National Aeronautics and Space Administration

Heliophysics Explorers Program (HEP) 2022 Small Explorer (SMEX) and Explorer Mission of Opportunity (MO) Announcements of Opportunity (AOs)

Preproposal Conference: Science Evaluation Overview

Dr. Dan Moses–Heliophysics Division Explorers Program Scientist
NASA Science Mission Directorate (SMD)

October 6, 2022

Scientific Merit and Science Implementation Merit

- The information provided in a proposal will be used to assess the **intrinsic scientific merit** (Form A) and the **science implementation merit** (Form B) of the proposed investigation.
- Scientific merit will be evaluated for the Baseline Science Mission and the Threshold Science Mission.
- "Baseline Science Mission" is the mission that, if fully implemented, would fulfill the Baseline Science Requirements, which are the performance requirements necessary to achieve the full science objectives. (AO Section 5.1.5, and Requirement B-16)
- "Threshold Science Mission" is a descoped Baseline Science mission that would fulfill the Threshold Science Requirements, which are the performance requirements necessary to achieve the minimum science acceptable for the investment. (AO Section 5.1.5, and Requirement B-18)

Requirement 10. Proposals shall specify only one Baseline Science Mission and only one Threshold Science Mission.

- In contrast to the science panel; TMC evaluates only the Baseline Mission.

Science Requirements: Science Goals and Objectives (AO Section 5.1.1)

Requirement 3: Proposals shall describe a science investigation with goals and objectives that address the program science objectives described in Section 2.

Requirement 4: Proposals shall demonstrate how the proposed investigation will fully achieve the proposed objectives.

A **goal** has a broad scope: e.g., discover whether life exists elsewhere in the universe
An **objective** is a more narrowly focused part of a strategy to achieve a goal: e.g., understand and improve predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition.
An investigation might only **make progress toward a goal** without fully achieving it.
Proposed investigations must (plan to) achieve their proposed objectives (science closure): the objectives must be **specific** enough that the proposal can make the case that they are scientifically compelling, and that the investigation can achieve them.

Requirement 5: Proposals shall state the specific science objectives and their required measurements at a level of detail sufficient to allow an assessment of the capability of the proposed mission to make those specific measurements and whether the resulting data are necessary and sufficient to the achievement of these objectives.

Science Requirements: Achieving Science Objectives

Requirement 7: Proposals shall clearly state the relationship between the science objectives, the data to be returned, and the instrument complement to be used in obtaining the required data.

Requirement 6: Proposals shall describe the proposed instrumentation, including a discussion of each instrument and the rationale for its inclusion in the proposed investigation.

The traceability matrix (**Requirement B-17**) tabulates what must be observed, to what precision, for how many objects, etc. to achieve the science objectives of the mission.

- **The traceability matrix defines a proposed investigation.**

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

***Requirement 18:** Proposals submitted in response to this AO shall demonstrate that the proposed investigation is a complete science investigation requiring a spaceflight mission.

*** SMEX AO Requirement 18, Explorer MO AO Requirement 15**

Science Requirements: Data Management and Archiving

Requirement 8: Proposals shall include Data Plans to calibrate (both preflight and in-flight), analyze, publish, and archive the data returned; and shall demonstrate, analytically or otherwise, that sufficient resources have been allocated to carry out the Data Plans within the proposed mission cost. The Data Management and Archiving Plan shall include a discussion and justification of any data latency period (see Appendix B, Section E.4, for additional detail). The Data Management and Archiving Plan shall be in compliance with the requirements and guidelines in the *NASA Plan for Increasing Access to the Results of Scientific Research* or a justification shall be provided that this is not necessary given the nature of the work proposed (see Section 4.4.2).

Section 4.5.2 of the AOs state: Following a short latency period, all data will be made available to the user community... No period of exclusive access is permitted. The Principal Investigator proposes and justifies any data product latency period for standard data products listed in the proposal, based primarily on the time required to produce, quality check, and validate the products. Barring exceptional circumstances, data product latency may not exceed six months.

Evaluation Criteria:

- Scientific Merit of the Proposed Investigation (Section 7.2.2);
- Scientific Implementation Merit and Feasibility of the Proposed Investigation (Section 7.2.3);
- TMC Feasibility of the Proposed Mission Implementation, including Cost Risk (Section 7.2.4).

Weighting:
- **the first criterion is weighted approximately 40%**
- **the second criteria is weighted approximately 30%**
- **the third criteria is weighted approximately 30%**

Other Selection Factors (Section 7.3):

- Programmatic factors
- PI-Managed Mission Cost

Form A: Scientific Merit Evaluation Factors

- The information provided in a proposal will be used to assess the scientific merit of the proposed investigation. *Do not rely upon externally referenced sources for the information necessary to evaluate the proposal.*

- Scientific merit will be evaluated for *both* the Baseline Science Mission and the Threshold Science Mission.

- Four (4) separate scientific merit factors will be evaluated

Evaluation Criterion A

- **Factor A-1. Compelling nature and scientific priority of the proposed investigation's science goals and objectives.** This factor includes the clarity of the goals and objectives; how well the goals and objectives reflect program, Agency, and national priorities; the potential scientific impact of the investigation on program, Agency, and national science objectives; and the potential for fundamental progress, as well as filling gaps in our knowledge relative to the current state of the art.
- **Factor A-2. Programmatic value of the proposed investigation.** This factor includes the unique value of the investigation to make scientific progress in the context of other ongoing and planned missions; the relationship to the other elements of NASA's science programs; how well the investigation may synergistically support ongoing or planned missions by NASA and other agencies; and the necessity for a space mission to realize the goals and objectives.
- **Factor A-3. Likelihood of scientific success.** This factor includes how well the anticipated measurements support the goals and objectives; the adequacy of the anticipated data to complete the investigation and meet the goals and objectives; and the appropriateness of the mission requirements for guiding development and ensuring scientific success.
- **Factor A-4. Scientific value of the Threshold Science Mission.** This factor includes the scientific value of the Threshold Science Mission using the standards in the first factor of this section and whether that value is sufficient to justify the proposed cost of the mission.

Form B: Scientific Implementation Merit & Feasibility

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

- Five (5) science implementation merit and feasibility factors are evaluated for each proposal.

Evaluation Criterion B

- **Factor B-1. Merit of the instruments and mission design for addressing the science goals and objectives.** This factor includes the degree to which the proposed mission will address the goals and objectives; the appropriateness of the selected instruments and mission design for addressing the goals and objectives; the degree to which the proposed instruments and mission can provide the necessary data; and the **sufficiency of the data** gathered to complete the scientific investigation.
- **Factor B-2. Probability of technical success.** This factor includes the maturity and technical readiness of the instruments or demonstration of a clear path to achieve necessary maturity; the adequacy of the plan to develop the instruments within the proposed cost and schedule; the robustness of those plans, including recognition of risks and mitigation plans for retiring those risks; the likelihood of success in developing any new technology that represents an untested advance in the state of the art; the ability of the development team—both institutions and individuals—to successfully implement those plans; and the likelihood of success for both the development and the operation of the instruments within the mission design.
- **Factor B-3. Merit of the data analysis, data availability, and data archiving plan.** This factor includes the merit of plans for data analysis and data archiving to meet the goals and objectives of the investigation; to result in the publication of science discoveries in the professional literature; and to preserve data and analysis of value to the science community. Considerations in this factor include assessment of planning and budget adequacy and evidence of plans for well-documented, high-level data products and software usable to the entire science community; assessment of adequate resources for physical interpretation of data; reporting scientific results in the professional literature (e.g., refereed journals); and assessment of the proposed plan for the timely release of the data to the public domain for enlarging its science impact.

Evaluation Criterion B

- **Factor B-4. Science resiliency.** This factor includes both **developmental** and **operational** resiliency. Developmental resiliency includes the approach to descoping the Baseline Science Mission to the Threshold Science Mission in the event that development problems force reductions in scope. Operational resiliency includes the ability to withstand adverse circumstances, the capability to degrade gracefully, and the potential to recover from anomalies in flight.
- **Factor B-5. Probability of science team success.** This factor will be evaluated by assessing the experience, expertise, and organizational structure of the science team and the mission design in light of any proposed instruments. The scientific expertise of the PI will be evaluated but not their experience with NASA missions. The role of each Co-Investigator will be evaluated for necessary contributions to the proposed investigation; the inclusion of Co-Is who do not have a well-defined and appropriate role may be cause for downgrading during evaluation. The inclusion of career development opportunities to train the next generation of science leaders will also be evaluated. This evaluation factor also includes an evaluation of the Diversity and Inclusion Plan (see Requirement B-70). **The Science Panel will evaluate the Diversity and Inclusion Plan focusing on how executable and effective the Plan is expected to be.** Additional reviewers with expertise in diversity and inclusion initiatives may also provide comments to NASA on the Diversity and Inclusion Plans.

Diversity & Inclusion – A new element in B-5 (Team Success)

- NASA recognizes and supports the benefits of having diverse and inclusive communities and fully expects that such values will be reflected in the composition of all teams involved in the proposing to and implementation of NASA's programs.

Requirement 53: In support of NASA's core value of Inclusion (see AO Section 1.2), proposers shall include a plan describing how they will create and maintain a diverse and inclusive team.

- The diversity and inclusion plan should describe:
  - any planned surveys or evaluations,
  - training to be offered or required,
  - codes of conduct to be developed and followed,
  - mentoring or professional development activities offered, and
  - planned management practices.
- The plan may also describe any plans to broaden participation with unrepresented or under-represented groups.

Science Evaluation Products: Findings

- **Major Strength:** A facet of the implementation response that is judged to be of superior merit and can substantially contribute to the ability of the project to meet its scientific objectives.

- **Major Weakness:** A deficiency or set of deficiencies taken together that are judged to substantially weaken the project's ability to meet its scientific objectives.

- **Minor Strength:** An aspect of the proposal that is judged to contribute to the ability of the project to meet its scientific objectives.

- **Minor Weakness:** A deficiency or set of deficiencies taken together that are judged to weaken the project's ability to meet its scientific objectives.

Note: Findings that are considered "as expected" are not documented on Forms A and B.

Form A and B Grade Definitions

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

Note: Only Major Findings are considered in the adjectival rating.

Clarification Process

- Before finalizing the evaluation, NASA will provide an opportunity for clarification on all potential major weaknesses in the Science Merit, Science Implementation Merit, and TMC Feasibility of Mission Implementation that were identified in the proposal.
- Proposers will receive communication in advance of the clarification round(s) with notification of the schedule, requirements, and limitations. Clarifications from the science panel may be sent separately from those from TMC.
- On the day of the clarification round, proposers will receive a second communication with the potential major weaknesses and instructions for responding. Proposers will have at least 48 hours to respond.
- **New process for responses:** proposers may use 8 pages (total for science) and 6 pages (for TMC) to address all potential major weaknesses from that panel. Details on the required format, and what may be included, are in today's SOMA presentation, and will be posted in the Evaluation Plan. Proposers must decide how best to use those pages: e.g. by concentrating on responses that are most likely to persuade the reviewers that no major weakness exists.
- Responses that go beyond the permitted response format will be deleted and will not be provided to the evaluation panels.

Science Reviewers: Conflict of Interest

Science reviewers are generally active scientists and must avoid conflicts of interest through their organizational affiliations and scientific activities.

Rules for conflict of interest follow SPD-01A, as for research proposals. But in contrast to research proposal reviews, every SMEX proposal competes with every other SMEX proposal, and every MO competes with every other MO. This means

- A reviewer with a conflict of interest with one SMEX proposal has a conflict with all of them; similarly for MOs.
- Thus if one SMEX proposal includes a Co-Investigator (or other funded participant) from organization X, no employee of organization X can review any SMEX proposal; similarly, for MOs.
- Science collaborators, and hence the organizations that employ them, contribute effort to a proposal. Before inviting other scientists from such organizations as reviewers, we must consider scientific community standards on conflict of interest. In particular, someone who is a collaborator on a MO proposal cannot review any other MO; similarly, for SMEX.

An over-large science team may result in a weakness on Factor B-5 and reduces the reviewer pool.

If all the experts in your field are on your science team, who will review your proposal??

Questions?

All further questions pertaining to the SMEX AO or Explorer MO AO

MUST be addressed by email to:

Dr. Dan Moses
Heliophysics Explorers Program Scientist
Science Mission Directorate
NASA Headquarters
Washington, DC 20546
dan.moses@nasa.gov
(subject line to read “SMEX AO or Explorer MO AO as applicable")

Back Up Slides

Heliophysics Science Requirements

- All investigations proposed in response to this solicitation must support the goals and objectives of the Heliophysics Explorers Program and must be implemented by Principal Investigator (PI)-led investigation teams.
- The NASA Strategic Objective (*NASA 2022 Strategic Plan*) that encompasses Heliophysics:
  - "understand the Sun, Earth, solar system, and universe"
- In response to the above strategic objective, the NASA Science Mission Directorate (SMD) conducts heliophysics investigations addressing the following science goals:
  - Explore the physical processes in the space environment from the Sun to the Earth and throughout the solar system;
  - Advance our understanding of the connections that link the Sun, the Earth, planetary space environments, and the outer reaches of our solar system; and
  - Develop the knowledge and capability to detect and predict extreme conditions in space to protect life and society and to safeguard human and robotic explorers beyond Earth
- Resource documents for NASA Heliophysics Science Goals
  - *Science 2020-2024, A Vision of Scientific Excellence* (formerly the 2014 SMD Science Plan)
  - *Our Dynamic Space Environment: Heliophysics Science and Technology Roadmap for 2014-2033*

Requirements Deferred to Step 2 (1 of 2)

The following proposal requirements have been deferred until Step 2, or at the end of Phase A if NASA chooses a one-step selection.

- Independent Verification and Validation of Software (Section 4.6.1)
- Costing of Conjunction Assessment Risk Analysis (Section 4.6.4)
- Planetary protection requirements (Section 5.1.7)
- Science Enhancement Option or its cost (Section 5.1.8)
- Enhancing Technology Demonstration Opportunity or its cost (Section 5.2.3.1)
- Applicable maximum channel bandwidth (Section 5.2.5)
- Critical Event Coverage (Section 5.2.6)
- Detailed plan for orbital debris and disposal (Section 5.2.7 and Requirements B-63 through B-66)
- Mission Operations Tools and Services (Section 5.2.9)
- Cybersecurity (Section 5.2.11)
- Naming of Project Manager and Project Systems Engineer (Sections 5.3.2 and 5.3.3)

References are for the SMEX AO, Explorer MO AO Section 1.1 provides references for MO deferrals

Requirements Deferred to Step 2 (2 of 2)

Continued list of proposal requirements deferred until Step 2, or at the end of Phase A if NASA chooses a one-step selection.

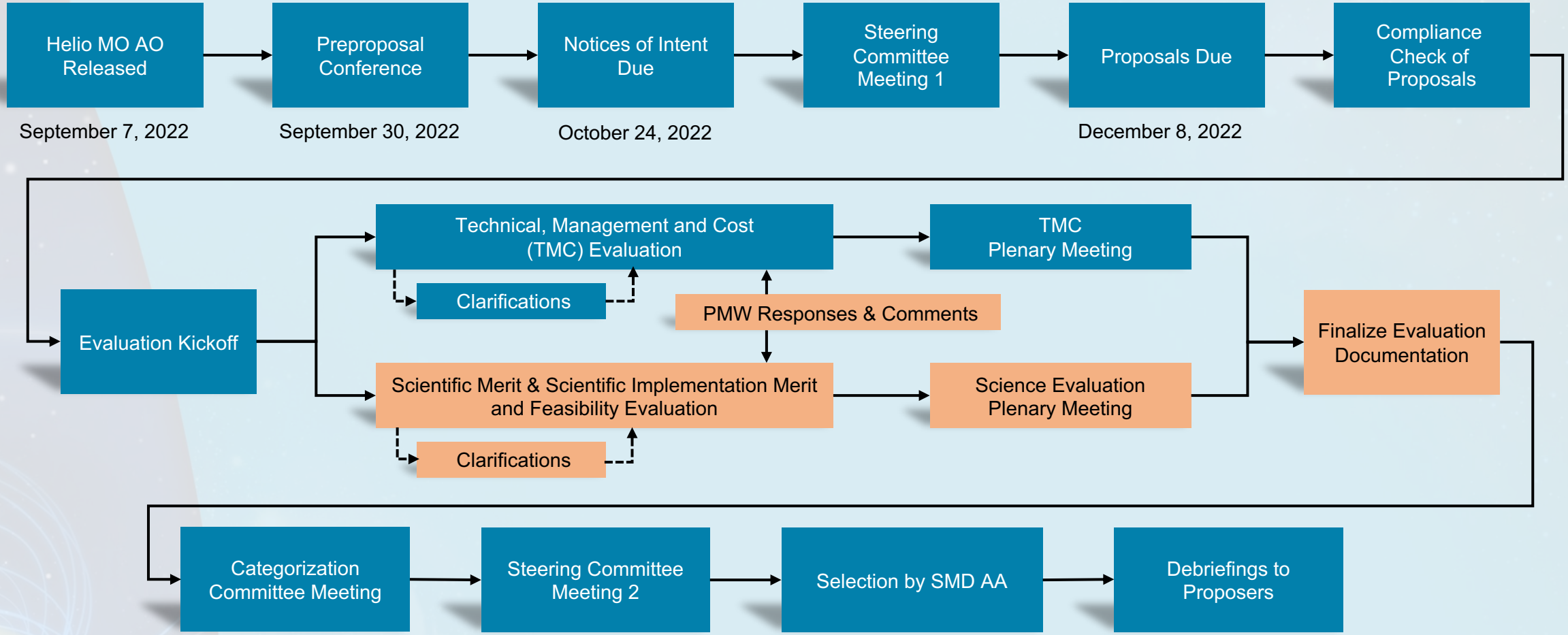
- Student Collaboration plans (Section 5.5.2 and Requirement B-53)
- AO-Provided Launch Services storage plans and budget (Section 5.9.2.1)
- Discussion of cost estimate error and uncertainty (Section 5.6.3)
- Institutional Letters of Commitment from major partners (Section 5.8.1)
- Schedule-based end-to-end component of Data Management and Archive Plans (Requirement B-24)
- Requirements for real year dollar costs: only costs in FY 2022 dollars are required in the Step 1 proposal (Section 5.6.2, Requirements B-13, B-51, and B-52)

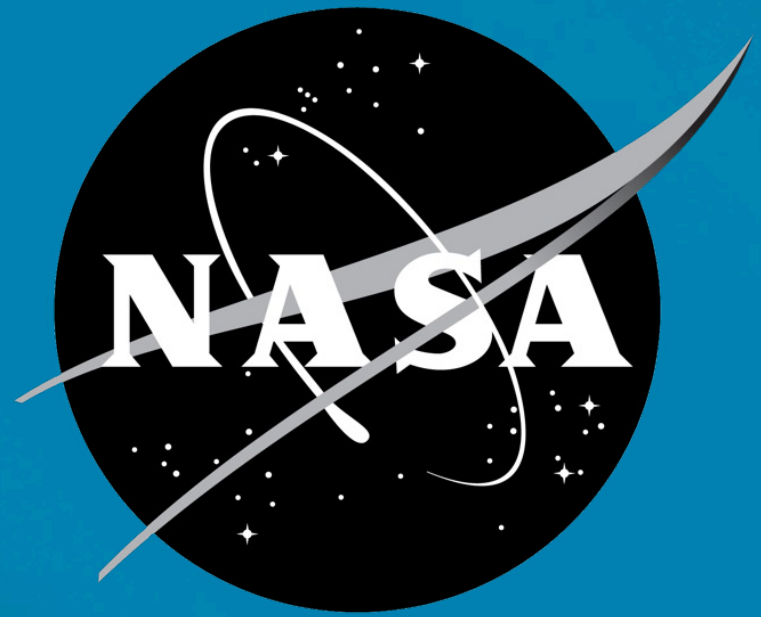
Ground systems and facilities will not be evaluated under Factor C-2 (Section 7.2.4) Details on each deferral are provided in the applicable section(s).

Many of the deferred requirements include budgeting for related activities, so **proposing at the AO Cost Cap with minimum reserves is strongly discouraged!**

References are for the SMEX AO, Explorer MO AO Section 1.1 provides references for MO deferrals

Proposal Evaluation Flow: Form A & B




NASA