Mid-scale Research Infrastructure-1 (Mid-scale RI-1)

PROGRAM SOLICITATION
NSF 19-537

National Science Foundation

Preliminary Proposal Due Date(s) *(required)* (due by 5 p.m. submitter's local time):

February 19, 2019

Full Proposal Deadline(s) (due by 5 p.m. submitter's local time):

May 20, 2019

By invitation only.

IMPORTANT INFORMATION AND REVISION NOTES

Preliminary proposals must be submitted by an Authorized Organizational Representative by the due date indicated. Full proposal submission is by invitation only.

Please consult NSF's Large Facilities Manual (LFM) and its successor to be published as the Major Facilities Guide (MFG) for definitions of terms used in this solicitation, such as the Project Execution Plan. Note that Project Execution Plans should be appropriate for the complexity of the project, and may not require all of the elements described in the LFM/MFG.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) (NSF 19-1), which is effective for proposals submitted, or due, on or after January 28, 2019.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Mid-scale Research Infrastructure-1 (Mid-scale RI-1)

Synopsis of Program:

In 2016, the National Science Foundation (NSF) unveiled a set of "Big Ideas," 10 bold, long-term research and process ideas that identify areas for future investment at the frontiers of science and engineering (see https://www.nsf.gov/news/special_reports/big_ideas/index.jsp). The Big Ideas represent unique opportunities to position our Nation at the cutting edge of global science and engineering leadership by bringing together diverse disciplinary perspectives to support convergence research. As such, when responding to this solicitation, even though proposals must be submitted to the Office of Integrative Activities, once received, the proposals will be managed by a cross-disciplinary team of NSF Program Directors.

Please consult NSF's Large Facilities Manual (LFM) and its successor to be published as the Major Facilities Guide (MFG) for definitions of terms used in this solicitation, such as the Project Execution Plan. Note that Project Execution Plans should be appropriate for the complexity of the project, and may not require all of the elements described in the LFM/MFG.

NSF-supported science and engineering research increasingly relies on cutting-edge infrastructure. With its Major Research Instrumentation (MRI) program and Major Research Equipment and Facilities Construction (MREFC) projects, NSF supports infrastructure projects at the lower and higher ends of infrastructure scales across science and engineering research disciplines. The Mid-scale Research Infrastructure Big Idea is intended to provide NSF with an agile, Foundation-wide process to fund experimental research capabilities in the mid-scale range between the MRI and MREFC thresholds.

Within Mid-scale RI-1, proposers may submit two types of projects, "Implementation" and "Design". Design and Implementation projects may comprise any combination of equipment, infrastructure, computational hardware and

software, and necessary commissioning. Design includes planning (preliminary and final design) of research infrastructure with an anticipated total project cost that is appropriate for future Mid-scale RI-1, Mid-scale RI-2 or MREFC-class investments. Mid-scale RI-1 uses an inclusive definition of implementation, which can include traditional stand-alone construction or acquisition and can include a degree of advanced development leading immediately to final system acquisition and/or construction.

Mid-scale RI-1 "Implementation" projects may have a total project cost ranging from $6 million up to below $20 million. Projects must directly enable advances in fundamental science, engineering or science, technology, engineering and mathematics (STEM) education research in one or more of the research domains supported by NSF. Implementation projects may support new or upgraded research infrastructure. Only Mid-scale RI-1 "Design" projects may request less than $6 million, with a minimum request of $600,000 and a maximum request below $20 million as needed to prepare for a future mid-scale or larger infrastructure implementation project. (Successful award of a Mid-scale RI-1 design project does not imply NSF commitment to future implementation of that project.)

Note: Mid-scale research infrastructure projects beyond the Mid-scale RI-1 program limit are anticipated to be separately solicited by a Mid-scale RI-2 program.

Mid-scale RI-1 emphasizes strong scientific merit and response to an identified need of the research community. Demonstrated technical and managerial experience is required for both design and implementation projects, as are well-developed plans for student training and the involvement of a diverse workforce in all aspects of mid-scale activities.

Cognizant Program Officer(s):

Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.

- Randy L. Phelps, OIA, telephone: (703) 292-8040, email: rphelps@nsf.gov

- Robert D. Fleischmann, BIO, telephone: (703) 292-7191, email: rfleisch@nsf.gov

- Deepankar (Deep) Medhi, CISE, telephone: (703) 292-8950, email: dmedhi@nsf.gov

- R. Steven Turley, EHR, telephone: (703) 292-2207, email: rturley@nsf.gov

- Paul A. Lane, ENG, telephone: (703) 292-2453, email: plane@nsf.gov

- Michael E. Jackson, GEO, telephone: (703) 292-8033, email: mejackso@nsf.gov

- Richard E. Barvainis, MPS, telephone: (703) 292-4891, email: rbarvai@nsf.gov

- Joseph Whitmeyer, SBE, telephone: (703) 292-7808, email: jwhitmey@nsf.gov

- Maija M. Kukla, OISE, telephone: (703) 292-4940, email: mkukla@nsf.gov

Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):

- 47.041 --- Engineering
- 47.049 --- Mathematical and Physical Sciences
- 47.050 --- Geosciences
- 47.070 --- Computer and Information Science and Engineering
- 47.074 --- Biological Sciences
- 47.075 --- Social Behavioral and Economic Sciences
- 47.076 --- Education and Human Resources
- 47.079 --- Office of International Science and Engineering
- 47.083 --- Office of Integrative Activities (OIA)

Award Information

Anticipated Type of Award:

Standard Grant or Continuing Grant or Cooperative Agreement

Estimated Number of Awards: 3 to 10

Mid-scale RI-1 program funding is pending the availability of funds. The number of awards within each Mid-scale RI-1 category (Implementation and Design) will depend on program funding level, categories of proposals and amounts requested, quality of proposals as determined by the NSF merit review process and award mechanisms utilized. Mid-scale RI-1 is expected to be a biennial competition. The frequency is dependent on the availability of appropriated funds. Proposals will typically be funded for up to five years, commensurate with the scope of the project.

"Implementation" projects may have a total project cost ranging from $6 million to below $20 million. Only "Design" projects may request less than $6 million, with a minimum request of $600,000 and a maximum request below $20 million.

Anticipated Funding Amount: $60,000,000

Estimated FY 2019 program budget is subject to the availability of funds.

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Proposals may only be submitted by organizations located in the United States, its territories or possessions, as follows.

  1. Institutions of higher education (Ph.D.-granting and non-Ph.D.-granting), acting on behalf of their faculty members, that are accredited in and have their main campus in the United States, its territories or possessions. Distinct academic campuses (e.g., that award their own degrees, have independent administrative structures, admissions policies, alumni associations, etc.) within multi-campus systems qualify as separate submission-eligible institutions.
  2. Not-for-profit, non-degree-granting domestic U.S. organizations, acting on behalf of their employees, for example (but not limited to) independent museums and science centers, observatories, research laboratories and similar organizations that are directly associated with the Nation's research activities. These organizations must have an independent, permanent administrative organization (e.g., a sponsored projects office) located in the United States, its territories or possessions, and have 501(c)(3) tax status.
  3. Consortia as follows:
     a. A legally incorporated, not-for-profit consortium that includes two or more submission-eligible organizations as described in items (1) and (2) above. Such a consortium is one with an independent administrative structure (e.g., a sponsored projects office) located in the United States, its territories or possessions and has 501(c)(3) status.
     b. Submission-eligible organizations as described in items (1) and (2) above, on behalf of an informal consortium. The Cover Sheet of such a proposal *must* identify both a PI and co-PI(s) from *at least two* Mid-scale RI-1 submission-eligible organizations (items 1 and/or 2 above) as lead investigators in the consortium. These consortium proposals may also include as partners, via subawards, other U.S. and non-U.S. organizations that are not eligible to submit Mid-scale RI-1 proposals.

        In either case, the proposal title should indicate that a consortium is proposing.

  For-profit commercial organizations, especially U.S. small businesses with strong capabilities in scientific or engineering research or education, are eligible for infrastructure support through subawards/subcontracts as private sector partners with submitting organizations; they may not submit proposals. Such partnerships must be substantive and meaningful, and build capacity for infrastructure development within Mid-scale RI-1 submission-eligible organization(s). In addition, the value added by the for-profit commercial organization should be justified as a unique contribution that is otherwise unavailable within organizations described in (1) and (2). Unless otherwise specified in the award, title to the resulting infrastructure should be retained by the Mid-scale RI-1-eligible performing organization(s). Prospective PIs may contact cognizant Mid-scale RI-1 program officers regarding organizational eligibility, and for information on other NSF funding opportunities for instrumentation and research infrastructure.

  Additionally:

  - **MREFC-related Proposals:** The Mid-scale RI-1 program will not accept proposals for an instrument or other infrastructure that augments an ongoing NSF Major Research Equipment and Facilities Construction (MREFC) project in the construction stage since the scope of those projects is already defined and subject to NSF's No Cost Overrun Policy. A list of such facilities can be found at https://www.nsf.gov/bfa/lfo/.
  - **FFRDC-related Proposals:** NSF's Federally Funded Research and Development Centers (FFRDCs) are eligible to submit under item 2) above. Proposals involving another Federal agency or one of their FFRDCs can be submitted as a consortium proposal by a Mid-scale RI-1 submission-eligible organization under item 3b) above. For submissions under 3b) above, in addition to at least two Mid-scale RI-1 eligible organizations, the proposal must include the agency/FFRDC (or its managing organization) as a partner in the consortium, even if the role of the FFRDC in the project is solely to house the infrastructure. The research infrastructure must make unique contributions to the needs of researchers within the consortium and/or establish access to new multi-user research capabilities. Preliminary inquiry to the cognizant Mid-scale RI-1 point of contact should be made before preparing a proposal for submission.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

For this Mid-scale RI-1 competition, there are no limits to the number of preliminary proposals submitted as the lead organization. Full proposals are to be submitted only if/when invited by NSF. There is no limit to participation as a partner organization or subawardee.

Although more than one organization may participate in a proposal, a single organization must accept overall management responsibility for the project. The proposal must be submitted by one organization, with funding provided to any other organization through subawards. The use of the separately-submitted collaborative proposal method is not permitted.

Limit on Number of Proposals per PI or Co-PI: 1

> Any one individual may be the Principal Investigator (PI) or co-Principal Investigator (co-PI) for no more than one preliminary or full proposal. A PI or co-PI for a preliminary proposal that is not invited for a full proposal submission may serve as a participant or co-PI on an invited full proposal at the full-proposal organization's and PI's discretion.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not required

- **Preliminary Proposals:** Submission of Preliminary Proposals is required. Please see the full text of this solicitation for further information.

- **Full Proposals:**

    - Full Proposals submitted via FastLane: *NSF Proposal and Award Policies and Procedures Guide* (PAPPG) guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.
    - Full Proposals submitted via Research.gov: *NSF Proposal and Award Policies and Procedures Guide* (PAPPG) guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.
    - Full Proposals submitted via Grants.gov: *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov* guidelines apply (Note: The *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide).

B. Budgetary Information

- **Cost Sharing Requirements:**

    Inclusion of voluntary committed cost sharing is prohibited.

- **Indirect Cost (F&A) Limitations:**

    Not Applicable

- **Other Budgetary Limitations:**

    Other budgetary limitations apply. Please see the full text of this solicitation for further information.

C. Due Dates

- **Preliminary Proposal Due Date(s)** *(required)* (due by 5 p.m. submitter's local time):

    February 19, 2019

- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):

    May 20, 2019

    > By invitation only.

Proposal Review Information Criteria

Merit Review Criteria:

National Science Board approved criteria. Additional merit review considerations apply. Please see the full text of this solicitation for further information.

Award Administration Information

Award Conditions:

Additional award conditions apply. Please see the full text of this solicitation for further information.

Reporting Requirements:

Additional reporting requirements apply. Please see the full text of this solicitation for further information.

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I. INTRODUCTION

The scientific research community is increasingly focused on the need for infrastructure that is too complex and costly for a single organization to procure, utilize and maintain. With its Major Research Instrumentation (MRI) program and Major Research Equipment and Facilities Construction (MREFC) projects, NSF is able to support instrumentation/infrastructure projects across the Foundation at the lower-end ($100,000 to $4 million [1]) and higher-end (greater than $70 million) of the spectrum of infrastructure costs. The Mid-scale Research Infrastructure Big Idea is intended to provide NSF with an agile, Foundation-wide process to fund experimental research capabilities in the mid-scale range.

The National Science Board report responding to Congress, "Bridging the Gap: Building a Sustained Approach to Mid-scale Research Infrastructure and Cyberinfrastructure at NSF" [2], highlights that:

"The research community has identified mid-scale research infrastructure as a key enabler of scientific advances on shorter timescales than required for the larger projects funded within the MREFC account. Mid-scale research infrastructure can also provide the foundations for new innovative large facilities, and, in the process, train early-career researchers in the development, design, construction, and effective use of cutting-edge infrastructure. Likewise, cyberinfrastructure (CI) is key to solving the challenges of collecting, processing, and distributing the big data so prevalent in today's science and engineering endeavors. Infrastructure investments at the required mid-level can also help maintain the United States' standing among global partners and competitors."

The NSB Report recommends that NSF should affirm and sustain the mid-scale Big Idea, noting that many mid-scale projects have potential for high scientific impact and have a level of community support as indicated by National Academies reports, directorate strategic plans and/or other advisory groups.

This solicitation for Mid-scale RI-1 activities covers the lower end of the mid-scale gap. Implementation projects may range from $6 million to below $20 million. Only Design projects may request less than $6 million, with a minimum cost of $600,000 and a maximum cost below $20 million.

A separate mid-scale activity, Mid-scale RI-2, spans the $20-70 million range.

[1] $5.7 million with the inclusion of Congressionally-mandated cost sharing.

[2] https://www.nsf.gov/nsb/publications/2018/NSB-2018-40-Midscale-Research-Infrastructure-Report-to-Congress-Oct2018.pdf

II. PROGRAM DESCRIPTION

The Mid-scale RI program provides a flexible, yet robust, competitive opportunity to support research infrastructure of intermediate scales above the MRI and below the MREFC thresholds, respectively. This solicitation calls for mid-scale projects in the lower portion of that range, from $6 million to below $20 million in total project costs. This funding range will support a wide variety of research infrastructure design and implementation activities for any combination of equipment, infrastructure, upgrades to major research facilities, computational hardware and software, and the necessary commissioning, all leading to the direct advancement of fundamental science, engineering and STEM education research. With the exception of design awards, infrastructure acquired or developed with support from the Mid-scale RI-1 Program is expected to be operational by the end of the award period to enable the research for which the infrastructure was proposed. Examples of projects that may be supported by Mid-scale RI-1 include, but are not limited to, upgrades and major new infrastructure for existing major facilities, infrastructure that supports high-priority research experiments/campaigns, major cyberinfrastructure that addresses community and national-scale computational- and data-intensive science and engineering research, and major shared community infrastructure and resources as may be required to enable community-scale research.

To organize the diverse range of projects expected across the research areas supported by NSF, with a wide range of project types and costs, the Mid-scale RI-1 program is planned to be divided into the following categories.

1. Mid-scale RI-1: Implementation Projects (M1:IP) (e.g., Procurement, Assembly, Construction and Commissioning)

   Implementation projects may a) enable well-defined, limited-term research experiments with broad community buy-in and shared data resources and/or b) shared-use, mid-scale infrastructure for broad community use. M1:IP provides for acquiring, assembling, constructing and/or commissioning mid-scale infrastructure e.g., *at* labs, facilities or in the field, but does not support the construction or operations *of* labs/facilities or the science or operations undertaken with the infrastructure. Operations and maintenance costs are discussed below.

2. Mid-scale RI-1: Design Projects (M1:DP).

   Design proposals may be submitted to prepare for future mid-scale (greater than $6 million total project cost) and larger-scale research infrastructure. Design may cover Preliminary or Final Design, preparing a future mid-scale or larger project to a level of readiness that allows for a determination of the feasibility for implementation (assembly/construction). Only M1:DP projects may ask for less than $6 million. The minimum M1:DP budget request is $600,000, with the upper request for M1:DP being the maximum allowable Mid-scale RI-1 request of below $20 million as needed to prepare for a future mid-scale or larger infrastructure implementation project. Mid-scale RI-1 will *not* support early phase Research and Development that addresses technological issues that are appropriate for funding through regular research programs, or conceptual designs. Successful award of an Mid-scale RI-1 design project does not imply NSF commitment to future implementation of that project. M1:DP projects that submit to future NSF competitions for implementation must re-compete against all other proposals in any competition.

The budgets for each of the categories are flexible, with the distribution across them dependent on proposal pressure and programmatic considerations.

The Mid-scale RI-1 Program does not provide operating or maintenance funds for projects it supports through this solicitation. However, both preliminary and full proposals must describe viable plans for continuing operations and maintenance of any awarded infrastructure. (See below.)

Mid-scale infrastructure is expected to serve a wide community and lead to public access to data resources. Mid-scale RI-1 investments are expected to demonstrate high potential to significantly advance the Nation's research capabilities. Support for infrastructure to be located at other Federal agencies or their FFRDCs may occur through proposals from Mid-scale RI-1 submission-eligible organizations only when the infrastructure meets one or more of the exceptions for "Other Federal Agencies" in the PAPPG. Broadly accessible infrastructure to be located at NSF-supported FFRDCs may be requested through direct submission of Mid-scale RI-1 proposals by the FFRDC's managing organization.

Mid-scale projects are ideal training grounds for the next generation of leaders in technological innovation. To maximize the impact of Mid-scale RI-1 investments, proposals must focus on innovative, potentially transformative research infrastructure that enables a strong component of student training in state-of-the-art infrastructure development and/or use.

The science justification in all proposals must demonstrate the importance of the proposed capability relative to that currently available to the general US research community. Investigators whose preliminary proposals are for capabilities similar to those currently available to the U.S. research community are unlikely to be invited to submit full proposals. All proposals must show the project's value and benefit to the U.S. research community. Examples of benefit include, but are not limited to, open-access time at a facility, access to data products and software, and/or cooperation and sharing of technology with other projects.

Strong project management and robust cost estimation will be emphasized in Mid-scale RI-1 proposal review, particularly for more costly or complex projects. Proposers are strongly encouraged to account for all foreseeable costs in the project budget, including adequate plans for risk mitigation. Prior to final selection, some implementation projects may be evaluated through a cost, schedule, and management review, involving a site visit or a reverse site visit with specialist reviewers, as a prerequisite for an award.

Prior to making a funding decision, NSF may be required to comply with applicable federal environmental authorities such as the National Environmental Policy Act (NEPA), the National Historic Preservation Act (NHPA), and the Endangered Species Act (ESA). For example, these statutes require NSF to consider the potential impacts of activities associated with proposals under consideration for NSF funding on a broad range of environmental resources (NEPA), significant historic properties (NHPA), and endangered and/or threatened species (ESA). To assist NSF in determining which environmental statutes may apply and what level of environmental may be appropriate, preliminary proposals (and if applicable full proposals) should indicate whether activities are anticipated to impact the natural or cultural environment, especially those involving renovation, construction, or major fixed equipment installation. In order to support NSF's federal environmental review and compliance obligations, additional information may be requested from the PI.

International Projects: Projects with an international component may be submitted to the Mid-scale RI-1 program in accordance with the eligibility requirements above. International projects typically involve partnering a U.S. project with one or more international collaborators in a specific institution or organization. Successful international projects include (1) true intellectual collaboration with a foreign partner and (2) benefits that are realized from the expertise, specialized skills, facilities, phenomena, or other resources that the

foreign collaborator or research environment provides.

Proposals will typically be funded for up to five years, commensurate with the scope of the project.

Important elements of the merit review process will include special attention to the project's 1) potential to significantly advance the Nation's research capabilities, 2) relevance to any research community-established priorities, e.g., through strategic goals and/or roadmaps, 3) potential to train the next generation of leaders in technological innovation, and 4) demonstration of appropriately robust project management and cost estimation plans.

III. AWARD INFORMATION

Awards may be in the form of a standard grant, a continuing grant or a cooperative agreement, depending on the complexity of the project. NSF reserves the right to undertake pre-award (reverse-)site visits and/or cost, schedule, and management reviews as part of the review of a proposed project. Post-award (reverse-)site visits, quarterly and annual reports may be part of NSF's post-award monitoring process.

The minimum proposal budget for M1:IP projects is $6 million, with the maximum proposal budget for the full award duration being below $20 million. Only M1:DP projects may request less than $6 million, with a minimum request of $600,000 and a maximum request below $20 million as needed to prepare for a future mid-scale or larger infrastructure implementation project.

Earliest expected start date is October 01, 2019.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Proposals may only be submitted by organizations located in the United States, its territories or possessions, as follows.

    1. Institutions of higher education (Ph.D.-granting and non-Ph.D.-granting), acting on behalf of their faculty members, that are accredited in and have their main campus in the United States, its territories or possessions. Distinct academic campuses (e.g., that award their own degrees, have independent administrative structures, admissions policies, alumni associations, etc.) within multi-campus systems qualify as separate submission-eligible institutions.
    2. Not-for-profit, non-degree-granting domestic U.S. organizations, acting on behalf of their employees, for example (but not limited to) independent museums and science centers, observatories, research laboratories and similar organizations that are directly associated with the Nation's research activities. These organizations must have an independent, permanent administrative organization (e.g., a sponsored projects office) located in the United States, its territories or possessions, and have 501(c)(3) tax status.
    3. Consortia as follows:
        a. A legally incorporated, not-for-profit consortium that includes two or more submission-eligible organizations as described in items (1) and (2) above. Such a consortium is one with an independent administrative structure (e.g., a sponsored projects office) located in the United States, its territories or possessions and has 501(c)(3) status.
        b. Submission-eligible organizations as described in items (1) and (2) above, on behalf of an informal consortium. The Cover Sheet of such a proposal *must* identify both a PI and co-PI(s) from *at least two* Mid-scale RI-1 submission-eligible organizations (items 1 and/or 2 above) as lead investigators in the consortium. These consortium proposals may also include as partners, via subawards, other U.S. and non-U.S. organizations that are not eligible to submit Mid-scale RI-1 proposals.

        In either case, the proposal title should indicate that a consortium is proposing.

    For-profit commercial organizations, especially U.S. small businesses with strong capabilities in scientific or engineering research or education, are eligible for infrastructure support through subawards/subcontracts as private sector partners with submitting organizations; they may not submit proposals. Such partnerships must be substantive and meaningful, and build capacity for infrastructure development within Mid-scale RI-1 submission-eligible organization(s). In addition, the value added by the for-profit commercial organization should be justified as a unique contribution that is otherwise unavailable within organizations described in (1) and (2). Unless otherwise specified in the award, title to the resulting infrastructure should be retained by the Mid-scale RI-1-eligible performing organization(s). Prospective PIs may contact cognizant Mid-scale RI-1 program officers regarding organizational eligibility, and for information on other NSF funding opportunities for instrumentation and research infrastructure.

    Additionally:

- **MREFC-related Proposals:** The Mid-scale RI-1 program will not accept proposals for an instrument or other infrastructure that augments an ongoing NSF Major Research Equipment and Facilities Construction (MREFC) project in the construction stage since the scope of those projects is already defined and subject to NSF's No Cost Overrun Policy. A list of such facilities can be found at https://www.nsf.gov/bfa/lfo/.

- **FFRDC-related Proposals:** NSF's Federally Funded Research and Development Centers (FFRDCs) are eligible to submit under item 2) above. Proposals involving another Federal agency or one of their FFRDCs can be submitted as a consortium proposal by a Mid-scale RI-1 submission-eligible organization under item 3b) above. For submissions under 3b) above, in addition to at least two Mid-scale RI-1 eligible organizations, the proposal must include the agency/FFRDC (or its managing organization) as a partner in the consortium, even if the role of the FFRDC in the project is solely to house the infrastructure. The research infrastructure must make unique contributions to the needs of researchers within the consortium and/or establish access to new multi-user research capabilities. Preliminary inquiry to the cognizant Mid-scale RI-1 point of contact should be made before preparing a proposal for submission.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

For this Mid-scale RI-1 competition, there are no limits to the number of preliminary proposals submitted as the lead organization. Full proposals are to be submitted only if/when invited by NSF. There is no limit to participation as a partner organization or subawardee.

Although more than one organization may participate in a proposal, a single organization must accept overall management responsibility for the project. The proposal must be submitted by one organization, with funding provided to any other organization through subawards. The use of the separately-submitted collaborative proposal method is not permitted.

Limit on Number of Proposals per PI or Co-PI: 1

Any one individual may be the Principal Investigator (PI) or co-Principal Investigator (co-PI) for no more than one preliminary or full proposal. A PI or co-PI for a preliminary proposal that is not invited for a full proposal submission may serve as a participant or co-PI on an invited full proposal at the full-proposal organization's and PI's discretion.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Preliminary Proposals *(required)*: Preliminary proposals are required and must be submitted via the NSF FastLane system, even if full proposals will be submitted via Grants.gov.

Special instructions for submitting to this Big Idea solicitation

FastLane Users: Proposers are reminded to identify the program solicitation number (located on the first page of this document) in the first block on the NSF Cover Sheet. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Please note that even though proposals must be submitted to the Office of Integrative Activities, once received the proposals will be managed by a cross-disciplinary team of NSF Program Directors.

Separately submitted collaborative proposals will not be accepted. Funding to partner institutions must be through subawards.

Preliminary Proposal Contents

The preliminary proposal should consist of the following elements

Cover Sheet. For planning purposes October 01, 2019 should be shown as the start date. Be sure to check the block indicating that a preliminary proposal is being submitted and identify the program solicitation number in the program announcement/solicitation block. When submitted, proposals will first reside in the Office of Integrative Activities which coordinates the Mid-scale RI-1 program in partnership with NSF Directorates.

The project title must be concise and include the primary Mid-scale RI-1 purpose of the proposal, e.g., "**Mid-scale RI-1 (M1:IP)**: *TITLE*" or "**Mid-scale RI-1 (M1:DP):** *TITLE*". Consortium projects must also be identified in the title.

NSF proposals identify only a single PI and up to four co-PIs with those titles. Other major participants may be designated as "senior personnel." Please see the NSF PAPPG for definitions of Senior Personnel.

NSF reserves the right to assign proposals to programs that are deemed to be the most appropriate for review. PI selection of a Division or Divisions for review is advisory to NSF.

Project Summary. (1-page maximum) Please follow guidance in the NSF PAPPG. The first line of the Project Summary should list the most relevant Directorate(s)/Division(s) for review of the proposal. NSF reserves the right to assign proposals to programs that are deemed to be the most appropriate for review. PI selection of a Division(s) for review is advisory to NSF.

Table of Contents. A Table of Contents is automatically generated for the proposal by the FastLane system. The proposer cannot edit this form.

Project Description (10-pages maximum), including the following: (Required section headings are highlighted in boldface).

- A statement of which of the categories of Mid-scale RI-1 is most appropriate for this proposal as the first sentence.
- Any project-related activities that are anticipated to have significant environmental and/or cultural impacts should be noted at the beginning of the Project Description.
- Along with the **Intellectual Merit**, describe the **Scientific Justification**, including the unique research capabilities and lack of general availability of the requested infrastructure and its potential to significantly advance the Nation's research infrastructure.
- Along with the **Intellectual Merit,** include a description of the **Research Community Priority** of the infrastructure, i.e., evidence, such as workshop reports or other publicly available indicators, that the infrastructure is a priority for a research community or important for a recognized NSF priority area such as one of NSF's research Big Ideas.
- Along with the **Broader Impacts**, include a discussion of student training, increased participation of underrepresented groups and a description of tangible benefits to the wider U.S. research community (access, data products, technology, etc.).
- Preliminary proposals *must* include an outline of ongoing operations and maintenance plans, including an estimate of any needs for ongoing, NSF-supported operations and maintenance that may be requested outside of the Mid-scale RI program.
- Note: Results from Prior NSF Support should not be included. Also, links to URLs may not be used.

Proposals with an international dimension should include a description of the foreign collaborator's role in the project. Biographical Sketches for foreign collaborators and letters of commitment from foreign institutions or organizations should be included as supplemental documents to ensure commitment to the collaboration.

References Cited (2-page limit). Please follow guidance in the NSF PAPPG for instructions.

Biographical Sketches (2 pages each). Biographical Sketches are required for the PI, all co-PIs, and any additional senior personnel at all participating organizations. See the PAPPG for details.

Budget and Budget Justification, including budgets for any subawards. For preliminary proposals cost estimates may be preliminary estimates with the Basis of Estimates (BoE) included. Copies of vendor quotations should not be included in preliminary proposals. If the budget includes contingency, that contingency should cover the "known unknowns" and be used to mitigate identified risks.

Facilities, Equipment, and Other Resources: In order for NSF, and its reviewers, to assess the scope of a proposed project, all organizational resources necessary for, and available to a project, must be described in this section of the proposal. Proposers should describe only those resources that are directly applicable. The description should be narrative in nature and must not include any quantifiable financial information. Proposers should include a description of the internal and external resources (both physical and personnel) that are expected to be available to the project. Such information must be provided in this section, in lieu of other parts of the proposal (e.g., Budget Justification, Project Description).

Supplementary Documents: (to be entered in the Supplementary Documents section of FastLane). 1) A list of the major team members, their affiliations, and their role in the project; 2) A list of Partner Organizations to be funded via subawards, and the role of each in the project; and 3) An *outline* of the **Project Execution Plan (PEP)**. (See the LFM/MFG. Greater detail will be required in invited full proposals should that occur. See Full Proposal Preparation section for further information.)

No other items or appendices should be included. Information pertaining to "Results from Prior NSF Support", "Current and Pending Support", "Data Management Plan", and "Postdoctoral Mentoring Plan" is not required for preliminary proposals and should not be included. Preliminary proposals containing items other than those required above will be returned without review.

Information to be submitted to NSF via the FastLane Single Copy Documents Section

Required: Collaborators & Other Affiliations (COA) information specified in the PAPPG should be submitted using the instructions and spreadsheet template found at https://nsf.gov/bfa/dias/policy/coa.jsp.

Optional: Proprietary or privileged information (if applicable). Any available, relevant environmental reports and/or documentation (e.g., permits, authorizations, etc.), if applicable, should be submitted in the Single Copy Document section.

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Full Proposal Preparation Instructions: Proposers may opt to submit proposals in response to this Program Solicitation via Grants.gov or via the NSF FastLane system.

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG). The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg. Paper copies of the PAPPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov. Proposers are reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov*. The complete text of the *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link

and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

See PAPPG Chapter II.C.2 for guidance on the required sections of a full research proposal submitted to NSF. Please note that the proposal preparation instructions provided in this program solicitation may deviate from the PAPPG instructions.

Special instructions for submitting to this Big Idea solicitation

FastLane Users: Proposers are reminded to identify the program solicitation number (located on the first page of this document) in the first block on the NSF Cover Sheet. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Please note that even though proposals must be submitted to the Office of Integrative Activities, once received the proposals will be managed by a cross-disciplinary team of NSF Program Directors.

Grants.gov Users: The program solicitation number will be pre-populated by Grants.gov on the NSF Grant Application Cover Page, however you will need to locate the Division Code, Program Code, Division Name, and Program Name for the specific solicitation you are applying to by visiting https://www.fastlane.nsf.gov/pgmannounce.jsp. As stated previously, even though proposals must be submitted to the Office of Integrative Activities, once received the proposals will be managed by a cross-disciplinary team of NSF Program Directors.

Full proposals should only be submitted if invited by NSF.

Due to the complexity of the proposals being submitted, use of FastLane to prepare and submit invited full proposals is strongly encouraged. ***Separately submitted collaborative proposals will not be accepted***. Funding to partner institutions must be through subawards. When preparing a full proposal for this competition, proposers are advised to review the Program Description and the Proposal Review Information found in this solicitation for general information pertinent to this program.

The full proposal should provide much more detail than the preliminary proposal and include a detailed project execution plan that clearly describes the management of the project within section C of the PEP. Descriptions should be clear and concise.

Every effort should be made to update information that was provided in the preliminary proposal and to fully address issues raised in the preliminary proposal review. Full proposals should be comparable in cost and scope to that which was presented in the preliminary proposal (i.e., the cost and scope of work may be fine-tuned relative to the preliminary proposal but should not be substantially different).

The following instructions supplement the guidance in the PAPPG or NSF Grants.gov Application Guide:

Additional instructions for full proposals may be provided in letters of invitation to submit full proposals.

Cover Sheet. For planning purposes October 01, 2019 should be shown as the start date. Identify the program solicitation number in the program announcement/solicitation block. When submitted, proposals will first reside in the Office of Integrative Activities which coordinates the Mid-scale RI-1 program in partnership with NSF Directorates.

The project title must be concise and include the primary Mid-scale RI-1 purpose of the proposal, e.g., "**Mid-scale RI-1 (M1:IP)**: *TITLE*" or "**Mid-scale RI-1 (M1:DP):** *TITLE*". Consortium projects must also be identified in the title.

Project Summary. (1-page maximum). See guidance for Preliminary Proposals. The first line of the Project Summary should list the most relevant Directorate(s)/Division(s) for review of the proposal. NSF reserves the right to assign proposals to programs that are deemed to be the most appropriate for review. PI selection of a Division(s) for review is advisory to NSF.

Table of Contents. See instructions for Preliminary Proposals.

Project Description (page limit is 20 pages unless otherwise specified in the invitation letter) must include the following: (Required section headings are highlighted in boldface).

- A statement of which of the categories of Mid-scale RI-1 is most appropriate for this proposal as the first sentence.
- Any project-related activities that are anticipated to have significant environmental and/or cultural impacts should be noted at the beginning of the Project Description.
- **Results from Prior NSF Support**. Note that this requirement applies to the PI and all co-PIs. When appropriate, focus on awards including infrastructure/management-related activities.
- Along with the **Intellectual Merit**, describe the **Scientific Justification.** Describe the potential for addressing one or more identified high-priority science goals within the relevant research community, the potential for advancing scientific discovery and the potential to significantly advance the Nation's research infrastructure. Explain the unique research capabilities and lack of general availability of the proposed mid-scale infrastructure. Discuss the relationship to NSF's six Research Big Ideas, if applicable.
- Along with the **Intellectual Merit**, include a description of the **Research Community Benefits** of the infrastructure in the context of, for example, the project's potential benefit to the broader U.S. research community (e.g., access to infrastructure, new research resources, data products, etc.). Describe how the proposed infrastructure responds to identified high-priority needs of a research community.
- **Preliminary Activities Accomplished**: For Implementation projects, include relevant activities that have prepared the infrastructure project to be implemented, including identification of the primary scientific, technical and system performance requirements, and associated designs and specifications. For all proposals, if Conceptual, Preliminary and or Final Designs are available, include them as part of the Special Information and Supplementary Documents section.
- **Implementation Plan:** Discuss the management and technical activities that will be accomplished to prepare, initiate, execute and conclude the project. This section should include a summary of the management plan including a description of technical readiness and project management, and an organizational chart or list of key personnel and their roles (see Supplementary Documents).
- **Operations and Utilization Plan**: For Implementation projects, discuss the overall plan for operating the infrastructure including as a minimum management/governance plans, strategy for access and utilization of the infrastructure by the target research communities, and planned metrics and evaluation of the success and impact of the NSF investment in this

infrastructure. This section must also identify the anticipated sources of operations and maintenance funding, including any needs for ongoing, NSF-supported operations and maintenance (O&M) that may be requested outside of the Mid-scale RI-1 program. *Only* if requested in the full-proposal invitation, an itemized budget for O&M, outside of the Mid-scale RI-1 budget, may be included as a supplementary document.

- A section containing a full discussion of the **Broader Impacts**, along with a discussion of student training, increased participation of underrepresented groups, and *assessment* of those efforts. Include a description of tangible benefits to the wider U.S. research community (access, data products, technology, etc.), including the anticipated impact of those benefits.

Proposals with an international dimension should include a description of the foreign collaborator's role in the project. Biographical Sketches for foreign collaborators and letters of commitment from foreign institutions or organizations should be included as supplemental documents to ensure commitment to the collaboration.

References Cited (2-page limit). Please follow guidance in the NSF PAPPG for instructions.

Biographical Sketches (2 pages each). Biographical Sketches are required for the PI and all co-PIs, and additional senior personnel at all participating organizations. See the PAPPG for details.

Budget and Budget Justification, including budgets for any subawards. Mid-scale proposals should include actual costs and budget estimates for all stages of the project lifecycle: development and design, construction/acquisition, operations, and divestment, although not all stages may be rigorously defined depending on project history. For example, actual costs should be included for investments previously made during development and design when submitting a proposal for construction or acquisition. Mid-scale project proposals should also include a Concept of Operations (CoP) discussion and the strategy for eventual divestment so the proposal can include estimates for eventual operations and divestment. For those invited to submit full proposals, more details may be specified in the letter of invitation.

Budgets should be supported by well-documented Basis of Estimates (BoE) developed in accordance with the good practices and twelve steps outlined in the GAO Cost Estimating and Assessment Guide [3] to meet the four characteristics of a high-quality estimate: well-documented; comprehensive; accurate; and credible (see the LFM/MFG). Schedules should be developed following the best practices outlined in the General Accounting Office (GAO) Schedule Assessment Guide [3].

If the budget includes contingency, that contingency should cover the "known unknowns" and be used to mitigate identified cost or schedule risks. (Contingency should be listed on Line G.6 (Other) on the Budget Pages.) The estimated risk-adjusted project cost is the sum of the performance baseline and the budget contingency. Proposed budget for CI projects should not include contingency. See the LFM/MFG for contingency guidance.

Vendor quotations for major components must be included as supplementary documents for full proposals only. Full proposals *must* also include a fully-developed estimate of any needs for ongoing operations and maintenance that may be requested outside of the Mid-scale RI program, specifying if that support will be requested from NSF or other sources. *Only* if requested in the full-proposal invitation, an itemized budget for NSF-supported operations and maintenance, outside of the Mid-scale RI-1 budget, for the award period may be included as a supplementary document.

Facilities, Equipment, and Other Resources: See instructions for Preliminary Proposals.

Current and Pending Support: See the NSF PAPPG for instructions.

Supplementary Documents:

1. A list of the major team members, their affiliations, and their role in the project;
2. A list of Partner Organizations to be funded via subawards, and the role of each in the project;
3. A *detailed description* of the **Project Execution Plan (PEP).** Concurrence on an initial PEP must be reached between NSF and the proposing organization prior to any award. It is reasonable to expect the PEP to evolve during the execution of the award. The following list provides the minimum required components of the PEP for a mid-scale project (see the section on components of a project execution plan in the LFM/MFG). Each of the sections should be tailored in both detail and scope to the specifics of the project. The PEP should be appropriate for the complexity of the project, and may not require all of the elements described in the LFM/MFG. Should the PI believe that some elements of the PEP are not applicable, the specific section(s) should include a justification for exclusion. Some material may be a duplication from other sections of the Mid-scale RI-1 proposal but should nevertheless be included for completeness and reference as the project proceeds.

   A. Introduction
   B. Organization
   C. Construction Project Definition
   D. Risk and Opportunity Management
   E. Configuration Control
   F. Acquisitions
   G. Project Management Controls (Note: the scope, complexity, budget profile, and duration of a project should be assessed to determine the need for Earned Value reporting)
   H. Cyberinfrastructure (Note: Proposed Mid-scale RI-1 projects that are focused on Cyberinfrastructure should use sections B and C to fully describe the project. In all cases, proposals that include the use of existing external shared cyberinfrastructure including computing, data, software and networking infrastructure and resources should discuss that utilization here.)
   I. Integration and Commissioning. (Note: If the project will be integrated into a larger facility or instrument, the proposal should include a section discussing planned system engineering activities.)

   If the site selected has any known or potential requirements for permitting or federal environmental compliance, a discussion of this should be included in the PEP. Inclusion of other PEP components detailed in in the NSF's Major Facilities Guide is optional and should consider the unique research capabilities enabled by the project;

4. Include a letter documenting the performing organization's commitment to ensuring successful operations and maintenance over the expected lifetime of the infrastructure. Proposals for infrastructure to be located at an organization other than the

performing organization must provide an additional (one-page maximum) supplementary document stating the host organization's commitment to house the infrastructure. *For the purposes of this solicitation, use of infrastructure at NSF's Antarctic facilities is considered to be field deployment and a supplementary document from the host facility is not required;*

5. Statements from ***individuals***, on organization letterhead, confirming substantive collaboration efforts and/or usage of the infrastructure may be submitted, but they ***must*** follow *only* the format indicated below.

_____

To: NSF Mid-scale RI-1 Coordinator

By signing below I acknowledge that I am listed as a collaborator on this Mid-scale RI proposal, entitled "_____(*proposal title)_____,*" with _____(*PI name)_____ as the Principal Investigator. I agree to undertake the tasks assigned to me, as described in the proposal, and I commit to provide or make available the resources therein designated to me.

Signed: _____ Print Name:_____

Date: _____ Organization:_____

The proposal body itself should describe the nature and need for a collaboration and describe the major users and their need for the infrastructure. Statements of collaboration beyond that specified above, including letters of support/endorsement, are not allowed. Each statement must be signed by the designated collaborator/user. PI requests to collaborators for these statements should be made well in advance of the proposal submission deadline since, if they are to be included, they must be included at the time of the proposal submission.

If a proposed effort involves a collaboration at an ***organizational level*** as opposed to an individual(s), e.g., a private sector partner, an entire organization, or a large formalized collaboration (e.g., through a memorandum of understanding or other legal document), a one-page-maximum letter confirming their participation may be included. In particular proposals involving large formalized collaborations are encouraged to have the collaboration utilize this letter to document the role, importance and priority of the requested infrastructure in the overall efforts being undertaken by the collaboration;

6. Vendor quotations for major components as appropriate. Inclusion of representative, itemized vendor quotations is required for full Mid-scale RI-1 proposals. Although a proposal might reference and have a quote(s) for a specific make and model, the proposer is reminded that his/her organization's approved procurement processes must be utilized in the event of an award to establish the appropriate item(s) to be purchased and that applicable procurement standards for institutions of higher education and other non-profit organizations are described in 2 CFR 215.40-48;
7. If conceptual, preliminary or final designs of the proposed infrastructure are available they should be included;
8. *Only* if requested in the full-proposal invitation, an itemized budget for operations and maintenance, outside of the Mid-scale RI-1 budget, for the award period may be included;

Data Management Plan: See the NSF PAPPG for instructions; and

Postdoctoral Mentoring Plan: As appropriate. See the NSF PAPPG for instructions.

No other items or appendices are to be included unless expressly allowed in the invitation to submit a full proposal. Full proposals containing items other than those allowed above will be returned without review.

Information to be submitted to NSF as Single Copy Documents

Required: Collaborators & Other Affiliations (COA). See Preliminary Proposal instructions and the NSF PAPPG.

Optional: List of suggested reviewers or reviewers not to include (with a brief explanation or justification for why the reviewer should be excluded); Proprietary or privileged information (if applicable). Information on potential environmental impacts, if any (including surveys that have been completed, environmental reviews and analyses, permits obtained, etc.) and decommissioning and divestment plans should be submitted in the Single Copy Documents section.

[3] Available at https://www.gao.gov/

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Other Budgetary Limitations:

Implementation projects may have a total project cost ranging from $6 million to below $20 million. Only Design projects may request less than $6 million, with a minimum request of $600,000 and a maximum request of below $20 million.

Budget Preparation Instructions:

A breakdown of project components and their expected costs must be included in the Budget Justification. For preliminary proposals the cost estimates may be preliminary estimates with the basis of estimates included. In the event of an award that totals $10 million or more, NSF may require the Awardee to develop budget estimates and associated risk estimates that are "bottom up" assessments that consider every element of the entire project. See the NSF's Major Facilities Guide for guidance.

Vendor quotes for major components must be included as supplementary documents for full proposals only.

C. Due Dates

- **Preliminary Proposal Due Date(s)** *(required)* (due by 5 p.m. submitter's local time):

    February 19, 2019

- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):

    May 20, 2019

    By invitation only.

D. FastLane/Research.gov/Grants.gov Requirements

For Proposals Submitted Via FastLane or Research.gov:

To prepare and submit a proposal via FastLane, see detailed technical instructions available at: https://www.fastlane.nsf.gov/a1/newstan.htm. To prepare and submit a proposal via Research.gov, see detailed technical instructions available at: https://www.research.gov/research-portal/appmanager/base/desktop?_nfpb=true&_pageLabel=research_node_display&_nodePath=/researchGov/Service/Desktop/ProposalPreparationandSubmission.html. For FastLane or Research.gov user support, call the FastLane and Research.gov Help Desk at 1-800-673-6188 or e-mail fastlane@nsf.gov or rgov@nsf.gov. The FastLane and Research.gov Help Desk answers general technical questions related to the use of the FastLane and Research.gov systems. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

For Proposals Submitted Via Grants.gov:

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: http://www.grants.gov/web/grants/applicants.html. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

Submitting the Proposal: Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to the NSF FastLane system for further processing.

Proposers that submitted via FastLane or Research.gov may use Research.gov to verify the status of their submission to NSF. For proposers that submitted via Grants.gov, until an application has been received and validated by NSF, the Authorized Organizational Representative may check the status of an application on Grants.gov. After proposers have received an e-mail notification from NSF, Research.gov should be used to check the status of an application.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program for acknowledgement and, if they meet NSF requirements, for review. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF either as *ad hoc* reviewers, panelists, or both, who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal. In addition, Program Officers may obtain comments from site visits before recommending final action on proposals. Senior NSF staff further review recommendations for awards. A flowchart that depicts the entire NSF proposal and award process (and associated timeline) is included in PAPPG Exhibit III-1.

A comprehensive description of the Foundation's merit review process is available on the NSF website at: https://www.nsf.gov/bfa/dias/policy/merit_review/.

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in *Building the Future: Investing in Discovery and Innovation - NSF Strategic Plan for Fiscal Years (FY) 2018 – 2022*. These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

One of the strategic objectives in support of NSF's mission is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions must recruit, train, and prepare a diverse STEM workforce to advance the frontiers of science and participate in the U.S. technology-based economy. NSF's contribution to the national innovation ecosystem is to provide cutting-edge research under the guidance of the Nation's most creative scientists and engineers. NSF also supports development of a strong science, technology, engineering, and mathematics (STEM) workforce by investing in building the knowledge that informs improvements in STEM teaching and learning.

NSF's mission calls for the broadening of opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

A. Merit Review Principles and Criteria

The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects.

1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.
- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

2. Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. **Both** criteria are to be given **full consideration** during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. (PAPPG Chapter II.C.2.d(i). contains additional information for use by proposers in development of the Project Description section of the proposal). Reviewers are strongly encouraged to review the criteria, including PAPPG Chapter II.C.2.d(i), prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- **Intellectual Merit:** The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- **Broader Impacts:** The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to
   a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
   b. Benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. NSF values the advancement of scientific knowledge and activities that contribute to achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

Proposers are reminded that reviewers will also be asked to review the Data Management Plan and the Postdoctoral Researcher Mentoring Plan, as appropriate.

Additional Solicitation Specific Review Criteria

The focus of the preliminary proposal review will be on the significance of the proposed science, the importance and benefit of the proposed infrastructure to the wider community, the ability of the team to undertake the project and the viability of long-tern operations and maintenance. In addition to these elements, the full proposal review will focus on the project management, the validity of the cost estimates (including for O&M), the potential training of students and assessment plans for that training and broadening participation of underrepresented groups in all aspects of the project.

1. Reviews of both preliminary and invited full proposals will consider the Scientific Justification, including the science drivers and the unique research capabilities and lack of general availability of the requested infrastructure. A major consideration will be the project's potential to significantly advance the Nation's research infrastructure. For implementation projects, proposals will be evaluated on the completeness of the research and design activities that have led to the project being ready for mid-scale support.
2. Reviews of both preliminary and invited full proposals will evaluate the Research Community Priority of the infrastructure, i.e., evidence, such as workshop reports or other publicly available indicators, that the infrastructure is a priority for a research community or important for a recognized NSF priority area such as one of NSF's research Big Ideas. The value and benefit to the US research community will be evaluated. Examples of benefit include, but are not limited to, open-access observing time on the facility, access to data products and software, and cooperation and sharing of technology with other projects.
3. Reviews of both preliminary and invited full proposals will be evaluated on the strength and maturity of the plan to execute and manage the project including but not limited to project management methods, soundness of the cost estimate, feasibility of the schedule, and comprehensiveness of the risk management plan. Reviews will consider the appropriateness of the assembled team, including their qualifications, experience working in a team environment and potential to advance the goals of the project.
4. For Implementation projects, a clear description of plans for continuing operations and maintenance must be provided and will be part of the review of both the preliminary and full proposals. Proposals will be evaluated on the strength of the anticipated lifecycle plans including utilization by and anticipated impact on the target research communities and US research; and consideration of the anticipated lifecycle costs. Letters of commitment (for full proposals only) from organizations that have agreed to provide support will be considered in the full proposal review.
5. While preliminary proposals must address cost estimates, evaluation of the robustness of the budget estimates will play a major role in the review of the full proposal. Cost estimates for i) implementation, ii) operation and maintenance, and iii) decommissioning and divestment will be evaluated. Review of design proposals that involve preliminary or final design of infrastructure will consider plans, costs and feasibility for construction of the proposed infrastructure.
6. While preliminary proposals must address plans for student training and broadening participation activities, review of full proposals, in particular, will include evaluation of plans for the involvement of a substantial component of student training and inclusion of a diverse workforce in instrumentation, infrastructure development, or data management/analysis. Evaluation of an assessment plan for these activities will also play a role in the proposal's review.
7. When applicable, environmental reviews may be required and evaluated as part of the review process.

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review, or / and additional technical review, including site visits, for complex projects.

Preliminary proposals will be reviewed internally by NSF, with the outcome being an invite/do not invite decision for full proposals. Full proposals, to be submitted by invitation only, will be reviewed by external reviewers.

Reviewers will be asked to evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will generally be completed and submitted by each reviewer and/or panel. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF strives to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new awardees may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

After programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications. After an administrative review has occurred, Grants and Agreements Officers perform the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal

Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

Once an award or declination decision has been made, Principal Investigators are provided feedback about their proposals. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers or any reviewer-identifying information, are sent to the Principal Investigator/Project Director by the Program Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process).

B. Award Conditions

An NSF award consists of: (1) the award notice, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award notice; (4) the applicable award conditions, such as Grant General Conditions (GC-1)*; or Research Terms and Conditions* and (5) any announcement or other NSF issuance that may be incorporated by reference in the award notice. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

*These documents may be accessed electronically on NSF's Website at https://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the NSF *Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

Special Award Conditions:

Grantees will be required to include appropriate acknowledgment of NSF support under the Mid-scale Research Infrastructure Big Idea in any publication (including World Wide Web pages) of any material based on or developed under the project, in the following terms:

"This material is based upon work supported by the National Science Foundation Mid-scale Research Infrastructure Big Idea under Grant No. (Grantee enters NSF grant number.)"

Grantees also will be required to orally acknowledge NSF support using the language specified above during all news media interviews, including popular media such as radio, television and news magazines.

NSF may require in-person meetings, site visits, and periodic reviews depending on project scope. The award oversight will depend on project scope and complexity.

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer no later than 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). No later than 120 days following expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report, will delay NSF review and processing of any future funding increments as well as any pending proposals for all identified PIs and co-PIs on a given award. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through Research.gov, for preparation and submission of annual and final project reports. Such reports provide information on accomplishments, project participants (individual and organizational), publications, and other specific products and impacts of the project. Submission of the report via Research.gov constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

More comprehensive information on NSF Reporting Requirements and other important information on the administration of NSF awards is contained in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

Additional reporting requirements, including possible reverse-/site visits to enable NSF oversight of the funded project may be required as part of the award terms and conditions. The level of oversight will be appropriate to the complexity of the award.

VIII. AGENCY CONTACTS

Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.

General inquiries regarding this program should be made to:

- Randy L. Phelps, OIA, telephone: (703) 292-8040, email: rphelps@nsf.gov

- Robert D. Fleischmann, BIO, telephone: (703) 292-7191, email: rfleisch@nsf.gov

- Deepankar (Deep) Medhi, CISE, telephone: (703) 292-8950, email: dmedhi@nsf.gov

- R. Steven Turley, EHR, telephone: (703) 292-2207, email: rturley@nsf.gov

- Paul A. Lane, ENG, telephone: (703) 292-2453, email: plane@nsf.gov

- Michael E. Jackson, GEO, telephone: (703) 292-8033, email: mejackso@nsf.gov

- Richard E. Barvainis, MPS, telephone: (703) 292-4891, email: rbarvai@nsf.gov

- Joseph Whitmeyer, SBE, telephone: (703) 292-7808, email: jwhitmey@nsf.gov

- Maija M. Kukla, OISE, telephone: (703) 292-4940, email: mkukla@nsf.gov

For questions related to the use of FastLane or Research.gov, contact:

- FastLane and Research.gov Help Desk: 1-800-673-6188

  FastLane Help Desk e-mail: fastlane@nsf.gov.

  Research.gov Help Desk e-mail: rgov@nsf.gov

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: support@grants.gov.

IX. OTHER INFORMATION

The NSF website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this website by potential proposers is strongly encouraged. In addition, "NSF Update" is an information-delivery system designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF Grants Conferences. Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. "NSF Update" also is available on NSF's website.

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this mechanism. Further information on Grants.gov may be obtained at http://www.grants.gov.

ABOUT THE NATIONAL SCIENCE FOUNDATION

The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to

more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

NSF receives approximately 55,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Arctic and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

Facilitation Awards for Scientists and Engineers with Disabilities (FASED) provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See the *NSF Proposal & Award Policies & Procedures Guide* Chapter II.E.6 for instructions regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

> The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.
>
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>
> - **Location:**   2415 Eisenhower Avenue, Alexandria, VA 22314
>
> - **For General Information** (NSF Information Center)**:**   (703) 292-5111
>
> - **TDD (for the hearing-impaired):**   (703) 292-5090
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> - **To Order Publications or Forms:**
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>   Send an e-mail to: nsfpubs@nsf.gov
>
>   or telephone: (703) 292-7827
>
> - **To Locate NSF Employees:**   (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004), and NSF-51, "Reviewer/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton
Reports Clearance Officer
Office of the General Counsel
National Science Foundation
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