposers communicate any changes to the investigation team between NOI and proposal submission to the Mars 2020 Program Scientist identified in Section 6.1.6 of this AO. Submitting an NOI does not commit the team to submitting a proposal.

### *6.1.3 Questions*

Questions regarding clarification of items in the AO, or the Mars 2020 Program Library references including the PIP should be submitted by mail/E-mail to the Mars 2020 Program Scientist (see Section 6.1.6 below). Requests for clarification of potential conflicts between the AO and PIP should also be submitted.

Responses to all inquiries will be answered by E-mail and/or posted at the Frequently Asked Questions (FAQ) location of the Mars 2020 Acquisition Website. Questions may be submitted until two weeks before the proposal due date. Questions can also be raised at the Preproposal Conference (see Section 6.1.1 above). Anonymity of persons/institutions who submit questions will be preserved.

### *6.1.4 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 Mars 2020 Teaming Interest page of the Mars 2020 Acquisition Homepage (see address given in Section 6.1.5) have expressed interest in teaming with other organizations on Mars 2020 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.

### *6.1.5 Program Library and Acquisition Home Page*

The Mars 2020 Program Library provides additional regulations, policies, and background information on the Mars 2020 Program. Information on the Program Library is contained in Appendix D. The Program Library is described in Appendix D and is accessible at <http://soma.larc.nasa.gov/mars2020/programlibrary.html>

The Mars 2020 Acquisition Homepage, available at <http://soma.larc.nasa.gov/mars2020/index.html>, will provide updates and any AO addenda during the Mars 2020 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 Mars 2020 Acquisition Homepage to the NSPIRES index page for the AO.

#### *6.1.6 Point of Contact for Further Information*

Inquiries about this AO may be directed to the Mars 2020 Program Scientist:

Dr. Mitchell D. Schulte  
Planetary Science Division  
Science Mission Directorate  
National Aeronautics and Space Administration  
Washington, DC 20546-0001  
Telephone: 202-358-2127  
Fax: 202-358-3097  
E-mail: [mars2020-ao@lists.nasa.gov](mailto:mars2020-ao@lists.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 69. Proposals shall conform to the uniform proposal format outlined in Appendix B.

#### *6.2.2 Certifications*

The authorizing institutional signature on the proposal certifies that the proposing institution has read and is in compliance with the required certifications 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 70. Electronic proposal files (see Appendix B) shall be submitted electronically via NASA's master proposal database system, the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com/>. This data site is secure and all information entered is strictly for NASA's use only. The proposal submittal deadline is specified in Section 3. [Partially repeats Requirement 2]

Requirement 71. In addition to electronic submission, two identical, clearly labeled CD-ROMs that contain electronic proposal file(s), Microsoft Excel files of tables, and a Microsoft Word

version of Table B6 (see Appendix B), shall be delivered to the following address by the proposal submittal deadline specified in Section 3. [Partially repeats Requirement 3]

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

Phone for commercial delivery: 202-479-9030

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 Mars 2020 Program Scientist at the address given in Section 6.1.6.

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 through NSPIRES, NASA's master proposal database system located at <http://nspires.nasaprs.com/>. This data site is secure and all information entered is strictly for NASA's use.

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

Requirement 72. 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 66).

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

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

### ***6.2.5 Submission of Proposals by Non-U.S. Organizations***

**In order to be able to submit a proposal to NASA, the PI needs to be “affiliated” with an NSPIRES organization and have an authorizing official from that organization submit the proposal; PIs cannot submit proposals themselves. Because many foreign organizations have not registered in NSPIRES, an organization has been created within NSPIRES that can be used to submit a proposal under the following conditions (which must all be met):**

- **The proposing organization is a non-U.S. organization. U.S. organizations must be registered in NSPIRES and proposals from U.S. organizations must be submitted by an authorizing official from the proposing organization.**
- **The proposing organization is not already registered in NSPIRES.**
- **In lieu of the proposal being submitted by an authorizing official of the proposing organization, the proposal must include a Letter of Submission that is signed by an authorizing official of the proposing organization. The Letter of Submission should be placed following the Fact Sheet and preceding the proposal Table of Contents. The Letter of Submission, if appropriately worded, can also serve the purpose of the letter of financial endorsement referenced in Section 5.10 of this Announcement of Opportunity.**
- **PIs considering taking advantage of this option must notify the NASA contact prior to December 31, 2013. [added December 3, 13]**

## **7. Proposal Evaluation, Selection, and Implementation**

### **7.1 Overview of the Proposal Evaluation and Selection Process**

Investigations employing individual instruments or suites of instruments may be proposed. Proposals to this AO will be selected through a single-step process. NASA reserves the right to make partial selections of investigations, as described in Section II of Appendix A. In addition, NASA reserves the right to make tentative selections for Phase A with options for further Phases (also in Section II of Appendix A). More than one instrument of the same type may be selected for Phase A. At the end of Phase A, a review will be held to decide which investigations continue into Phase B. The option on contracts of those investigations not selected to continue will not be executed.

#### ***7.1.1 Evaluation Process***

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

Compliant proposals will be evaluated against the criteria specified in Section 7.2 by panels of individuals who are peers of the proposers. Proposals will be evaluated by more than one panel (e.g., a science or exploration technology 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. Exploration technology investigations as described in Section 5.3 will be evaluated by a panel that includes the proposers' peers.

In the case of investigations that propose to provide suites of instruments, the science or exploration technology merit; science or exploration technology implementation merit and feasibility of the proposed investigation; and the technical, management, and cost (TMC) **of each instrument** will be evaluated in addition to the overall suite.

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 investigation implementation (see Section 7.2.4), NASA will request clarification on specific, potential major weaknesses in the feasibility of investigation implementation that have been identified in the proposal. NASA will request clarification in a uniform manner from all proposers. The ability of proposers to provide clarification to NASA is 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. Due to the accelerated evaluation schedule, clarifications will not be requested for Factors A-1 through A-4 (see Section 7.2.2).

A proposal evaluation plan template can be found at [http://soma.larc.nasa.gov/StandardAO/sao\\_templates.html](http://soma.larc.nasa.gov/StandardAO/sao_templates.html).

#### *7.1.2 Categorization and Steering Process*

NASA will convene 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, with participation by HEOMD and STMD. The categorization subcommittee will consider the science and technology merit and feasibility peer reviews and TMC 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.

After categorization, the Mars 2020 Program Scientist may request payload accommodation assessments of highly ranked proposals to aid in developing a recommendation for selection of an integrated payload that addresses the AO objectives (Section 2). The accommodation assessments will be performed by firewalled members of the Mars 2020 Project Office (Section 7.3). The accommodation assessment may include Category I, II, and III investigations.

The SMD AO Steering Committee, with participation by HEOMD and STMD, 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 SMD who will make the final selection(s), with concurrence by Associate Administrators for HEOMD and STMD for the exploration technology investigations. As the Selection Official, the SMD Associate Administrator may consult with senior members of the Agency concerning the selections.

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

### **7.2 Evaluation Criteria**

#### *7.2.1 Overview of Evaluation Criteria*

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

- Intrinsic science or exploration technology merit of the proposed investigation;
- Experiment science or exploration technology implementation merit and feasibility of the proposed investigation; and
- Technical, management, and cost (TMC) feasibility of the proposed approach for investigation implementation, including cost risk.

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

The evaluation 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 (science or exploration technology merit and science or exploration technology 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 weaknesses 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 ( <i>e.g.</i> , 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. Investigation 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 Intrinsic Science or Exploration Technology Merit of the Proposed Investigation*

The information provided in a proposal will be used to assess the intrinsic science or exploration technology merit of the proposed investigation. Science or exploration technology merit will be evaluated for the Baseline Investigation and the Threshold Investigation. The factors for intrinsic merit include the following:

- Factor A-1. Compelling nature and priority of the proposed investigation's science or exploration technology goals and objectives. This factor includes the clarity of the goals and objectives; how well the goals and objectives reflect program, mission, Agency, and National priorities; the potential scientific or exploration technology impact of the investigation on program, mission, Agency, and National science or exploration technology 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 science or exploration technology progress in the context of other ongoing and planned missions; the relationship to the other elements of NASA's programs; how well the investigation may synergistically support ongoing or planned missions by NASA and other agencies.
- Factor A-3. Likelihood of science or exploration technology 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 investigation requirements for guiding development and ensuring success.
- Factor A-4. Science or exploration technology value of the Threshold Investigation. This factor includes the value of the Threshold Investigation using the standards in the first factor of this section and whether that value is sufficient to justify the proposed cost of the investigation.

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

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 or exploration technology merit of the investigation.

### *7.2.3 Experiment Science or Exploration Technology 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 experiment implementation merit, feasibility, resiliency, and probability of science or exploration technology success of the proposed investigation. The factors for scientific or exploration technology implementation merit and feasibility include the following:

- Factor B-1. Merit of the instrument and investigation design for addressing the science or exploration technology goals and objectives. This factor includes the degree to which the proposed investigation will address the goals and objectives; the appropriateness of the selected instruments and investigation design for addressing the goals and objectives; the degree to which the proposed instruments and investigation can provide the necessary data; and the sufficiency of the data gathered to complete the science or exploration technology investigation.
- Factor B-2. Probability of technical success. This factor includes the maturity and technical readiness of the instruments or demonstration of a clear path to achieve necessary maturity; the adequacy of the plan to develop the instruments within the proposed cost and schedule; the robustness of those plans, including recognition of risks and mitigation plans for retiring those risks; the likelihood of success in developing any new technology that represents an untested advance in the state of the art; the ability of the development team—both institutions and individuals—to successfully implement those plans; and the likelihood of success for both the development and the operation of the instruments within the investigation design.
- Factor B-3. Merit of the data analysis, data availability, and data archiving plan. This factor includes the merit of plans for data analysis and data archiving to meet the goals and objectives; to result in the publication of science discoveries in the professional literature; and to preserve data 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; reporting scientific or exploration technology results in the professional literature (*e.g.*, refereed journals); and assessment of the proposed plan for the timely release of the data to the public domain for enlarging its science or exploration technology impact.
- Factor B-4. Science or exploration technology resiliency. This factor includes both developmental and operational resiliency. Developmental resiliency includes the approach to descoping the Baseline Investigation to the Threshold Investigation 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 investigation team success. This factor will be evaluated by assessing the experience, expertise, and organizational structure of the investigation team and the experiment 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.

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

#### *7.2.4 TMC Feasibility of the Investigation 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 investigation implementation include the following:

- Factor C-1. Adequacy and robustness of the technical plan. This factor includes assessment of implementation elements such as: the overall investigation observation plan within the planned investigation design; the instrument design and design margins; the impact of the instrument on the heritage rover design, the impact of the instrument on payload resources, the impact of the proposed instrument on the rover and other instruments; and 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 investigation 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 Investigation.
- Factor C-2. Adequacy and robustness of the cost plan and schedule. This factor includes assessment of proposal elements such as cost and cost risk, the adequacy of the approach, the methods and rationale used to develop the estimated cost, the discussion of cost risks, the subcontracting plan, and the team's understanding of the scope of work (covering all elements of the investigation, including contributions). Proposals will be evaluated for the adequacy of the cost reserves and whether proposals demonstrate a thorough understanding of the cost risks. 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 cost and schedule management tools to be used on the project.
- Factor C-3. Adequacy of the management approach, including the capability of the management team. This factor includes: the adequacy of the proposed organizational structure; the management approach; the roles, qualifications, and experience of the PI, IPM, other named key management team members, and implementing organization, management team, and known partners; the commitment, spaceflight experience, and relevant performance of the PI, IPM, other named key management team members, and

implementing organization, 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 investigation, including contributions.

- Factor C-4. Adequacy of the risk management approach. The adequacy of the proposed risk management approach will be assessed, as will 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 descope of investigation capabilities will be assessed against the proposed Baseline Investigation. The plans for managing the risk of contributed critical goods and services will be assessed, including 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.
- Factor C-5. Technical readiness. This factor includes the plans for the development and use of new technology and the adequacy of backup plans to ensure success of the investigation when technologies having a TRL less than TRL 6 are proposed. The maturity and technical readiness of the instrument complement 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.

When appropriate, Factor C-1 will include an assessment of proposed planetary protection provisions to avoid potential biological contamination (forward and backward) that may be associated with the investigation.

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 instrument investigation implementation.

### 7.3 Selection Factors

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

Considering the critical role of the PI, IPM, and their institutions, prior experience (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, in consultation with the Associate Administrators for HEOMD and STMD for exploration technology investigations, may take into account a wide range of programmatic factors in deciding whether or not to select any proposals and in selecting among top-rated proposals, including, but not limited to, planning and policy considerations, available funding, programmatic merit and risk of any proposed partnerships, and maintaining a programmatic and scientific balance. 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 accommodation assessment to be conducted by firewalled members of the Mars 2020 Project will also inform the Selection Official of the technical, implementation, and operational risks associated with the accommodation of individual and combinations of investigations and especially the impact on the basic heritage assumptions being relied upon by the Mars 2020 Project in maximizing reuse of the MSL rover and systems design.

The overriding consideration for the final selection of proposals submitted in response to this AO will be to maximize scientific and exploration technology return and minimize implementation risk while advancing NASA's goals and objectives within the available budget. Therefore, proposed PI-Managed Investigation Costs, as well as the costs/risks to accommodate the investigation within the heritage rover design capabilities, will be considered in the final selection of investigations through this AO.

## 7.4 Implementation of Selected Proposals

### *7.4.1 Notification of Selection*

Selected proposers will be notified by telephone and by letter. The letter will provide instructions concerning the steps necessary to initiate funding of their award, and to schedule a debriefing by NASA with regards to the strengths and weaknesses noted in their proposals. Non-Government awardees will receive subcontracts from JPL. It is expected that all selected PIs will attend a first meeting of the Project Science Group (see Section 2.6.2) within 30 days of selection notification.

The Selection Statement for this solicitation, which will be signed by the Selection Official, may include information from the Proposal Summary for any proposal, whether or not it is selected. Since the Selection Statement is a releasable document, the Proposal Summary 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 Mars 2020 Project Office at the Jet Propulsion Laboratory. The responsibilities of the Mars 2020 Project Office will include oversight of investigation implementation; coordination of Government-furnished services, equipment and facilities; and contract management for selected investigations.

It is anticipated that the Mars 2020 Project Office will provide funding to the selected investigations, as **within the constraints** stated in Section 5.8.2 [**amended December 4, 2013**]. These Phase A awards to perform investigation Accommodation and Definition work are to be initiated as soon as possible after notification of Selection. Government organizations will receive funding via intraagency funding mechanisms, which are also to be managed by the Mars 2020 Project Office. In order to put Phase A awards in place quickly, Statements of Work (SOWs), cost and pricing data (as applicable), and small business subcontracting plans (as applicable) – all for the Phase A work – will be **required** to be included with proposals.

SOWs will be required from all investigations regardless of whether a proposing organization is Governmental or non-Governmental. SOWs will include the requirement for the Phase A Accommodation and Definition work, as well as general task statements for Phases B through E. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science or exploration technology data), and Government Responsibilities (as applicable). SOWs need not be more than a few pages in length. If more than one contractual arrangement between JPL and the proposing team is required, a separate SOW is required for each organization.  
**[amended December 4, 2013]**

For Phase A contracts that exceed \$650K (\$700K for NASA organizations), the contractor will be required to provide cost and pricing data to support the Phase A cost estimate, in the format specified in NPR 5800.1, *Grant and Cooperative Agreement Handbook*, Section A, Exhibit A, and to certify the costs proposed for the Phase A contract in accordance with FAR 15.406-2.

See Section 5.7.1 for details regarding small business subcontracting plans.

#### *7.4.3 Contribution of Investigations to Mission Key Decision Points*

The Mars 2020 project will follow the Key Decision Point gates as described in NPR 7120.5E. PIs will be expected to contribute to project documentation at each mission KDP. If, at any time, the cost, schedule, scientific, or exploration technology performance commitments appear to be in peril, the investigation will be subject to termination or cancellation.

#### *7.4.4 Confirmation of Investigations*

Using the results of the investigation Preliminary Design Review, NASA will conduct an independent review of the investigation's readiness to proceed to Confirmation. This review must be completed before the investigation will be authorized to spend more than the proposed/agreed to (based upon special instructions that may be contained in the Selection Letter) Phase A/B portion of the PI-Managed Investigation Cost. The results of the independent review and the project status will be presented to the SMD Program Management Council (PMC) at the Mission Confirmation Review (KDP-C) for Confirmation to enter Phase C. 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 by telephone and 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 5101.32E, *Procurement, Grants, and Cooperative Agreements*, 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

NASA plans to continue the pursuit of its “*Seeking the Signs of Life*” Mars Exploration Program science theme beyond the near-term missions that include *Curiosity* and *MAVEN*. The 2020 Mars rover mission will focus on *surface-based geological and geochemical reconnaissance in search of signs of life*, with clearly defined preparation for eventual return to Earth of carefully selected materials. Supporting *in situ* measurements will be undertaken to address key questions about the potential for life on Mars via possible preservation of biosignatures within accessible geologic materials. This mission will enable concrete progress toward sample return, thereby satisfying NRC Planetary Decadal Survey science recommendations, and provide opportunities for accommodation of contributed Human Exploration and Operations Mission Directorate and Space Technology Mission Directorate payload element(s), technology infusion, and international participation.

NASA's Science Mission Directorate invites the entire scientific and technical community, including international scientists, to participate in this important and exciting mission.



**James L. Green**  
Director, Planetary Science Division  
Science Mission Directorate



**John M. Grunsfeld**  
Associate Administrator for  
Science Mission Directorate

## APPENDIX A

### GENERAL INSTRUCTIONS AND PROVISIONS

*See 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 5.9 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 Phase A costs exceed \$650,000 (\$700,000 for NASA organizations). Cost or pricing data will also be required for proposals for subsequent investigation phases. The investigator's institution agrees that the cost proposal submitted in response to the AO 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 1815.208.)

#### VIII. SOURCE OF SPACE INVESTIGATIONS

Investigators are advised that candidate space investigations 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 1852.227-70, New Technology, shall apply. Such contractors may, in advance of a contract, request waiver of rights as set forth in the provision at NFS 1852.227-71, 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 1852.227-11) 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 or JPL subcontracts resulting from this solicitation which offer subcontracting possibilities, exceed \$650,000 or \$550,000 respectively, and are with organizations other than small business concerns, the clause at FAR 52.219-9 shall apply. Accordingly, offerors awarded contracts that exceed \$650,000 or \$550,000 as applicable, other than small business concerns, are required to submit small business subcontracting plans consistent with the FAR. Failure to do so will make the offeror ineligible for award. 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

NOTICE TO ALL OFFERORS: NASA, through its FFRDC, JPL, will award subcontracts to non-Government participants, including as appropriate, Co-Investigators, hardware fabricators, and service providers who are named members of the proposing team, as long as the selecting official specifically designates the participant(s) in the selection decision. These subcontracts will require submission of proposal data to JPL as discussed in Section J.14A of this appendix. This proposal information will be reviewed by the JPL subcontracting official as the basis for negotiating and awarding a subcontract.

#### 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 proposals, as well as for implementing investigations selected in response to this opportunity, Appendix B contains the specific requirements for the format and content of 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

In order to provide a firm basis for the uniform evaluation of proposals received in response to this AO, the information concerning the Mars 2020 capabilities and constraints, the expected flight environments, the ground system capabilities and constraints, implementation, verification and management/system engineering and the requirements for data archiving, as described in the Mars 2020 Proposal Information Package (PIP) **must** be used for proposal preparation (for information on accessing the PIP, see Section 6.1.5 of this AO).

*The following expands requirements in the AO, in particular Requirement 69.*

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 or exploration technology 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. Text shall not exceed 55 lines per page and page numbers shall be specified. Margins at the top, both sides, and bottom of each page shall be no less than 1 inch if formatted for 8.5 x 11 inch paper; no less than 2.5 cm at the top and both sides, and 4 cm at the bottom if formatted for A4 paper. Single-column format is required 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.

<b>Proposal Structure and Page Limits</b>		
<b>Section</b>	<b>Contents</b>	<b>Page Limits</b>
A	Proposal Summary Information Graphic Cover Page Export controlled material statement (Section 5.10.2) <b>PI Commitment</b>	As per NSPIRES 1 0.5 <b>1</b>
B	Fact Sheet	2
C	Table of Contents	None
D	Science or Exploration Technology Investigation	20 + 2 pages / additional instrument
E	Experiment Implementation	
F	Investigation Implementation Schedule Foldout(s)	20 (Schedule Foldout(s) do(es) not count against limit)
G	Management	
H	Cost and Cost Estimating Methodology Cost Tables B3 and B4	8 (Tables B3 and B4 do not count against limit)
I	Small Business Subcontracting Plan	2
J	Appendices (no others permitted):	None None None None None None <b>N/A-1</b> None None None None None None None None
J.1	Table of Proposal Participants	
J.2	Letters of Commitment	
J.3	Resumes	
J.4	Summary of Proposed Program Cooperative Contributions	
J.5	Draft International Participation Plan Discussion on Compliance with U.S. Export Laws and Regulations	
J.6	Planetary Protection Compliance Plan	
J.7	Life Cycle SOWs	
J.8	Compliance with Procurement Regulations by NASA PI Proposals	
J.9	Master Equipment List (MEL)	
J.10	Heritage	
J.11	List of Abbreviations and Acronyms	
J.12	List of References (optional)	
J.13	Instrument Accommodation Requirements Worksheet	
J.14A	Phase A Task Plan	
J.14B	Cost and Pricing Data for Phase A	

\*\* Total extra pages limited to 10 as described in Requirement B-3. [amended December 4, 2013]

Requirement B-3. Proposals shall conform to the page limits specified in the *Proposal Structure and Page Limits* table. 2 extra page(s) each is (are) allotted for each additional instrument in Section D/E. The total number of such extra pages in Section D/E shall not exceed a maximum of 10 extra pages regardless of the number of instruments. Every side of a page upon which printing appears will count against the page limits and, unless specifically exempted (*e.g.*, Requirement B-33 and Requirement B-45), 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-4. Electronic proposals shall be a single searchable PDF file, comprised of the main proposal, all tables (see Requirement B-46 and Requirement B-58), and all applicable appendices (see Section J of this appendix). Electronic proposals shall be limited to 20 MB in size.

Requirement B-5. CD-ROMs of proposals shall include electronic proposals specified in Requirement B-4, and shall additionally include Microsoft Excel and Word files of tables (see Requirement B-46, Requirement B-58, Requirement B-62, and Requirement B-63). CD-ROMs of proposals may additionally include up to 100 MB, but otherwise identical, versions of electronic proposals. In the event of a conflict between versions of electronic proposals, the version specified in Requirement B-4 shall take precedence.

## A. PROPOSAL SUMMARY AND GRAPHIC COVER PAGE INFORMATION

### 1. Electronic Proposal.

*The following expands requirements in the AO, in particular Requirement 69.*

Requirement B-6. Proposal Summary Information and a Graphic Cover Page, prepared as directed below, shall preface every proposal. The Proposal Summary Information will not be counted against the page limits. Note that the Graphic Cover Page should be the first page of the PDF proposal document; when combined by NSPIRES with the Proposal Summary Information, the Graphic Cover page will follow that information.

Requirement B-7. 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

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).

## 2. Electronic Cover Page (NSPIRES Submission).

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

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

Requirement B-8. This AO requires that 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 NSPIRES electronic cover page includes the response to the following instruction: “List all participants in this investigation, both requesting funding and not requesting funding, who do not appear on the proposal's cover page as a Co-investigator, Collaborator, or any other category of participant. Include name, institution, city, state or country, and a description of the role in five words or less (e.g., data analyst, facility provider, support technician).” It is recognized that individuals may be affiliated with the proposed investigation without being listed as team members on the proposal cover page. The information provided is used to ensure that the evaluation panels do not include individuals who have participated in one or more proposals as reviewers as they have the appearance of being biased.

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

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

Requirement B-10. With the proposal submission via NSPIRES, the proposers shall identify any institution that is specified in the proposal but that does not appear in either the "Team Member" section of the cover page or in answer to the question about “participants [...] who do not appear on the proposal’s cover page.” The proposer shall list the institution and division name, role (e.g., instrument component provider), and estimated real year dollars to be received. This information will be used to avoid financial and organizational conflicts of interest during the evaluation process by checking evaluators against institutions that are proposed to supply materials, parts, or services.

### 3. Proposal Team Member Commitment Through NSPIRES.

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

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 72.

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 NNH13ZDA018O.” 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 E-mail 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-11. Every proposal team member named on the proposal cover page shall personally commit to the proposed investigation through NSPIRES and identify the organization

through which he/she is participating. The PI and every proposal team member shall ensure that the organization listed on the proposal cover page is the organization through which the proposal team member is participating in the proposal.

## B. FACT SHEET

*The following expands requirements in the AO, in particular Requirement 69.*

Requirement B-12. 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 or exploration technology objectives (including the importance of the objectives to the program goals);
- Investigation overview;
- Instrument complement;
- Investigation management and participating organizations (including teaming arrangements, as known);
- Schedule summary;
- The proposed PI-Managed Investigation Cost in real year dollars (RY\$) from Tables B3 and B4; and
- The proposed Total Investigation Cost, including a breakdown of any contributed costs by contributing organization, in real year dollars (RY\$) from Tables B3 and B4.

## C. TABLE OF CONTENTS

*The following expands requirements in the AO, in particular Requirement 69.*

Requirement B-13. 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 OR EXPLORATION TECHNOLOGY INVESTIGATION

*The following expands requirements in the AO, in particular Requirement 4 through Requirement 14.*

### 1. Investigation Background, Goals, and Objectives.

Requirement B-14. This section shall describe the goals and objectives of the investigation; the compelling nature of the investigation; the investigation's value to advancing NASA program goals and objectives; and the relationship of the proposed investigation to past, current, and future investigations and missions.

### 2. Investigation Requirements and Baseline Investigation.

Requirement B-15. 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 or exploration technology 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, laboratory data, etc.) and the objectives, as well as the expected results, shall be described. How the products and data obtained will be used to fulfill the requirements shall be demonstrated and supported by quantitative analysis. These descriptions shall constitute the Baseline Investigation.

Requirement B-16. Traceability from investigation goals to measurement requirements to instrument requirements (functional and performance) and to top-level investigation 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 Investigation Traceability Matrix, with examples of matrix elements. This matrix provides the reference points and tools needed to track overall investigation requirements, provide systems engineers with fundamental requirements needed to design the investigation, show clearly the effects of any descoping or losses of elements, and facilitate identification of any resulting degradation to performance.

### 3. Threshold Investigation.

Requirement B-17. This section shall identify the minimum acceptable data and scientific or exploration technology return for the investigation (the Threshold Investigation), below which the investigation would not be worth pursuing. The Threshold Investigation is identified with the “Threshold Science Requirements” in NPR 7120.5E. The scientific or exploration technology value of the Threshold Investigation shall be discussed. NASA recognizes that, in some circumstances, the Threshold Investigation may be identical to the Baseline Investigation. In such cases, the proposer shall explain why there is no viable investigation below the Baseline Investigation.

## E. EXPERIMENT IMPLEMENTATION

In this section, provide a full description of the experiment hardware and software proposed to be supplied that will produce the data necessary to complete the activities described in the investigation, including all information necessary to plan for its design, development, integration, test, ground operations, and flight operations. The proposal must describe the technical approach for every element of the investigation to ensure that the investigation’s requirements do not exceed available accommodation and/or financial resources. This section must be responsive to the evaluation criteria for Intrinsic Science or Exploration Technology Merit and Feasibility of the Investigation, as well as some parts of the evaluation criteria for TMC Feasibility of the Investigation Implementation as discussed in Section 7.2 of the AO. This section must be complete without the need for additional information for its full understanding, however, references to data or information in other Parts or Sections is acceptable to avoid redundancy.

## 1. Instrumentation.

*The following expands requirements in the AO, in particular Requirement 7 through Requirement 14 and Requirement 40 through Requirement 43.*

**Requirement B-18. Payload Instrumentation Description.** Fully describe the proposed flight instrumentation, including any associated Instrument-Specific mechanisms, deployments and/or pointing devices. Performance requirements should be directly related to the stated investigation objectives. Strategies for any type of data compression that may be implemented should be discussed clearly. The proposal should also describe any recognized need for supporting laboratory research or ground-based, airborne, or other activities required to support development of the instrument and/or its operation during the mission.

The proposal must outline hardware or software items proposed for development, as well as any existing instrumentation or design/flight heritage to be used. The heritage of various components of the instrument (suite), supporting systems, and software must be clearly described. The proposal shall describe the technology readiness levels and the approach to bring systems to technology readiness level (TRL) 6 by preliminary design review (PDR). Note that, for any level of heritage claimed, cost information about the referenced sources of heritage will also be required.

As a minimum, preliminary description of the instrument/suite design with a block diagram showing the components, subsystems, and their interfaces must be included. In the case of a new or not-yet-space-qualified design, the instrument/suite component or system must, to the extent possible, be compared based on performance, complexity, and cost to existing instruments.

The proposal shall provide a fabrication, test, and calibration concept by describing a fabrication plan, a test and verification plan, and a calibration plan at the instrument suite and component level. Instrument/suite component testing and calibration during flight must also be described. The proposal shall include a flow diagram indicating order of assembly and tests; and required facilities. The description of the test concept shall include a verification matrix that describes the tests that are to be performed on components, development units, and subassemblies.

**Requirement B-19. Payload/Instrument Integration/Accommodation.** The proposal must describe all parameters of the instrumentation that are pertinent to its accommodation within the resources and configuration of the rover, as described in this AO and the PIP. This information must be given in sufficient detail to permit an evaluation of both the concept and the feasibility of the instrumentation. These resources include, but are not limited to, volumetric envelope, mass, power, thermal limits, interface types, telemetry and command requirements, environmental sensitivities (*e.g.*, to electromagnetic fields, gaseous effluences, organic contamination, *etc.*); any special integration constraints; pointing requirements; and onboard data processing. Mass, power, and data processing budgets should be provided. The power discussion must outline average and peak usage, and provide a time profile of the power needs consistent with instrument operating modes and/or each of the sol templates described in the PIP.

This section must include an illustration with key dimensions of the proposed instrument and any ancillary hardware that would be integrated onto the rover or spacecraft. Additional descriptions of accommodation details are described in the PIP.

Since the instrument locations and the interface approaches are not finalized, proposers must identify possible electrical, mechanical, and data interfaces based on information provided in the PIP. In addition, the preferred location of the instrument/suite component itself on the rover must be described. Where more than one choice is available, proposers must identify and justify their preference. Proposals must include a discussion of the requirements of the instrument/suite component data rate (peak and average), field of view, resolution, sensitivity, pointing accuracy, average data volume per Sol, etc. **A summary of the investigation's accommodation requirements must be provided per Table B6 in Appendix 13, Instrument Accommodation Requirements Summary. Explicit guidelines for providing these requirements can be found in the PIP.**

Requirement B-20. Ground Operations. Describe all requirements for pre- and postlaunch ground operations support, science or exploration technology site implementation, and configuration control. Include an estimate of the cost of developing and maintaining a science or exploration technology operations facility at the Principal Investigator's home institution (see Section 5.4.9 of this AO).

Requirement B-21. Flight Operations. Describe all requirements for flight operations support, including instrument testing, calibration, and mission planning, including any special communications or near real-time ground support requirements, and indicate any special equipment or skills required of ground personnel.

Requirement B-22. Data Reduction and Validation. Discuss the data reduction and validation plan, including a definition of archival data products and, insofar as possible, the method of their production and expected format. Include an estimate of the cost of (ground) processor capabilities required for data reduction, validation, analysis, and archiving. The data plan should include discussion of the volume and timing of data for early release, a schedule for the submission of validated archival products to the Planetary Data System (PDS), and the plan for submission of final interpretive papers to the peer-reviewed literature, with an estimate of the costs for these activities (see Section 4.4 of this AO and Appendix E of the PIP).

Requirement B-23. Instrument Contingencies and Margins: This section shall summarize contingencies and margins (defined below) of all key instrument resources. For the driving investigation element requirements derived from the Investigation Functional Requirements, it should provide estimates of implementation performance and design margins with respect to the required performance. At a minimum, it shall include the following:

- Mass;
- Consumables;
- Power;
- Data Storage; and
- Volume (include stowed and deployed configurations).

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

For proposals with more than one instrument, contingencies and margins must be identified separately for each instrument, as well as for the proposed suite. Discuss the allocation of contingency and margin to the instruments.

Requirement B-24. Performance Margins: For the instrument performance, this section shall provide estimates of performance margin with respect to the performance requirements.

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 been 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> <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:</p> <p>Contingency = Max Expected Resource Value – current estimate of Resource Value</p> $\% \text{ Contingency} = \frac{\text{Contingency}}{\text{Max Expected Resource Value} - \text{Contingency}} \times 100$ <p>Margin = Max Possible Resource Value – Max Expected Resource Value</p> $\% \text{ Margin} = \frac{\text{Margin}}{\text{Max Expected Resource Value}} \times 100$

## 2. Data Sufficiency.

Requirement B-25. This section shall discuss the quality and quantity of data to be generated by each instrument, as they relate to the proposed science or exploration technology investigation goals and objectives. The flow-down from science or exploration technology investigation goals to measurement objectives and instrument performance shall be stated clearly and supported by quantitative analysis.

## 3. Data Plan.

Requirement B-26. A schedule-based end-to-end data management plan, including approaches for data retrieval, validation, preliminary analysis, and archiving shall be described. Products (e.g., flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, laboratory data, etc.) shall be identified, including a list of the specific data products and the individual team members responsible for the data products. The plan shall be consistent with the Mars 2020 Project policy selecting NASA PDS as the data archive for mission data. 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 or exploration technology community.

## 4. Investigation Team.

Requirement B-27. This section shall identify each key member (*i.e.*, one whose participation is essential to the success of the investigation) of the investigation team and his/her role and responsibilities. Resumes or curriculum vitae of 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. Nonfunded members of the team shall be identified in the proposal as collaborators (see Section 5.6 of this AO). The role of collaborators may be defined and justified.

## F. INVESTIGATION IMPLEMENTATION

*The following expands requirements in the AO, in particular AO Requirement 15 through Requirement 28.*

### 1. General Requirements.

Requirement B-28. Investigation Operations: This section shall address, at a minimum, the following elements of investigation operations to the extent that they are applicable to the proposed investigation and that they are known at the time of proposal submission. Any additional elements that are applicable to explaining the investigation 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;
- A discussion of the investigation operations plan, including nominal sequence planning and commanding, team training, availability of experts for operations, and investigation operations center development.

## 2. Development Approach.

Requirement B-29. 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 nonuse of redundancy, requirements for burn-in of parts, requirements for total operating time without failure prior to flight, *etc.*);
- Identification of instrument to rover or 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).

## 3. New Technologies/Advanced Developments.

Requirement B-30. 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 7123.1B, *NASA Systems Engineering Processes and Requirements*, Appendix E, 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.

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

Requirement B-31. 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-32. The project's verification approach shall be described briefly in this section including the approach to maintain a Verification and Validation Tracking matrix with traceability back to the test or analysis documentation/artifacts used for acceptance. 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.

#### 5. Schedule.

Requirement B-33. A project schedule foldout(s) covering all phases of the investigation shall be provided. This foldout 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 the WBS elements for task descriptions as prescribed in this appendix. The schedule foldout 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:

- Instrument development and major review dates, including instrument-to-rover integration and test;
- Preparations for operations support and major review dates (*e.g.*, mission operations support and data analysis development schedule);
- Major deliverables (*e.g.*, Interface Control Documents (ICDs), simulators, GSE, engineering modules, flight modules, *etc.*);
- Long-lead item specifications, development paths, and their impacts to schedule;
- Schedule critical path identification supported by a brief explanation of the principal factors driving this schedule path
- ~~A minimum of ten months of funded schedule reserve against the FM delivery date should be clearly identified (also see Section 5.11.2 of this AO).~~ **Funded schedule reserve against the FM delivery date should be clearly identified (also see Section 5.11.2 of this AO) and justified. The Mars 2020 Project baseline assumes a minimum of ten months funded schedule reserve, but it is acknowledged that simple or high heritage instruments may require less.** Funded schedule reserve should be distributed through the development

schedule with indications of appropriate reserves associated with major milestones and deliverables. **[amended December 4, 2013]**

- Specific tasks planned for Phase A should be discussed and if applicable correlated to tasks in the contractual Statements of Work (SOW) discussed in Section J.7 of this appendix

#### G. MANAGEMENT

*The following expands requirements in the AO, in particular Requirement 23, Requirement 30 through Requirement 37, Requirement 46, and Requirement 60.*

This section should provide insight into the organization proposed for implementing the investigation, including the distribution of the work, the internal operations and lines of authority with delegations, together with internal interfaces and relationships with NASA, major subcontractors, and associated investigators.

Requirement B-34. 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 investigation team is structured. The names of the primary team members, their organization, and their reporting relationship within the project shall be provided.

Requirement B-35. This section shall describe the specific roles and responsibilities of the PI, IPM, and other named key management team members. It shall describe the qualifications and experience, especially any unique capabilities or previous experience with similar systems and/or equipment (including their performance in meeting cost and schedule), of these key management team members, and demonstrate that they are commensurate with the technical and managerial needs of the proposed investigation. 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-36. A Work Breakdown Structure (WBS) shall be defined in this part of the proposal that clearly links the investigation organization with the cost information in the cost plan (see Section 5.8 of this AO). At a minimum, the elements of the proposed WBS should include the following that also need to be reflected in the WBS Summary of Investigation Cost (see Table B3 in Section H of this Appendix):

- 1.0—Management
  - 1.1. Management Staff
  - 1.2. Travel
  - 1.3. Reviews
- 2.0—Systems Engineering
- 3.0—Safety and Mission Assurance
- 4.0—Instrument /Suite Development
  - 4.1. Inst./ Subsystem #1
  - 4.2. Inst./Subsystem #2
  - 4.3. Inst./Subsystem #3
- 5.0—Instrument/Suite Integration and Test

- ~~5.1. Instrument/Suite Assembly~~
- ~~5.2. Functional Test~~
- ~~5.3. Environmental Test~~
- ~~5.4. Calibration~~
- ~~6.0 Post Delivery Support~~
  - ~~6.1. Engineering Model Integration and Test Support~~
  - ~~6.2. Flight Model Integration and Test (ATLO) Support~~
- ~~7.0 Investigation Team~~
  - ~~7.1. PI Support~~
  - ~~7.2. Co-I #1~~
  - ~~7.3. Co-I #2~~
  - ~~7.4. Co-I #3~~
- ~~8.0 Investigation Data Processing~~
  - ~~8.1. Computers, Data Communications and SA Support~~
  - ~~8.2. Algorithms and Software: flight and ground~~
- ~~9.0 Mission Operations and Data Analysis~~
  - ~~9.1. Mission Operations Development (Phase C/D)~~
  - ~~9.2. Mission Operations Support (Phase E)~~
  - ~~9.3. Investigation Data Analysis (Phase E/F)~~
- ~~10.0 Reserves~~
- 1.0 Management**
  - 1.1. Management Staff**
  - 1.2. Travel**
  - 1.3. Reviews**
- 2.0 Systems Engineering**
- 3.0 Safety and Mission Assurance**
- 4.0 Investigation Science Team**
  - 4.1. PI Support**
  - 4.2. Co-I #1**
  - 4.3. Co-I #2**
  - 4.n. Co-I #n**
- 5.0 Instrument Design, Fabrication and Test**
  - 5.1. Inst. / Subsystem #1**
  - 5.2. Inst. / Subsystem #2**
  - 5.n. Inst. / Subsystem #n**
- 6.0 Suite Integration and Test (Suite Proposals Only)**
  - 6.1. Instrument Suite Assembly**
  - 6.2. Functional Test**
  - 6.3. Environmental Test and Calibration**
- 7.0 Postdelivery Support**
  - 7.1. Engineering Model Integration and Test Support**
  - 7.2. Flight Model Integration and Test (ATLO) Support**
- 8.0 Prelaunch MOS/GDS Development**
  - 8.1. Computers, Data Communications and SA Support**
  - 8.2. Algorithms and Software: flight and ground ops**

## **9.0 Mission Operations and Data Analysis**

### **9.1. System Testbeds / Simulators, etc. (Ph C/D/E)**

### **9.2. Mission Operations Support (Ph E)**

### **9.3. Investigation Data Analysis (Ph E)**

## **10.0 Reserves**

**[amended December 4, 2013]**

Additional subelements and breakdowns to better describe the proposed investigation may be added at the discretion of the proposer.

Requirement B-37. Risk List and Risk Management: This section shall describe the top risks considered significant by the PI and the IPM, especially technical risks and risks associated with critical and 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-44). The management strategies for control, allocation, and release of technical margins, cost reserves, and schedule reserves shall be described as well as an anticipated profile of reserves release (*i.e.*, burn-down curve). The approach to any potential descopes, including savings of resources (mass, power, dollars, schedule, etc.) by implementing descopes, the decision milestone(s) for implementing descopes, and the scientific or exploration technology impact of individual as well as combined 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.

Requirement B-38. Method of Instrument/Payload Acquisition: Describe the proposed method of instrument acquisition including the following, as applicable:

- (i) Rationale for the investigator to obtain the payload instrument through or by the investigator's institution;
- (ii) Method and basis for the selection of the proposed payload instrument fabricator;
- (iii) Unique or proprietary capabilities of the payload instrument fabricator that are not available from any other source;
- (iv) Contributions or characteristics of the proposed fabricator's payload instrument that make it an inseparable part of the investigation;
- (v) When significant subcontracts are required, the acquisition strategy, including the anticipated date and length of the subcontract, and the use of performance or other incentives, should be described.
- (vi) Availability of supporting personnel in the institution to successfully administer the payload instrument contract and technically monitor the fabrication;
- (vii) Status of development of the payload instrument, *e.g.*, what additional development is needed, areas that need further design or in which unknowns are present, and backup options for any function or hardware requiring technology development;
- (viii) Method(s) by which it is proposed to:
  - (a) Prepare payload instrument hardware and software specifications;
  - (b) Review development progress and maintain configuration control;
  - (c) Review design and fabrication changes;

- (d) Participate in testing program;
- (e) Participate in final checkout and calibration;
- (f) Provide for integration of instrument/payload;
- (g) Support the flight operations;
- (h) Coordinate with Co-Investigators, other related investigations, and the payload integrator;
- (i) Assure safety, reliability, and quality; and
- (j) Control cost and schedule.

Requirement B-39. Facilities and Infrastructure Planning and Commitments: For proposals seeking NASA funding, describe:

- (i) Planned participation by small and/or minority business in any subcontracting for instrument fabrication or investigative support functions;
- (ii) Commitments for all major facilities, laboratory equipment, and ground-support equipment (GSE) (including those of the investigator's proposed contractors and those of NASA and other U.S. Government agencies) essential to the experiment in terms of its system and subsystems, distinguishing insofar as possible between those in existence and those that will be developed in order to execute the investigation; and
- (iii) The acquisition of new facilities and equipment with the lead time involved and the planned schedule for construction, modification, and/or acquisition of the facilities.

Requirement B-40. Contributions and Cooperative Agreements: 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 or exploration technology and technical capabilities, and contingency plans for coping with potential failures of the proposed cooperative arrangements.

Requirement B-41. Licenses or Exemptions: The transfer of technical data or hardware to foreign parties may require export licenses or exemptions. In some cases, Technical Assistance Agreements (TAAs) may be needed by U.S. entities to work with foreign partners. The proposal should outline plans to meet these requirements, where applicable. Early phase interactions required to prepare for Instrument Accommodations Review and PDR may be required prior to TAA finalization. Proposals should describe the method by which they will accomplish these interactions prior to having approved TAA(s) in place.

## H. COST AND COST ESTIMATING METHODOLOGY

*The following expands requirements in the AO, in particular Requirement 44, Requirement 45, and Requirement 47 through Requirement 56.*

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.

Proposers must present their estimation of the total life cycle costs for the investigation for Phases A-E. This discussion must provide sufficient depth and correlation with planned project

activities to allow the reliability of these estimates to be judged. This discussion must include the basis of the cost estimates provided and a substantiation of the cost estimation methodology used. Recommended cost reserves and cost reserve management should be discussed.

Requirement B-42. This section shall include the estimated cost of the proposed investigation. The estimated cost shall encompass all proposed activities, including all applicable mission phases, contributions, any other AO-specific activities 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-43. 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-44. This section shall include a discussion of cost risks.

Requirement B-45. This section shall provide foldout cost tables, Tables B3 and B4, which will not be counted against the page limit. Tables B3 and B4 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 Investigation Cost (NASA funded). The lower portion shall contain cost data for contributions. The rows in Table B3 shall be the NASA standard WBS elements as defined in this appendix. The costs for most elements shall be provided to WBS level 2, as shown in Table B3. The columns in Tables B3 and B4 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 column in Tables B3 and B4 are totals in real year dollars (RY\$).

For an individual instrument proposal, one set of Tables B3 and B4 is required. For proposals with more than one instrument, one set of Tables B3 and B4 is required for each instrument and one set of Tables B3 and B4 is required for the total cost for all instruments. For example, if three instruments are proposed, then there must be four versions of Tables B3 and B4, of which one will show the total cost if all instruments are selected as proposed. The other three tables must address the cost of each instrument as if it were selected separately.

Requirement B-46. Tables B3, B4, and those identified in the Phase A Task Plan (see Section J.14A of this appendix) shall be additionally provided in Microsoft Excel format on each CD submitted. Table B6 shall be additionally provided in Microsoft Word format on each CD submitted. Microsoft format templates are available for download in the Program Library.

Requirement B-47. This section shall include a statement as to whether the proposer's approved forward pricing rates were used or NASA's inflation/deflation indices (see the Program Library)

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..

## I. SMALL BUSINESS SUBCONTRACTING PLAN

*There are no additional requirements for Proposal Section I.*

## J. PROPOSAL APPENDICES

Requirement B-48. 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.

### J.1. Table of Proposal Participants

*The following expands requirements in the AO, in particular Requirement 65.*

Requirement B-49. 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 or exploration technology only, nonhardware partners, and (iii) minor partners, vendors, and suppliers, as known at the time of the proposal. Major partners are defined to be organizations responsible for providing project management, system engineering, major hardware elements, science or exploration technology instruments, spacecraft accommodations, launch services, integration and test, mission operations, and other major elements of the proposed investigation, as defined by the proposer.

### J.2. Letters of Commitment.

*The following expands requirements in the AO, in Requirement 59, Requirement 64, and Requirement 65.*

Requirement B-50. 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 and collaborator 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 5.10.1 of this AO.

### J.3. Resumes.

*The following expands requirements in the AO, in particular Requirement 30, Requirement 31, Requirement 40, and Requirement 41.*

Requirement B-51. This section shall include resumes or curriculum vitae for the PI, IPM, and all Co-Is identified, 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 and IPM. 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.

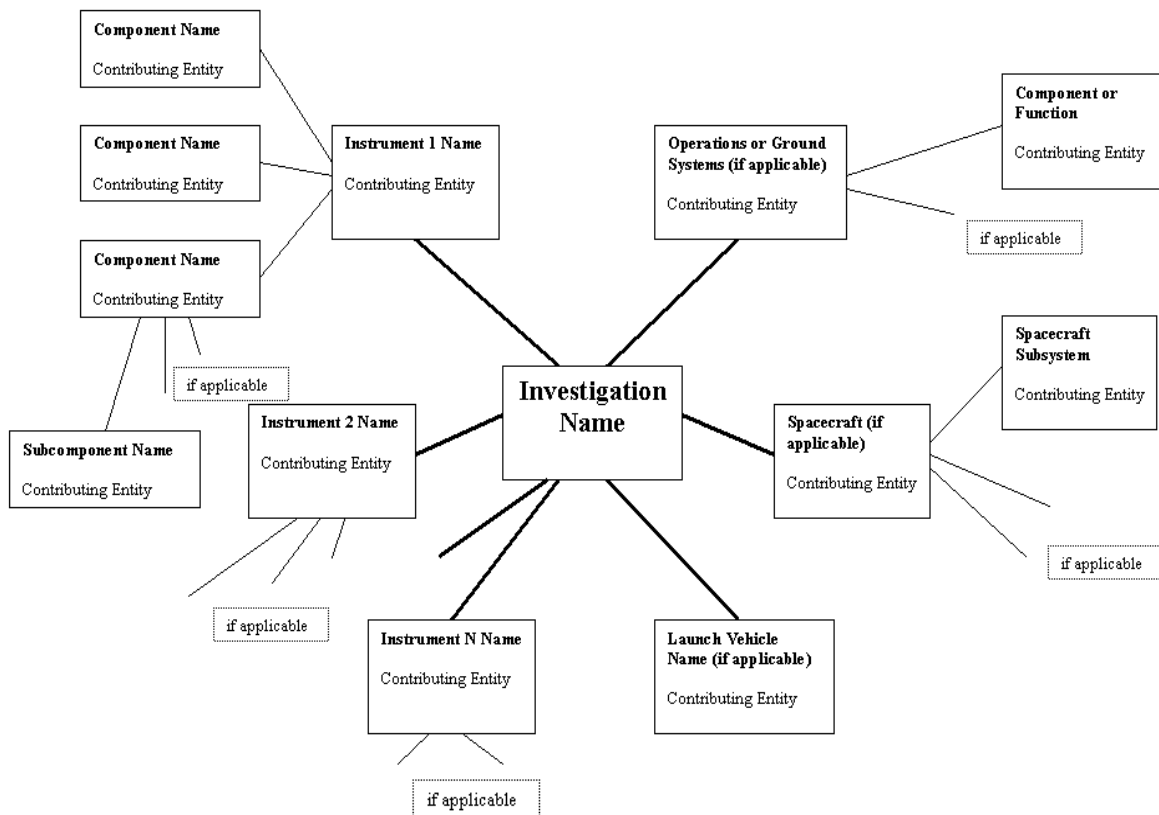
### J.4. Summary of Proposed Program Cooperative Contributions.

*The following expands requirements in the AO, in particular Requirement 55 through Requirement 57 and Requirement 62.*

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.

#### SAMPLE EXPLODED DIAGRAM



**Requirement B-52.** 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 or exploration technology 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.

b. A supporting table of collaborative contributions

Requirement B-53. 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 5.8.8 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 5.8.8 of this AO; and
- (vi.) Cross reference to letters of commitment, as required in Section 5.10.1 of this AO.

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

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

Requirement B-54. 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.pmddtc.state.gov/> and <http://www.bis.doc.gov/>. Proposers are advised that under U.S. law and regulation, spacecraft and their specifically designed, modified, or configured systems, components, parts, etc., such as instrumentation responsive to this AO, are generally considered “Defense Articles” on the United States Munitions List and subject to the provisions of the International Traffic in Arms Regulations (ITAR), 22 CFR 120-130, *et seq.*

Foreign nationals requiring access to NASA facilities and information systems will be required to comply with Homeland Security Presidential Directive HSPD-12 (see <http://www.dhs.gov/homeland-security-presidential-directive-12>), where applicable. This appendix shall also discuss the impact, if any, on the investigation and the proposed international participation of compliance with HSPD-12. If no impact is anticipated, this shall be explicitly stated.

## J.6 Planetary Protection Compliance Plan

*~~This appendix is not applicable to the Mars 2020 Investigations AO and should be left out. The appendices following this one should not be renumbered.~~*

Planetary protection requirements flowed down from the Mars 2020 Project's preliminary planning are given in the PIP. **Proposers are allowed one page in this Appendix to provide a description of proposed approaches to supporting the Project planetary protection program implementation. [amended December 4, 2013]**

## J.7. Life Cycle SOWs

Requirement B-55. For investigations managed from non-Government institutions, provide a Statement of Work to be used in the JPL subcontract with the investigator. For investigations managed from Government institutions, provide a Statement of Work as if the institution were non-Government. The Statement of Work must include general task statements for the development phase and for the operations phase of the investigation. The Specimen Contract in the Program Library may be used as a guide. All Statements of Work must include the following as a minimum: Scope of Work, Deliverables (including science or exploration technology data), and Government Responsibilities (as applicable). Statements of Work need not be more than a few pages in length. If more than one contractual arrangement between NASA and the proposing team is required, funding information must be provided that identifies how funds are to be allocated among the organizations.

## J.8. Compliance with Procurement Regulations by NASA PI Proposals.

*The following expands requirements in the AO, in particular Requirement 39.*

This appendix is required only for proposals submitted by 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-56. For NASA Center proposals, this section shall include any descriptions, justifications, representations, indications, statements, and/or explanations that are required by the regulations.

## J.9. Master Equipment List.

*The following expands requirements in the AO, in particular Requirement 51.*

Requirement B-57. 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.

Contributed flight element subsystem components and individual instrument element components that are a part of the PI's proposed hardware development shall be included in the MEL. This does not include the spacecraft when the spacecraft is external to the PI's proposed hardware development. This does not include the launch vehicle.

Requirement B-58. The MEL shall be additionally provided in Microsoft Excel format on each CD submitted with the proposal. A Microsoft Excel template of the MEL is available for download in the Program Library.

The breakouts should be traceable to block diagrams and heritage claims provided in other parts of the proposal. For each major component, current best estimates (CBE) and contingency for mass and power, number of flight units required, and some description of the heritage basis must be provided. Power values should represent nominal steady-state operational power requirements. Information to be provided includes identification of planned spares and prototypes, required deliveries for simulators and testing, contingency allocations for individual components, and other component description/characteristics. Certain items (like electronic boxes and sensor heads) should include additional details, as applicable, to identify and separate individual elements.

#### J.10. Heritage.

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

Requirement B-59. 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.

Requirement B-60. If a proposal claims any heritage from which the proposed investigation derives substantial benefit, this appendix shall discuss each element to an appropriate level of granularity (*e.g.*, component, assembly, subsystem) to clearly separate the heritage element from other elements of the design.

The evaluation team will use a scale with 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

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

*The following expands requirements in the AO, in particular Requirement 69.*

Requirement B-61. This appendix shall provide a list of abbreviations and acronyms.

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

In addition to the above items, this appendix may provide a reference list of documents and other materials that were fundamentally important in generating the proposal. This may include a Uniform Resource Locator (URL) for documents that are available through the Internet. As noted at the outset of Appendix B of this AO, however, proposals must be self-contained: any data or other information intended as part of a proposal must be included within the proposal itself. If any documents or other materials are submitted as a part of a proposal, they must fit within the prescribed page limits. If internal documents such as Flight Project Practices are referenced, an externally accessible URL shall be provided to download them.

### J.13. Instrument Accommodation Requirements Worksheet

The Mars 2020 Project is somewhat constrained in its investigation accommodation environment owing to the heritage assumptions that are made to use the MSL rover design to the maximum extent possible. Having said that, the MSL rover did accommodate a range of instrument types and configurations. The Project has provided a range of interface options (*e.g.*, a choice of data bus options) and locations (arm, mast, payload module and elsewhere on rover), within the baseline project provided interfaces at each location.

Requirement B-62. In this appendix, proposers shall summarize their accommodation requirements. The **required information must be submitted in the format as shown in the Microsoft Word formatted Table B6 below.** Descriptions of any other pertinent accommodation information and/or instrument unique items may be added to this table. Appendix D of the PIP provides further guidance on how to describe and provide trade studies and cost estimates for instrument unique accommodation assumptions. Proposers may include description and trades information for any of these instrument unique accommodation approaches in their proposal appendix response to this required Instrument Accommodation Requirements Summary.

#### J.14A. Phase A Task Plan

Requirement B-63. Proposers shall deliver the following documentation as an Appendix to the proposal, to facilitate funding of initial activities as soon as possible after selection.

#### **1. Point of Contact**

Identify the contract manager/program coordinator responsible for direct interaction with the Mars 2020 Payload Manager and JPL Subcontract Manager.

#### **2. Data Submittal**

- 2.1. Complete the acknowledgement form found at: A1 Acknowledgement, JPL 2384 ([https://acquisition.jpl.nasa.gov/files/A1\\_2384\\_4-12.docx](https://acquisition.jpl.nasa.gov/files/A1_2384_4-12.docx)) or at: A5 Acknowledgement - CREI Subcontract, JPL 2384-3 ([https://acquisition.jpl.nasa.gov/files/A5\\_2384-3\\_4-12.docx](https://acquisition.jpl.nasa.gov/files/A5_2384-3_4-12.docx)) if the proposer is a university. The appropriate acknowledgement form must be executed by the proposer's cognizant authority.
- 2.2. Complete and submit the Government Property form found at: A3 Government Property, JPL 0544 ([https://acquisition.jpl.nasa.gov/files/A3\\_0544\\_12-11.docx](https://acquisition.jpl.nasa.gov/files/A3_0544_12-11.docx)).
- 2.3. Complete and submit the Past Performance form found at: A14 Past Performance, JPL 0358 ([https://acquisition.jpl.nasa.gov/files/A14\\_0358\\_11-11.docx](https://acquisition.jpl.nasa.gov/files/A14_0358_11-11.docx)).
- 2.4. Provide a letter authorizing the release of rate and other relevant information to the Jet Propulsion Laboratory.

### 3. Phase A Cost Proposal

Submit the cost information requested below for the period of Phase A only, summarized by cost element and time phased by month. Labor should be proposed by work hour, not work month. Provide a breakdown of all labor categories and associated hours to perform the effort defined in the Specimen Subcontract. This information should be submitted using the format found in A15 Cost Elements Breakdown, JPL 0549 ([https://acquisition.jpl.nasa.gov/files/A15\\_0549\\_12-112.docx](https://acquisition.jpl.nasa.gov/files/A15_0549_12-112.docx)). The data must be provided on a CD in Microsoft Excel or Excel-compatible format that corresponds to the Microsoft Word template above.

This data provides a detailed cost proposal for performing the Phase A activities. Detailed plans for Phase A should be described, but reference may be made to other sections of the investigation proposal, as appropriate. Other guidance for developing this cost proposal is below:

#### 3.1. Phase A SOW

To facilitate the issuance of Phase A funding immediately after selection, the Phase A cost proposal must include all costs for the following activities:

1. Participation at an investigator's kick-off meeting held at JPL within 30 days following selection. (PI and IPM to attend, other key personnel at discretion PI.)
2. Preparation of investigation products for, and participation in the **Instrument Accommodation Review (IAR)** [PIP Section 7.3.1.2]. Investigation products include:
  - (a) **Experiment Implementation Plan (EIP)** [PIP Section 7.4.4]. The EIP will be due at the end of the third month following selection.
  - (b) **Safety Plan** [PIP Section 7.4.4]. The Safety Plan (part of the EIP) will be due at the end of the fourth month following selection.
  - (c) **Instrument Functional Requirements Document (IFRD)** PIP Section 7.4.4]. The IFRD will be due at the end of the fourth month following selection.
3. Work with the Mars 2020 Project team to understand instrument accommodation issues, to provide a preliminary interface approach with the Mars 2020 rover, and to perform engineering trade studies as needed to provide preliminary **Interface Control Document (ICD) inputs prior to the Instrument Accommodation Review**.
4. Initiation of subcontracts with Co-Investigator (Co-I) institutions and industrial partners as appropriate.

5. Conduct reviews and meetings:

- (a) **Monthly Management Reviews** (MMRs) [Section 7.3.1.1] starting at the end of the second month following selection.
- (b) Team meetings to complete investigation requirement definitions.

As a guide for preparing cost data you may use the format found on the form at A15 Cost Elements Breakdown, JPL 0549 ([https://acquisition.jpl.nasa.gov/files/A15\\_0549\\_12-112.docx](https://acquisition.jpl.nasa.gov/files/A15_0549_12-112.docx)). However, you may use your own formatting, so long as the information required is provided.

3.2. Work Breakdown Structure

A Work Breakdown Structure (WBS) should be included for Phase A of the mission. The structure of the WBS should be consistent with the plans set forth in the Technical Approach and Management sections of the investigation proposal and the Statements of Work provided per Section J.7 of Appendix B of the AO.

3.3. Workforce-Staffing Plan

Provide a workforce-staffing plan that is consistent with the WBS. This workforce-staffing plan should include all team member organizations and should cover all management, technical (scientific and engineering), and support staff. The workforce-staffing plan should be phased by month. Time commitments for the PI, PM, and other key personnel should be clearly shown.

3.4. Proposal Pricing Technique

Describe the process and techniques used to develop the Phase A cost proposal. Provide a description of the cost-estimating model(s) and techniques used in the Phase A cost estimate. Discuss the heritage of the models and/or techniques applied to this estimate, including any known differences between missions contained in the model's data base and key attributes of the proposed mission. Include the assumptions used as the basis for the Phase A cost and identify those which are critical to cost sensitivity in the investigation. Identify any "discounts" assumed in the cost estimates for business practice initiatives or streamlined technical approaches. Describe how these have been incorporated in the cost estimate and will be managed by the investigation team.

3.5. Phase A Time-Phased Cost Summary

Provide a summary of the total Phase A costs consistent with below Cost Element Breakdown. Since Phase A costs also appear in Cost Tables B3 and B4, the Phase A cost summary should be developed consistent with the WBS used to develop these tables, and should include all costs to NASA along with all contributed costs (shown

separately). The Phase A time-phased cost summary shall be phased by month and be provided as a Microsoft Excel file format.

#### **4. Cost Elements Breakdown and Supporting Data**

To effectively evaluate the Phase A cost proposals, JPL requires costs and supporting evidence stating the basis for the estimated costs. The categories of cost for Phase A should include the following:

**Direct Labor.** List by labor category, with labor hours and rates for each. Provide actual salaries of all personnel, including civil service labor, and the percentage of time each individual will devote to the effort. NASA civil service labor and supporting NASA Center infrastructure must be costed on a full cost accounting basis (see Section 5.8.7 of this AO).

**Overhead.** Include indirect costs that, because of their inclusion for common or joint objectives, are not readily subject to treatment as a direct cost (usually this is in the form of a percentage of the direct labor costs).

**Materials.** Provide the total cost of the bill of materials, including estimated cost of each major item, including lead time of critical items.

**Subcontracts.** List subcontracts over \$5,000, specifying the vendor and the basis for estimated costs and including any baseline or supporting studies.

**Special Equipment.** List special equipment with lead and/or development time, including number of units and types.

**Travel.** List estimated number of trips, destinations, duration, purpose, number of travelers, and anticipated dates.

**Other Costs.** Provide all costs not covered elsewhere.

**General and Administrative Expense.** Include the expenses of the institution's general and executive offices and other miscellaneous expenses related to the overall business.

**Contribution Costs.** Provide the value of Contribution to be accrued in Phase A.

**Fee.** List any applicable fee for the submitting organization. Incentives on major contracts to the PI investigation are to be based, at least in part and as appropriate, on performance under the contract.

#### **5. Long-Lead Procurements**

Identify and provide information on the cost for each long lead purchased part of assembly. Long lead is identified as any purchased item that would impact the investigation development critical path if not purchased within five months following selection.

## 6. Exceptions to Terms and Conditions

JPL Subcontracts include certain General Provisions. These can be found at:

- Cost-Reimbursement without Fee with an Educational Institution (CREI) (04/13) ([https://acquisition.jpl.nasa.gov/files/CostReimbursementWithoutFeeWithEducationalInstitutional\\_04-13.pdf](https://acquisition.jpl.nasa.gov/files/CostReimbursementWithoutFeeWithEducationalInstitutional_04-13.pdf)) for universities, or
- Cost Reimbursement with Commercial Organizations (04/13) ([https://acquisition.jpl.nasa.gov/files/CostReimbursementWithCommercialOrgs\\_4-13.pdf](https://acquisition.jpl.nasa.gov/files/CostReimbursementWithCommercialOrgs_4-13.pdf)) for other cost-type Subcontracts.

A large number of exceptions, or one or more significant exceptions to these General Provisions, may substantially delay getting on Subcontract. You must provide a detailed explanation, including the rationale, for any exceptions your organization may take.

### J.14B. Cost and Pricing Data and Documentation for Phase A Subcontract

Requirement B-64. This appendix shall provide cost and pricing data for Phase A, **if the proposed cost of Phase A exceeds \$650,000 (\$700,000 for NASA organizations)**. The data must meet the requirements of the FAR Part 15 Table 15-2. These cost and pricing data are necessary and required to implement the contract. Complete cost or pricing data shall be included with the proposal for each organization participating in Phase A and must be signed by each organization's authorized representative. This requirement may be satisfied with one form, provided that all institutions involved in Phase A are included and have provided the appropriate signatures. These data are *in addition* to the data provided in Cost Tables Templates B3 and B4 for evaluation purposes, allocate project costs per the cost categories defined in FAR Part 15 Table 15-2, but still align at the highest levels with the evaluation data.

TABLE B1  
EXAMPLE INVESTIGATION TRACEABILITY MATRIX

Goals	Objectives	Measurement Requirements		Instrument Functional Requirements		Projected Performance	Investigation Functional 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				Need AA seasons to trace evolution of phenomena	
Etc.		Morphological feature	Size of features	Vert. Resol.	XX km	ZZ km		Need AA months of observation to observe variability 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.		
			Precision	XX K	ZZ K			
		Rate of change of observable phenomenon	Accuracy	XX K	ZZ K			
		Objective 2 to N			Repeat above categories			

TABLE B2  
EXAMPLE MISSION TRACEABILITY MATRIX

This table is not applicable to the Mars 2020 Investigations AO and should be left out. The tables following this one should not be renumbered.

**TABLE B3**  
**WBS SUMMARY OF NASA COST [amended December 4, 2013]**

Project WBS Elements (1)	Phase A/B					Phase C/D					Phase E					TOTALS	
	FY 2014					FY 2015					FY 2016					Subtotal	RYS
	FY 2014	FY 2015	Subtotal	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	Subtotal	FY 2020	FY 2021	FY 2022	FY 2023	Subtotal		
<b>1.0 Management</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.1. Management Staff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.2. Travel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.3. Reviews	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>2.0 System Engineering</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>3.0 Safety and Mission Assurance</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>4.0 Investigation Science Team</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.1. PI Support	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.2. Co-I #1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.3. Co-I #2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.x. Co-I fix	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>5.0 Instrument Design, Fabrication and Test</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.1. Inst./ Subsystem #1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.2. Inst. Subsystem #2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.n. Inst. Subsystem #n	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>6.0 Suite Integration and Test (Suite/Proposals Only)</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.1. Instrument Suite Assembly	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.2. Functional Test	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.3. Environmental Test and Calibration	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>7.0 Post Delivery Support</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.1. Engineering Model Integration and Test Support	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.2. Flight Model Integration and Test (ATLO) Support	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>8.0 Pre-Launch MOS/CDS Development</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.1. Computers, Data Communications and SA Support	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.2. Algorithms and Software: flight and ground ops	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>9.0 Mission Operations and Data Analysis</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.1. System Testbeds / Simulators, etc. (Pr C/D/E)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.2. Mission Operations Support (Ph E)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.3. Investigation Data Analysis (Ph E)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>10.0 Reserves</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Pr-Managed Investigation Cost</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Contributions (List by organization and WBS Element)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>TOTAL Investigation Cost</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

The WBS spreadsheet includes end- or labor level 3 and lower-level elements as necessary to describe Investigation Elements of Cost.

A Microsoft Excel version of this template is available in the Program Library.

TABLE B4  
MISSION PHASE SUMMARY OF NASA COST

TABLE B4  
< INVESTIGATION NAME / PI > MISSION PHASE SUMMARY OF NASA COST  
(FY Costs in Real Year Dollars, (to nearest thousand); Totals in RY Dollars)

Cost Element	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	TOTALS RY \$
Phase A Accommodation/Definition		-	-	-	-	-	-	-	-	-	-
Phase B			-	-	-	-	-	-	-	-	-
Phase C/D	-							-	-	-	-
Phase E	-	-	-	-	-	-					-
PI-Managed Investigation Cost	-	-	-	-	-	-	-	-	-	-	-
Contributions											-
Total Investigation Cost	-	-	-	-	-	-	-	-	-	-	-

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TABLE B5  
MASTER EQUIPMENT LIST

Table B5 MASTER EQUIPMENT LIST (MEL) Template - Investigation X												
Instrument Subassembly 1		# OF UNITS			FLIGHT HARDWARE MASSES			FLIGHT HARDWARE POWER			OTHER COMPONENT INFORMATION	
Component	Unit Mass, Current Best Estimate (CBE)	Flight Units	Flight Spares	EMs & Proto-types	Total Mass, kg CBE	Contingency %	Total Mass w/ Contingency	Total Power, W CBE	Contingency %	Total Power w/ Contingency	Description (Vendor, Part #, Heritage Basis)	Other characteristics/issues (volume, other component-specific information)
Total Mass/Power												
Instrument Subassembly n		# OF UNITS			FLIGHT HARDWARE MASSES			FLIGHT HARDWARE POWER			OTHER COMPONENT INFORMATION	
Component	Unit Mass, Current Best Estimate (CBE)	Flight Units	Flight Spares	EMs & Proto-types	Total Mass, kg CBE	Contingency %	Total Mass w/ Contingency	Total Power, W CBE	Contingency %	Total Power w/ Contingency	Description (Vendor, Part #, Heritage Basis)	Other characteristics/issues (volume, other component-specific information)
Total Mass/Power												

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TABLE B6  
INSTRUMENT ACCOMMODATION REQUIREMENTS WORKSHEET

8.1.1.1.1 Item	8.1.1.1.2 Description	8.1.1.1.3 Instrument Needs/Characteristics
8.1.1.1.4 1	8.1.1.1.5 Instrument Name	
8.1.1.1.6 2	8.1.1.1.7 PI/Team	
	Mass by mounting location (CBE)	
8.1.1.1.8 3-1	Turret (arm)	
8.1.1.1.9 3-2	Mast	
8.1.1.1.10 3-3	Rover Body	
8.1.1.1.11 3-4	Other – Please Specify	
8.1.1.1.12 3-5	Total (CBE/CBE + Proposed Reserve)	
	Volume (for each major element)	
8.1.1.1.13 4	Please provide dimensional drawing	8.1.1.1.14 <i>PROVIDE AS ATTACHED SHEET</i>
	8.1.1.1.15 Power (CBE / CBE + Margin)	

<b>8.1.1.1.1 Item</b>	<b>8.1.1.1.2 Description</b>	<b>8.1.1.1.3 Instrument Needs/Characteristics</b>
8.1.1.1.16 5-1	Peak Operational Power	
8.1.1.1.17 5-2	Peak Standby Power	
8.1.1.1.18 5-3	Average Operational Power	
8.1.1.1.19 5-4	Average Standby Power	
5-5	Non-operating, if applicable	
8.1.1.1.20 5-6	Required voltage(s)	
8.1.1.1.21	Power Profile	
8.1.1.1.22 5-7	8.1.1.1.23 Typical operational timeline, including typical data collection duration(s)	
8.1.1.1.24	Thermal	
8.1.1.1.25 6-1	Operating temperatures	
8.1.1.1.26 6-2	Survival temperatures	
8.1.1.1.27 6-3	8.1.1.1.28 Specify if non-operational thermal maintenance for instrument survival may be required	
8.1.1.1.29 6-4	Other thermal constraints	
	Output Data Volume	
8.1.1.1.30 7-1	8.1.1.1.31 Average Data Volume generated per data collect/observation	
8.1.1.1.32 7-2	Profile for typical operational timeline	8.1.1.1.33 PROVIDE AS ATTACHED SHEET
	Mast-Mounted Pointing Requirements	

<b>8.1.1.1.1 Item</b>	<b>8.1.1.1.2 Description</b>	<b>8.1.1.1.3 Instrument Needs/Characteristics</b>
8.1.1.1.34 8-1	Azimuth - Precision	
8.1.1.1.35 8-2	Azimuth - Repeatability	
8.1.1.1.36 8-3	Azimuth - Stability	
8.1.1.1.37 8-4	Azimuth - Timing	
8.1.1.1.38 8-5	Elevation - Precision	
8.1.1.1.39 8-6	Elevation - Repeatability	
8.1.1.1.40 8-7	Elevation - Stability	
8.1.1.1.41 8-8	Elevation - Timing	
8.1.1.1.42	<b>8.1.1.1.43 Operational Info:</b>	
8.1.1.1.44 10-1	Time of day constraints	
8.1.1.1.45 10-2	Stand-off distance	
8.1.1.1.46 10-3	Dark only? Cold only?	
8.1.1.1.47 10-4	8.1.1.1.48 Instrument unique use of flight computer?	
8.1.1.1.49 10-5	Sample preparation requirements?	
8.1.1.1.50 10-6	No sun looks?	
	<b>8.1.1.1.51 Lifetime Limiting Consumables</b>	

<b>8.1.1.1.1 Item</b>	<b>8.1.1.1.2 Description</b>	<b>8.1.1.1.3 Instrument Needs/Characteristics</b>
8.1.1.1.52 11-1	List consumables and associated limits	
	<b>8.1.1.1.53 Radiation sources, list material and strength</b>	
8.1.1.1.54 12-1	Source(s) internal to instrument	
8.1.1.1.55 12-2	8.1.1.1.56 Source(s) required for test and calibration activities	
	<b>8.1.1.1.57 Optional</b>	
8.1.1.1.58 13-1	Instrument Unique Trade Studies	8.1.1.1.59 <i>PROVIDE AS ATTACHED SHEETS</i>
8.1.1.1.60 13-2	8.1.1.1.61 Other pertinent information at discretion of proposer	

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## 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 Investigation** — The investigation that, if fully implemented, would fulfill the “Baseline Science Requirements”, which are defined in NPR 7120.5E as the “performance requirements necessary to achieve the full [...] objectives of the mission.”

**Baseline objectives** — The entire set of objectives proposed for the investigation.

**Basis of Estimate (BOE)** — A record of the procedures, ground rules and assumptions, data, environment, and events that underlie a cost estimate’s development or update. Good documentation of the BOE supports the cost estimate’s credibility.

**Categorization** — The process whereby proposed investigations are classified into four categories synopsized here as Category I (recommended for acceptance); Category II (recommended for acceptance but at a lower priority than Category I proposals); Category III (sound investigations requiring further development); Category IV (not recommended).

**Categorization 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.

**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.

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

**Exploration technology investigation** — investigations primarily addressing SKGs and funded by HEOMD and STMD

**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.

**Implementing organization** — The organization chosen by the Principal Investigator to manage the development of the mission.

**In Situ Resource Utilization (ISRU)** – the capability to harvest local resources to benefit human and robotic missions.

**Instrument Project Manager (IPM)** — The individual responsible to the PI for overseeing the technical and programmatic implementation of the project. The IPM works closely with the PI in order to ensure that the mission meets its objectives within the resources committed to the project.

**Instrument science investigation** — investigations funded by SMD

**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, IPM, and where appropriate, IS and partner leads, and other roles as identified in the proposal. [amended December 4, 2013]

**Margin** — The allowance carried on a resource (*e.g.*, budget, schedule, mass) to account for uncertainties and risks. It is the difference between the maximum possible capability of a resource (the physical limit or the agreed-to limit) and the maximum expected value for a resource.

**Mission** — Used interchangeably with investigation.

**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.

**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 multiparty 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 Investigation 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 E 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 Investigation Cost even though the PI is not responsible for those costs (*e.g.*, NASA-provided facilities, test equipment). [amended December 4, 2013]

**Planetary Protection** — The practice of avoiding biological contamination of other planetary bodies and samples to be returned to Earth, to preserve the capability to perform future scientific and other investigations.

**Principal Investigator (PI)** — The person who conceives of an investigation and leads implementation of it. The PI is invested by NASA with primary responsibility for implementing and executing selected investigations. A NASA employee can participate as a PI only on a Government-proposed investigation.

**Program** — An activity involving human resources, materials, funding, and scheduling necessary to achieve desired goals.

**Project** — Within a program, an undertaking with a scheduled beginning and ending, which normally involves the design, construction, and operation of one or more spacecraft or instruments and necessary ground support in order to accomplish a scientific or technical objective.

**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 Investigation to the Threshold Investigation 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-Exploration-Technology Enhancement Option (SEO)** — Options for enlarging the science impact beyond the baseline investigation, such as an extended mission, guest investigator programs, general observer programs, or archival data analysis programs are termed SEO activities.

**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.

**Threshold Investigation**— A descoped Baseline Investigation that would fulfill the “Threshold Science Requirements,” which are defined in NPR 7120.5E as the “performance requirements necessary to achieve the minimum [...] acceptable for the investment.”

**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** — Reserves that are free of liens identified by proposers and are held for risks that may be realized during project execution.

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

## Part C.2: COST ELEMENT DEFINITIONS

This is a short dictionary of definitions for the cost elements shown in the tables and discussed in the body of this AO.

**Instruments** — Instrument costs include costs incurred to design, develop, and fabricate the individual scientific or exploration technology 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 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.

**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 or exploration technology objectives, including spacecraft and instrument navigation, control, pointing, health monitoring, and calibration. Data analysis activities include collecting, processing, distributing, and archiving the scientific or exploration technology data. MO&DA costs include postlaunch all costs for people, procedures, services, hardware, and software to carry out these activities. It includes postlaunch investigation team support costs.

**NASA Center Costs (all categories)** — Additional costs borne by the science or exploration technology 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 Investigation Team Support** — Includes all Phase B/C/D (prelaunch) support costs for the investigation team. (See MO&DA for postlaunch component.)

**Prelaunch Ground Data System (GDS)/Mission Operations Services (MOS) Development** — Includes costs associated with development and acquisition of the ground infrastructure used to transport and deliver the telemetry and other data to/from the Mission Operations Center and the Science or Exploration Technology Operations Center. (For more information, refer to *NASA's Mission Operations and Communications Services* document in the Program Library.) Includes development of science or exploration technology 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 or exploration technology 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** — 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 specific WBS items, dollar amounts to fund each must be identified.

### Part C.3: ABBREVIATIONS AND ACRONYMS

AA	Associate Administrator
AO	Announcement of Opportunity
AOR	Authorized Organizational Representative
CADRe	Cost Analysis Data Requirement
CASP	Cross-Agency Support Programs
CBE	Current Best Estimate
CCR	Central Contractor Registry
CD-ROM	Compact Disc-Read Only Memory
CDR	Critical Design Review
CFR	Code of Federal Regulations
CM&O	Center Management and Operations
Co-I	Co-Investigator
CTS	Cornell Technical Services
DRD	Data Requirement Description
DSN	Deep Space Network
EA	Environmental Assessment
EAR	Export Administration Regulations
EASSS	Evaluations, Assessments, Studies, Services, and Support
EBPOC	Electronic Business Point of Contact
EGSE	Electrical Ground-Support Equipment
EIS	Environmental Impact Statement
ELV	Expendable Launch Vehicle
EM	Engineering Model
EOSDIS	Earth Observing System Data and Information System
E/PO	Education and Public Outreach
EVM	Earned Value Management
FAQ	Frequently Asked Questions
FAR	Federal Acquisition Regulations
FASAB	Federal Accounting Standards Advisory Board
FM	Flight Model
FRR	Flight Readiness Review
FFRDC	Federally Funded Research and Development Center
FY	Fiscal Year
G&A	General and Administrative
GAO	Government Accountability Office
GDS	Ground Data System
GFE	Government Furnished Equipment
GFS	Government Furnished Service

GSE	Ground-Support Equipment
HBCU	Historically Black Colleges and Universities
HBZ	HUB Business Zone
HEOMD	Human Exploration and Operations Mission Directorate
HUBZone	Historically Underutilized Business Zone
IAT	Integration, Assembly, and Test
ICD	Interface Control Document
IPM	Instrument Project Manager
IRD	Interface Requirements Document
IS	<del>Instrument Scientist</del> <b>[amended December 4, 2013]</b>
ISRU	<i>In Situ</i> Resource Utilization
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
MO&DA	Mission Operations and Data Analysis
MOS	Mission Operations Services
MOU	Memorandum of Understanding
MSL	Mars Science Laboratory
NAICS	North American Industry Classification System
NASA	National Aeronautics and Space Administration
NASA-STD	NASA-Standard
NEPA	National Environmental Policy Act
NFS	NASA FAR Supplement
NLS	NASA Launch Services
NLSA	Nuclear Launch Safety Approval
NODIS	NASA Online Directives Information System
NOI	Notice of Intent
NPD	NASA Policy Directive
NPR	NASA Procedural Requirements
NRC	National Research Council
NSPIRES	NASA Solicitation and Proposal Integrated Review and Evaluation System
NSS	NASA Safety Standard
OCFO	Office of the Chief Financial Officer
OMI	Other Minority Institution
OSTP	Office of Science and Technology Policy
PDF	Portable Data Format
PDR	Preliminary Design Review
PI	Principal Investigator
PIC	Procurement Information Circular
P.L.	Public Law
POC	Point of Contact
PS	Project Scientist

ROM	Rough Order-of-Magnitude
RPS	Radioisotope Power System
RY	Real Year
SB	Small Business
SC	Student Collaboration
SDB	Small Disadvantaged Business
SDRL	Subcontract Data Requirements List
SDVOSB	Service Disabled Veteran Owned Small Business
SE	System Engineer(ing)
SEO	Science-Exploration-Technology Enhancement Option
SKG	Strategic Knowledge Gaps
SMD	Science Mission Directorate
SN	Space Network
SOW	Statement of Work
SPD	SMD Policy Document
SPG	Strategic Planning Guidance
TA	Technical Authority
TAA	Technical Assistance Agreement
TMC	Technical, Management, and Cost
TRL	Technical Readiness Level
UARC	University Affiliated Research Center
URL	Uniform Resource Locator
U.S.	United States
U.S.C.	United States Code
VOSB	Veteran Owned Small Business
WBS	Work Breakdown Structure
WOSB	Women Owned Small Business

## APPENDIX D

### MARS 2020 PROGRAM LIBRARY

Mars 2020 Acquisition Homepage: <http://soma.larc.nasa.gov/mars2020/>

Mars 2020 AO Library: <http://soma.larc.nasa.gov/mars2020/programlibrary.html>

#### Strategic Documents

NPD 1001.0A, *The 2011 NASA Strategic Plan*  
*2010 Science Plan for NASA's Science Mission Directorate*

The National Research Council 2013 Planetary Decadal Survey, *Vision and Voyages for Planetary Science in the Decade 2013-2022*, may be accessed at [http://www.nap.edu/catalog.php?record\\_id=13117](http://www.nap.edu/catalog.php?record_id=13117).

#### Program Specific Documents

*Mars Science Goals, Objectives, Investigations, and Priorities of September 2010*  
*Science Definition Team July 2013 Report*  
*Science Definition Team Frequently Asked Questions (SDT FAQs)*  
*Analysis of Strategic Knowledge Gaps Associated with Potential Human Missions to the Martian System*  
D-80637, *Mars Exploration Program Mars 2020 Landed Science Payload Proposal Information Package*  
D-79808, *Mars 2020 Mission Assurance Plan (MAP)*  
*Subcontract Plans and Documentation, Subcontract Data Requirements List (SDRL) and Data Requirements Descriptions (DRDs)*  
*NASA Planetary Data System (PDS) Archive Preparation Guide (APG)*  
*NASA's Mission Operations and Communications Services*  
*Mars Exploration Program Data Management Plan*  
*Microsoft Excel version of table B3, B4, and B5 templates in the AO*  
*Table B3: WBS Summary of NASA Cost*  
*Table B4: Mission Phase Summary of NASA Cost*  
*Table B5: Master Equipment List*  
*Microsoft Word version of table B6 template in the AO*  
*Table B6: Instrument Accommodation Requirements Worksheet*  
*Specimen Subcontract*  
*NASA FY12 Inflation Tables - to be utilized in FY13*

The *Step-One Proposal Evaluation Plan Template* is applicable to this single-step AO and may be accessed at [http://soma.larc.nasa.gov/StandardAO/sao\\_templates.html](http://soma.larc.nasa.gov/StandardAO/sao_templates.html).

#### NASA and Federal Documents

NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*

NPR 7123.1B, *NASA Systems Engineering Processes and Requirements*  
NPR 8020.12D, *Planetary Protection Provisions for Robotic Extraterrestrial Missions*  
NPD 8020.7G, *Biological Contamination Control for Outbound and Inbound Planetary  
Spacecraft*  
*Statement of Federal Financial Accounting Standards 4: Managerial Cost Accounting Standards  
and Concepts*  
*Procurement Information Circular (PIC) 05-15*

#### Additional NASA and Federal Documents

All NASA Policy Directives (NPD) and NASA Procedural Requirements (NPR) documents referenced in this AO may be found in the NASA Online Directives Information System (NODIS) Library (<http://nodis.hq.nasa.gov/>)

NPD 1360.2B, *Initiation and Development of International Cooperation in Space and  
Aeronautics Programs*  
NPR 7150.2A *NASA Software Engineering Requirements*  
NPD 5101.32E, *Procurement, Grants, and Cooperative Agreement*  
NPR 5810.1, *Standard Format for NASA Research Announcements (NRAs) and other  
Announcements for Grants and Cooperative Agreements*  
NPD 7100.10E, *Curation of Extraterrestrial Materials*  
NPR 8580.1A, *NASA National Environmental Policy Act Management Requirements*  
NPD 8610.7D, *Launch Services Risk Mitigation Policy for NASA-Owned and/or NASA-  
Sponsored Payloads/Missions*  
NPR 8705.4, *Risk Classification for NASA Payloads*  
NPR 8715.3, *NASA General Safety Program Requirements,*  
NPR 8715.6A, *NASA Procedural Requirements for Limiting Orbital Debris*

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

The following standards and reports may be useful for proposals to this AO:

NASA-HDBK-6022b, *NASA Handbook for the Microbiological Examination of Space  
Hardware (DRAFT)*  
NASA-STD-8719.14, *NASA Process for Limiting Orbital Debris*  
NASA/CP-2002-211842, *A Draft Test Protocol for Detecting Possible Biohazards in Martian  
Samples Returned to Earth*

The Federal Acquisition Regulations (FAR) are available at <http://www.acquisition.gov/far/>. 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 1852.234-2, "Earned Value Management System"  
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.

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

14 CFR Part 1216.3, "Procedures for Implementing the National Environmental Policy Act (NEPA)"  
14 CFR Part 1250, "Nondiscrimination in Federally-Assisted Programs of NASA"  
14 CFR Part 1265, "Governmentwide Debarment and Suspension (Nonprocurement)"  
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.gpo.gov/fdsys/>. The following parts of the United States Code are referenced in this AO.

42 USC 4321 *et seq.*, "National Environmental Policy Act of 1969, as amended (NEPA)"  
44 USC 3504(d)(1) and 3516

Executive Orders may be accessed at <http://www.archives.gov/federal-register/executive-orders/>.  
The following Executive Orders are referenced in this AO.

Executive Order 12114, “Environmental effects abroad of major Federal actions” (see <http://www.archives.gov/federal-register/codification/executive-order/12114.html>)

Homeland Security Presidential Directive HSPD-12 (see <http://www.dhs.gov/homeland-security-presidential-directive-12>)

## APPENDIX E

### MARS 2020 INVESTIGATIONS PLANNING BUDGET PROFILE

#### SMD

Total Allocation (\$M RY)	FY'14	FY'15	FY'16	FY'17	FY'18	FY'19	FY'20	FY'21	FY'22	FY'23
Phase A/B	10	15								
Phase C/D		5	28	15	15	7	5			
Phase E							2	22	24	12

## APPENDIX F

### COMPLIANCE CHECKLIST

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

<b>Administrative</b>	
1. Electronic proposal received on time	Requirement 2
2. Proposal on CD-ROM received on time	Requirement 3
3. Correct number of copies of CDs	Requirement 71
4. Meets page limits	Requirement B-3
5. Meets general requirements for format and completeness (one volume, maximum 55 lines text/page, maximum 15 characters/inch --approximately 12 pt font)	Requirement 69 Requirement B-1 Requirement B-2
6. Required appendices included; no additional appendices	Requirement B-48
7. Budgets are submitted in required formats	Requirement B-45
8. All individual team members who are named on the cover page indicate their commitment through NSPIRES	Requirement 66
9. All export-controlled information has been identified.	Requirement 67
<b>Scientific or Exploration Technology</b>	
10. Addresses solicited programs	Requirement 5
11. Requirements traceable from science or exploration technology objectives to instrument(s)	Requirement 7
12. Appropriate data archiving plan	Requirement 8
13. Baseline Investigation and Threshold Investigation defined	Requirement 10
<b>Technical</b>	
14. Complete spaceflight investigation (Phases A-E F) proposed <b>[amended December 4, 2013]</b>	Requirement 15
15. Team led by a single PI	Requirement 30
16. Contributions within contribution limit	Requirement 56
17. Co-investigator costs in budget	Requirement 42
18. Includes table describing non-U.S. participation	Requirement 62
19. Includes letters of commitment from funding agencies for non-U.S. participating institutions	Requirement 59
20. Includes letters of commitment from all U.S. organizations offering contributions	Requirement 64
21. Includes letters of commitment from all major partners	Requirement 65

## 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.

<u>AO Reqmt</u>	<u>AO Section</u>	<u>AO Reqmt Topic</u>	<u>Appendix B Reqmt</u>
1	2.7	Science mission and/or HEO Exploration Technology [amended December 4, 2013]	
2	3	Proposal submission	
3	3	Electronic submission	
4	5.1.2	Planetary protection plans	
5	5.2.1	Science goal and objectives	B-14
6	5.2.1	Investigation objectives	B-14, B-16, B-18
7	5.2.2	Science traceability	B-15, B-16
8	5.2.2	Data Plan	B15, B-17, B-22, B-25
9	5.2.3	Measurement traceability	B-15, B-16, B-18
10	5.2.4	Baseline and threshold mission	B-17
11	5.2.4	Threshold mission	B-17
12	5.3.2	ISRU requirements	
13	5.3.2	ISRU plant capabilities	
14	5.3.3	ISRU requirements - additional	
15	5.4.2	Complete science/Tech. investigations	B-29, B-33
16	5.4.2	Instrumentation description and rationale for choosing it	B-18
17	5.4.2	Instrumentation suite rationale	
18	5.4.2	Instrument operations concept	B-18, B-20, B-21
19	5.4.2	Instrument accommodation req.	B-19
20	5.4.2	Instrument suite science, tech, cost info	
21	5.4.3	PIP Instrument compliance	B-19
22	5.4.3	Instrument participation in system	B-19
23	5.4.5	Management approach	B-34
24	5.4.5	Systems engineering approach	B-29
25	5.4.6	Technology maturation and TRL	B-30, B-60

26	5.4.7	Rationale for using radioactive material	
27	5.4.7	Cost of using radioactive material	
28	5.4.8	Deviation from Mars Assurance Plan	B-29
29	5.5	Management and teaming approach	B-27, B-34, B-35, B-36, B-49
30	5.5.1	Principal Investigator	B-27, B-35, B-51
31	5.5.2	Instrument Project Manager	B-27, B-35, B-51
32	5.5.2	PI and IPM roles	B-27, B-35
33	5.5.3	Qualifications of individuals	B-27, B-35
34	5.5.3	Qualifications of institutions	B-35
35	5.5.4	Risk identification	B-37, B-44
36	5.5.4	Risk mitigation	B-37, B-44
37	5.5.4	Descopes	B-37
38	5.5.4	International contribution risk	B-55
39	5.5.5	NASA PI proposals	B-56
40	5.6.1	Science team	B-27, B-34, B-35 B-36, B-49, B-51
41	5.6.2	Co-Investigator roles	B-27, B-36, B-38, B-51
42	5.6.2	Co-Investigator funding	B-50
43	5.6.3	Collaborators	B-27
44	5.8.1	PI-managed investigation costs	B-42, B-43, B-45, B-46
45	5.8.1	Funds expenditure prior to KDP-C	B-45, B-46
46	5.8.3	Teaming arrangement	B-34, B-40, B-49
47	5.8.4	Cost methodologies	B-43, B-47
48	5.8.4	Cost control	B-37
49	5.8.4	Cost reserves	B-37, B-43
50	5.8.5	Work Breakdown Structure	B-36
51	5.8.6	Master Equipment List	B-57, B-58
52	5.8.7	Full cost accounting for NASA proposals	
53	5.8.7	NASA contributions (non-SMD)	
54	5.8.7	Applicable accounting standards	
55	5.8.8	Contribution identification	B-40, B-42, B-45, B-50, B-52, B-53, B-54
56	5.8.8	Contribution value	B-50, B-52, B-53
57	5.8.8	Contribution risk management	B-40
58	5.9.2	Non-US cost plan	B-53
59	5.9.2	Non-US letters of commitment	B-50

60	5.9.2	Non-US contribution risk management'	
61	5.9.2	Non-US contribution detail	B-50, B-52, B-53, B-54
62	5.9.2	Non-US participation table	B-53
63	5.9.4	ITAR requirements	
64	5.10.1.1	US contribution letters of commitment	B-50
65	5.10.1.2	Major partner letters of commitment	B-50
66	5.10.1.3	NSPIRES commitment for team members	B-11
67	5.10.2	Export controlled proposal material	B-41, B-54
68	5.11.1	Cost, schedule, and investigation letter of commitment	B-33
69	6.2.1	Proposal format	B-1, B-2, B-3, B-4, B-5, B-6, B-7, B-12, B-13, B-61
70	6.2.3	Proposal submission electronically via NSPIRES	B-4, B-6, B-8, B-9, B-10
71	6.2.3	2 CD-ROMs with electronic proposal(s), Excel, and Word files	B-4, B-5, B-46, B-58, B-62, B-63
72	6.2.4	NSPIRES registration	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.**

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

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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.

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**Certification Regarding Lobbying**

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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

