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NASA Science Mission Directorate
And Office of the Chief Engineer

HANDS-ON PROJECT Experience (HOPE) - 2015

Training Opportunity For NASA Personnel

Fifth Call (HOPE-2015)

Release date	April 29, 2015
Q&A Telecom	May 12, 2015
Notices of Intent deadline	June 2, 2015
Proposal deadline	August 4, 2015

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HANDS-ON PROJECT EXPERIENCE (HOPE) TRAINING OPPORTUNITY

FOREWORD

The Science Mission Directorate (SMD), in collaboration with the Office of the Chief Engineer (OCE)/Academy of Program/Project and Engineering Leadership (APPEL), is releasing this Hands-On Project Experience (HOPE) Training Opportunity (TO) to solicit National Aeronautics and Space Administration (NASA) Center proposals to develop an in-house Project Team that will fly an Earth or space science and/or technology payload having a useful purpose to SMD on any suborbital-class platform including sounding rocket, balloon, aircraft (piloted or unmanned), CubeSat, or suborbital reusable launch vehicle (sRLV). The Centers are encouraged to embrace this training opportunity for early career hires and interleave it with the Center's own training program in order to develop future science, engineering, and project/program leaders.

The maximum funding available from SMD for a proposed effort including the design, development, integration and test, and flight of the payload is $800K in Real Year (RY) dollars for both procurement and civil servant labor, including any cost of the suborbital-class platform. A supplement of an additional $200K is provided for any project using a sounding rocket. This funding may be supplemented with contributions by the implementing NASA Center(s) (no limit). SMD in collaboration with OCE/APPEL expects to select at least one project for implementation, subject to available funding. The selected project must be launch or flight-ready within 18 months from the Project Initiation Conference with SMD and OCE/APPEL, with submittal of a final report, along with preliminary data analysis, to the sponsors within three months of completion of the project.

The two objectives of the HOPE Training Program are:

- Primary: To provide a hands-on training project to enhance the technical, leadership, and project skills for the selected NASA in-house project team.

- Secondary: To fly an Earth or space science and/or technology investigation beneficial to SMD.

In order to ensure the secondary goal of this solicitation, and notwithstanding the low cost approaches being employed, every effort will be made to ensure the project experience provided by this training is as similar as possible to that of larger flight projects, from proposal to selection, through project implementation. The proposal submission process is considered the first step in meeting the learning objectives of the HOPE Project. As much as practicable, this TO will follow the requirements of an Announcement of Opportunity (AO) so as to support proposers in gaining experience in responding to future NASA AOs.

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1. Description of Training Opportunity

1.1 Introduction

The National Aeronautics and Space Administration (NASA) Science Mission Directorate (SMD), in collaboration with the NASA Office of the Chief Engineer (OCE)/Academy of Program/Project & Engineering Leadership (APPEL), is releasing this Hands-On Project Experience (HOPE) Training Opportunity (TO) for the purpose of providing a hands-on training project experience for NASA in-house early career hire (ECH) employees.

This HOPE TO solicits proposals for an in-house NASA Center team to design, develop, and fly an Earth or space science and/or technology investigation beneficial to NASA science strategic objectives and goals on a sounding rocket, balloon, aircraft (piloted or unmanned), CubeSat, suborbital reusable launch vehicle (sRLV), or other commercial suborbital vehicle (hereafter referred to as suborbital-class platforms).

Centers are encouraged to embrace this opportunity and interleave it with the Center's own training program, in order to develop future project/program leaders.

All proposals submitted in response to this solicitation must support the goals and objectives of this solicitation, and they must be implemented by a NASA Center ECH project team, where it is understood that a NASA Center project team could be a multi-Center team and that the Jet Propulsion Laboratory (JPL) is one of the ten NASA Centers eligible to propose.

The maximum funding available from SMD for a proposed effort is $800K in Real Year dollars for both procurement and civil servant labor, including any cost of the suborbital-class platform. A supplement of $200K is provided for any project using a sounding rocket. The selected project must be launch or flight-ready within 18 months from the Project Initiation Conference, with submittal of a final report within three months after the completion of the mission operations phase. SMD, in collaboration with OCE/APPEL, expects to select at least one project for implementation, subject to available funding. The sponsors reserve the right to select a second project, if the budget permits, which would result in a delay of any HOPE-6 solicitation.

Information regarding the preparation and submission of proposals is described in Section 4. Proposals will be evaluated and selected through the process described in Section 5.

The following appendices are provided to assist HOPE proposers:

- Appendix A provides summary information for each of the HOPE suborbital-class platform carriers offered by NASA. Other commercial sRLV may also be proposed.
- Appendix B provides training guidelines and best practices for HOPE projects.
- Appendix C provides example tables and matrices for the HOPE proposals.
- Appendix D provides a glossary of terms, abbreviations, and acronyms.
- Appendix E provides a summary table of HOPE-5 requirements.
- Appendix F provides a compliance checklist.

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1.2 Major Changes from the Previous TO

Proposers should be aware of the following significant changes in this HOPE TO from the last TO:

- The Space Technology Mission Directorate (STMD) is not a sponsor this TO cycle; therefore the requirement of relevance to STMD technology goals has been omitted; however, technology investigations having a useful purpose to SMD are permitted.
- There is a charge against the project budget for the use of sRLVs provided by the STMD/Flight Opportunities Program.
- A supplement of $200K will be provided against the cost of a sounding rocket.
- SMD offers a new no-cost 'piggy-back' flight (no project funding is available) opportunity for Centers wishing to fly an existing science or technology payload by ECHs on a high-altitude scientific balloon.
- This TO will include a clarification step during in the evaluation process between the proposal evaluation panels and the proposers to address any questions the evaluators may have to ensure that the proposal information is clearly understood.

1.3 Strategy and Objectives for HOPE

The HOPE training project was created by SMD and OCE in 2008 through the recognition of the long-term issues associated with the loss of in-house civil servant technical project capabilities, combined with inadequate hands-on technical project training for its future scientists, systems engineers, and projects managers. NASA developed HOPE as part of a long term strategy to increase hands-on training opportunities to ensure the next generation in-house core of highly experienced and competent technical project personnel to achieve its strategic objectives.

The objectives of HOPE TO are to enable an ECH project team to:

- Take on meaningful leadership roles and complete all phases of a hands-on project in a short time-frame (18 months), including design through hardware development, integration and test, launch, mission operations, data collection and analysis of results;
- Receive customized training and mentoring throughout the project;
- Develop and fly a project using suborbital-class platforms for access to space; and
- Advance new technology and/or produce valuable science results.

1.4 HOPE's Primary and Secondary Goals

Training: The primary goal of this solicitation is to provide a hands-on training project to enhance the technical, leadership, and project skills for the selected NASA in-house project team (see Section 3.1 for complete training requirements). This goal is expected to be accomplished by the Center team developing in concert with its training office a (i) comprehensive training plan and (ii) with structured and frequent coaching and mentoring by Center experts, and (iii) supported by informal and formal APPEL training tailored toward individual team member roles and the learning needs that support the success of the project, and (iv) with lessons learned and knowledge sharing for the Center and the Agency.

Science/Technology Investigation: The secondary goal of this solicitation is to fly an Earth or space science payload having a useful purpose for SMD, or to mature or develop a space-related technology having a useful purpose to the goals of one or more of the SMD Science Divisions (see Section 3.2 for complete investigation requirements). Proposed HOPE investigations must address an aspect of the science strategic objectives identified in the NASA Strategic Plan and the science goals in the SMD 2014 Science Plan. These plans are available at:

http://science.nasa.gov/about-us/science-strategy/.

This goal can be accomplished either (i) by providing useful (new or complementary) science data in support of SMD science goals for one of the four SMD Science Divisions or (ii) by advancing the development of technology or capabilities in support of SMD science goals, e.g., by providing re-flights of instruments or components, demonstrating a proof of concept, providing flight calibration, or enabling TRL advancement of sensors or technologies for future use.

1.5 Training Opportunity General Information

The following schedule describes the major milestones for this TO:

TO release date .....April 29, 2015
Q&A telecom .....May 12, 2015
Notice of Intent (NOI) to propose deadline .....June 2, 2015
Proposal submittal deadline .....August 4, 2015 (11:59 PM EDT)
Selections announced (target) .....October 23, 2015
Launch/flight readiness .....June 1, 2017

HOPE TO release: The HOPE TO will be released in accordance with the schedule in Section 1.5, to all Center Directors, Center Chief Scientists, Chief Technologists, Chief Engineers and Center Training Officers via email.

HOPE TO website: The HOPE TO, its appendices, as well as additional HOPE TO information, including links to previously-selected projects, lessons learned, HOPE survey, and Frequently Asked Questions (FAQs) are available at:

http://appel.nasa.gov/developmental-programs/hope/

HOPE TO Point of Contact (POC): If you have any questions concerning this TO please contact:
David Pierce
SMD/Senior Program Executive for Suborbital Research
NASA/Headquarters
Telephone: 202-358-3808
Email: david.l.pierce@nasa.gov

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Question and Answer (Q&A) Telecom: A Q&A telecom will be held, in accordance with the schedule in Section 1.5. Telecom logistics information will be posted on the HOPE TO website. Centers wishing to participate in the telecom should provide a POC to the HOPE TO POC via the email address given in Section 1.5.

The purpose of the Q&A telecom is to provide an overview of this TO solicitation, and address questions about the proposal process. Questions may be sent prior to the telecom to the HOPE TO POC, and they may also be addressed at the telecom. Anonymity of the authors of all questions will be preserved. Presentations (if any) made at the telecom, including answers to all questions addressed at the Q&A telecom, will be posted as part of a FAQ section on the HOPE TO website. Additional questions and answers subsequent to the conference will be handled similarly, if necessary. Questions may be submitted until 10 calendar days before the proposal due date given in Section 1.5. Answers will be provided no later than 7 calendar days before the proposal due date.

Notice of Intent to propose: To assist in planning the proposal evaluation process and the dissemination of additional information concerning this TO, all prospective proposers are required to submit a NOI to propose before the NOI submittal deadline specified in Section 1.5. Material in a NOI is deemed confidential, and will be used for planning purposes only. Those who submit NOIs will receive via email any TO updates or TO amendments that may occur.

NOIs are to be submitted in a short PDF document by email to the HOPE TO POC. Each NOI must provide the following requested information to the extent that it is known:

(a) Name, address, telephone number, and email address of the designated Center POC.
(b) A list of any participating Centers and, to the extent known, the participating individuals including principal investigator (PI), project manager (PM), and Center training professional.
(c) A brief abstract (250 words or less) summarizing the following:
    (i) the objective(s) of the proposed SMD-aligned science and/or technology mission;
    (ii) any new technologies that may be employed as part of the mission; and
    (iii) any relationship of the mission to other prior or planned projects.
(d) A summary of the anticipated investigation, including the launch/flight services to be used.

Proposal Submittal deadline: Electronic proposals may be received until the August 4, 2015 close date at 11:59 P.M. via email to david.l.pierce@nasa.gov.

Requirement 1. Proposals submitted in response to this solicitation shall be delivered no later than the proposal submittal deadline following the instructions for submission in Section 1.5.

Evaluation panel: Government personnel from NASA will participate in evaluation of proposals. Contractor personnel participating in the evaluation will be bound by conflict of interest provisions and appropriate non-disclosure requirements to protect proposal information.

Submission instructions: All proposals submitted in response to this TO must be emailed to the HOPE TO POC. Proposals received after the response date and time will not be considered. Contact the HOPE TO POC for secure transmission requirements. Files must be submitted in a single bookmarked and searchable PDF of less than 20 MB. SMD/OCE will notify proposers that their proposals have been received. Proposers who have not received this confirmation within one week after submittal of their proposals should contact the POC at the address given in Section 1.5.

2. Policies Applicable to this HOPE TO

2.1 NASA Management Policies

The following policies will impose requirements on selected projects throughout the project lifecycle, for which planning may need to be considered and described as part of the proposal process.

2.1.1 NASA Flight Program and Project Requirements

Proposals selected in response to this TO must be implemented in accordance with NASA project management processes, as defined by NASA Procedural Requirements (NPR) 7120.5E, NASA Space Flight Program and Project Management Requirements, and NPR 7123.1B, NASA System Engineering Processes and Requirements. These standard management processes are: Formulation, Approval, Implementation, and Evaluation. ***The requirements in NPR 7120.5E, however, should be appropriately tailored depending on the project size, complexity, and the project scope.***

2.1.2 HOPE Management Responsibilities

The Associate Administrator for the Science Mission Directorate (AA SMD) has the overall authority over conduct of the TO activity, and in consultation with OCE, will be the selection official for all HOPE projects. SMD and OCE/APPEL intend to maintain an essential degree of oversight into mission development of the selected HOPE project(s) throughout the project lifecycle. To that end, the AA SMD, in collaboration with OCE, has designated the Earth System Science Pathfinder (ESSP) Program Office (PO) at NASA Langley Research Center (LaRC) to be responsible for project oversight. The ESSP PO will represent SMD/OCE and serve as the principle project management interface with the selected Center project team(s) throughout the project.

The Science Office for Mission Assessments (SOMA) at LaRC supports the SMD in the acquisition of HOPE training Projects through development of the HOPE TO solicitation and leading the technical, management, and cost (TMC) evaluation process during the proposal evaluation process. The NASA Evaluations, Assessments, Studies, Services, and Support (EASSS) contract with Cornell Technical Services, Inc. (CTS) 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 TO.

2.1.3 Center Management Responsibilities

The NASA Center where the project (or Team Leader for multi-center projects) is located has primary responsibility for ensuring the successful completion of the project. The implementing project management organization must be prepared to carry out this responsibility. The independent technical authority for the project, will also be located at the lead-implementing Center, and will work with the ESSP PO on establishment of the Standing Review Board (SRB).

It is the responsibility of each participating Center to provide the necessary resources to support the ECH Project Team. Centers should strive to ensure that the makeup of the project team members and their multi-disciplinary roles reflect the diversity of the NASA organization. Centers are responsible for supporting their project team members by assigning a training professional to assess, plan, and oversee each ECH team member's formal and informal training. Centers are also responsible for assigning senior-level mentors, and for ensuring active and consistent mentoring of each ECH team member throughout the project lifecycle. The proposal shall show that the Center is fully prepared to carry out each of these responsibilities.

2.2 Participation Policies

2.2.1 Eligibility to participate in this TO

Prospective project teams can be composed only of in-house NASA Center (NASA badged) civil servant (or lab employees for JPL) personnel, where it is understood that a NASA Center project team could be a multi-Center team and that the JPL is one of the ten NASA Centers eligible to propose. For the purpose of this TO, the term "Centers" refers to NASA Centers, and JPL. NASA Headquarters (HQ) personnel may not participate in HOPE. Center contractors can be used for project implementation support roles but not in roles of management or leadership. The intent is to engage Center personnel who intend to have long term associations with NASA. The proposed project team must be composed of individuals who will benefit from participation in this training opportunity and whose training will benefit NASA and the Center.

2.2.2 Early Career Hire (ECH) employees

For purposes of this TO, the term "Early Career Hire" employee is broadly defined as personnel who are either in the early, or transitional stage of their career at NASA, who are judged to have the necessary pre-requisite experience to successfully execute the proposed project role, and who will benefit from the HOPE TO. The intent of HOPE is that Early Career Hire (ECH) is not tied to years of service but acquired experience. The ideal candidate for an ECH team member in HOPE is a stretch assignment with increased responsibility for a team member with evidence of some past experience serving in a similar or lower-level role of responsibility. Examples of potential stretch assignments include: a post-doc or junior researcher serving as the PI, a mechanical, aerospace or electrical discipline engineer serving as the payload systems engineer, a resource analyst serving as the project business manager, or a previous Payload Development Lead (PDL) serving as the Project Manager. *For more guidance, see the team member experience guidelines in Appendix B, Training Guidelines Training Guidelines and Best Practices for HOPE Projects.*

2.2.3 Technical Constraints on Proposals

Only those proposals that do not exceed the constraints identified in this TO and that demonstrate sufficient margins, reserves, and resiliency to ensure mission success within committed cost and schedule, will be considered for selection.

2.2.4 Number of Allowable Proposals

Each Center is allowed to submit one training proposal composed solely of personnel from that Center. One additional proposal will be allowed if the second proposal is composed of a team that has participation from multiple Centers (at least one additional Center). Thus, a Center may only *submit* two proposals as the lead Center (if one involves another Center). There is no limit on the number of proposals in which a center may participate.

2.3 Cost Policies

2.3.1 Requested Funding

Requested Funding is defined as the funding that SMD will be expected to provide for the selected Center's project team for the formulation and implementation of the proposed project. Requested Funding may not exceed $800K (RY$) for procurement and civil servant labor. In addition, a supplement of an additional $200K is provided for any project using a sounding rocket.

2.3.2 Center Contributions

Center contributions to the proposed effort of funds, labor, facilities, spare or residual hardware, *etc.* are acceptable and unlimited. There are no set expectations as to the amount of Center Contributions, which are determined strictly by the Center based on the project needs. These Center Contributions may be applied to any Work Breakdown Structure (WBS) or work element of the proposed project as determined by the Center; however, these contributions must be specifically identified and allocated against the total project cost (see Cost Tables C-3 and C-4 in Appendix C).

2.3.3 Total Project Cost

Total project cost is defined as the requested funding plus any Center contributions. Examples of costs to be included in the total project cost are: development activities (*e.g.*, instrument(s) development, instrument platform development, management, software, integration and testing); all reserves; suborbital-class platform and associated services costs; subcontracting costs, including fees; all other personnel required to develop the payload, conduct the flight, and analyze the data; any project-specific costs; and all labor. Total project costs are in terms of funding outlaid; cost proposals do not need to be full cost, and do not need to include Center services that are covered in other budgets (*e.g.*, Center Management and Operations (CM&O)).

The suborbital-class platform cost is defined as the total cost for the selected suborbital carrier and its associated flight/launch services. The suborbital-class platforms include sounding rockets, balloons, aircraft (piloted or unmanned), CubeSats, or sRLV.

Proposers are free to trade within the total project cost for different suborbital-class platforms depending on the needs of the proposed investigation. SMD and OCE/APPEL are not holding any reserves to accommodate any cost overrun incurred by a particular investigation, including schedule slips or launch delays. Therefore, failure to achieve the proposed goals within the proposed time and budget could require either de-scoping the proposed project, delaying it, canceling a particular launch opportunity, or canceling the investigation altogether. If the estimated cost at completion exceeds the proposed total project cost, the proposing Center(s) shall supply the necessary additional funds.

2.4 Data Policies

The PI will be responsible for analysis of the mission data necessary to complete the proposed science or technology goals and, where appropriate, for timely dissemination of any scientific or technical results, including, presentations at professional conferences and publication in refereed scientific journals, as part of their mission operations activities. If appropriate, data shall be stored in a NASA data archive. Otherwise, the data shall be made available to the public in the minimum time necessary, but barring exceptional circumstances, within six months following collection.

Project team learning and development advances should also be considered for publication and presentation. Project teams are required to submit a final HOPE project report, including preliminary data analysis, to SMD and OCE/APPEL within three months of completion of the project. Further, the project team will be requested to present a summary of the project, the team, its results and lessons learned at the SMD Monthly Status Review after the project is completed.

3. Requirements and Constraints

This section provides general training, investigation, and proposal submittal requirements and constraints. Supplemental requirements on standard proposal content and format are provided in Section 4.1.

3.1 Training Requirements

The primary goal of this solicitation is to provide a training opportunity for a junior-level in-house NASA Center project team. It is intended that this training opportunity will be primarily guided by a Center Training professional and senior-level mentors with active mentoring of the project team, and that HOPE will complement and be integrated into the Center's ongoing training for project personnel in all areas of Center business, including non-technical areas.

Center training professional: It is a requirement of HOPE that a Center training professional be included as an active member of the HOPE project team. Teams should work with their Center training professional to develop a training plan, tailored to the team members' learning needs. The Center training professional should have a training and development background, with the project team role to work with the mentors to assess each ECH team member's phase-specific learning needs, oversee the development of the training plan, monitor progress and customize learning, and be available to coach and guide the team members/mentors throughout

the phases of the project lifecycle. The Center training professional assigned to the team is required to oversee the formal and informal training of team members.

Mentoring: It is also a requirement of HOPE for mentors to be assigned to each of the ECH team members. The Center is responsible for assigning mentors to each ECH team member, ensuring regular and frequent mentor/ECH team member interaction, and active coaching of the project team members by the mentors throughout the project lifecycle. Note that active mentoring is considered a critical element of the HOPE training, and Centers must demonstrate a commitment to mentoring each project team member. A well-defined mentoring plan is expected to be included as part of the training plan. The mentor should work with the Center training professional to identify ECH learning gaps, and establish training goals.

The *Training Guidelines and Best Practices for HOPE Projects*, found in Appendix B, is intended to provide useful guidance to proposers in submitting training plans to meet TO requirements. It is recognized that project teams will implement the training plan differently, depending on the learning needs of team members and project objectives.

Hands-On Project Experience Personnel Training: Proposals shall include a training section (see Section 4.1, Table 1, section C) which addresses the following training requirements of the solicitation, including:

Requirement 2. Proposals shall identify the key ECH project team members, Center Training Professional, and mentors, by name, and describe their roles and responsibilities.
Requirement 3. Proposals shall describe the qualifications and experience of all project team members, why these individuals are appropriate for the proposed project roles, and how the Center will benefit through their training.
Requirement 4. Proposals shall describe the mentoring plan for each ECH team member, including the mentor's relevant professional experience, mentoring approach to be used, and frequency of interaction between the mentor/mentee, and rationale.
Requirement 5. Proposals shall describe the training and the developmental plan (technical, project, and leadership skills) for each ECH team member, including a summary of initial skills assessment, customized formal, informal, and just-in-time training, monitoring, and plans for measurement of learning goals.
Requirement 6. Proposals shall include in the appendix section, any resumes, individual development plans, and skill assessments for the key ECH project team members, as well as the resume(s) for the Center training professional, and associated mentors.
Requirement 7. Proposals shall describe training courses to be used as part of the projects' training plan, and show relevancy toward team member's learning goals. The list of OCE/APPEL training courses can be found at:
http://www.nasa.gov/offices/oce/appel/curriculum/index.html.
Requirement 8. Proposals shall describe how the project will complement the Center's ongoing training programs, and is aligned with the Center's succession planning strategy.
Requirement 9. Proposals shall describe how the knowledge captured by the HOPE project will be integrated into the Center's overall training and development process.

After selection, SMD and OCE/APPEL reserves the right to negotiate the training requirements in order to maximize the learning for the ECH project team members. At the completion of the project, the project team will be responsible for providing an in-person briefing to SMD and OCE at NASA HQ during the SMD Monthly Status Review.

3.2 Science/Technology Requirements

The secondary goal of this solicitation is to fly a payload that either contributes to NASA science strategic objectives and goals, or matures or develops a space related technology having a useful purpose toward SMD's overall science program.

Investigations must address an aspect of NASA science strategic objectives and goals, as identified in the NASA Strategic Plan and the NASA 2014 Science Plan. These plans are available at: http://science.nasa.gov/about-us/science-strategy/.

This goal can be accomplished either (i) by providing useful (new or complementary) science data in support of SMD science goals for one of the four SMD Science Divisions or (ii) by advancing the development of technology or capabilities in support of SMD science goals, e.g., by providing re-flights of instruments or components, demonstrating a proof of concept, providing flight calibration, or enabling technology readiness level (TRL) advancement of sensors or technologies for future use, or for advancing the readiness of selected space related technology systems. In the context of this solicitation, the term payload refers to the essential science and/or technology experiment being carried aboard the suborbital-class platform.

The ability to determine whether a proposed project can successfully carry out the proposed hands-on flight project experience training and accomplish the science or technology payload objectives depends on a crisp, 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 mission. The term "complete" encompasses both the payload element and the subsystems that support the payload in the accomplishment of its proposed mission as well as the carrier and its associated subsystems.

Proposers have the responsibility to clearly trace the scientific/technological goals to instrument requirements, mission requirements, and expected science/technology closure. This should be demonstrated through the flow from science/technology goals through measurements, projected performance, and mission requirements to expected data products and science closure using the standard matrix, and supported by text to provide an assessment of the proposed science/technology investigation.

Baseline and Threshold Science/Technology Investigations: the Baseline Science/Technology Investigation and Threshold Science/Technology Investigation are defined as follows:

> The "Baseline Science/Technology Investigation" is the investigation that, if fully implemented, would achieve the full science or technology objectives proposed for the investigation.

> The "Threshold Investigation" is a descoped Baseline Investigation that would accomplish the minimum subset of Baseline Science/Technology objectives sufficiently to justify the proposed cost of the investigation. The threshold requirements set the science/technology floor for the proposed investigation.

The differences between the Baseline Investigation and the Threshold Investigation provide resiliency to potential cost and schedule growth in the proposed development and implementation plan. A descope is an 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.

It is recognized that, in some circumstances, the Threshold Investigation may be identical to the Baseline Investigation.

Science/technology investigation and implementation: Proposals shall provide a science or technology payload that contributes toward advancing NASA science strategic objectives and goals. Proposals shall include a Science/Technology Investigation and Implementation section (see Section 4.1, Table 1, section D) that addresses the science/technology investigation goals and requirements of this solicitation, including the following:

Requirement 10. Proposals shall state explicitly whether it is principally a (i) science investigation, (ii) technology investigation, or (iii) mixed science *and* technology investigation.
Requirement 11. Proposals shall describe the science/technology investigation to be performed, with goals and objectives that address NASA's strategic science objectives and goals. Proposals shall describe the investigation's value, and how the investigation will contribute to advancing SMD science goals.
Requirement 12. Proposals shall describe the types of measurements to be taken, including a discussion of each instrument and the rationale for its selection, the instrument precision required to attain the science objectives, and the projected instrument performance.
Requirement 13. Proposals shall show the relationship between the investigation's objectives, mission to be flown, measurements to be obtained, the instrument complement to be used in obtaining the required data, and the proposed data products, at a level of detail sufficient to allow an assessment of the capability of the investigation to meet its goals. This requirement can be met with an appropriate science (or technology) traceability matrix (see Appendix C, Table C-1, example science traceability matrix).
Requirement 14. Proposals shall describe the plans to calibrate, analyze, and, if appropriate, publish and archive the data returned in an SMD approved data archive. The data should be made available to the public in the minimum time necessary, but barring exceptional circumstances, within six months following collection.
Requirement 15. Proposals shall describe the proposed science/technology investigation's baseline and threshold science/technology investigation requirements. Proposals shall describe potential descopes which maintain the threshold mission.

3.3 Technical Requirements

The term "complete" encompasses both the payload element and the subsystems that support the payload in the accomplishment of its proposed mission as well as the suborbital carrier and its

associated subsystems. It also encompasses all appropriate mission phases from project initiation through mission operations, as well as analysis of the data. Proposals shall include a Mission Implementation Section (see Section 4.1, Table 1, section E) that addresses the technical requirements of this solicitation, including the following:

Requirement 16. Proposals submitted in response to this TO shall be for complete science/technology investigations requiring a suborbital mission. Proposals shall describe the proposed complete flight system concept, including the payload and its major subsystems, as well as the carrier and its associated subsystems. Proposals shall provide a mission traceability matrix (see Appendix C, Table C-2, example mission traceability matrix).
Requirement 17. Proposals shall describe the proposed mission design and mission operations concept for a suborbital-class mission, including sounding rocket, balloon, aircraft (piloted or unmanned), CubeSat, sRLV, or other commercial suborbital vehicle. The discussion shall include the launch site, launch/flight window, mission duration, flight trajectory, as well as ground facilities needed to conduct the mission.
Requirement 18. Proposals shall describe the proposed payload interface with the carrier/launch vehicle, including any required resources from its major subsystems.
Requirement 19. The proposal shall describe the proposed development approach, including payload integration and testing with the carrier to meet the mission requirements within schedule and cost.

3.3.1 Suborbital-Class Platforms

Suborbital-class platforms provided under HOPE, including the points of contact, associated carrier services, and web links are shown in Appendix A. Balloons are administered by the Astrophysics Division (APD), and can be procured through the Balloon Program Office (BPO). Airborne science aircraft are administered by the Earth Sciences Division (ESD), and can be procured through the Airborne Science Project (ASP). Sounding rockets are administered by the Heliophysics Division (HPD), and can be procured through the Sounding Rocket Program Office (SRPO). SMD sponsored investigations utilizing cubesats can arrange launch manifesting through the CubeSat Launch initiative (CSLI) through the Human Exploration & Operations Mission Directorate (HEOMD) CubeSat Launch Initiative (CSLI) at NASA HQ. Commercial suborbital reusable launch vehicle support can be arranged through STMD's Flight Opportunities Program (FOP).

The proposing Center is free to negotiate with any of these project offices or other commercial carrier providers (including use of their own capabilities) to obtain the necessary capabilities and services. The suborbital-class platform services cost must be included as part of the proposed budget. Proposers are strongly encouraged to contact the referenced carrier POC prior to submitting proposals to understand the technical capabilities, associated technical services, and costs as part of developing the proposal, and to ensure the proposed investigation is realistic and feasible.

Suborbital-class platform: Proposals shall include a discussion of the suborbital-class platform within the Mission Implementation Section that addresses the suborbital vehicle, its interfaces, services, etc., including the following:

Requirement 20. Proposals shall describe the mission requirements for the carrier, its flight support systems (i.e., power, data, pointing, etc.), and the associated carrier services.

3.3.2 Development Approach, Test and Verification

Requirement 21. Proposals shall describe the science instrument/technology payload development approach for implementing the project to meet the mission requirements within schedule and cost. In addition, the proposal shall describe the approach for test and verification of both payload and suborbital platform, including any critical facilities or tools needed to implement the project.

3.4 Schedule and Reviews

The proposer should provide a detailed schedule that demonstrates a comprehensive understanding of the project tasks required, critical path, and funded schedule reserves necessary to be launch or flight-ready within 18 months from the Project Initiation Conference (PIC) date.

There are four reviews that are mandatory during the project life cycle. These are the System Requirements Review (SRR), the Preliminary Design Review (PDR), the Critical Design Review (CDR), and the Mission Readiness Review (MRR), or equivalent reviews that perform the same functions. After selection, the ESSP PO and selected project will work together to agree upon the terms for the NASA Independent Life-Cycle Reviews (ILCRs), Gate, and Peer Reviews for the project.

Proposals shall include a schedule section, along with accompanying narrative (see Section 4.1, Table 1, section F) that addresses the schedule requirements of this solicitation, including the following:

Requirement 22. Proposals shall provide a project schedule foldout(s) covering all phases of the project. This foldout will not be counted against the page limits. The schedule foldout and accompanying narrative shall include identification of the critical path, estimates of schedule reserves, and appropriate reviews, and demonstrate a launch or flight readiness date no later than 18 months from the Project Initiation Conference (PIC) date.

Requirement 23. Proposals shall identify appropriate peer and ILCRs for the needs of the project. These ILCRs shall include at a minimum the SRR, PDR, CDR, and MRR, or equivalent reviews that perform the same functions.

3.5 Management Requirements

Project teams are free to propose their own processes, procedures, and methods for managing their mission as long as they are consistent with the principles of NPR 7120.5E. The requirements in NPR 7120.5E, however, should be appropriately tailored to the project, depending on the project's size, complexity, and scope.

The project PI is accountable to SMD/OCE for the success of the science or technology investigation with full responsibility for its scientific integrity and for execution within the committed cost and schedule. Note that if the payload includes development of technical

capabilities, then scientific integrity includes the technology or technical integrity and success of the mission.

The Project Manager (PM) oversees the technical and programmatic (management, cost and schedule) implementation of the project. Either the PI or the PM must be designated as the team leader. The team leader is responsible for the project's execution within committed cost and schedule. Regardless of which is designated the team leader, the PI and the PM must work closely together in order to ensure that the project meets its objectives within the resources outlined in the proposal.

The general qualifications of the key team members of the project team identified as beneficiaries of the training opportunity must be commensurate with the technical and managerial needs of the proposed project, as well as the project training needs.

Proposals shall include a management and risk management section (see Section 4.1, Table 1, section G) that addresses the management requirements of this solicitation, including the following:

Requirement 24. Proposals shall describe the project's proposed management approach, including the decision-making process, the multi-Center teaming arrangement (if one exists), and risk mitigation plans.
Requirement 25. Proposals shall clearly define the respective roles of the PI and PM, and designate either the PI or PM as the project team leader.
Requirement 26. Proposals shall clearly describe the proposed management organization, identifying individual team members by name, and defining their respective roles and responsibilities. This shall also include the roles and responsibilities of the suborbital-class platform organization.
Requirement 27. Proposals shall describe plans to tailor NPR 7120.5 toward management of the proposed project, including mission assurance, testing, parts program, schedule, reviews, and risk management.

3.6 Risk Management

Proposers must demonstrate clear understanding of specific risks inherent in development and implementation of their proposed project, and they must discuss their approaches to mitigating these risks. Examples of such risks that must be discussed in the proposal are: project team experience, any new technologies, or any nontrivial modifications or upgrades of existing technologies proposed for the payload; any manufacturing, test, or other facilities needed to ensure successful completion of the proposed project, including the payload and the carrier; 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 success of the mission.

Proposals shall include within the management and risk management section their approach to risk management for the project, including the following:

Requirement 28. The proposal shall define and discuss major risks to the development and implementation of the proposed payload within the proposed cost and schedule, including management approaches to mitigate risk.
Requirement 29. If the proposed risk management approach includes potential descoping of project capabilities, the proposal shall include a discussion of the approach to such descopes, including the associated savings of resources (mass, power, dollars, schedule, *etc.*) and decision milestone(s).

3.7 Cost Requirements

Cost policies, including the definitions of requested funding, Center contributions, and total project cost are given in Section 2.3. Proposers have the responsibility to provide a validated grass-roots cost estimate. Proposers may use any combination of cost estimates derived from appropriate methodologies, including grass roots (bottoms-up, WBS related estimation), parametric analysis using cost models, and detailed Basis of Estimate(BOE) by analogy and cost estimating relationships to support the proposed costs.

Proposal budgets are to include within the total project cost, all costs that will be paid out of the project budget, including all Center and other contributions as well as civil servant labor. The total project cost will also include the cost of the suborbital-class platform, as well as the costs for center contributions of hardware, equipment, test or other facilities. Proposal budgets do not need to be full cost; costs that are covered in other budgets (e.g., CM&O) do not need to be included in the proposed budget.

Requirement 30. Proposals shall include the proposed total project cost and its components (proposed requested funding and proposed Center contributions) in all required cost tables (see Appendix C, Tables C-3 and C-4).
Requirement 31. Proposals shall provide a WBS similar to that shown in Appendix C, Cost Tables C-3 and C-4, but adapted to the suborbital platform being used. Costs for most elements should be specified to WBS Level-2. Exceptions are the costs of elements that explicitly appear only at a level below WBS Level-2 such as individual instruments or sensors.
Requirement 32. Proposals shall state all carrier and associated support service costs, including integration, campaign and manpower costs, and shall be shown within the total project cost.
Requirement 33. Proposals shall include a Master Equipment List (MEL) for the payload and carrier accommodation summarizing all the appropriate individual flight subsystems and instrument element components including mass, volume, power, and associated margins as well as level of development, heritage and source, in order to support validation of the proposed design and cost (see Appendix C, Table C-5).
Requirement 34. Proposals shall identify the methodologies and rationale used to develop the proposed cost estimate for the entire project, including the payload and suborbital-class platform.
Requirement 35. Proposals shall identify sufficient margins in performance, schedule, and cost reserves, in order to provide appropriate project reserves to complete the project (see Appendix C, Table C-6).

3.8 Contributions and Letters of Commitment

Contributions from sources other than the funds provided by SMD and OCE for this opportunity are welcome. These may include, but are not limited to, labor, services, and/or contributions to the payload including the use of existing hardware. For such contributions there must be accompanying letters of commitment signed by an institutional official from all organizations offering contributions of funds, goods, and/or services.

The required elements in an institutional letter of commitment for a contribution are: (i) a precise description of what is being contributed; (ii) a statement that the organization intends to provide the contribution or required funding for the project if it is selected; (iii) the strongest possible statement of financial commitment from the responsible organization to assure SMD/ OCE that all contributions will be provided as proposed; and (iv) a signature by an official authorized to commit the resource of the organization for participation in the payload.

3.9 Additional Proposal Requirements

3.9.1 Personnel Resumes

Resumes for each of the key project team personnel, the Center training professional, and the associated mentors shall be provided in the proposal.

Requirement 36. Resumes for each of the key ECH project team members, additional team members, the associated mentors, and associated training development professional shall be provided in the appendix section of the proposal.

4. Proposal Preparation and Submission Requirements

4.1 Structure of the Proposal

A uniform proposal format is required from all proposers to aid in proposal evaluation. The required proposal format and content is outlined below:

(a) A proposal shall consist of a single PDF file with readily identifiable sections (bookmarked) that correspond and conform to Sections A through I, as shown in the Page Limit Table below (Table 1). It shall be typewritten in English, and it shall employ metric (SI) and/or standard astronomical units, as applicable. Proposals for aircraft will use English measures regarding sensor integration. It shall contain all data and other information that will be necessary for scientific and technical evaluations; provision by reference to external sources, such as Internet websites, or additional material that is required for evaluation of the proposal is prohibited.

(b) Page size shall be American standard 8.5 x 11 inches. Text shall not exceed 55 lines per page. Margins at the top, both sides, and bottom of each page shall be no less than 1 inch. Single-column or double-column formats are acceptable for text pages. Type fonts for text and figure captions shall be no smaller than 12-point (i.e., no more than 15 characters per inch; six characters per centimeter). There is no minimum requirement for fonts used

within figures and tables but all text in figures and tables shall be legible; fonts smaller than 8-point are often illegible.

(c) Proposals shall conform to a limit of 32 pages, excluding table of contents, cost tables, and appendices. The following page limit table provides guidance as to the suggested (but not required) length of the individual sections.

TABLE 1: PAGE LIMITS

Section	Page Limits
A. Cover Page and Abstract Combined	1
B. Table of Contents	No page limit
C. Hands-On Project Experience Personnel Training D. Science/Technology Investigation and Implementation	6 8
E. Mission Implementation F. Schedule Narrative, and Schedule Foldout(s) G. Management and Risk Management	7 2 No page limit 2
H. Cost and Cost Estimating Methodology Cost Tables (see Appendix C, Tables C-3 & C-4)	3 No page limit
I. Appendices: (no others permitted) • Letter(s) of Commitment • Resumes • ECH Assessments • Equipment List (EL) • Suborbital-Class Platform Description • Heritage • List of Abbreviations and Acronyms • References	No page limit unless noted but brevity is encouraged. No limit 1 page / resume 1 page / ECH No limit No limit No limit No limit No limit
The proposal may also contain three additional pages to be distributed among Sections C through H at the total discretion of the proposer.	3

(d) A project schedule covering all phases of the investigation shall be provided on a foldout page(s). 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 a WBS similar to that shown in Appendix C, Cost Tables C-3 and C-4, but adapted to the carrier being used, allowing WBS, schedule, and cost to flow in a traceable manner. 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:

1. Subsystems development and major review dates;
2. Instrument development and major review dates including instrument-to-subsystems/host integration and test;
3. Ground systems development and major review dates (*e.g.*, mission operations and data analysis development schedule);
4. Major deliverables (*e.g.*, ICDs, simulators, engineering modules, flight modules, *etc.*);
5. Carrier integration and mission readiness;
6 Project reviews;
7 Long-lead item specifications, development paths, and their impacts to schedule; and
8 Schedule critical path identification, including funded schedule reserve, with indications of appropriate reserves associated with major milestones and deliverables.

5. Proposal Evaluation, Selection, and Implementation

5.1 Overview of the Proposal Evaluation and Selection Process

5.1.1 Evaluation Process

Proposals will be evaluated by an internal NASA review panel, augmented as necessary by a few external reviewers, all of whom are peers of the proposers. Proposals will be evaluated according to the evaluation criteria set forth in Section 5.2 of the HOPE TO. Panel members will be instructed to evaluate every proposal independently without comparison to other proposals. This panel may be augmented through the solicitation of non-panel (mail-in) reviews, which the panel has the right to accept in whole or in part, or to reject.

Proposals will be evaluated against the standard of providing the appropriate training experience for the team members while being able to successfully deliver the required science payload.

The carrier proposed is provided GFE by NASA, and is neither an evaluation factor nor a selection criterion. However, the probability of payload success (Factor B-3) and the risk of flying the payload on the selected carrier (Factor C-4) will be evaluated.

Proposers should be aware that, during the evaluation and selection process, SMD/OCE may request clarification of specific points in a proposal. In particular, before finalizing the evaluation of the personnel training opportunity merit (see Section 5.2.2), scientific/technology merit and implementation feasibility (see Section 5.2.3) and the TMC feasibility, including suborbital platform compatibility (see Section 5.2.4), SMD/OCE will request clarification on specific, potential major weaknesses 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.

5.1.2 Selection Process

After evaluation review by the TO Categorization Committee, the final evaluation results will be presented to the AA SMD, who will make the final selection(s). As the selection official, the AA SMD may consult with senior members of SMD, OCE/APPEL, the NASA Chief Engineer and the Agency concerning the selection. The AA SMD may also 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, the training needs of individual Centers, as well as other programmatic constraints.

5.2 Evaluation Criteria

5.2.1 Overview of Evaluation Criteria

The general evaluation criteria below will be used to evaluate the proposals, applied to both the training objective and the science/technology objective. Specific factors to be applied to each the two objectives, as well as to the TMC feasibility, are defined in more detail in sections 5.2.2, 5.2.3, and 5.2.4. For selection, the evaluation criteria, with weighting, is as follows:

- The merit of the proposed project for personnel training, weighted 40% at selection;
- The science/technology merit and implementation feasibility of the investigation, weighted 30% at selection, and
- The TMC feasibility of the proposed approach for mission implementation, including suborbital carrier compatibility, weighted 30% at selection.

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 (merit of the personnel training and scientific/technology merit and feasibility) will be reported as Excellent, Very Good, Good, Fair, or Poor, as defined in the table below.

Summary Evaluation	**Basis for Summary Evaluation**
Excellent	A comprehensive, thorough, and compelling proposal of exceptional merit that fully responds to the objectives of the TO as documented by numerous and/or significant strengths and having no major weaknesses.
Very Good	A fully competent proposal of very high merit that fully responds to the objectives of the TO, whose strengths fully out balance any weaknesses.
Good	A competent proposal that represents a credible response to the TO, having neither significant strengths nor weakness and/or whose strengths and weaknesses essentially balance.

Fair	A proposal that provides a nominal response to the TO but whose weaknesses outweigh any perceived strengths.
Poor	A seriously flawed proposal having one or more major weaknesses (*e.g.*, an inadequate or flawed plan of research or lack of focus on the objectives of the TO).

The evaluations of personnel training and scientific/technology merit and feasibility will be supported by identifying strengths and weaknesses of the individual proposals. These will be defined as follows.

- **Major Strength:** A facet of the response that is judged to be well above expectations and substantially contributes to the scientific/technology merit or personnel training.
- **Minor Strength:** A strength that substantiates the scientific merit or personnel training.
- **Major Weakness:** A deficiency or set of deficiencies taken together that are judged to substantially detract from the scientific merit or personnel training.
- **Minor Weakness:** A weakness that detracts from the scientific merit or personnel training.

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

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

The TMC feasibility evaluations will be supported by identifying the strengths and weaknesses of the individual proposals. These will be defined as follows.

- **Major Strength:** A facet of the implementation response that is judged to be well above expectations and can substantially contribute to the ability of the project to meet its technical requirements on schedule and within cost.
- **Minor Strength:** A strength that is worthy of note and can be brought to the attention of proposers during debriefings, but is not a discriminator in the assessment of risk.
- **Major Weakness:** A deficiency or set of deficiencies taken together that are judged to substantially weaken the project's ability to meet its technical objectives on schedule and within cost.
- **Minor Weakness:** A weakness that is sufficiently worrisome to note and can be brought to the attention of proposers during debriefings, but is not a discriminator in the assessment of risk.

5.2.2 Merit of the Personnel Training Opportunity

The information provided in a proposal will be used to assess the degree to which the goal of providing hands-on flight systems development and flight experience that will enhance the technical, leadership, and project skills of the project team will be met. The factors for training merit include the following:

- Factor A-1. Identification and readiness of key (ECH) team members. The factor includes the professional history of each key team member's qualifications demonstrating that they have the appropriate technical background and experience to be positioned to assume larger management or technical responsibilities; includes skill assessments and development plans during the project.
- Factor A-2. Benefit to the key (ECH) team members. This factor includes a demonstration of how each individual will benefit from participating in the project in the assigned position. This also includes the identification of the additional skills the individual should acquire, including skill assessments, development plans, formal and informal training, and how the individual should grow as a result of the assignment.
- Factor A-3.Benefit to the Center. This factor includes a demonstration that the Center has a need for additional personnel to be trained in the positions proposed in the project and show how this training will support those needs in the future. It also includes how the project will complement the Center's ongoing training development efforts, and how the project plans to extend the learning achieved by the ECH project team, such as formal, informal, and just-in-time training.
- Factor A-4. Center support to the project team. This factor includes how well the Center will monitor, guide, and/or maintain oversight of the project by the assigned mentors and training professional in order to support the ECH team members and assure the successful accomplishment of both the personnel training experience and mission technical objectives**.**

5.2.3 Science/Technology Merit and Implementation Feasibility of the Investigation

The information provided in a proposal will be used to assess the intrinsic science/technology merit and the science/technology implementation merit and feasibility of the proposed investigation. Note that these factors concern the evaluation of the quality of the science/technology investigation (i.e., answers science questions), as well as the evaluation of the implementation (or methodology) of the science or technology investigation. The factors for science/technology merit and science/technology implementation feasibility include the following:

- Factor B-1. Science/Technology value and/or Science/Technology utility of the proposed investigation's goals and objectives. This factor includes the clarity of the goals and objectives; how well the goals and objectives reflect SMD priorities; and the potential impact of the investigation on SMD science/technology objectives.
- Factor B-2. Likelihood of scientific/technological success. This factor includes how well the anticipated scientific measurements or technology development support the goals and objectives, the appropriateness of the proposed investigation for addressing the goals and objectives, the appropriateness of the anticipated data to meet the goals and objectives, and the appropriateness of the mission requirements for guiding development and ensuring scientific success.
- Factor B-3. Probability of technical success. This factor includes the plan for technical readiness of the scientific or technology payload; the adequacy of the plan to develop the payload within the proposed cost and schedule; the robustness of those plans, including recognition of risks and mitigation plans for retiring those risks; the ability of the project team to successfully implement those plans; and the likelihood of success for both the development and operation of the payload within the mission design.
- Factor B-4. Probability of project team success. This factor includes the qualifications and organizational structure of the project team and the investigation/development design in light of proposed goals and objectives, and the role of team member for the necessary contributions to the proposed investigation.

5.2.4 TMC Feasibility, including Suborbital Platform Compatibility

The information provided in the proposal will be used to assess the TMC risk. Specific factors include the following:

- Factor C-1. Adequacy and robustness of the technical plan. This factor includes assessment of implementation elements, such as the overall project design and architecture including design margins; and the proposer's understanding of the processes, products, and activities required to accomplish development and integration of all project elements, including the selected carrier.
- Factor C-2. Adequacy of the management approach including the capability of the management team and its approach to risk management. This factor includes the adequacy of the proposed organizational structure and management approach; the roles and qualifications of the PI, PM, PSE, and implementing organization, including the project mentors and

project management team; and the team's understanding of the scope of work covering all elements of the mission.

- Factor C-3. 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 and reserves, and the team's understanding of the scope of work. This factor also includes an assessment of proposal elements to the project schedule, the project element interdependencies, the associated schedule margins, and an assessment of the likelihood of launching or initiating the mission by the proposed date.
- Factor C-4. The risk of flying the particular investigation on the selected carrier will be assessed. In particular, the compatibility of proposed investigation and carrier resources with those available and the appropriateness of the proposed interfaces will be judged for reasonableness and degree of difficulty for implementation. Cost realism/reasonableness includes assessing the amount of work to be accomplished versus the amount of time proposed.

5.2.5 Selection Factors

As described above in Section 5.2 the results of the proposal evaluations are based on the defined criteria being considered in the selection process. The overriding consideration for the final selection of proposals submitted in response to this TO will be to provide a hands-on training experience to any selected NASA Center in-house project team while advancing NASA's science strategic objectives and goals within the available budget and schedule for this project.

5.3 Implementation of Selected Proposals

5.3.1 Notification of Selection

Following selection, the project team leader for the selected proposal(s) will be notified by telephone and email, followed by formal written notification that may include special conditions or terms of the offer of selection. The formal notification will also include instructions for scheduling a debriefing, where any issues noted during the evaluation that may require attention will be discussed, as well as instructions for attending the PIC via videoconference.

5.3.2 Project Initiation Activities

Project Retreat. Because this is a short duration training project, the sponsors of HOPE highly encourage team building by the proposing Center team after the proposal has been submitted in order for the project to effectively start-up after selection. The team is encouraged to hold a project retreat, facilitated by the Center Training Professional and the assigned mentors, prior to the Project Initiation Conference, in order to promote team building, outline roles and responsibilities, discuss communications processes and interaction, and to ensure the project has the necessary foundation for an efficient startup.

Project Initiation Conference - SMD/OCE/APPEL and the ESSP PO will host a PIC with the selected project team(s). Topics to be covered at the PIC include:

- Overview of HOPE and introduction to key leadership
- Fundamentals of a successful project (Safety, Planning, Tailoring, and Organizing)
- Value of the Mentoring Process
- Value of focused Informal and Formal Training
- A Systems Engineers' perspective
- Suborbital Platform Specifics
- Budgets, Reporting and Reviews
- Lessons Learned from previous HOPE Projects
- A panel discussion with previous HOPE participants

5.3.3 HOPE Project Management Oversight

The ESSP PO will assign a mission manager to assist the selected HOPE team(s) in the execution of the project. This responsibility will be carried out in large part by regularly meeting with the project teams, attending peer reviews, and using a SRB that will in general be responsible for conduct of the SRR, PDR, CDR, and MRR (or equivalent reviews). The formation of the SRB is a joint responsibility between the project's Center and the ESSP PO. After selection, the ESSP PO and selected project will work together to agree upon the terms for the NASA Independent Life-Cycle Reviews (ILCRs), Gate, and Peer Reviews for the project.

5.3.4 Approval of the Project Plan and the PLRA

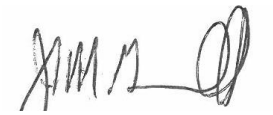
The project plan will be completed prior to PDR and submitted to ESSP PO for approval prior to Key Decision Point (KDP)-C. In addition, the Project Level Requirement Agreement (PLRA), which identifies the science/technology, mission, schedule, and cost requirements for the development and operation of the HOPE Project, will be completed prior to PDR and submitted to ESSP PO for approval prior to Key Decision Point (KDP)-C.

5.3.5 Opportunity for Debriefing of Non-Selected Proposers

Proposers of all investigations not selected will be notified and offered debriefings by telephone in order to help prepare the teams for subsequent proposal opportunities.

6. Conclusion

This HOPE training opportunity represents an innovative way for SMD/OCE to advance NASA science strategic goals while providing exciting hands-on flight opportunities to enhance the technical, leadership, and project training for NASA Center in-house ECH personnel. Further, HOPE enables early career employees to gain the knowledge and skills necessary to manage NASA's future flight projects. SMD/OCE invites all NASA Centers to propose in response to this TO.



John Grunsfeld
Associate Administrator
Science Mission Directorate

Ralph Roe
NASA Chief Engineer

APPENDIX A Suborbital Platform Capabilities

A.1 through A.5 lists the Points of Contact for Suborbital-Class Platforms: NASA provides different avenues for procurement of suborbital launch vehicle services, including: aircraft, balloons, CubeSats, sRLV, and sounding rockets. All prospective PIs are required to demonstrate the capacity, availability, and commitment of the suborbital-class platform to support their investigation. PIs are strongly urged to discuss prospective investigations with NASA program personnel (see below) prior to submitting their proposal to ensure that probable operational costs are properly anticipated.

A.1 Airborne Science Program

Within the NASA Science Mission Directorate, the Earth Science Division's Airborne Science Program (ASP) manages and operates unique, modified aircraft that support NASA satellite missions, related scientific experiments, as well as providing platforms for airborne/space borne instrument development. The Program maintains a core asset pool of aircraft, as well as a range of other NASA-owned and leased aircraft, and provides a gateway to researchers for the use of other aircraft. For HOPE, ASP will provide project assistance with all aspects of the airborne science investigation, including platform identification, mission/flight planning, integration and engineering as needed to integrate and fly the payload.

Airborne mission support costs vary widely depending on aircraft type, operations location, mission unique support, and contractor support required. The proposing team must pay for: aircraft flight costs, subsystems, expendables, mission unique engineering, fabrication, travel, and logistics. Proposers are encouraged to contact the listed Airborne Science Program Point of Contact directly to identify mission specific services and develop aircraft mission estimates costs. The full suite of ASP assets, processes, and procedures can be found at http://airbornescience.nasa.gov. Investigators proposing aircraft payloads should contact the ASP to obtain technical information related to ASP capabilities, services, and the latest planned campaign schedules.

Questions concerning Airborne Science Program aircraft may be addressed to:

Bruce Tagg
ASP Director, NASA Airborne Science Program
Earth Science Division
Science Mission Directorate
Washington, DC 20546-0001
Telephone: (202) 358-2890
E-mail: Bruce.A.Tagg@nasa.gov

A.2 Balloon Program Office

Within the NASA/GSFC/WFF's Suborbital and Special Orbital Projects Directorate, the Balloon Program Office (BPO) manages the scientific balloon program on behalf of the NASA/SMD Astrophysics Division, including balloon launch operations conducted by the Columbia Scientific Balloon Facility (CSBF). The Balloon Program offers a wide range of standard balloon platforms and support systems to meet user requirements.

For HOPE, projects are eligible to be launched on a NASA standard design, zero-pressure balloon from the NASA remote site at Fort Sumner, New Mexico. Projects may also be launched from Palestine, Texas, dependent on meeting the prescribed NASA Flight Safety criteria.

Due to a wide array of possible payload/gondola configurations and flight support systems to meet investigation requirements, proposal teams are encouraged to contact the Balloon Program Office Point of Contact to discuss support options. Balloon mission support costs vary depending upon balloon vehicle, flight support systems, and launch location. For HOPE, BPO will provide standard/nominal support services, including payload integration with standard CSBF support systems, payload testing prior to launch, launch, flight operations, and payload/data recovery. The HOPE team must pay for: launch (balloon and expendables), as well as any mission unique engineering, fabrication, travel, or logistics support.

Proposers needing investigation unique engineering, flight support systems, and/or technical support services from BPO should contact the BPO directly for an estimate of the cost of the desired support. Information on the capabilities of current available balloon vehicles is available at http://sites.wff.nasa.gov/code820/ and at http://www.csbf.nasa.gov/balloons.html.

Proposers are encouraged to consider these capabilities in designing their investigations, but the Balloon Program Office (BPO) has final authority in the choice of which balloon vehicle is used. Investigators proposing balloon payloads should contact the BPO to obtain technical information related to BPO balloon capabilities, services, and the latest planned campaign schedules.

Questions concerning balloons may be addressed to:

Debora Fairbrother
Balloon Program Office
GSFC/Wallops Flight Facility
National Aeronautics and Space Administration
Wallops Island, VA 23337
Telephone: (757) 824-1453
E-mail: debora.a.fairbrother@nasa.gov

A.3 CubeSats

Short duration orbital platforms, such as CubeSats (built in increments of 10 centimeter cubes), can be built as a single unit (1U), weighing less than 1.33 kg, or combined in units of two, three or six.

Launch services will be provided under the NASA/HEOMD CubeSat Launch Initiative (CSLI) at no cost to the project. The CubeSat Launch Initiative (CSLI) program regularly provides an annual solicitation for launch opportunities for CubeSats to fly as secondary (auxiliary) payloads on rockets planned for upcoming U.S. Government missions. Under the CSLI process, an Agency-wide selection recommendation committee considers candidate CubeSats for selection to be manifested. At an appropriate time following selection, SMD will provide direction for being considered for manifest on a launch vehicle going to an appropriate orbit.

For more information about the CSLI, including previously-selected respondents, see http://www.nasa.gov/directorates/heo/home/CubeSats_initiative.html.

As a result of their secondary status, CubeSats are placed into orbits that are dictated by the primary. In any given year a finite number of specific orbits (e.g. inclinations and altitudes) will be available for CubeSats, and the types of orbits available will vary from year to year. Therefore, CubeSat-based missions requiring very specific orbital parameters may be at a disadvantage for securing a timely launch. Proposals should clearly indicate both the required and the acceptable range of orbital parameters needed to meet mission objectives.

NASA's CubeSats are deployed from a Poly-Picosatellite Orbital Deployer, or P-POD. CubeSats must be compliant with the NASA/KSC Launch Services Program (LSP) Program Level Poly-Picosatellite Orbital Deployer (PPOD) and CubeSat Requirements Document and the Compliance and Reference Documents referenced therein. That document may be found at: http://www.nasa.gov/pdf/627972main_LSP-REQ-317_01A.pdf

- Proposals for investigations using CubeSats must satisfy the constraints for a standard CubeSat (one "Cube" or "1U" defined above) and the NASA CubeSat deployer.
- Proposals must specify any constraints placed on the required orbit and orbital lifetime. The likely availability of NASA launches satisfying any constraints in the time period contemplated will be a consideration for the HOPE evaluation. The less stringent the orbital constraints, the more probable it will be that NASA can manifest the CubeSat investigation for launch.
- Proposals must demonstrate knowledge of the requirements for limiting orbital debris and must address how the mission will meet the requirements of NPR8715.6 NASA Procedural Requirement for Limiting Orbital Debris.
- Proposals must address the approach to downlink and uplink communications licensing, frequency band selection, and frequency coordination for operations between space and ground within the RF spectrum.

- All costs for preparing and delivering the CubeSat for launch must be included in the proposal. No launch service charges should be included in the proposal cost request.
- Proposals for short duration orbital experiments other than CubeSats must include provisions for access to space as part of the proposal.

Investigators proposing CubeSats are strongly urged to discuss prospective investigations with personnel listed below regarding constraints, launch opportunities, and other technical matters.

For further information on CubeSats, please contact the HOPE POC:

David L Pierce,
Senior Program Executive for Suborbital Research,
Phone: 202-358-3808,
E-mail: david.l.pierce@nasa.gov

For further information on CSLI, please contact:

Anne E Sweet,
Launch Services Program Executive,
Phone: 202-358-3784,
E-mail: anne.sweet-1@nasa.gov

or

Jason C Crusan,
Director, Advanced Exploration Systems,
Phone: 202-358-0635,
E-mail: jason.c.crusan@nasa.gov

A.4 Flight Opportunities Program

Suborbital Reusable Launch Vehicles: sRLVs offer newly developed commercial capabilities for the conduct of NASA scientific research, education, and technology advancement. The NASA STMD's Flight Opportunities Program (FOP) has issued commercial contracts to several sRLV flight service providers.

Information on sRLV vehicles, including general vehicle capabilities and contact information for some vendors, is available at http://flightopportunities.nasa.gov/platforms.
Proposers interested in using sRLVs as platforms for a HOPE investigation must identify a vehicle that can provide the technical capabilities required to conduct the proposed investigation.

The cost to SMD for the flight and all other services provided by the sRLV vendor must be clearly stated in the proposal, and included in the PI's proposed investigation budget. All other costs for conducting the investigation must be included in the PI's proposed investigation budget. Upon final selection for flight, the flight and all other services provided by the sRLV vendor will be procured directly by the FOP and will not be funded through the PI's award.

Note that the Flight Opportunities Program is available to assist the PI with this process. Investigators proposing sRLV payloads are strongly urged to discuss prospective investigations with operations personnel in the Flight Opportunities Program and/or a potential vendor to

ensure that probable integration, safety and mission assurance, and operational costs are properly anticipated.

Proposers are encouraged to consider these capabilities in designing their investigations, but the Flight Opportunities Program (FOP) has the final authority in the choice of which vehicles to be used. Investigators proposing sRLV payloads should contact the FOP to obtain technical information related to FOP capabilities, services, and the latest planned campaign schedules. Questions concerning sRLVs may be addressed to:

LK Kubendran
Flight Opportunities Program
Space Technology Mission Directorate
NASA Headquarters
Washington, DC 20546
Telephone: (202) 358-2528
E-mail: lk@nasa.gov

A.5 Sounding Rockets Program Office

The Sounding Rockets Program Office (SRPO) can provide a wide variety of support to assist HOPE teams in developing their sounding rocket payload and mission design. This support can include payload design, standardized support subsystems (telemetry, attitude control, recovery, deployment mechanisms, fabrication services, etc.), and environmental testing services. It is also possible for the HOPE teams to perform all development, fabrication, and testing in-house at their own facility and arrive at the launch site "flight ready" as long as all flight worthiness and safety criteria are satisfied. Due to variable payload configurations and engineering efforts, proposers must contact the SRPO for pre-proposal discussions to identify mission requirements, integration and test/environmental support services and to develop mission cost estimates.

Sounding Rockets. Information on the capabilities of current available sounding rocket vehicles is available at http://sites.wff.nasa.gov/code810/vehicles.html. Proposers are encouraged to consider these capabilities in designing their investigations, but the SRPO has the final authority in the choice of which vehicle is to be used.

The Terrier-Improved Orion is offered as the baseline launch vehicle for HOPE. The payload is typically 14.0" in diameter outer-diameter, but can be expanded to 17.26" diameter if necessary. In general, the Terrier-Improved Orion launch vehicle is capable of lofting a 250 kg (550 lb) payload to an altitude of approximately 200 km. This provides nearly 300 seconds of flight time above 100 km. The baseline launch vehicle cost is $100K.

Sounding Rockets Launch Sites. The available sounding rockets launch sites in support of HOPE are White Sands Missile Range (WSMR) in New Mexico, Wallops Island in Virginia, and Poker Flat Rocket Range (PFRR) in Alaska, subject to science community requirements and the availability of SRPO operations funding to conduct the launch.

Projects utilizing SRPO subsystems must be integrated and testing at Wallops Flight Facility. Payloads that do not utilize SRPO subsystems may be integrated and tested elsewhere, but all standard sounding rocket testing protocols must be followed to ensure there will be no catastrophic failures that will cause a public safety risk (i.e. internal structural failure that results in severe imbalance).

The SRPO will cover costs associated with general project consultation and standard sounding rocket project reviews (Mission Initiation Conference, Requirements Definition Meeting, Design Review, and Mission Readiness Review). Costs associated with offsite meetings and reviews, and reviews that go beyond the standard sounding rocket reviews must be covered by the HOPE project. The cost for the sounding rocket launch and all other services provided by SRPO must be clearly stated in the proposal, and included in the PI's proposed investigation budget.

Information on the Sounding Rockets Program provided services, the vehicles offered, summaries of their capabilities, as well as the processes, and procedures to arrange for flight may be found at:
http://sites.wff.nasa.gov/code810/

A project that uses a sounding rocket as the suborbital-class platform may request a supplement of $200K toward the cost of the sounding rocket.

Investigators proposing sounding rocket payloads should contact the SRPO to obtain technical information related to SRPO launch vehicle capabilities, services, and the latest planned campaign schedules. Questions concerning sounding rockets may be addressed to:

Philip Eberspeaker
Sounding Rockets Program Office
GSFC/Wallops Flight Facility
National Aeronautics and Space Administration
Wallops Island, VA 23337
Telephone: (757) 824-2202
E-mail:Philip.J.Eberspeaker@nasa.gov

APPENDIX B Training Guidelines and Best Practices

The following outline and training element tables are provided to aid the proposer in developing a comprehensive Training Plan which meets the required TO elements (see Requirements 2-9).

Recommended Outline of the HOPE Training Plan

- Project Organizational Roles and Responsibilities
- Role of Training Team Member in Project Team
- Team Member Evaluation, Individual Development Plans and Team Skill Assessments
- Center Skill alignment, skill tracking, and succession planning, re-integration activities
- Center Training Program and alignment to project
- Career Counseling, Coaching and Mentoring
- Training Opportunities, APPEL, Formal and Informal Training
- Knowledge Sharing and Lessons Learned

Recommended Training Plan Elements for HOPE Projects

- Training Courses
- Team Member Experience
- Training Expert as Team Member
- Mentoring
- Measurement Strategy and Reentry Needs
- Lessons Learned/Knowledge Sharing

Training Courses

Minimal	Project team attending training offerings
Good	Training offerings targeted and scheduled to meet HOPE Project team needs
Better	Training expert identifies and schedules just-in-time, phase specific training for HOPE project team members
Best	Training expert works with team members to identify learning gaps and works with trainers to redesign their courses to meet phase specific, just-in-time team member's learning needs

Team Members Experience

Minimal	Team member who has had some exposure to role assigned in HOPE
Good	Stretch assignment for team member who has had some experience in supporting the role assigned in HOPE
Better	Stretch assignment with evidence of direct exposure to duties in the role assigned in HOPE at next lowest level of complexity
Best	Stretch assignment with evidence of some past experience serving in the role assigned (or as deputy) in HOPE at next lowest level of complexity

Training Expert as Team Member

Minimal	Program manager or engineer as learning lead contacts training office with needs
Good	Program manager or engineer as learning lead contacts training office with identified needs based on skill/knowledge gap analysis
Better	Training expert as project team member who consults with the project member on identifying learning gaps and sources to meet training needs
Best	Training expert as project team member who is actively involved in all aspects of the project, continually monitoring and identifying needs and sources to meet training needs, and coaches team members and mentors, establishes individual, phase specific learning needs for each team member

Mentoring

Minimal	Experienced mentors with relevant experience
Good	Experienced mentors with relevant experience and a defined mentoring plan that includes regular and frequent meetings with their assigned mentee
Better	Experienced mentors with relevant experience, a defined mentoring plan that includes regular and frequent meeting s with their assigned mentee, including preparing for reviews, and mentor involvement in identifying mentee leaning needs/gaps
Best	Experienced mentors with relevant experience, a defined mentoring plan for each early career hire team member that includes regular and frequent meetings with their mentee including preparing for reviews, mentor involvement in identifying mentee leaning needs/gaps, and includes a way to advance the mentee's skills

Measurement Strategy and Reentry Needs

Minimal	Includes pre and post measurement of team members learning goals
Good	Includes pre and post measurement of team member's learning goals, addresses alignment with Center needs, and establishes a re-entry plan based on knowledge gained from experience
Better	Includes pre and post measurement of team member's learning goals, addresses alignment with Center needs and alignment with succession planning strategy, and establishes a re-entry plan based on knowledge gained from experience
Best	Includes pre and post measurement of team member's learning goals, addresses alignment with Center needs and succession planning strategy, and establishes a re-entry plan based on knowledge gained from experience

Lessons Learned/Knowledge Sharing

Minimal	Within the team
Good	Within the center
Better	Within NASA
Best	Inside and outside NASA

APPENDIX C Example Tables and Matrices

TABLE C-1
EXAMPLE SCIENCE TRACEABILITY MATRIX

Investigation Science Goals	Investigation Science Objectives	Scientific Measurement		Instrument Requirements		Projected Performance	Mission Requirements (Top Level)
		Physical parameters	Observables				
GOAL 1	Objective 1	Column Density of Absorber	Absorption Line	Alt. Range	XX km	ZZ km	Observing strategies: requires yaw & elevation maneuvers
							Launch window: to meet nadir and limb overlap requirement.
		Density and Temperature of Emitter	Emission Line				
		Size of Features	Morphological Feature	Vert. Resolution	XX km	ZZ km	Need NN seasons to trace evolution of phenomenon
				Horiz. Resolution	XX deg x XX lat x XX long	ZZ deg x ZZ lat x ZZ long	
			Rise Time of Eruptive Phenomena	Temperature Resolution	XX min	ZZ min.	Need MM months of observation to observe variability of phenomenon.
				Precision	XX K	ZZ K	
				Accuracy	XX K	ZZ K	

An Excel version of this template is available in the HOPE Library

TABLE C-2
EXAMPLE MISSION TRACEABILITY MATRIX

Mission Requirements	Mission Design Requirements	Spacecraft Requirements	Ground System Requirements	Operations Requirements
From Table B1	Rocket type Launch date: Mission length Orbit altitude requirement and rationale Geographic coverage and how it drives orbit requirement Orbit local time and rationale for the requirement Type of orbit, e.g. Sun synchronous, precessing, Lagrangian point, other Other	Spinning, stabilized Mass Power Volume: Data Rate Temperature Range for spacecraft systems Pointing Control: Knowledge, Stability, Jitter, Drift , Other Detector radiation shielding requirements and rationale Other	Passes per day and duration Assumed antenna size Data volume per day Real time data transmission requirements Transmit frequency Power available for comm (Watts) Downlink data rate Number of data dumps per day Spacecraft data destination (e.g., mission operations center) Science data destination (e.g., science operations center) Other	General spacecraft maneuver requirements and frequency Special maneuvers requirements Rationale for maneuvers Ephemeris requirements Changes in viewing modes and directions per orbit, per day or over longer time periods. Rationale for these changes Other
Mission Requirements or Instrument Accommodation (from Table B1)	Mission	Spacecraft	Ground System	Operations
Four different observing strategies: Solar, limb, nadir, zenith; requires yaw and elevation maneuvers		Agility requirements Slew rate = y deg/sec Settle = stability < .001 deg/sec after 30 secs		Target planning on 3 day centers Ephemeris accuracy of x with updates every 2 days
Instrument X precision of 5K		Thermal stability of 1 deg/hr S/C bus stability of .01 deg over 10 secs	Bit error rate < 1e-5 Time correlation to 2 msec over 1 week	Weekly time correlation

An Excel version of this template is available in the HOPE Library

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TABLE C-3
TOTAL PROJECT FUNDING PROFILE TEMPLATE

WBS	WBS Element	FY 2016			FY 2017			Total Project		
		Requested Funding	Contrib utions	Total	Requested Funding	Contrib utions	Total	Requested Funding	Contrib utions	Total
1	Project Management									
2	Systems Engineering									
3	Safety & Mission Assurance									
4	Science / Technology									
5	Payload(s)									
	List each instrument separately									
6	Platform/Carrier									
	List each major flight system element separately									
7	Mission Operations									
8	Carrier / Services									
9	Ground System(s)									
10	Systems Integration & Testing									
	Reserves									
	Total Requested Funding									
	Total Contributions									
	Total Project Cost									

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TABLE C-4
TOTAL PROJECT CIVIL SERVANT LABOR PROFILE TEMPLATE

WBS	WBS Element	FY 2016			FY 2017			Total Project		
		Requested CS Labor	Contrib uted CS Labor	Total CS Labor	Requested CS Labor	Contrib uted CS Labor	Total CS Labor	Requested CS Labor	Contrib uted CS Labor	Total CS Labor
1	Project Management									
2	Systems Engineering									
3	Safety & Mission Assurance									
4	Science / Technology									
5	Payload(s)									
	List each instrument separately									
6	Platform/Carrie r									
	List each major flight system element separately									
7	Mission Operations									
8	Carrier / Services									
9	Ground System(s)									
10	Systems Integration & Testing									
	Reserves									
	Total Requested CS Labor									
	Total Contributed CS Labor									
	Total Project CS Labor									

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TABLE C-5
EXAMPLE MASTER EQUIPMENT LIST (MEL) TEMPLATE

MASTER EQUIPMENT LIST Template - MISSION X

S/C Element 1		# OF UNITS			FLIGHT HARDWARE MASSES			FLIGHT HARDWARE POWER			OTHER COMPONENT INFORMATION	
Subsystem/Component	Unit Mass, Current Best Estimate (CBE)	Flight Units	Flight Spares	EMs & Proto-types	Total Mass, kg CBE	Contin-gency %	Total Mass w/ Contin-gency	Total Power, W CBE	Contin-gency %	Total Power w/ Contin-gency	Description (Vendor, Part #, Heritage Basis)	Other characteristics/issues (volume, other component-specific information)
Total Mass/Power												

S/C Element *n*		# OF UNITS			FLIGHT HARDWARE MASSES			FLIGHT HARDWARE POWER			OTHER COMPONENT INFORMATION	
Subsystem/Component	Unit Mass, Current Best Estimate (CBE)	Flight Units	Flight Spares	EMs & Proto-types	Total Mass, kg CBE	Contin-gency %	Total Mass w/ Contin-gency	Total Power, W CBE	Contin-gency %	Total Power w/ Contin-gency	Description (Vendor, Part #, Heritage Basis)	Other characteristics/issues (volume, other component-specific information)
Total Mass/Power												

Payload Element 1		# OF UNITS			FLIGHT HARDWARE MASSES			FLIGHT HARDWARE POWER			OTHER COMPONENT INFORMATION	
Subsystem/Component	Unit Mass, Current Best Estimate (CBE)	Flight Units	Flight Spares	EMs & Proto-types	Total Mass, kg CBE	Contin-gency %	Total Mass w/ Contin-gency	Total Power, W CBE	Contin-gency %	Total Power w/ Contin-gency	Description (Vendor, Part #, Heritage Basis)	Other characteristics/issues (volume, other component-specific information)
Total Mass/Power												

Payload Element *n*		# OF UNITS			FLIGHT HARDWARE MASSES			FLIGHT HARDWARE POWER			OTHER COMPONENT INFORMATION	
Subsystem/Component	Unit Mass, Current Best Estimate (CBE)	Flight Units	Flight Spares	EMs & Proto-types	Total Mass, kg CBE	Contin-gency %	Total Mass w/ Contin-gency	Total Power, W CBE	Contin-gency %	Total Power w/ Contin-gency	Description (Vendor, Part #, Heritage Basis)	Other characteristics/issues (volume, other component-specific information)
Total Mass/Power												

TABLE C-6
RESERVES/MARGINS CALCULATION DEFINITIONS

Definitions:

Contingency, when added to the current estimate for a resource, results in the maximum expected value for that resource. Percent contingency is the value of the contingency divided by the value of the resource less the contingency.

Margin is the difference between the maximum possible capability of a resource (the physical limit or the agreed-to limit) and the maximum expected value for a resource. Percent margin for a resource is the available margin divided by its maximum expected value.

Example: A payload in the design phase has a maximum expected mass of 115 kg including a mass contingency of 15 kg. There is no other payload on the ELV and the ELV provider plans to allot the payload the full capability of the vehicle, if needed. The ELV capability is 200 kg. The mass contingency is 15/100 = 15% and the mass margin is 85 kg or 85/115 = 74%.

Example: The end-of-life (EOL) capability of a spacecraft power system is 200 Watts, of which 75 Watts has be allocated to the instrument and 100 Watts has been allocated to the spacecraft bus. The power margin is the unallocated 25 Watts or 25/175 = 14.3%. The current best estimate for the instrument power is 60 Watts, leaving 15 Watts or 15/60 = 25% contingency to the 75 Watt maximum expected value.

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

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

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

Margin = Max Possible Resource Value – Max Expected Resource Value

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

APPENDIX D Glossary of terms and abbreviations, and Acronyms

Part D.1: GLOSSARY OF TERMS

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

Baseline science/technology 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 science objectives of the investigation.

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

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

Categorization — The process whereby proposed investigations are classified with three grades synopsized here as Excellent Recommended, Selectable, or Not Recommended.

Categorization Subcommittee — An *ad hoc* committee appointed by the Associate Administrator for the Science Mission Directorate, that categorizes proposals for investigations submitted in response to a TO based on the evaluations.

Complete science/technology investigation — A science/technology investigation requiring a suborbital mission, that encompasses all appropriate mission phases from project initiation (Phase A) through mission operations (Phase E) and spacecraft disposal (Phase F), including the analysis and publication of data in the peer reviewed scientific literature, and delivery of the data to an appropriate NASA data archive.

Communications — Comprises the comprehensive set of functions necessary to effectively convey — and provide an understanding of — a program, its objectives and benefits to target audiences, the public, and other stakeholders. This includes a diverse, broad, and integrated set of efforts and is intended to promote interest and foster participation in NASA's endeavors and the develop exposure to, and appreciation for, STEM.

Contingency — That quantity, when added to a resource, results in the maximum expected value for that resource.

Contribution — Labor, services, or hardware funded by any source other than the Program sponsoring the TO.

Descope — Any alteration of a mission that results in savings of resources (mass, power, dollars, schedule, etc.) at the cost of reduced scientific performance.

Early Career Hire — Personnel who are either in the early, or transitional stage of their career at NASA, who are judged to have the necessary pre-requisite experience to successfully execute the proposed project role, and who will benefit from the HOPE TO.

Education — Comprises those activities designed to enhance learning in science, technology, engineering, and mathematics (STEM) content areas using NASA's unique capabilities.

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

Investigation — Activities or effort aimed at the generation of new knowledge. NASA-sponsored investigations generally concern the generation and analysis of data obtained through measurement of space phenomena or Earth phenomena using spaceflight hardware developed and operated for that purpose.

Investigation Team — The group of scientists, engineers, and other professionals implementing an investigation.

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

Mission — Used interchangeably with investigation.

Mission Architecture — The summary level description of the overall approach to the mission in the context of achieving the science objectives including mission elements such as flight systems, instruments, high-level mission plan, high-level operations concept, etc.

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 (v) — The process of proposal review utilizing a group of peers in accordance with the review criteria as outlined in the Training Opportunity.

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.

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

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

Project Office — An office established to manage a project.

Proposing Organization — The organization that submits the proposal; commonly this is also the Principal Investigator's home institution.

Reserve — Resource not allocated to any specific task but held by the project for unexpected needs.

Resiliency — The quality of a mission to gracefully degrade from the Baseline Science Mission to the Threshold Science Mission as technical, schedule, or budgetary problems occur.

Risk — The combination of the probability that a program or project will experience an undesired event and the consequences, impact, or severity of the undesired event, were it to occur. The undesired event may come from technical or programmatic sources (*e.g.*, a cost overrun, schedule slippage, safety mishap, health problem, malicious activities, environmental impact, failure to achieve a needed scientific or technological objective, or success criterion). Both the probability and consequences may have associated uncertainties.

Selection Official — The NASA official designated to determine the source for award of a contract or grant.

Threshold science mission — A descoped Baseline Science Mission that would fulfill the Threshold Science Requirements, which are defined in NPR 7120.5E as the performance requirements necessary to achieve the minimum science acceptable for the investment.

Training Opportunity (TO) — A document used to announce opportunities to participate in the Hands-On Project Experience program.

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 D.2: ABBREVIATIONS AND ACRONYMS

AA	Associate Administrator
AO	Announcement of Opportunity
APPEL	NASA Academy of Program, Project, and Systems Engineering Leadership
ASP	Airborne Science Program
BOE	Basis of Estimate
BPO	Balloon Program Office
CBE	Current Best Estimate
CDR	Critical Design Review
CM&O	Center Management and Operations
CSBF	Columbia Scientific Balloon Facility
CSLI	CubeSat Launch Initiative
CTS	Cornell Technical Services
EASSS	Evaluations, Assessments, Studies, Services, and Support
ECH	Early Career Hire
ESSP	Earth System Science Pathfinder
FAQ	Frequently Asked Questions
FOP	Flight Opportunities Program
FY	Fiscal Year
G&A	General and Administrative
GAO	Government Accountability Office
GFE	Government Furnished Equipment
GFS	Government Furnished Service
HQ	NASA Headquarters
HOPE	Hands-On Project Experience
IAT	Integration, Assembly, and Test
ILCR	Independent Life-Cycle Review
JPL	Jet Propulsion Laboratory
KDP	Key Decision Point
LaRC	Langley Research Center
LSP	Launch Services Program
MEL	Master Equipment List
MRR	Mission Requirements Review
NASA	National Aeronautics and Space Administration
NASA-STD	NASA-Standard
NOI	Notice of Intent
NPD	NASA Policy Directive
NPR	NASA Procedural Requirements
OCE	Office of the Chief Engineer
PDF	Portable Data Format
PDL	Payload Development Lead
PDR	Preliminary Design Review
PFRR	Poker Flat Rocket Range
PI	Principal Investigator

PIC	Project Initiation Conference
PLRA	Project Level Requirement Agreement
PM	Project Manager
POC	Point of Contact
PO	Program Office
PPOD	Program Level Poly-Picosatellite Orbital Deployer
PS	Project Scientist
PSE	Project Systems Engineer
ROM	Rough Order-of-Magnitude
RY	Real Year
SE	System Engineer(ing)
SMD	Science Mission Directorate
SRB	Standing Review Board
sRLV	suborbital Reusable Launch Vehicle
SRPO	Sounding Rockets Program Office
SRR	System Requirements Review
TA	Technical Authority
TDO	Technology Demonstration Opportunity
TMC	Technical, Management, and Cost
TO	Training Opportunity
TRL	Technical Readiness Level
WBS	Work Breakdown Structure
WSMR	White Sands Missile Range

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APPENDIX E Summary of Requirements

Requirement	Description
1	**Submittal Deadline (sect. 1.5):** Proposals submitted in response to this solicitation shall be delivered no later than the proposal submittal deadline following the instructions for submission in Section 1.5.
2	**Training (sect. 3.1):** Proposals shall identify the key ECH project team members, Center Training Professional, and mentors, by name, and describe their roles and responsibilities.
3	**Training (sect. 3.1):** Proposals shall describe the qualifications and experience of all project team members, why these individuals are appropriate for the proposed project roles, and how the Center will benefit through their training.
4	**Training (sect. 3.1):** Proposals shall describe the mentoring plan for each ECH team member, including the mentor's relevant professional experience, mentoring approach to be used, and frequency of interaction between the mentor/mentee, and rationale.
5	**Training (sect. 3.1):** Proposals shall describe the training and the developmental plan (technical, project, and leadership skills) for each ECH team member, including a summary of initial skills assessment, customized formal, informal, and just-in-time training, monitoring, and plans for measurement of learning goals.
6	**Training (sect. 3.1):** Proposals shall include in the appendix section, any resumes, individual development plans, and skill assessments for the key ECH project team members, as well as the resume(s) for the Center training professional, and associated mentors.
7	**Training (sect. 3.1):** Proposals shall describe training courses to be used as part of the projects' training plan, and show relevancy toward team member's learning goals. The list of OCE/APPEL training courses can be found at: http://www.nasa.gov/offices/oce/appel/curriculum/index.html.
8	**Training (sect. 3.1):** Proposals shall describe how the project will complement the Center's ongoing training programs, and is aligned with the Center's succession planning strategy.
9	**Training (sect. 3.1):** Proposals shall describe how the knowledge captured by the HOPE project will be integrated into the Center's overall training and development process.
10	**Science/Technology (sect. 3.2):** Proposals shall state explicitly whether it is principally a (i) science investigation, (ii) technology investigation, or (iii) mixed science *and* technology investigation.

11	**Science/Technology (sect. 3.2):** Proposals shall describe the science/technology investigation to be performed, with goals and objectives that address NASA's strategic science objectives and goals. Proposals shall describe the investigation's value, and how the investigation will contribute to advancing SMD science goals.
12	**Science/Technology (sect. 3.2):** Proposals shall describe the types of measurements to be taken, including a discussion of each instrument and the rationale for its selection, the instrument precision required to attain the science objectives, and the projected instrument performance.
13	**Science/Technology (sect. 3.2):** Proposals shall show the relationship between the investigation's objectives, mission to be flown, measurements to be obtained, the instrument complement to be used in obtaining the required data, and the proposed data products, at a level of detail sufficient to allow an assessment of the capability of the investigation to meet its goals. This requirement can be met with an appropriate science (or technology) traceability matrix (see Appendix C, Table C-1, example science traceability matrix).
14	**Science/Technology (sect. 3.2):** Proposals shall describe the plans to calibrate, analyze, and, if appropriate, publish and archive the data returned in an SMD approved data archive. The data should be made available to the public in the minimum time necessary, but barring exceptional circumstances, within six months following collection.
15	**Science/Technology (sect. 3.2):** Proposals shall describe the proposed science/technology investigation's baseline and threshold science/technology investigation requirements. Proposals shall describe potential descopes which maintain the threshold mission.
16	**Technical (sect. 3.3):** Proposals submitted in response to this TO shall be for complete science/technology investigations requiring a suborbital mission. Proposals shall describe the proposed complete flight system concept, including the payload and its major subsystems, as well as the carrier and its associated subsystems. Proposals shall provide a mission traceability matrix (see Appendix C, Table C-2, example mission traceability matrix).
17	**Technical (sect. 3.3):** Proposals shall describe the proposed mission design and mission operations concept for a suborbital-class mission, including sounding rocket, balloon, aircraft (piloted or unmanned), CubeSat, sRLV, or other commercial suborbital vehicle. The discussion shall include the launch site, launch/flight window, mission duration, flight trajectory, as well as ground facilities needed to conduct the mission.
18	**Technical (sect. 3.3):** Proposals shall describe the proposed payload interface with the carrier/launch vehicle, including any required resources from its major subsystems.

19	**Technical (sect. 3.3):** The proposal shall describe the proposed development approach, including payload integration and testing with the carrier to meet the mission requirements within schedule and cost.
20	**Suborbital-Class Platform (sect. 3.3.1):** Proposals shall describe the mission requirements for the carrier, its flight support systems (i.e., power, data, pointing, etc.), and the associated carrier services.
21	**Development Approach, Test and Verification (sect. 3.3.2):** Proposals shall describe the science instrument/technology payload development approach for implementing the project to meet the mission requirements within schedule and cost. In addition, the proposal shall describe the approach for test and verification of both payload and suborbital platform, including any critical facilities or tools needed to implement the project.
22	**Schedule and Reviews (sect. 3.4):** Proposals shall provide a project schedule foldout(s) covering all phases of the project. This foldout will not be counted against the page limits. The schedule foldout and accompanying narrative shall include identification of the critical path, estimates of schedule reserves, and appropriate reviews, and demonstrate a launch or flight readiness date no later than 18 months from the Project Initiation Conference (PIC) date.
23	**Schedule and Reviews (sect. 3.4):** Proposals shall identify appropriate peer and ILCRs for the needs of the project. These ILCRs shall include at a minimum the SRR, PDR, CDR, and MRR, or equivalent reviews that perform the same functions.
24	**Management (sect. 3.5):** Proposals shall describe the project's proposed management approach, including the decision-making process, the multi-Center teaming arrangement (if one exists), and risk mitigation plans.
25	**Management (sect. 3.5):** Proposals shall clearly define the respective roles of the PI and PM, and designate either the PI or PM as the project team leader.
26	**Management (sect. 3.5):** Proposals shall clearly describe the proposed management organization, identifying individual team members by name, and defining their respective roles and responsibilities. This shall also include the roles and responsibilities of the suborbital-class platform organization.
27	**Management (sect. 3.5):** Proposals shall describe plans to tailor NPR 7120.5 toward management of the proposed project, including mission assurance, testing, parts program, schedule, reviews, and risk management.
28	**Risk Management (sect. 3.6):** The proposal shall define and discuss major risks to the development and implementation of the proposed payload within the proposed cost and schedule, including management approaches to mitigate risk.

29	**Risk Management (sect. 3.6):** If the proposed risk management approach includes potential descoping of project capabilities, the proposal shall include a discussion of the approach to such descopes, including the associated savings of resources (mass, power, dollars, schedule, *etc.*) and decision milestone(s).
30	**Cost (sect. 3.7):** Proposals shall include the proposed total project cost and its components (proposed requested funding and proposed Center contributions) in all required cost tables (see Appendix C, Tables C-3 and C-4).
31	**Cost (sect. 3.7):** Proposals shall provide a WBS similar to that shown in Appendix C, Cost Tables C-3 and C-4, but adapted to the suborbital platform being used. Costs for most elements should be specified to WBS Level-2. Exceptions are the costs of elements that explicitly appear only at a level below WBS Level-2 such as individual instruments or sensors.
32	**Cost (sect. 3.7):** Proposals shall state all carrier and associated support service costs, including integration, campaign and manpower costs, and shall be shown within the total project cost.
33	**Cost (sect. 3.7):** Proposals shall include a Master Equipment List (MEL) for the payload and carrier accommodation summarizing all the appropriate individual flight subsystems and instrument element components including mass, volume, power, and associated margins as well as level of development, heritage and source, in order to support validation of the proposed design and cost (see Appendix C, Table C-5).
34	**Cost (sect. 3.7):** Proposals shall identify the methodologies and rationale used to develop the proposed cost estimate for the entire project, including the payload and suborbital-class platform.
35	**Cost (sect. 3.7):** Proposals shall identify sufficient margins in performance, schedule, and cost reserves, in order to provide appropriate project reserves to complete the project (see Appendix C, Table C-6).
36	**Personnel Resumes (sect. 3.9.1):** Resumes for each of the key ECH project team members, additional team members, the associated mentors, and associated training development professional shall be provided in the appendix section of the proposal.

APPENDIX F Compliance Checklist

Administrative	
1. Electronic proposal received on time	Requirement 1
2. Original signature of authorizing official included	Sect 3.8
3. Meets general requirements for format and completeness (PDF, text maximum 55 lines text/page, maximum 15 characters per inch -- approximately 12 pt font)	Sect 4.1 (b)
4. Meets page limits	Sect 4.1 (c)
5. Required appendices included; no additional appendices	Requirement 6
6. Budgets, MEL are submitted in required formats	Requirement 30 Requirement 33
7. Proposals include all required sections (e.g, Training, Management)	Sect 4.1, Table 1
Training	
8. All individual key team members, training professional, and associated mentors are named	Requirement 2
9. Required mentoring plan for each ECH team member	Requirement 4
10. Required training and the developmental plan	Requirement 5
11. Required resumes, IDPs, skill assessments	Requirement 6 Requirement 36
Scientific/Technological	
12. States explicitly whether it is principally a (i) science investigation, (ii) technology investigation, or (iii) mixed science and technology investigation.	Requirement 10
13. Requirements traceable from science to instruments to mission	Requirement 13
14. Appropriate data archiving plan	Requirement 14
15. Baseline and threshold science/technology investigation defined	Requirement 15
Technical	
16. Complete science/technology mission investigation (Phases A-F) proposed; Mission Traceability Matrix included	Requirement 16
17. Proposals describe a proposed mission using a suborbital-class carrier	Requirement 17
18. Required Project Schedule (foldout(s)/narrative) included	Requirement 22
19. Launch Ready date prior to 18 month deadline	Requirement 22
20. Team Lead Identified (PI or PM)	Requirement 25
21. Includes Risk Management Plan	Requirement 28
22. Descope Plan Included	Requirement 15 Requirement 29
23. Includes letters of commitment from participating institutions	Sect. 3.8
24. Reserves are Identified	Requirement 35