# Charge to the SMD Advisory Committees:
# Review NASA SMD R&A Methods to Foster High-Impact Research

## July 3, 2017

**Purpose:** Determine how SMD's Research and Analysis (R&A) program can foster and enable, in the best way, potentially high-impact and highly innovative endeavors, while preserving important foundational and/or more gradual research activities, to the benefit of the nation and scientific community. Both content and process aspects (which are connected) will be involved.

**Task:** Deliberate and provide written advice on the two questions posed below, utilizing the full capabilities of the NAC Science Committee and the four new SMD division committees – Astrophysics Advisory Committee, Earth Science Advisory Committee, Heliophysics Advisory Committee and Planetary Advisory Committee. Each committee is asked to review materials, represent the views of the scientific community, and draw on member experience with both SMD and other research programs. The advice delivered should address the issues at a tactical use-focused level, rather than focusing on generalities at a strategic level. Each question should have an answer which includes options and solutions and their associated pros/cons, as well as any supporting data for a given option.

**Key Questions:**

1. Does the SMD R&A program have processes in place to effectively solicit, review and select high-risk/high-impact research?
   a) What is your committee's working definition of a high-impact project? A high-risk project?
   b) Are there aspects of the solicitation, review and selection process that could be added, removed or modified that would allow SMD to more effectively elicit and support high-risk/high-impact projects or, is the current practice of soliciting by topic and evaluation for merit followed by flagging high-impact/high-risk projects for the selection official adequate?
   c) If it were to be recommended that solicitations or evaluation methods be modified for high-impact/high-risk projects, how should these be designed?
   d) Acknowledging the value of incremental progress on achieving strategic objectives, and thus recognizing that much of the research that SMD supports will be of moderate impact, how should SMD determine the correct balance between moderate impact research and high-impact/high-risk research?

2. Does the SMD R&A program have effective processes in place to most effectively solicit, review and select focused, interdisciplinary, and interdivisional projects?
   a) How should SMD determine the right balance between division-specific and interdivisional research?
   b) Once determined, does SMD have effective processes in place to achieve this balance?
   c) How should each of SMD's divisions determine the right balance between discipline-focused and interdisciplinary research?
   d) Once determined, do SMD's divisions have effective processes in place to achieve this balance?
   e) Is SMD missing out on important interdisciplinary and/or interdivisional work because of the way in which we solicit, review, and select projects? If so, what specific research foci are missing?

f) Are there aspects of the solicitation, review and selection process that could be added, removed, or modified that would allow SMD to more effectively elicit and support interdisciplinary and or interdivisional projects?
g) If it is recommended that solicitations or evaluation methods be modified for interdisciplinary and/or interdivisional projects, how should these be designed?
h) What role, if any, should collaborative research structures such as NIH-style "Program-Project" grants, virtual institutes (the NASA Astrobiology Institute (NAI) and Solar System Exploration Research Virtual Institute (SSERVI)) and research coordination networks (the Nexus of Exoplanetary System Science (NExSS)) play?

**Product to Deliver:** Each SMD committee is requested to utilize its next two public meetings to receive and review information, deliberate and finalize written answers to the questions above, which could include recommendations or findings, plus any supporting data. Presentation format is the preferred medium for initial communication of the answer, followed up by a letter. Each SMD division committee is requested to provide a presentation to the Division Director, and the chair of each committee is requested to make a presentation at the Science Committee meeting. The Science Committee is requested to provide a summary and overview presentation to the SMD AA.

**Materials to be Provided:**

1) R&A program solicitations
2) Proposal evaluation criteria
3) Working definitions
4) SMD R&A program statistics (e.g. proposal selection rates, 2008-2015)
5) SMD policy documents
6) *An Enabling Foundation for NASA's Earth and Space Science Missions* (2010). A report by the Space Studies Board of the National Academies.
7) *Review of the Restructured Research and Analysis Programs of NASA's Planetary Science Division* (2017). A report by the Space Studies Board of the National Academies.

Other available and relevant material, as requested (e.g., titles/abstracts of selected proposals, division-specific information on how high-impact/high-risk and other proposals are handled)

**Timeframe:** July-November, 2017 (5 months) – report back at Fall advisory committee meetings

**Initial Feedback from Science Committee:** Initial discussions were held at the April, 2017 NAC Science Committee (SC) meeting, at the suggestion of the SMD AA, on the merits of reviewing the impact of SMD R&A. In particular, one key interest is whether the SMD R&A program is able to support revolutionary breakthroughs of high-impact, highly innovative research endeavors (which may also be high-risk). Of critical importance is the need to assess portfolio balance - whether there is an appropriate balance of high-risk/high-impact research and incremental research.

The SC conveyed a sense that the scientific community may perceive the R&A process to be inherently conservative and incremental. Risk-adverse choices are made by proposers (choosing safer lines of inquiry or trusted methods), reviewers (who may not be familiar with new ideas and thus not support those) and selections made by SMD officers (to safeguard success rates). The community may in consequence fail to grow new ideas, thus furthering this cycle.

A variety of tools and mechanisms already exist in the R&A program that could support high-impact endeavors. The SC underscored that multi-year awards allow long-term vision, and SMD and the SC noted generally that awards of at least 3 years work well. Also, though small-scale awards support many researchers, there may be a need for a quota for important, large-scale projects that require more investment.

**Internal, Data Collection:** The SMD R&A program will initiate collection of at least one year of data (in ROSES 17) to support the ongoing review. Every reviewer and each program official will be asked to assess if each proposal is potentially 1) low- to high-impact, and 2) low- to high-risk. A set of working definitions for level of impact and risk will be used so these assessments can be consistent. A value for each proposal will be calculated and plotted. Especially of interest will be the number of proposals that land in the high-impact/high-risk quadrant; and what portion of those were funded. This also may be assessed by division, program or other parameters. If this assignment of values continues in future years, it is possible that policy changes could be tracked to see any resulting changes in the data, using ROSES 17 as the baseline year. In the future, SMD may ask the Committees' their view of the data results.

# APPENDIX

## Materials - R&A Charge

### 1. R&A program solicitations

ROSES solicitations top level links by year:
http://solicitation.nasaprs.com/ROSES2016
http://solicitation.nasaprs.com/ROSES2017

Lists of program elements in those ROSES solicitations by topic:
http://solicitation.nasaprs.com/ROSES2016table3 http://solicitation.nasaprs.com/ROSES2017table3

Those that are interdivisional by definition are found in Appendix E at the bottom of the tables. Those that are both interdivisional and related to research are E.3, Exoplanets Research Program and E.4 Habitable Worlds.

The most recent call for Interdisciplinary Research in Earth Science is in ROSES 16: ROSES-16 A.28 Interdisciplinary Research in Earth Science

The most recent Cooperative Agreement Notice (CAN) for the Solar System Exploration Research Virtual Institute: SSERVI CAN 2 NNH16ZDA009C

The NASA Astrobiology Institute CAN, currently open at this time: NNH17ZDA003C

### 2. Proposal evaluation criteria

The Agency-level NRA or Cooperative Agreement Notice Proposers' Guidebook, more commonly known as "the guidebook for proposers" notes that "At a minimum, the evaluation criteria against which the proposals will be judged will be those listed Appendix D, although these may be supplemented by specific criteria given in the FA [i.e., the Funding announcement or solicitation] itself." Appendix D states:

> "Unless otherwise specified in the FA, the evaluation criteria considered in evaluating a proposal are its relevance to NASA's objectives, intrinsic merit and its cost. The failure of a proposal to be rated highly in any one of these elements is sufficient cause for the proposal to not be selected.
>
> Evaluation of a proposal's relevance includes the consideration of the potential contribution to NASA's mission as expressed in its most recent NASA strategic plans and the specific objectives and goals given in the FA. If an FA describes the program's relevance to the NASA strategic plans, it is not necessary for proposals to show relevance to NASA's broader goals and objectives but, rather only to demonstrate relevance to the goals and objectives of the specific goals and objectives of the FA.
>
> Evaluation of Intrinsic Merit includes the consideration of the following factors, as applicable to the particular proposal:
>
> - The scientific quality of the proposed project, including, but not limited to, the scientific rationale and the expected significance and/or impact of the proposed work;

- Overall technical quality of the proposed work, including, but not limited to, the quality of the management plan and project timeline for carrying out the work and the effectiveness and resilience of the proposed experimental designs, methods, techniques, and approaches for achieving the proposed goals and/or objectives;
- The qualifications, capabilities, and related experience of personnel demonstrated by the proposal (e.g., publications, delivered products, and other measures of productivity and/or expertise) that would affect the likelihood of achieving the objectives.
- Facilities, instruments, equipment and other resources or support systems presented in the proposal that would affect the likelihood of achieving the proposed objectives.

Evaluation is against the state-of-the-art. Review panels are instructed not to compare proposals to each other; any comparative evaluations are conducted by NASA program personnel.

Evaluation of the cost of a proposed effort may include the reasonableness of the proposed cost, as well as whether costs are allowable and allocable to the project. The comparison of the proposed cost to available funds is performed by NASA program personnel and is not part of the peer review process."

The SMD research NRA is Research Opportunities in Space and Earth Sciences (ROSES). The ROSES-17 summary of solicitation, Section VI. (a) "Evaluation Criteria" cites the guidebook and further clarifies some aspects of the evaluation of ROSES proposals as follows:

"As stated in the *NASA Guidebook for Proposers*, proposals are ordinarily evaluated on three criteria: intrinsic merit, relevance, and cost. Despite the implication of some kind of average when the guidebook states that the three criteria are of approximately equal weight, a ROSES proposal that is not relevant is not selectable, no matter what the scores for Merit or Cost, or mean or median of all three criteria scores. Indeed, SMD may return without peer review a proposal deemed to be not relevant. The manner in which SMD evaluates ROSES proposals for relevance, and cost varies from program to program. ROSES proposals may be scored by peer reviewers for all three criteria on a full scale, or the proposal may be scored on a full scale only for merit, with relevance and/or cost evaluated on an abridged scale, or with only comments provided for relevance and/or cost, or the peer review panel may not be asked to comment on relevance and cost at all.

Note the following specific points:

- Some of the program elements discussed in Appendices A through E will give specific factors, based on the solicited research objectives, which will be considered when evaluating a proposal's science and/or technical merits and/or its relevance to program objectives.
- Unless otherwise stated, relevance will be judged by whether the proposal addresses goals and objectives for that ROSES Appendix and/or specific program element, rather than NASA's broader goals. This focus on relevance to the program element supersedes the instructions in the *NASA Guidebook for Proposers*. Unless otherwise stated in the program element, relevance of the proposed work is judged based on whether the work proposed is deemed to be relevant, independent of whether or not it includes an overt, clear and direct statement of relevance. That is, unless otherwise stated in the program element, no proposal will be returned as noncompliant for lack of a relevance section or statement, and inclusion of a relevance section or statement is no guarantee that the proposal will be judged relevant. Please read the program elements carefully. See also Section I(h).

- Cost data for U.S. proposals may be evaluated both by peer review (for reasonableness) and by NASA program personnel (vs. the available budget). Proposers must follow the budget requirements in Section IV (b) iii and Table 1 of this document. When evaluating the cost reasonableness of the proposals, reviewers will assess whether the proposed level of effort (i.e., labor FTEs) and the proposed other direct costs (i.e., supplies, equipment, travel) are commensurate with those required to accomplish the goals of the investigation. Salary levels, fringe benefit rates, and overhead rates are not part of that evaluation, and will be hidden from peer reviewers."

**3. Starting Point Working Definitions**

High-Impact: Research whose outcome, if confirmed, would have a large and measurable effect on current thinking, methods, or practice.

High-Risk: Research that tests novel and significant hypotheses for which there is scant precedent or preliminary data or which run counter to the existing scientific consensus.

Multidisciplnary: Research in which contributions from two or more different disciplines *are independently or sequentially* applied, *providing additive contributions* to the solution of a common problem.

Interdisciplinary: Research in which contributions from two or more different disciplines are *jointly applied, providing interactive contributions* to the solution of a common problem.

Interdivisional: Research that simultaneously advances the strategic objectives of more than one SMD Division. Such research may be multi- or inter-disciplinary but need not be.

The committees are encouraged to consider improving these definitions.

**4. SMD R&A program statistics (e.g. proposal selection rates, 2008-2015)**

Most current data: https://science.nasa.gov/researchers/sara/grant-stats

**5. SMD policy documents**

The SARA library: https://science.nasa.gov/researchers/sara/library-and-useful-links

The library has the following useful links:
Peer Review Conflicts of Interest (SPD-01)
SMD Peer Review Policy (SPD-22)

NASA 2014 Strategic Plan
NASA 2014 Science Plan

**6. *An Enabling Foundation for NASA's Earth and Space Science Missions* (2010)**

The 2010 NRC report *An Enabling Foundation for NASA's Earth and Space Science Missions* (also known as the Fisk report) highlighted the importance of R&A programs to all of the activities undertaken by NASA's Science Mission Directorate (SMD).

A summary of this report can be found here: https://www.nap.edu/read/12822/chapter/2
The full report can be downloaded here: https://www.nap.edu/catalog/12822/an-enabling-foundation-for-nasas-earth-and-space-science-missions

This report was based on a NASA SMD charge that asked the committee to address two questions:

1. Are the PSD R&A program elements appropriately linked to, and do they encompass the range and scope of activities needed to support the NASA strategic objective for planetary science and the Planetary Science Division's science goals, as articulated in NASA's 2014 Science Plan?
2. Are the PSD R&A program elements appropriately structured to develop the broad base of knowledge and broad range of activities needed both to enable new spaceflight missions and to interpret and maximize the scientific return from existing missions?

The 2009 report recommended, in part, that

> *NASA should ensure that SMD mission-enabling activities are linked to the strategic goals of the agency and of SMD and that they are structured so as to: encompass the range and scope of activities needed to support those strategic goals; provide the broad knowledge base that is the context necessary to interpreting data from spaceflight missions and defining new spaceflight missions; maximize the scientific return from all spaceflight missions; supply a continuous flow of new technical capabilities and scientific understanding from mission enabling activities into new spaceflight missions; and enable the healthy scientific and technical workforce needed to conduct NASA's space and Earth science program. (p. 47)*

**7. *Review of the Restructured Research and Analysis Programs of NASA's Planetary Science Division* (2017).**

This 2017 report reviewed the restructuring of the research and analysis program of the Planetary Science Division and was established to determine if the new structure appropriately aligns with the agency's strategic goals, supports existing flight programs, and enables future missions. This report explores whether any specific research areas or subdisciplinary groups that are critical to NASA's strategic objectives for planetary science and PSD's science goals are not supported appropriately in the current program or have been inadvertently disenfranchised through the reorganization.

The full report can be found at: https://www.nap.edu/catalog/24759/review-of-the-restructured-research-and-analysis-programs-of-nasas-planetary-science-division.

This report was based on a NASA SMD charge that asked the committee to address two questions:

1. Are the PSD R&A program elements appropriately linked to, and do they encompass the range and scope of activities needed to support, the NASA Strategic Objective for Planetary Science and the Planetary Science Division Science Goals, as articulated in the 2014 *NASA Science Plan?*
2. Are the PSD R&A program elements appropriately structured to develop the broad base of knowledge and broad range of activities needed both to enable new spaceflight missions and to interpret and maximize the scientific return from existing missions?

The report concluded, in part, that

> *In response to the first of the two questions in the charge, the committee finds that the current R&A structure is properly aligned with scientific priorities of the decadal survey and the Planetary Science Division 2014 science goals. In particular, the committee finds that, despite early community concerns, keyword analyses of the type of task, target body, and science discipline revealed no evidence that restructuring has led to deleterious effects on the planetary science R&A program or on specific segments of the community. Furthermore, in response to the second of the two questions in the charge, the committee finds that, in general, the structure of the program elements will allow NASA PSD to prepare for future spaceflight missions and to maximize science value from existing missions. (p. 2)*