

NNH12ZDA0060
SECOND STAND ALONE MISSIONS OF OPPORTUNITY NOTICE (SALMON-2)
NNH12ZDA0060-EVI4
PROGRAM ELEMENT APPENDIX (PEA) S:
EARTH VENTURE INSTRUMENT (EVI)-4

NOTICE: Clarified August 16, 2016. The letter designation for several of the requirements in this Program Element Appendix have been corrected. They were incorrectly identified as “Requirement T-“, rather than “Requirement S-“. New letters are in bold; old, incorrect letters are struckthrough. The numbering remains unchanged.

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1 BACKGROUND

1.1 Programmatic Overview

The National Aeronautics and Space Administration (NASA) Science Mission Directorate (SMD) Earth Science Division's Earth Venture (EV) mission portfolio is an element within the Earth System Science Pathfinder (ESSP) Program. Earth Venture missions consist of a series of regularly solicited, competitively selected, cost and schedule constrained Earth science investigations as recommended by the most recent National Research Council's decadal survey in Earth science, *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* (The National Academies Press, 2007), available at http://www.nap.edu/catalog.php?record_id=11820.

The goal of NASA's Earth Venture mission portfolio is to provide frequent flight opportunities for high quality, high value, focused Earth science investigations that can be accomplished under a not-to-exceed cost cap and that can be developed and flown relatively quickly, generally in five years. The investigations will be Principal Investigator (PI) led and will be selected through an open competition to ensure broad community involvement and encourage innovative approaches.

The programmatic objectives of the Earth Venture mission portfolio are to implement missions that will:

- advance scientific knowledge of Earth science processes and systems;
- add scientific data and other knowledge-based products to data archives for all to access;
- result in scientific progress and results published in the peer-reviewed literature to encourage, to the maximum extent possible, the fullest commercial use of the knowledge gained;
- provide opportunities to expand the pool of well-qualified Principal Investigators and Project Managers for implementation of future NASA missions;
- implement technology advancements accomplished through related programs; and
- communicate scientific progress and results through popular media, scholastic curricula, and outreach materials that can be used to inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.

The EV investigations will accomplish high quality Earth science investigations utilizing efficient management approaches to contain mission cost through commitment to, and control of, design, development, and operations costs.

This solicitation calls for proposals for complete PI-led science investigations requiring spaceflight instrument or CubeSat(s) development. The term "complete" encompasses

investigation phases from project initiation, through development and science operations, to scientific analysis of space based data. These spaceflight missions will be used to conduct innovative, integrated, hypothesis or scientific question-driven investigations addressing pressing Earth system science issues.

This solicitation calls for investigations addressing any of the science goals in NASA's Earth Science program (see Section 2.1 for a description of the science goals). Investigations may target any Earth science question or issue in order to advance the strategic goals outlined in Section 2.1, answer any of the science questions for Earth Science from Section 2.1 of this PEA and the *2014 Science Mission Directorate Science Plan* (hereafter referred to as the *2014 Science Plan*; available at <http://science.nasa.gov/about-us/science-strategy/>), or address any of the science goals for Earth Science also from the *2014 Science Plan*.

Investigations that address NASA goals in other areas such as heliophysics, astrophysics, or planetary science are not solicited in this PEA. Priority will be given to cost-effective, innovative investigations with demonstrable reliability, rather than ones with excessive technology development requirements. Investigations that focus on establishing entirely new research avenues or demonstrating key applications-oriented measurements are solicited.

A key to the success of the Earth Venture portfolio will be maintaining a steady and predictable stream of opportunities for community participation and innovative idea development. This requires that strict schedule and cost guidelines be enforced on the selected EV missions and mission teams.

1.2 Earth Venture Background

The National Research Council's decadal survey in Earth science recommended that NASA maintain a line of competitively selected, moderate size missions and opportunities in the Earth Venture mission portfolio. Six solicitations/selections have already resulted from the NASA Earth Venture program. Earth Venture is being implemented in the broader context of NASA's Earth Science program and has resulted in more frequent opportunities than afforded by the strategic and directed missions outlined in the decadal survey.

The following foci have been identified for the Earth Venture-class missions:

- measurement and observation innovations;
- demonstration of innovative ideas allowing the use of existing moderately higher-risk technologies or approaches;
- establishment of new research avenues; and
- possible demonstration of key application-oriented measurements.

The selection criteria for EV missions are based primarily on the direct science return from the measurement.

The National Research Council's decadal survey in Earth science and applications has recommended three types of Earth Venture-class missions. Through the Earth Venture mission

portfolio, NASA intends to obtain a mix of suborbital, instrument, and complete spaceflight mission investigations. To achieve this mix, three different kinds of solicitations are being pursued under the Earth Venture-class line.

- *EV Suborbital* (i.e., EVS-1, 2, 3, ...). These solicitations call for proposals for complete suborbital, PI-led investigations to conduct innovative, integrated, hypothesis or scientific question-driven approaches to pressing Earth system science issues. The first suborbital science investigations funded under the EV-1 element (or EVS-1 by the new EV naming scheme) are now completed. Under EVS-2 solicitation, the second one of this series, investigations are now in operations. This is not solicited in this SALMON-2 PEA.
- *EV-Mission* (i.e., EVM-1, 2, 3, ...). These solicitations call for proposals for complete PI-led spaceflight missions to conduct innovative, integrated, hypothesis or scientific question-driven approaches to pressing Earth system science issues. The EV-2 (or EVM-1 by the new EV naming scheme) solicitation was the first of this series, with the selected mission now in development. The second solicitation in this series, EVM-2, is expected to announce a selection in FY16. This is not solicited in this SALMON-2 PEA.
- *EV Instrument* (e.g., EVI-1, 2, 3, ...). These solicitations call for developing instruments for participation on a NASA-arranged spaceflight mission of opportunity or for developing CubeSat(s) to fly on a NASA arranged launch vehicle. These investigations must conduct innovative, integrated, hypothesis or scientific question-driven approaches to pressing Earth system science issues. The NASA funded PI will retain a central role on the instrument package or CubeSat(s) development, integration and testing, calibration, and science operations. The EVI-1 solicitation was the first of this series, with the selected mission in development. As a result of the EVI-2 call, two investigations were selected that are now also in development. Two additional investigations were selected as a result of the EVI-3 call. Solicitations in this series are anticipated every 18 months (or shortly after the selection announcement of the previously solicited EVI). EVI-4 is solicited in this SALMON-2 PEA.

All Earth Venture-class spaceflight missions require a schedule for launch (or delivery for platform integration in the case of EVI) within five years of project initiation and projects are cost-capped. The Earth Venture class is not intended to be a mechanism for accelerating the implementation of decadal survey missions. However, it is also possible and acceptable that an instrument selected and developed through this solicitation could address significant portions of missions or measurements identified by the decadal survey.

This is the fourth solicitation in the Earth Venture Instrument series. The fifth solicitation in this series is anticipated to be 18 months after the release of this EVI-4 PEA, but not before the selection announcement for EVI-4.

1.3 Overview of this Program Element Appendix

NASA issues this Program Element Appendix (PEA) as an appendix of the Second Stand Alone Missions of Opportunity Notice (SALMON-2) Announcement of Opportunity (AO) for the purpose of soliciting proposals for Mission of Opportunity (MO) investigations to be

implemented through the Earth Venture Instrument (EVI) element of the Earth System Science Pathfinder (ESSP) Program. All investigations proposed in response to this solicitation must support the goals and objectives of the ESSP Program and the EVI element (Section 2.1) and must be implemented by Principal Investigator (PI) led investigation teams (Section 5.4 of the SALMON-2 AO). Two types of investigations are solicited: Instrument Investigations and CubeSat Investigations.

Instrument Investigations must encompass the provision of a flight qualified spaceflight instrument or instrument package ready for integration to a spacecraft (Phase A-C), the technical support for integration onto a NASA-determined spacecraft (Phase D, see Section 4.4.1), the on-orbit operations, and the delivery of science quality data (Phase E), as described in Section 4.1 of the SALMON-2 AO.

CubeSat Investigations must encompass the provision of CubeSat(s) (instrument and flight systems) ready for integration to the launch vehicle (Phases A-D), the technical support for integration onto a NASA-determined launch vehicle (part of Phase D, see Section 4.4.1), the on-orbit operations, and the delivery of science quality data (Phase E), as described in Section 4.1 of the SALMON-2 AO.

Proposals submitted in response to this SALMON-2 PEA will be evaluated and selected through a single step competitive process. As the outcome of this single step, NASA intends to select at least one proposed investigation to proceed to mission development for flight and operations. If more than one proposal is deemed selectable such that combined costs are within the available funding (as defined in Section 4.4.1), NASA may select more than one investigation in response to this solicitation.

The SALMON-2 AO and this PEA, particularly Section 4, present the requirements and constraints that apply to proposals that are to be submitted. Appendix B of the SALMON-2 AO and this PEA, particularly Section 5.1, contain additional requirements on the format and content of the proposals. Documents available in the EVI-4 Library at http://essp.larc.nasa.gov/EVI-4/evi-4_library.html are intended to provide guidance for proposers; they are specifically not intended to impose requirements on proposals.

2 SCIENCE AND PROGRAM OBJECTIVES

2.1 NASA Earth Science Goals

One of NASA's strategic goals is to "Advance understanding of Earth and develop technologies to improve the quality of life on our home planet." Further information on NASA's Strategic Goals may be found in NASA Policy Directive (NPD) 1001.0B, *The 2014 NASA Strategic Plan*, available through the EVI-4 Library. The NASA Science Mission Directorate (SMD) is addressing this strategic goal by pursuing the Earth Science Goals.

Our planet is changing on all spatial and temporal scales and studying the Earth as a complex system is essential to understanding the causes and consequences of climate change and other global environmental concerns. The purpose of NASA's Earth science program is to advance our

scientific understanding of Earth as a system and its response to natural and human-induced changes and to improve our ability to predict climate, weather, and natural hazards.

NASA's ability to observe global change on regional scales and conduct research on the causes and consequences of change position it to address the NASA strategic objective for Earth science, which is to advance knowledge of Earth as a system to meet the challenges of environmental change, and to improve life on our planet. NASA addresses the issues and opportunities of climate change and environmental sensitivity by answering the following key science questions through our Earth science program:

- How is the global Earth system changing?
- What causes these changes in the Earth system?
- How will the Earth system change in the future?
- How can Earth system science provide societal benefit?

These science questions translate into seven overarching science goals to guide the Earth Science Division's selection of investigations and other programmatic decisions:

1. Advance the understanding of changes in the Earth's radiation balance, air quality, and the ozone layer that result from changes in atmospheric composition (*Atmospheric Composition*);
2. Improve the capability to predict weather and extreme weather events (*Weather*);
3. Detect and predict changes in Earth's ecological and chemical cycles, including land cover, biodiversity, and the global carbon cycle (*Carbon Cycle and Ecosystems*);
4. Enable better assessment and management of water quality and quantity to accurately predict how the global water cycle evolves in response to climate change (*Water and Energy Cycle*);
5. Improve the ability to predict climate changes by better understanding the roles and interactions of the ocean, atmosphere, land and ice in the climate system (*Climate Variability and Change*);
6. Characterize the dynamics of Earth's surface and interior, improving the capability to assess and respond to natural hazards and extreme events (*Earth Surface and Interior*); and
7. Further the use of Earth system science research to inform decisions and provide benefits to society.

Two foundational documents guide the overall approach to the Earth science program: the National Research Council's (NRC's) 2007 Earth science decadal survey and NASA's 2010 climate-centric architecture plan. The NRC decadal survey articulates the following vision for Earth science research and applications in support of society:

Understanding the complex, changing planet on which we live, how it supports life and how human activities affect its ability to do so in the future is one of the greatest intellectual challenges facing humanity. It is also one of the most important challenges for society as it seeks to achieve prosperity, health, and sustainability.

The 2007 decadal survey recommended a broad portfolio of missions to support the research that is needed to provide answers to the key science questions and accomplish the related science goals. Recognizing the pressing challenge of climate change, NASA addressed the need to ensure the continuity of key climate monitoring measurements in its 2010 climate-centric architecture plan. The plan reflects the need to collect additional key climate monitoring measurements, which are critical to informing policy and action, and which other agencies and international partners had not planned to continue. The plan also accelerated key decadal survey recommendations to address the nation's climate priorities.

NASA's ability to view the Earth from a global perspective enables it to provide a broad, integrated set of uniformly high-quality data covering all parts of the planet. NASA shares this unique knowledge with the global community, including members of the science, Government, industry, education, and policy-maker communities. For example, NASA plays a leadership role in a range of Federal interagency activities, such as the U.S. Global Change Research Program (USGCRP), by providing global observations, research results, and modeling capabilities. It also maintains an expansive network of partnerships with foreign space agencies and international research organizations to conduct activities ranging from data sharing agreements to joint development of satellite missions. These interagency activities and international partnerships substantially leverage NASA's investments and provide knowledge essential for understanding the causes and consequences of climate change and other global environmental concerns.

Further information on the goals and objectives of NASA's Earth Science program may be found in the *2014 Science Mission Directorate Science Plan* available through the EVI-4 Library.

2.2 Accommodation of EV Instruments and Launch of EV CubeSats

The objective of this solicitation is to select one or more Instrument Investigation(s) where an instrument(s) is built and deployed on an existing or planned spacecraft, and/or one or more CubeSat Investigation(s) where CubeSats are developed and ride to space on an available launch vehicle. Both types of investigations must produce high quality and highly useful Earth Science data. Instrument investigations will be proposed without a firm identification of the spacecraft to accommodate these instruments and CubeSat Investigations will face uncertainty about access to space. Therefore, selection of proposals from this solicitation will take into account the "accommodatability" of the proposed instruments and/or the access to space for proposed CubeSats, as well as the value of the science to be returned from the selected investigations.

Many satellites that will be launched to orbits appropriate for observations of the Earth System are expected to have capacity to accommodate Instrument Investigations. These spacecraft could be developed by NASA (including the International Space Station), other U.S. agencies, foreign space agencies, or commercial vendors. In order to take advantage of excess payload capacity on any of these platforms, NASA is planning to have instruments available for inclusion on these various spacecrafts. The available capacity including size, weight, power, thermal control, pointing stability, pointing ability, orbits, and data rates for each potential platform will vary, but, in general, the platform requirements and capacities will be defined by their primary payloads. The instruments provided through this PEA will have to work within the available resources. Hence, there will be some constraints on the specifications of any instruments potentially selected for development through this EVI-4 PEA. Proposed instruments that cannot

meet many of the requirements anticipated for most potential platforms will be seen as a higher risk for accommodation than those that have higher specification margin.

NASA has initiated a CubeSat Launch Initiative (CSLI) and begun regularly providing launch opportunities for CubeSats as secondary payloads on U.S. Government missions. The CubeSat Launch Initiative is managed by the NASA Human Exploration and Operations Mission Directorate; see http://www.nasa.gov/directorates/heo/home/CubeSats_initiative.html.

For further information, please contact: Anne E. Sweet, Launch Services Program Executive, Phone: 202-358-3784, E-mail: anne.sweet-1@nasa.gov or, Jason C. Crusan, Chief Technologist for Human Exploration and Operations, Phone: 202-358-0635, E-mail: jason.c.crusan@nasa.gov

2.3 NASA Management of the Earth Venture Program

The selected investigation(s) will be managed by the Earth System Science Pathfinder (ESSP) Program. The Associate Administrator for NASA SMD has established an ESSP Program Office (ESSP PO) at the NASA Langley Research Center (LaRC) to be responsible for project oversight. The ESSP Program Manager at NASA LaRC reports to the Associate Director for Flight Programs within the Earth Science Division at NASA Headquarters. Additional details about the program office staffing, structure, and management approach can be found in the *ESSP Program Plan*, available through the EVI-4 Library. There are appropriate protective firewalls between the ESSP Program Office and the rest of NASA LaRC, allowing investigators from LaRC to propose in response to this PEA. ESSP PO will manage the EVI investigations under the requirements of NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements*, as described in Section 4.1.2 of the SALMON-2 AO.

3 PROPOSAL OPPORTUNITY PERIOD AND SCHEDULE

This solicitation is an appendix to the NASA SALMON-2 AO. The SALMON-2 AO provides the overall structure and guidelines for several types of mission of opportunity solicitations. Each new opportunity is announced with a Program Element Appendix (PEA). This document is such a PEA. The SALMON-2 AO (NNH12ZDA006O) can be found in the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at <http://nspires.nasaprs.com> and at <http://go.nasa.gov/SALMON2-AO>.

This PEA solicits Earth science investigations that include the development of instruments to be provided to and integrated with yet-to-be-identified space platforms and/or the development of CubeSats to be provided to and integrated with yet-to-be-identified launch vehicles.

Evaluation and selection will be done using a single step selection process; no competitive Phase A (Step 2) or down selection is planned. Normal Phase A activities will be conducted by the selected investigation team or teams following selection.

The following schedule applies to this PEA.

- A Preproposal Workshop will take place in association with this solicitation. Further information will be available at the Earth Venture Instrument-4 Acquisition Homepage (see Section 7 of this PEA) prior to the Preproposal Workshop.
- Questions concerning any portion of this PEA should be addressed to the Point of Contact given in Section 7 of this PEA. The period for questions will close two weeks before the proposal due date.
- A Notice of Intent (NOI) to propose to this announcement is **REQUIRED** for this solicitation. It is desired by NASA SMD that all NOIs have the entire investigation team identified within the NOI to allow for the identification of unconflicted evaluators by the proposal due date. SMD requires that proposers communicate any changes to the investigation team between NOI and proposal submission directly to the EVI-4 Program Scientist identified in Section 7 of this PEA. NOIs are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Section 6.1.2 of the SALMON-2 AO provides information on electronic NOI submission through NSPIRES. Submitting an NOI does not commit the team to submitting a proposal.
- All proposals are due no later than 11:59 p.m. Eastern Time on the date given in Section 7 of this PEA. Proposals must be fully electronic and must be submitted through NSPIRES. Proposal submission requirements are outlined in Section 5 of this PEA.
- NASA funding for selected proposals will begin as soon as appropriate funding vehicles can be put in place, usually within four months following receipt of the Statement of Work, as set forth in Section 6.3.1 of this PEA.

4 REQUIREMENTS AND CONSTRAINTS

4.1 Eligibility to Propose

Refer to Section 4.2 of the SALMON-2 AO for the rules on participation policy. For this particular PEA, NASA will place full or partial limitations (as described in the SALMON-2 AO) on organizations that will be involved in the evaluation process. Cornell Technical Services LLC (CTS) is subject to the "Full Limitation" as described in Section 4.2.1 of the SALMON-2 AO. There is no limitation on The Aerospace Corporation for EVI-4.

4.2 Type of Mission of Opportunity

In the context of the SALMON-2 AO, this PEA is a Focused Mission of Opportunity (FMO). A FMO is one that addresses a specific, NASA-identified flight opportunity that fulfills the solicited objectives and includes all of the elements specified in this document and in the SALMON-2 AO.

The investigation PI is responsible for conducting the proposed science investigation which includes, but is not limited to: (i) development and delivery of the instrument, instrument package, and/or CubeSat(s); (ii) working with NASA to integrate the instrument on the NASA-chosen platform and/or the complete CubeSat(s) onto the NASA-determined launch vehicle; (iii) commissioning, validating, and operating the instrument and/or CubeSat(s) on-orbit and required ground systems in order to carry out the proposed science investigation; (iv) preparing and delivering appropriate data analysis software, including required calibration data, analyzing the data, archiving all the proposed investigation data at a NASA-chosen Distributed Active

Archive Center (DAAC) for public distribution to the scientific community, and reporting the results of the science investigation in the scientific literature.

4.3 Science Requirements and Constraints

The science goals and questions are fully described in Section 2 of this PEA. Any appropriate science question relevant to Earth system science can be addressed with the proposed investigations. Section 2 provides the basis for the evaluation of intrinsic science merit as described in Section 7.2.2 of the SALMON-2 AO. Investigations addressing areas of science outside Earth system science as described in Section 2 are not solicited through this call.

Requirement S-1. Proposals shall address appropriate science goals and questions relevant to Earth system science as described in Section 2 of this PEA.

Requirement S-2. Each proposal shall clearly define its science goals and questions, shall demonstrate how the science questions map into high-level science requirements, and shall show how the science requirements subsequently map into the measurement and instrument performance requirements and for CubeSat Investigations into the CubeSat(s) performance requirements.

Baseline and threshold investigations are defined in Section 5.2.4 of the SALMON-2 AO.

Requirement S-3. Each proposal shall clearly state the baseline and threshold requirements for the performance of the instrument and/or CubeSat(s), the prime mission lifetime for operations, and the range of satellite orbits acceptable or required for deployment.

Requirement S-4. Proposals shall designate all Co-Investigators (Co-Is), describe the role of each Co-I in the development of the mission, and justify the necessary nature of the role; see Section 5.6 of the SALMON-2 AO.

Each observation from space has natural synergies with other observations. Some proposed observations may either require or desire additional observations in order to better address the science questions as proposed for the investigation. Some of these observations may be currently existing or planned either from other NASA missions or from missions by other U.S. or non-U.S. agencies. Proposers are expected to clearly state any dependencies on other data sets, what assumptions are made on the likelihood that these observations will exist during potential time frames for operation of their proposed investigations and the implications if those observations do not exist.

Requirement S-5. Each proposal shall clearly outline which additional ongoing or planned observations, if any, are required for the proposed investigation to achieve its baseline mission science investigation. The proposal shall describe how the high-level science requirements will be impacted if such observations do not exist when the proposed investigation is in operation.

Most NASA Earth science observations from space require stringent and well-defined calibration and validation plans. NASA expects each proposal to fully describe the requirements for calibration and validation. If some required validation data are not to be funded directly by the

selected PI-led investigation, the proposal should provide information about the commitment to funding for those data in the time frame of five to ten years after selection of the investigation and describe the implications to meeting the science requirements if such data do not become available.

Requirement S-6. Each proposal shall fully describe the requirements for calibration and validation. If some required validation data are not to be funded directly by the selected PI led investigation, the proposal should provide information about the expectations for available calibration and validation instruments and/or data in the time frame of five to ten years after selection of the investigation and describe the implications to meeting the science requirements if such activities do not become available.

4.4 Cost and Schedule Requirements and Constraints

4.4.1 Cost Requirements and Constraints

The PI-Managed Mission Cost Cap for an Earth Venture Instrument investigation depends on the instrument class, as described in Section 4.5.5 of this PEA. For Class D instrument based investigations or for CubeSat based investigations, the cost cap is \$33M in Fiscal Year (FY) 2020 dollars. For Class C instrument based investigations, the cost cap is \$102M in FY 2020 dollars.

NASA expects to select some combination of Class C and Class D investigations based on funding availability at the time of selection, assuming such investigations are deemed selectable.

Each selected investigation is PI-Managed, and the PI will be responsible for defining and controlling the costs within the proposed budget for each phase of the investigation. Since NASA will be arranging the spacecraft for the Instrument Investigation(s) and access to space for CubeSats, some costs cannot be defined and controlled by the PI, and these costs will be outside the constrained PI-Managed Mission Cost. This section identifies those costs that are constrained within the PI-Managed Mission Cost and those where NASA requires planning budgets that are outside the constrained PI-Managed Mission Cost. A summary of budgeted costs that are and are not to be included within the PI-Managed Mission Cost cap for Instrument Investigations is listed in Table 1 and for CubeSat Investigations is listed in Table 2.

The ESSP Program's planning budget can accommodate one or more selection(s) within this solicitation's cost cap with a typical (combined) funding profile over a nominal five-year development period for Class C instrument delivery and a nominal four-year development period for Class D instrument or CubeSat(s) delivery. Proposers should propose a funding profile that is appropriate for their investigation. However, NASA cannot guarantee that every proposed funding profile can be accommodated within the ESSP Program's budget. The inability of NASA to accommodate the requested funding profile may be a reason for nonselection of a proposal. Final funding profiles for all selected investigations will be negotiated between the ESSP Program and the selected investigation teams.

Requirement S-7. Proposals shall be for complete investigations including Phases A-F.

Requirement S-8. The proposed PI-Managed Mission Cost shall be no more than \$102M in FY 2020 dollars for a Class C instrument based investigation. The PI-Managed Mission Cost shall be no more than \$33M in FY 2020 dollars for any Class D instrument or any CubeSat based investigation. The PI-Managed Mission Cost for Instrument Investigations excludes the integration of the instrument to the selected platform and for CubeSat Investigations excludes the integration of the CubeSat to the selected launch vehicle; it also excludes launch services. All proposals shall include the proposed science team, instrument personnel, and key management and engineering staff activity in Phase D. Proposals shall assume two years for Phase D.

Requirement S-9. Proposals shall include detailed plans and budgets for Phases A-F for costs that are within the PI-Managed Mission Cost (see Tables 1 and 2).

4.4.1.1 Instrument Investigation Cost Requirements and Constraints

For Instrument Investigations, costs that are within the PI-Managed Mission Cost include: instrument delivery ready for integration onto the selected platform (Phases A-C); development and delivery of functional algorithms and ground processing system (Phases B-D); supporting a science team that will contribute directly to the successful implementation of the investigation (Phases A-F); required calibration and validation activities (Phases C-E); operations, product generation, and data analysis during the proposed prime mission lifetime of the investigation (Phases E); and close out of the investigation once the investigation has been concluded (Phase F). The PI-Managed Mission Cost also includes the cost of the science team and of key management, instrument, and engineering staff during Phase D, as this is not expected to be dependent on the final platform of the selected investigation. For support of the science team and key management and engineering during Phase D, a two-year duration should be assumed for budgeting purposes.

It is expected that once an appropriate platform is determined (preferably before the Preliminary Design Review) minor changes to the selected instrument will be required. Appropriate budget margin should be planned to account for such changes.

Costs that are outside the PI-Managed Mission Cost include integration to the NASA selected platform (Phase D); and investigation costs during any potential gap between the delivery of the completed instrument (end of Phase C) and the start of integration of the instrument to the designated spacecraft (start of Phase D).

For planning purposes, the proposal must include estimates of costs for Phase D (nominally two years) that would be outside the PI-Managed Mission Cost as identified above. It is understood that final Phase D cost will be dependent on the selected platform for the instrument and the actual time frame for each development phase.

NASA also requires proposals to include plans and planning budgets that estimate the minimum costs for the project if there is a gap between the delivery of the completed instrument (end of Phase C) and the start of integration of the instrument to the designated spacecraft (start of Phase D). Instrument and essential ground processing/algorithm/science development activities must not be planned during this gap as the instrument must be completed for delivery; only

instrument maintenance activities such as storage and periodic monitoring must be planned. These "gap planning" budgets should be on a per-year basis up to a maximum of four years. The costs for both of these planning budgets are outside of the PI-Managed Mission Cost.

Requirement S-10. Instrument Investigation proposals shall include integration plans and planning budgets that occur during Phase D, with the assumption that this phase will take two years. With the exception of the PI-Managed science, management, and engineering cost for Phase D identified in Table 1, these costs are outside the PI-Managed Mission Cost.

Requirement S-11. Instrument Investigation proposals shall include plans and planning budgets for the required costs to minimally support the project during a potential gap between instrument delivery (end of Phase C) and the start of integration with the spacecraft (start of Phase D). These budgets should be on a per-year basis for up to four years. These costs are outside the PI-Managed Mission Cost.

Table 1: List of portions of an Instrument Investigation cost that are within and outside the PI-Managed Mission Cost. Budgets for both are required in each proposal.

Portion of the Investigation	Within PI-Managed Mission Costs	Outside PI-Managed Mission Costs
Phase A	X	
Phase B	X	
Phase C	X	
Investigation Costs during a potential gap between completion of instrument and start of integration (planning budget up to four years, on a per-year basis)		X
Science Team activity within Phase D	X	
Key management and engineering staff during Phase D (Project manager, instrument manager, systems engineer, etc.) assuming a two year Phase D	X	
Integration and test to selected platform (within Phase D) (planning budget nominally two years)		X
Cal/Val planning (all phases)	X	
Postlaunch instrument commissioning activity (within Phase D)	X	
Phase E	X	
Phase F	X	
Cost for access to space		X
Education or Communication program, not required, see Section 4.6.		X
Student Collaboration (SC) (optional)	X – any SC cost above 1% of the PI-Managed Mission Cost	X - Up to 1% of the PI-Managed Mission Cost

4.4.1.2 *CubeSat Investigations Cost Requirements and Constraints*

For CubeSat Investigations, all costs are inside the PI-Managed Mission Cost except the cost associated with integration and launch of the CubeSats on the NASA selected launch vehicle(s), as identified in Table 2. The PI-Managed Mission Cost also includes the cost of the science team and of key management, mission, and engineering staff during the integration and test to selected launch vehicle part of Phase D, as this is not expected to be dependent on the launch services provided to the selected investigation. For support of the science team and key management and engineering during this part of Phase D, a one-year duration should be assumed for budgeting purposes.

Once an appropriate launch vehicle is determined (preferably before the Preliminary Design Review) minor changes to the CubeSat(s) may be required. Appropriate budget margin should be planned to account for such changes.

Costs that are outside the PI-Managed Mission Cost include integration to the NASA selected launch vehicle (part of Phase D); and investigation costs during any potential gap between the delivery of the completed CubeSat(s) (part of Phase D) and the start of integration to the designated launch vehicle (part of Phase D).

For planning purposes, the proposal must include estimates of cost for the part of Phase D (nominally one year) that would be outside the PI-Managed Mission Cost, as identified above. It is understood that final Phase D cost will be dependent on the selected launch service and the actual time frame for each development phase.

NASA also requires proposals to include plans and planning budgets that estimate the minimum costs for the project if there is a gap between the delivery of the completed CubeSat(s) (part of Phase D) and the start of integration of the CubeSat(s) to the designated launch vehicle (part of Phase D). CubeSat(s) and essential ground processing/algorithm/science development activities must not be planned during this gap as the CubeSat(s) must be completed for delivery; only maintenance activities, such as storage and periodic monitoring, must be planned. These “gap planning” budgets should be on a per-year basis up to a maximum of two years. The costs for both of these planning budgets are outside of the PI-Managed Mission Cost.

Requirement S-12. CubeSat Investigation proposals shall include launch vehicle integration plans and planning budgets that occur during this part of Phase D, with the assumption that this part of Phase D will take one year. With the exception of the PI-Managed science, management, and engineering cost necessary for this portion of Phase D identified in Table 2, these costs are outside the PI-Managed Mission Cost.

Requirement S-13. CubeSat Investigation proposals shall include plans and planning budgets for the required costs to minimally support the project and science during a potential gap between CubeSat(s) delivery (part of Phase D) and the start of integration with the launch vehicle (part of Phase D). These budgets should be on a per-year basis for up to two years. These costs are outside the PI-Managed Mission Cost.

Table 2: List of portions of a CubeSat Investigation cost that are within and outside the PI-Managed Mission Cost. Budgets for both are required in each proposal.

Portion of the Investigation	Within PI-Managed Mission Costs	Outside PI-Managed Mission Costs
Phase A	X	
Phase B	X	
Phase C	X	
Phase D (integration of instrument(s) to CubeSat(s) and delivery of CubeSat(s) to Launch Services)	X	
Investigation Costs during a potential gap between completion of CubeSat(s) and start of integration to launch vehicle (planning budget up to -two years, on a per-year basis)		X
Science Team activity within Phase D	X	
Key management and engineering staff during integration and test to selected launch vehicle part of Phase D (Project manager, instrument manager, systems engineer, etc.) assuming a one year part of Phase D	X	
Integration and test to selected launch vehicle (within Phase D) (planning budget nominally one year)		X
Cal/Val planning (all phases)	X	
Postlaunch instrument commissioning activity (within Phase D)	X	
Phase E	X	
Phase F	X	
Cost for access to space		X
Education or Communication program, not required, see Section 4.6.		X
Student Collaboration (SC) (optional)	X – any SC cost above 1% of the PI-Managed Mission Cost	X - Up to 1% of the PI-Managed Mission Cost

4.4.2 Full Cost Accounting for NASA Facilities and Personnel

This Section supersedes Section 5.5.5 of the SALMON-2 AO.

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

Estimated NASA Center Management and Operations (CM&O) overhead costs must also be included within the cost cap, to enable a level playing field for all proposers. Per Headquarters

policy guidance signed in June 2010 by the Associate Administrator, Mission Support Directorate and by the Agency Chief Financial Officer, all Centers shall use an identical CM&O burden rate of \$45K (FY 2017) per "equivalent head." For years after FY 2017, this number must be inflated. Per Agency policy, this rate must be applied as a "cost per equivalent head" to all Civil Service Full Time Equivalents (FTEs), plus on/near site contractor Work Year Equivalents (WYEs) associated with the proposal. The estimated FTEs and WYEs per fiscal year, and the resulting CM&O burden, must be identified in a separate table within the budget justification section of the proposal.

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

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

Table 3: Cost Elements for NASA Center Budget Proposals in response to SMD AOs

	Identify in proposal	Include in PI-Managed Mission Cost	Funding source	Comments
Civil Service Labor	Yes	Yes	SMD Program	Includes salaries and benefits
Civil Service Travel	Yes	Yes	SMD Program	
Other Direct/Procurements	Yes	Yes	SMD Program	Includes procurements as typically identified by flight projects in the NASA N2 budget database
CM&O	Yes	Yes	CASP	Applied to NASA provided labor, including Center civil servants and on/near-site contractors
AM&O	No	No	CASP	Includes NASA provided independent technical authority
NASA Contributed Costs	Yes	No	Identify	Must be non-SMD
Non-NASA Federal Government (funding requested from NASA)	Yes	Yes	SMD Program	If NASA funding is requested for the non-NASA Federal Government agency
Contributions	Yes	No	Identify	Includes all non-NASA contributions

Requirement S-14. Proposals including costs for NASA Centers shall conform to the full cost policy stated in this Section. Each of the elements of the NASA Center costs (direct labor, travel, and procurements) shall be separately identified by year.

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

Requirement S-15. 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 EVI-4 Library.

Requirement S-16. Proposals including costs for non-NASA Federal Government agencies shall follow the applicable accounting standards.

4.4.3 Schedule Requirements and Constraints

Each selected Class C instrument investigation under this EVI solicitation will be expected to deliver an instrument that can be integrated onto a NASA-determined platform by August 31, 2022. Nominally, the selected investigation(s) development Phases A through C will span the years of FY 2017-FY 2022. Proposals that include a more rapid instrument development timelines may be selected, provided the required budget phasing can be accommodated by NASA.

Each selected Class D instrument or CubeSat investigation under this EVI solicitation will be expected to deliver an instrument that can be integrated onto a NASA-determined platform and/or a CubeSat(s) that can be integrated to a NASA-determined launch vehicle by August 31, 2021. Nominally, the selected investigation(s) development Phases A through C (or into Phase D for CubeSats) will span the years of FY 2017-FY 2021. Proposals that include more rapid development timelines may be selected, provided the required budget phasing can be accommodated by NASA.

It is expected that once an appropriate platform and/or launch service is determined by NASA, preferably before the Preliminary Design Review, minor changes to the selected instrument and/or CubeSat(s) will be required. Appropriate schedule margin should be planned to account for such changes.

Requirement S-17. For Class C instrument investigations, proposals shall include a development schedule that delivers an instrument for integration onto the selected platform no later than August 31, 2022. For Class D instrument or CubeSat investigations, proposals shall include a development schedule that delivers an instrument for integration onto the selected platform and/or a CubeSat(s) that can be integrated to a launch vehicle no later than August 31, 2021.

4.5 Technical Requirements and Constraints

4.5.1 *New Technologies/Advanced Engineering Developments*

This section intends to clarify the requirement for New Technologies and/or Advanced Engineering Developments and supersedes Section 5.3.4 of the SALMON-2 AO.

This EVI-4 PEA solicits flight missions, not technology or advanced engineering development projects. Proposed investigations are generally expected to have mature technologies, with systems at a Technology Readiness Level (TRL) of 6 or higher. For the purpose of TRL assessment, systems are defined as level 3 Work Breakdown Structure (WBS) payload developments (i.e., individual instruments) and level 3 WBS spacecraft elements (e.g., electrical power system); see Figure 3-7 of the *NASA WBS Handbook*, NASA/SP-2010-3404, which can be found in the EVI-4 Library. TRLs are defined in NPR 7123.1B *NASA Systems Engineering Processes and Requirements*, Appendix E, which can be found in the EVI-4 Library.

Proposals with a limited number of less mature technologies and/or advanced engineering developments are permitted as long as they contain a plan for maturing systems to TRL 6 (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*) by no later than at Preliminary Design Review (PDR) and adequate backup plans that will provide mitigation in the event that the systems cannot be matured as planned. The TRL state of systems may be validated by an independent team at PDR.

Requirement S-18. Proposals that use systems currently at less than TRL 6 shall include a plan for system maturation to TRL 6 by no later than PDR and a backup plan in the event that the proposed systems cannot be matured as planned (see Section 5.1 of this PEA, for additional detail).

4.5.2 *Instrument Investigation Science Instrument System and Platform Interfaces*

Because there is no defined platform that directly limits the design of the proposed instrument characteristics and observing strategy, this PEA does not list specific requirements or constraints for mass, instrument dimensions, power consumption, data rate, platform stabilization, observational geometry, launch vibration, or desired orbit. However, all of these characteristics must be well characterized and clearly stated within the proposal in order for NASA to determine the feasibility of finding an appropriate platform in the near future to deploy any potential selected instrument.

Instruments that have less stringent and more easily accommodated requirements will be considered more desirable for selection, providing they return high value science, as they are more flexible in being accommodated by the range of potential platforms available in the near future.

Requirement S-19. Proposals for instrument investigations that will be accommodated on a NASA selected platform shall clearly state the proposed instrument mass, volume dimensions, power requirements, platform stabilization requirements, thermal requirements, observational geometry requirements, launch vibration constraints, electromagnetic interference/electromagnetic compatibility (EMI/EMC) requirements, data rate requirements,

and all other requirements (or constraints, preferences, etc.) that the instrument places on the platform for accommodation, launch, deployment, operations, etc. A template is provided on the EVI-4 Library to aid proposers to provide this data. This table shall be provided in the experiment implementation section (Section E) of the proposal. This table does not count towards the proposal page limit.

NASA has been cataloguing the potential platforms that will exist over the next decade with capacity to accommodate a potential EVI Instrument. The goal of this activity is to document, as a service to both NASA and all who are interested in potential integration of instruments on available payloads, the types of opportunities that exist and the current interfaces and constraints that exist for each potential platform. It is also desired that, as much as possible, agreements can be reached as to potential common instrument interfaces for many of these potential platforms. Documentation of this Common Instrument Interface (CII) work is available through links in the EVI-4 Library.

One result of this work is to determine the relative probabilities of NASA identifying a feasible opportunity platform for any potential or proposed EVI instrument. A proposed instrument with a high probability of being compatible with several potential platforms is more likely to be selected than an instrument with less flexible accommodation and orbit requirements (see Section 6.2).

Compared with other candidate platforms, the International Space Station (ISS) may be able to accommodate instruments with higher requirements for mass, volume/dimensions, power, and thermal control. Proposers should state whether the ISS is a potential platform for their instrument and identify the tradeoffs of using the ISS orbit vs. other orbits. Proposers that identify ISS as a potential platform must maintain flexibility to be accommodated on other platforms. Even though NASA has current plans to support ISS operations through 2024, any instrument investigation that is appropriate for the ISS should describe an adequate timeline of development and operation for the proposed investigation, regardless of whether it is completed by the end of 2024. Differences between the investigation's timeline and NASA's plans for future ISS operations will be factored into the proposal's risk assessment for selection.

Proposals may include information on any research the proposing team has done relative to potential payload accommodations for their proposed instrument. This is not a requirement for any proposal. However, such information can serve to demonstrate to NASA the potential of finding one or more opportunities for accommodating the proposed instrument. If a proposal includes such information, effort should be made to address all known integration criteria and make clear which integration criteria have not been completely researched. Failure to include such research will not be counted against a proposal in evaluation. Inclusion of such information has the potential to support the arguments within a proposal that the instrument has an acceptable chance of being integrated on a platform within an appropriate time frame.

4.5.3 CubeSat Investigations

CubeSat proposals are recommended to comply with the Cal Poly CubeSat Design Specification, found at <http://www.cubesat.org/resources/>. NASA's Launch Services Program has issued a *Program Level Dispenser and CubeSat Requirements Document* (found in the EVI-4 Library)

with standard requirements for launching CubeSats with form factors up to 6U and qualifying form factors of 1U, 1.5U, 2U, 3U and 6U.

Concepts that do not comply with these standards should clearly describe how their designs are packaged and deployed, but with the understanding that CubeSat form factors larger than 6U will not be considered.

Requirement S-20. All CubeSat investigations proposing compliance with the requirements in the NASA Launch Services Program *Program Level Dispenser and CubeSat Requirements Document* shall propose CubeSat form factors (size) no larger than 6U, with qualifying form factors of 1U, 1.5U, 2U, 3U and 6U. Concepts that do not comply with these standards should clearly describe how their designs are packaged and deployed. CubeSat form factors larger than 6U will not be considered.

4.5.4 Orbit Requirements

Requirement S-21. Proposals shall clearly state the desired and acceptable orbits and operational constraints (e.g., duty cycle or observational cadence) and describe the relative scientific merits of each possible orbit.

4.5.5 Payload Risk Classification

This opportunity solicits proposals for science investigations requiring the development and operation of space-based instrument(s) of either Class C or Class D risk classification (as defined in NPR 8705.4, *Risk Classification for NASA Payloads*; found in the EVI-4 Library). CubeSats are designated as Class D. Section 4.4.1 describes the Cost Caps for Class C vs. Class D investigations.

Requirement S-22. If an investigation requires operation on-orbit for two or more years to meet the science requirements, the proposal must demonstrate how the instrument will meet that time requirement. If any requirements to the instrument that are more stringent than Class C (or Class D, as appropriate for each proposal) are needed, these requirements must be clearly described in the proposal.

4.5.6 End-of Mission Spacecraft Disposal

Section 5.3.10 of the SALMON-2 AO discusses the requirements related to end-of-mission spacecraft disposal for Partner Missions of Opportunity and hosted payloads where the PI is not responsible for the host mission. For instrument investigation proposals, information shall be included regarding the instrument's plan for passivation at the end of operations or in preparation for end-of-mission disposal. In addition, information shall be provided identifying system components expected to survive Earth reentry as the postmission disposal method. This will allow NASA to remain in compliance with NPR 8715.6A, *NASA Procedural Requirements for Limiting Orbital Debris*, and NASA-STD-8719.14, *Process for Limiting Orbital Debris*.

Requirement S-23. Instrument investigation proposals shall describe the instrument's passivation plans at end-of-mission and identify components anticipated to survive Earth reentry.

This supersedes Requirement 39 in the SALMON-2 AO for instrument investigation proposals. However, Requirement 39 shall be met for CubeSat proposals.

4.5.7 NASA Earth Science Data Policy

4.5.7.1 Data Analysis

The PI will be responsible for production and analysis of the mission data necessary to achieve the proposed science objectives, delivery of products to NASA selected Distributed Active Archive Centers (DAAC), and for timely publication of initial scientific results in refereed scientific journals, as part of their mission operations (Phase E) or postmission activities. The assigned NASA DAAC(s) will be responsible for archival and public distribution of all data collected by the instrument(s) and produced by the investigations prime measurement phase. The PI is required to work with the DAAC to ensure that the mission data is delivered in a format that meets NASA requirements. The NASA DAAC will not levy any additional cost for its services to the PI, therefore this cost is not to be included as part of the PI Managed Mission Cost. Science studies with the archived data sets beyond the science investigations proposed by the PI-led team will be solicited and selected by NASA in subsequent NASA solicitations through the Research Opportunities in Space and Earth Sciences (ROSES) NASA Research Announcement (NRA).

Requirement S-24. Proposals shall clearly identify the standard products from the investigation and describe the complete data processing flow leading to archived data products, including the time required to complete the initial and final on-orbit calibration and validation of the measurements. Proposal shall show adequate resources for delivering data products to the assigned NASA DAAC.

Requirement S-25. Proposals shall clearly present a plan for analysis of the mission data leading to completion of the proposed science investigation and achieving the identified investigation goals and objectives. Proposals shall show that adequate resources, including funding, schedule, and personnel, are identified to complete the proposed science investigation.

4.5.7.2 Data Rights

By NASA policy, all science data returned from NASA missions are made available immediately in the public domain. There shall be no period of exclusive access. The principal investigator shall propose and justify the data product latency period for standard products listed in the proposal, based primarily on the time required to produce, quality-check, and validate the products. Barring exceptional circumstances, data product latency may not exceed six months.

Requirement S-26. Proposals shall include a clear commitment to minimizing the latency for data products. Proposals shall specify the minimum necessary data latency period and shall provide a justification for that data latency period.

4.5.7.3 Delivery of Data to Archive

Mission data will be made fully available to the public in the minimum time necessary, and no longer than six months following its collection, barring exceptional circumstances. The PI will

be responsible for collecting the scientific, engineering, and ancillary information necessary to validate and calibrate the data. During Phase A, NASA will assign a data center, e.g., one of the Earth Observing System Data and Information System (EOSDIS) Distributed Active Archive Centers (DAACs), to be the data archive. Proposals should not be tailored to one specific DAAC. Throughout the investigation, the project will deliver all data products, along with the scientific algorithm software, coefficients, and ancillary data used to generate these products, and the algorithm and calibration documentation to the NASA-assigned DAAC as they are generated or updated. Information on EOSDIS and the DAACs is available at <https://earthdata.nasa.gov/about/esdis-project> and <https://earthdata.nasa.gov/about/daacs>.

Archival data products will include low-level (raw) data, high-level (processed) data, and derived data products such as maps, ancillary data, calibration data (ground and in-flight), documentation, related software, and/or other tools or parameters that are necessary to interpret the data. The PI will be responsible for generating data products that are documented, validated, and calibrated in physical units that are usable by the scientific community at large.

NASA data archives have budgets to support core activities, including the basic ingestion and review of new data. Proposed mission data archiving plans and budgets must be consistent with the policies and practices of NASA Earth Science data archives. For information on NASA Earth Science data policy, nomenclature, standards, and EOSDIS, see <http://science.nasa.gov/earth-science/earth-science-data/>. Proposals may include funding for up to one year after end-of-operations for the generation and archiving of derived data products. This funding must be included in the capped PI-Managed Mission Cost.

Requirement S-27. A schedule-based end-to-end data management plan, including approaches for data retrieval, validation, preliminary analysis, metadata generation and delivery to the assigned NASA DAAC for public distribution, and archiving shall be described. The science 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 identify the formats and standards to be used, selected from the published list of approved NASA Earth Science Data System Standards (<https://earthdata.nasa.gov/data/standards-and-references>). It shall include an estimate of the raw data volume and a schedule for the submission to the data archive of raw and reduced data in physical units accessible to the science community. The plan shall conform to the NASA Earth Science Data and Information Policy (see <http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/>). This supersedes Requirement B-21 in Appendix B of the SALMON-2 AO.

4.6 SALMON-2 Required Specifications for PEAs

The SALMON-2 AO requires that PEAs make certain specifications.

- Section 2.4 of the SALMON-2 AO states that the PEA will specify the specific goals and objectives of the sponsoring Mission Directorate for that proposal opportunity. For this PEA, those goals and objectives are specified in Section 2.
- Section 2.4 of the SALMON-2 AO states that the PEA will specify the funding available for selected investigations. For this PEA, the available funding is specified in Section 4.4.1.
- Section 3 of the SALMON-2 AO states that each PEA will specify a due date for proposals, as well as requirement and constraints for that specific solicitation, including the sponsoring NASA Headquarters mission directorate and division, the type of MO, the cost cap, and any launch-by or commitment-by dates. For this PEA, the due date is specified in Section 7, requirements and constraints are specified in Section 4, the sponsoring mission directorate and division is specified in Section 1, the type of MO is specified in Section 4.2, the cost cap is specified in Section 4.4.1, and the schedule constraint is specified in Section 4.4.2.
- Section 4.1.2 of the SALMON-2 AO states that each PEA will specify the designated NASA Center for program office and any program-specific safety, reliability, and quality assurance document. The NASA Center for program office is specified in Section 2.3.
- Section 4.1.4 of the SALMON-2 AO states that each PEA will specify the mission category and the payload risk classification that will be applied to selected investigations. For this PEA the payload risk classifications are specified in Section 4.5.5.
- Section 4.2.1 of the SALMON-2 AO states that each PEA will specify whether there are any additional restrictions on participation in this solicitation. For this PEA, those limitations are specified in Section 4.1
- Sections 4.3.1, 4.3.2, and 4.3.3 of the SALMON-2 AO state that each PEA will specify additional costs to be included in, and any cap on, the PI-Managed Mission Cost, the Total Mission Cost, and the Enhanced Mission Cost. For this PEA, that information is specified in Sections 4.4.1 and 4.4.2.
- Section 4.3.4 of the SALMON-2 AO states that each PEA will specify any constraints on funding profile, selection date, and launch readiness date. For this PEA, those constraints are found in Sections 4.4.1, 4.4.2 and 4.4.3.
- Section 4.6 of the SALMON-2 AO states that each PEA will identify any NASA-provided launch services. For this PEA, NASA plans for access to space are discussed in Section 2.2, 4.5.2 and 4.5.3.
- Section 5.3.1 of the SALMON-2 AO states that each PEA will provide a determination as to whether a two-step competitive process will be used. This PEA states in Section 3 that evaluation and selection will be done using a single step selection process; no competitive Phase A (Step 2) or down selection is planned.
- Section 5.3.4 of the SALMON-2 AO states that the PEA may specify that it solicits science or exploration investigations, not technology development projects. This PEA so states in Section 1.1.
- Section 5.7.1 of the SALMON-2 AO states that the PEA will specify whether an Education or Communication (previous E/PO) program that is consistent with SMD policy is required. This PEA states that an Education program is not required. A Communication program may be required, pending further NASA guidance for Communication policy, and those costs will

be outside the PI-Managed Mission Cost cap. Section 5.7.2 of the SALMON-2 AO states that the PEA may state that proposals may define a Student Collaboration (SC) that is a separate part of the proposed investigation. This PEA so states, and Requirements 71 and 72 of the SALMON-2 AO apply to this PEA.

- Section 5.8 of the SALMON-2 AO states that the PEA may specify unallowable sources of contributions. This PEA is sponsored by NASA SMD and it does not permit contributions of funding from SMD programs other than the funding offered through this PEA.
- Section 7.1 of the SALMON-2 AO states that the PEA will identify the Selection Official. This PEA identifies the Selection Official in Section 6.2.

4.7 Exceptions to General SALMON-2 Requirements

This PEA contains the following exceptions to the SALMON-2 proposal preparation and submission requirements described in the SALMON-2 AO.

- Proposals or portions of proposals requesting NASA funding shall report proposal costs in Fiscal Year 2020 dollars as well in Real Year (RY) dollars. The former is for determining compliance with the PI-Managed Mission Cost cap requirement. The latter is for NASA SMD budget planning. This instruction supersedes the request for costs only in RY dollars described in Appendix B of the SALMON-2 AO including Table B-3. A modified template of Table B-3 is available on the EVI-4 library.
- Requirement ~~ST~~-19 in Section 4.5.2 of this PEA requires the inclusion of a table in the proposal document. As noted in the requirement, this table does not count against the page limits specified in Appendix B of the SALMON-2 AO. **[Requirement letter corrected August 16, 2016]**
- Section 4.5.7 of this PEA provides data policies and supersedes Section 4.4 of the SALMON-2 AO.
- Proposals shall not include a plan or a budget for science-exploration-technology enhancement options (SEOs); this supersedes Section 5.2.5 of the SALMON-2 AO.
- Section 4.5.6 provides End-of Mission requirements that supersede those in Section 5.3.10 of the SALMON-2 AO.
- The proposal's Heritage Appendix will be limited to 30 pages. This supersedes the proposal's Heritage Appendix (proposal Appendix J.9) page limit as stated on the "Proposal Structure and Page Limits" table in page B-2 of the SALMON-2 AO. Also, note that cost information in the heritage appendix is limited to a comparison of the cost of the heritage items to the proposed items' cost. Cost information for the proposed investigation is only permitted in Section H.
- Section 5.1 provides Proposal Content Requirements; in this section Requirement ~~ST~~-30 supersedes Requirement B-15 of the SALMON-2 AO, Requirement ~~ST~~-31 supersedes Requirement B-23 of the SALMON-2 AO, Requirement ~~ST~~-32 supersedes Requirement B-24 of the SALMON-2 AO, Requirement ~~ST~~-33 supersedes Requirement B-27 of the SALMON-2 AO and Requirement ~~ST~~-34 supersedes Requirement B-57 of the SALMON-2 AO. **[Requirement letters corrected August 16, 2016]**

5 PROPOSAL PREPARATION AND SUBMISSION

5.1 Proposal Content Requirements

Requirement S-28. Proposal content must conform to the guidelines set forth in Appendix B of the SALMON-2 AO.

It is unnecessary to download the NSPIRES-generated Proposal Cover Page and incorporate it into the Proposal Document. NSPIRES will automatically route the two parts of the proposal (Cover Page form, proposal document) to the appropriate peer or NASA reviewers.

The key data associated with the electronic submission of proposals (see Section 6.2 of the SALMON-2 AO) includes questions indicating whether or not a proposal contains export-controlled information (see Sections 5.9.4 and 5.10.2 of the SALMON-2 AO). All proposers must answer these questions YES or NO when completing the electronic submission; these questions shall not be left unanswered.

All proposals must identify any export-controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO. To the extent possible, International Traffic in Arms Regulation (ITAR) sensitive material should be organized into separate clearly marked sections.

Requirement S-29. All proposals must identify any export-controlled material in the proposal as instructed in Sections 5.9.4 and 5.10.2 of the SALMON-2 AO.

Below, Requirements B-15, B-23, B-24, B-27 and B-57 of Appendix B of the SALMON-2 AO are clarified for this solicitation. All references to "instruments" in this section also apply to CubeSats.

The following Requirement ~~S~~30 further clarifies the information requested on the traceability of the proposed investigation and supersedes Requirement B-15 of the SALMON-2 AO. A modified template is available on the EVI-4 Library to assist proposers on presentation of the investigation traceability. **[Requirement letter corrected August 16, 2016]**

Requirement S-30. Traceability from science goals to measurement requirements to instrument requirements (functional and performance) and to top-level mission requirements shall be provided in tabular form and supported by narrative discussion. Instrument projected performance shall be compared to the instrument (or CubeSat) performance requirements.

The following Requirement ~~S~~31 clarifies the information requested on instrument contingencies and margins and supersedes Requirement B-23 of the SALMON-2 AO. **[Requirement letter corrected August 16, 2016]**

Requirement S-31. This section shall summarize contingencies and margins of all instrument resources. It shall provide estimates of implementation design margins with respect to the required performance or allocations for mass, power, data storage, and any other resource requirements. For proposals for more than one instrument, the mass, telemetry, and power and

contingency and margins must be identified separately for all the necessary components of each instrument in case only an individual instrument is selected from the proposed suite (see SALMON-2 AO for definitions of contingency and margin). Discuss the allocation of contingency and margin to the instrument and/or suite.

The following Requirement ~~ST~~-32 clarifies the information requested on performance margins and supersedes Requirement B-24 of the SALMON-2 AO. [**Requirement letter corrected August 16, 2016**]

Requirement S-32. For each instrument performance, this section shall provide estimates of performance margin with respect to the performance requirements as compared to projected performance estimates and shall justify that these performance margins are appropriate.

The following Requirement ~~ST~~-33 clarifies the information requested on new technologies and/or advanced engineering developments and supersedes Requirement B-27 of the SALMON-2 AO. [**Requirement letter corrected August 16, 2016**]

Requirement S-33. This section shall describe any proposed new technologies and/or advanced engineering developments and the approaches that will be taken to reduce associated risks. Descriptions shall address, at a minimum, the following topics:

- Identification and justification of the TRL for each proposed system (level 3 WBS payload developments and level 3 WBS spacecraft elements) incorporating new technology and/or advanced engineering development at the time the proposal is submitted (for *TRL definitions*, see NPR 7123.1B, *NASA Systems Engineering Processes and Requirements*, Appendix E, in the EVI-4 Library);
- Rationale for combining the TRL values of components and subsystems to derive each full system TRL as proposed, appropriately considering TRL states of integration (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*);
- Rationale for the stated TRL value of an element that is an adaptation of an existing element of known TRL;
- The approach for maturing each of the proposed systems to a minimum of TRL 6 by PDR:
 - Demonstration (testing) in a relevant environment can be accomplished at the system level or at lower level(s);
 - If applicable, justify what demonstration(s) in a relevant environment at lower level(s) (subsystem and/or subsystem-to-subsystem) would be sufficient to meet system level TRL 6, considering (i) where any new technology is to be inserted, (ii) the magnitude of engineering development to integrate elements, (iii) any inherent interdependencies between elements (e.g., critical alignments), and/or (iv) the complexity of interfaces – see the EVI-4 Library for examples;
 - Include discussion of simulations, prototyping, demonstration in a relevant environment, life testing, etc., as appropriate;
- An estimate of the resources (staffing, cost, and schedule) required to complete the technology and/or advanced engineering development; and
- Approaches to fallbacks/alternatives that exist and are planned, a description of the cost, decision date(s) for fallbacks/alternatives, relevant development schedules, and performance

liens they impose on the baseline design, and the decision milestones for their implementation.

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

Requirement ~~ST~~-34 clarifies the intent of Requirement 89 and B-57 of the SALMON-2 AO. Requirement ~~ST~~-34 supersedes Requirement B-57 of the SALMON-2 AO. [**Requirement letter corrected August 16, 2016**]

Requirement S-34. 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. The proposer shall not include in these Appendices material required in the page-limited sections in the body of the proposal. Any additional information not specifically required in a given appendix will not be considered by the evaluation panel and may result in reduced ratings during the evaluation process or, in some cases, could lead to rejection of the proposal without review. No other appendices are permitted.

5.2 Proposal Submission Requirements

Requirement S-35. Proposals must be submitted electronically via NASA's master proposal data base 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.

Proposal submission instructions and requirements are provided in Section 6.2 of the SALMON-2 AO.

Requirement S-36. The proposal must be received no later than the time deadline on the proposal due date given in Section 7 of this PEA.

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

Requirement S-37. 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 (Section VI) of the cover page or in answer to the question about "participants [...] who do not appear on the proposal's cover page". The proposer shall list the institution and division name, role (e.g., instrument component provider), and estimated funds to be received. This information will be used to avoid financial and organizational conflicts of interest during the evaluation process by checking evaluators against institutions that are proposed to supply materials, parts, or services.

5.3 Questions

In order to make sure that all proposers receive the same information, all questions concerning the content provided in this appendix, or in the documents available through the EVI-4 Library,

should be sent to the E-mail address for the point of contact that is listed in Section 7 of this PEA. When appropriate, responses will be posted on the website also listed in Section 7 of this PEA.

The deadline for receipt of questions is two weeks before the proposal due date listed in Section 7 of this PEA.

6 PROPOSAL EVALUATION, SELECTION, AND IMPLEMENTATION

6.1 Scientific/Technical Evaluation Factors

Proposals will be evaluated according to the evaluation criteria set forth in Section 7.2 of the SALMON-2 AO.

In addition to the evaluation criteria given in Section 7.2 of the SALMON-2 AO, the evaluation of the Science Merit of the Proposed Investigation also includes the following addition to Factor A-2:

- Factor A-2, programmatic value of the proposed investigation, also includes the extent to which the proposed science investigation addresses unique science areas that are not being addressed by other missions (both NASA and non-NASA missions) expected to be in operation five to ten years from the start of the proposed investigation.

In addition to the evaluation criteria given in Section 7.2 of the SALMON-2 AO, the evaluation of the Experiment Science Implementation Merit and Feasibility of the Investigation also includes the following additions to Factors B-2 and B-3:

- Factor B-2, probability of technical success, also includes the maturity of the design or the demonstration of a clear path to achieve the necessary maturity.
- Factor B-3, merit of the data and/or sample analysis plan, also includes the quality of the plans for calibration and data archiving, including development of a data pipeline.

The panel evaluating the third evaluation criterion; Technical, Management, and Cost (TMC) Feasibility of the Investigation Implementation, including Cost Risk, will also provide comments to NASA regarding the extent to which the proposed instrument is compatible with potential satellite platform interfaces and operations or the CubeSat mission is compatible to potential launch opportunities. These comments will not be considered for the TMC Feasibility of the Investigation Implementation, including Cost Risk evaluation.

After the evaluation, but prior to the selection decision, NASA will perform an accommodation study of selectable instrument investigation proposals to assess the extent to which the proposed instrument is compatible with potential satellite platform interfaces and operations. This accommodation study will also consider the accommodations of selectable CubeSat proposals for launch.

6.2 Selection Process

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

As stated in Section 7.3 of the SALMON-2 AO, the Selection Official may take into account a wide range of programmatic factors in deciding whether or not to select any proposals and in selecting among selectable proposals, including, but not limited to, planning and policy considerations, available funding and funding profiles, programmatic merit and risk of any proposed partnerships, and maintaining a programmatic balance across the Mission Directorate(s). For an EVI Instrument proposal selection, these factors also include the likelihood that the proposed instrument can be accommodated on a NASA-selected platform in the near future. For an EVI CubeSat proposal selection, these factors also include the likelihood that the appropriate launch services can be provided.

6.3 Implementation Activities

Proposal award will be implemented according to the guidelines set forth in Section 7.4 of the SALMON-2 AO and this section of this PEA with the following amendments.

6.3.1 Award Administration and Funding of Investigations

Oversight management responsibilities have been assigned to the Earth System Science Pathfinder Program Office (ESSP PO) at the NASA Langley Research Center (LaRC). The responsibilities of the ESSP PO will include oversight of the selected investigation(s) development; coordination of Government-furnished services, equipment and facilities, coordination of the selected team with potential platforms for integration; and contract management for selected investigations.

The ESSP PO will authorize the release of funding to each selected investigation. The initiation of the investigation will take place as soon as possible after notification of selection.

Investigators are advised that Statements of Work (SOWs), updated cost, and pricing data are required to initiate awards. For reference, a SOW template is available in the EVI-4 Library. If more than one contractual arrangement between NASA and the proposing team is required, separate SOWs, updated cost, and pricing data are required for each contractual arrangement. NASA Centers will receive funding via intra-agency funding mechanisms.

Proposals are not required to include SOWs and cost and pricing data. However, these items will be required for investigations selected for award. The process of awarding contracts cannot begin until final SOWs, cost and pricing data, and small business subcontracting plans have been received, and funds cannot be provided to the implementing organizations until this process has been completed. For each selection, and unless otherwise stated in the selection letter, the selected investigation's Cost Cap will be set at the proposal's proposed cost.

SOWs will be required for selected investigations, regardless of whether a proposing organization is Governmental or non-Governmental. SOWs will include the following as a minimum: Scope of Work, Deliverables (including science data), and Government Responsibilities (as applicable). For contracts that exceed \$750K, the contractor will be required to provide cost and pricing data to support the cost estimate and to certify the cost proposed for the contract in accordance with FAR 15.403-4.

NASA Centers shall follow their standard operation procedure for selecting teaming partners to facilitate the rapid implementation of their proposal, if selected, and this shall be documented in Appendix 6 of the proposal (see Appendix B, Section J.6, of the SALMON-2 AO).

6.3.2 *International Agreements*

Should a non-U.S. proposal, or a U.S. proposal with non-U.S. participation, be selected by NASA, NASA's Office of International and Interagency Relations, Science Division, will arrange with the non-U.S. sponsoring agency for the proposed participation to go ahead on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail a letter of notification by NASA with a subsequent exchange of letters between NASA and the sponsoring governmental agency or a formal Agency-to-Agency Memorandum of Understanding (MOU). For additional policies and requirements, see Section 5.9 of the SALMON-2 AO.

7 SUMMARY OF KEY INFORMATION

Funding available	See Section 4.4.1 of this PEA
PEA Release Date	July 27, 2016
Date for Pre-proposal Teleconference/WebEx	August 18, 2016 via Webex; see the EVI-4 Acquisition Homepage at http://essp.larc.nasa.gov/EVI-4/ for time, agenda, and logistical information
Due Date for NOI (notice of intent to propose, required for this solicitation)	11:59 pm eastern time on September 1, 2016
Last Date for submission of Questions	11:59 pm eastern time on November 4, 2016
Due Date for Proposals	11:59 pm eastern time on November 18, 2016
EVI-4 Acquisition Homepage (for additional information on the EVI-4 PEA)	http://essp.larc.nasa.gov/EVI-4/
Library for the EVI-4 PEA	http://essp.larc.nasa.gov/EVI-4/evi-4_library.html
Submission Medium	Electronic copies only; see Section 5.2 of this PEA
Web site for submission of electronic proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at 202-479-9376 or nspires-help@nasaprs.com)

NASA point of contact	Dr. Thomas Wagner Earth Venture Instrument-4 Program Scientist Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Tel: 202-358-4682 E-mail: thomas.wagner@nasa.gov
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