

Mid-scale Research Infrastructure-2 (Mid-scale RI-2)

PROGRAM SOLICITATION NSF 21-537

REPLACES DOCUMENT(S): NSF 19-542



National Science Foundation

Letter of Intent Due Date(s) (required) (due by 5 p.m. submitter's local time):

February 03, 2021

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

March 05, 2021

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

September 20, 2021

IMPORTANT INFORMATION AND REVISION NOTES

A letter of intent is required by the due date indicated above for subsequent preliminary proposal submission and review. 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 19-068, [Major Facilities Guide](#) (MFG) for definitions of terms used in this solicitation, such as the Project Execution Plan (PEP). Note that the PEP should be consistent with the complexity of the project.

Any preliminary proposal or invited full proposal submitted in response to this solicitation should be submitted in accordance with the NSF Proposal & Award Policies & Procedures Guide (PAPPG) that is appropriate for the submission deadline date.

The Mid-scale RI-2 Program seeks broad representation of PIs and institutions in its award portfolio, including a geographically diverse set of institutions (including those in EPSCoR jurisdictions) and PIs who are women, early-career researchers, members of underrepresented minorities, and persons with disabilities. For the latter group, Mid-scale RI-2 encourages PIs to consider Facilitation Awards for Scientists and Engineers with Disabilities (FASSED) requests as part of a Mid-scale RI-2 proposal submission (see PAPPG Chapter II.E.6). The total amount requested, including the base Mid-scale RI-2 budget and the FASSED request must not exceed the Mid-scale RI-2 program's budget limit.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) ([NSF 20-1](#)), which is effective for proposals submitted, or due, on or after June 1, 2020.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Mid-scale Research Infrastructure-2 (Mid-scale RI-2)

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.

NSF-supported science and engineering research increasingly relies on cutting-edge infrastructure. With its Major Research Instrumentation (MRI) program and Major Multi-user Research Facility projects (Major Facilities), 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 Major Facilities thresholds.

NSF defines Research Infrastructure (RI) as any combination of facilities, equipment, instrumentation, or computational hardware or software, and the necessary human capital in support of the same. Major facilities and mid-scale projects are subsets of research infrastructure. The NSF Mid-scale Research Infrastructure-2 Program (Mid-scale RI-2) supports the implementation of unique and compelling RI projects. Mid-scale RI-2 projects may include any combination of equipment, instrumentation, cyberinfrastructure, broadly used large-scale data sets, and the commissioning and/or personnel needed to successfully complete the project. Mid-scale RI-2 projects should fill a research community-defined scientific need, or address an identified national research priority, that enables current and next-generation U.S. researchers and a diverse STEM workforce to remain competitive in a global research environment. The total cost for Mid-scale RI-2 projects ranges from \$20 million to below the threshold for a Major Facilities Project, currently \$100 million. Mid-scale RI-2 projects will directly enable advances in any of the research domains supported by NSF, including STEM education research. Projects may also include upgrades to existing research infrastructure.

The Mid-scale RI-2 Program emphasizes projects that have strong scientific merit, respond to an identified need of the research community, demonstrate technical and managerial readiness for implementation, include a well-developed plan for student training *in the design and implementation of mid-scale research infrastructure*, and involve a diverse workforce in mid-scale facility development, and/or associated data management. Training of students in design and implementation, not just in scientific exploitation of the infrastructure, is essential.

Please consult NSF 19-068 [Major Facilities Guide](#) (MFG) for definitions of terms used in this solicitation, such as the Project Execution Plan (PEP). Section 5 of the MFG provides guidance specific to Mid-Scale Research Infrastructure Projects, including guidance on the PEP.

Mid-scale RI-2 will consider only the implementation (typically construction or acquisition) stage of a project, including a limited degree of final development or necessary production design immediately preparatory to implementation. It is thus intended that Mid-scale RI-2 will support projects in high states of project and technical readiness for implementation, i.e., those that have already matured through previous developmental investments. Accordingly, Mid-scale RI-2 does not support pre-implementation (early-stage design or development) activities. Mid-scale RI-2 also does not support post-implementation research, operations or maintenance, the anticipated source(s) of which are expected to be discussed in the proposal.

The Mid-scale RI-2 Program seeks broad representation in its award portfolio, with PIs from a broad geographic distribution of institutions (including EPSCoR jurisdictions), women, early-career researchers, underrepresented minorities, and persons with disabilities. For the latter group, Mid-scale RI-2 encourages PIs to consider Facilitation Awards for Scientists and Engineers with Disabilities (FASSED) requests as part of a Mid-scale RI proposal submission (see the current PAPPG). The total amount requested, including the base Mid-scale RI-2 budget and the FASSED request must not exceed the Mid-scale RI-2 program's budget limit.

It is anticipated that future solicitations will be issued approximately biennially.

Note: Research infrastructure and instrumentation in the range just above the current Major Research Instrumentation Program threshold and below the Mid-scale RI-2 threshold is the subject of the Mid-scale Research Infrastructure-1 solicitation ([NSF 21-505](#)).

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.

- Brian Midson, GEO, telephone: (703) 292-8145, email: bmidson@nsf.gov
- Allena K. Oppen, telephone: (703) 292-8958, email: aopper@nsf.gov
- William L. Miller, CISE, telephone: (703) 292-7886, email: wlmiller@nsf.gov
- Joy M. Pauschke, ENG, telephone: (703) 292-7024, email: jpauschk@nsf.gov
- Sridhar Raghavachari, BIO, telephone: (703) 292-4845, email: sraghava@nsf.gov
- Joseph M. Whitmeyer, telephone: (703) 292-7808, email: jwhitmey@nsf.gov
- Lee L. Zia, EHR, telephone: (703) 292-5140, email: lzia@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: Cooperative Agreement

Estimated Number of Awards: 2 to 6

Subject to the availability of funds and quality of proposals received.

Anticipated Funding Amount: \$150,000,000 to \$200,000,000

Total funds available are anticipated to be approximately \$150 million to \$200 million over five years.

Individual awards from \$20 million up to but not including \$100 million are anticipated for advanced design and implementation, pending availability of funds. Duration of the award may be up to five (5) years.

Estimated program budget, number of awards and average award size/duration are 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-2 submission-eligible organizations (items 1 and/or 2 above) as lead investigators in the consortium. These consortium proposals may also include as partners other U.S. and non-U.S. organizations that are not eligible to submit Mid-scale RI-2 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 development 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-2 submission-eligible organization(s). Unless otherwise specified in the award, the title to the resulting infrastructure should be retained by the Mid-scale RI-2-eligible performing organization(s). Prospective PIs may contact the cognizant Mid-scale RI-2 program officer regarding organizational eligibility, and for information on other NSF funding opportunities for instrumentation and research infrastructure.

Additionally:

- **Major Facilities-related Proposals:** The Mid-scale RI-2 program will not accept proposals for an instrument or other infrastructure that augments an ongoing NSF Major Multi-user Research Facility (Major Facility) project in the construction stage since the scope of those projects is already defined. A list of such facilities can be found at <https://www.nsf.gov/bfa/ffo/>.
- **FFRDC-related Proposals:** Although 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 its FFRDCs can only be submitted as a consortium proposal by a Mid-scale RI-2 submission-eligible organization under item 3(b) above. In addition to at least two Mid-scale RI-2 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-2 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:

There is no limit on the number of preliminary proposals an organization may submit 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: 2

An individual may serve as the Principal Investigator (PI) or a co-Principal Investigator (co-PI) for no more than two (2) proposals. 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:** Submission of Letters of Intent is required. Please see the full text of this solicitation for further information.
- **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 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

- **Letter of Intent Due Date(s) (required)** (due by 5 p.m. submitter's local time):

February 03, 2021
- **Preliminary Proposal Due Date(s) (required)** (due by 5 p.m. submitter's local time):

March 05, 2021
- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):

September 20, 2021

Proposal Review Information Criteria

Merit Review Criteria:

National Science Board approved criteria. Additional merit review criteria 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 need for a well-defined NSF mid-scale research infrastructure funding program has been recognized by stakeholders in the scientific community and by Congress in the American Innovation and Competitiveness Act (AICA) of 2017. Responding to Congress, the National Science Board report, “Bridging the Gap: Building a Sustained Approach to Mid-scale Research Infrastructure and Cyberinfrastructure at NSF”^[1], 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 (Major Research Equipment and Facilities Construction) account. Mid-scale research infrastructure can also provide the foundations for new innovative large infrastructure, 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 notes 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.

The Mid-scale Research Infrastructure programs are aimed at transforming scientific and engineering research fields as well as science, technology, engineering and mathematics (STEM) education research by making available new capabilities, while simultaneously training early-career researchers in the development, design, and construction of cutting-edge infrastructure.

This solicitation for Mid-scale RI-2 activities supports implementation of projects with a total cost ranging from \$20 million to below the threshold for Major Facilities projects, currently \$100 million. Mid-scale RI-2 projects will directly enable advances in any of the research domains supported by NSF, including STEM education research. Projects may also include upgrades to existing research infrastructure.

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

II. PROGRAM DESCRIPTION

Mid-scale RI-2 is an NSF-wide competitive program that addresses scientific demand for research infrastructure in the \$20 million - \$100 million cost range for implementation. Mid-scale RI-2 is intended to support visionary projects that are high-priority national needs as identified by research communities of the United States, rather than projects primarily serving regional, campus or local interests. Solving the most pressing scientific and societal problems of the day – such as those called out in National Academies reports and decadal surveys, identified through research community planning and prioritizing exercises or other emerging national priorities– using new technologies, techniques, and concepts is encouraged in this competition. The scientific justification should demonstrate how the proposed infrastructure provides potentially transformative research capability or access relative to what is currently available to the general U.S. 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 should show the project’s value and benefit to the U.S. science community.

Proposals for infrastructure that is part of a larger project must clearly state the impact of the proposed infrastructure on the project, whether and how any specific part(s) of the infrastructure would be identified with NSF, and the benefit to the U.S. research communities that NSF supports.

The Total Project Cost (TPC) to NSF for implementation must be at least \$20 million and less than \$100 million.

NSF defines Research Infrastructure (RI) as any combination of facilities, equipment, instrumentation, or computational hardware or software, and the necessary human capital in support of the same. Major facilities and mid-scale projects are subsets of research infrastructure. The NSF Mid-scale Research Infrastructure-2 Program (Mid-scale RI-2) supports the implementation of unique and compelling RI projects at a national scale. Mid-scale RI-2 projects may include any combination of equipment, instrumentation, cyberinfrastructure, broadly used large-scale data sets, and the commissioning and/or personnel needed to successfully complete the project. Mid-scale RI-2 projects should fill a research community-defined scientific need or national research priority that enables current and next-generation U.S. researchers and a diverse STEM workforce to remain competitive in a global research environment. Mid-scale RI-2 investments are expected to demonstrate high potential to significantly advance the Nation’s research capabilities. Mid-scale RI-2 projects will directly enable advances in any of the research domains supported by NSF, including STEM education research. Projects may also include upgrades to existing research

infrastructure.

Mid-scale RI-2 is intended to support the implementation stage of a wide variety of mid-scale research infrastructure projects. Mid-scale RI-2 therefore uses an inclusive definition of implementation, which can include traditional stand-alone construction or acquisition as well as a degree of final development for infrastructure and equipment projects. For example, it could include a spiral development step leading to a larger system acquisition for cyberinfrastructure or other shared community research capability.

The Mid-scale RI-2 program will NOT consider preliminary or full proposals that include the following:

- Pre-implementation research and development and other community or technical preparatory activities;
- Science research (except for validation of operational capability);
- Post-implementation research, operations, and maintenance;
- Education and outreach activities other than student training in the implementation of state-of-the-art research infrastructure;
- Projects for which the amount requested from NSF is outside the limits of this solicitation;
- General-purpose buildings, support systems and equipment that are not directly required for the implementation and eventual operation of the proposed infrastructure and/or that support multi-purpose usage in addition to research, e.g., classroom, offices, or general office space;
- Infrastructure that is primarily at the regional, campus or local scale;
- Multiple pieces of infrastructure/instrumentation that are grouped together, either within a single campus or for a collection of consortium or campus labs, to meet the minimum Total Project Cost but would not be widely recognized as a single, well-integrated entity that addresses documented national research priorities; or
- Other organized activities, such as research centers, that are not consistent with the definition of NSF mid-scale research infrastructure provided in this solicitation.

Guidance on Proposals for Research Cyberinfrastructure Projects:

The Mid-scale RI-2 program will consider proposals for research cyberinfrastructure (CI) projects that aim to significantly enable new science and engineering research at national and international scales. Such research CI proposals must be strongly driven by the identified research needs of one or more science and engineering communities supported by NSF, advance the Nation's holistic research cyberinfrastructure ecosystem, and comprise innovative technical and operational objectives. Proposals that specifically focus narrowly on data storage or seek to support broadly-provisioned high-performance computing resources will **not** be supported by the Mid-scale RI-2 program. Prospective principal investigators (PIs) with questions should contact the Mid-scale RI-2 program team.

All Mid-scale RI-2 proposals seeking support are subject to return without review if noncompliance with any of the above bulleted items or guidance on research cyberinfrastructure projects is established prior to review, or declination if noncompliance is established as a result of merit review.

Proposals for mid-scale research infrastructure should describe the types of research for which the infrastructure would be used. These should be in fields of science, engineering, mathematics, or STEM education research that are typically supported by NSF programs. However, as long as they are in such NSF-supported fields, the specific research projects for which the instrumentation will be used need not be funded by NSF or the Federal government.

Mid-scale projects are ideal opportunities for training the next generation of leaders in engineering, science and technology and creators of cutting-edge new capabilities, which are otherwise uncommon. As such, proposals must include a well-developed plan for student training *in the design and implementation of mid-scale research infrastructure*, and involvement of a diverse workforce in mid-scale facility development, and/or associated data management. Training of students in design and implementation, not just in scientific exploitation of the infrastructure, is essential.

Strong project management and cost controls should be demonstrated features of the proposed Project Execution Plan (PEP), in particular the identification and mitigation of foreseeable risks, budget management and project controls, including plans for budget contingency as appropriate. Please consult NSF's Major Facilities Guide (MFG, NSF 19-068) for terms used in this solicitation, such as the PEP.

The Mid-scale RI-2 program will evaluate projects based on standard NSF merit review criteria of Intellectual Merit and Broader Impacts, as well as the solicitation-specific criteria presented below that include special attention to relevance to science drivers and community-established strategic goals and roadmaps, demonstration of technical maturity, project management, and planning for operations including data management.

In the Facilities, Equipment and Other Resources section of the proposal, proposers should include an aggregated description of the internal and external resources that the organization and its collaborators will provide to the project, should it be funded. The description should not include any quantifiable financial information.

Required supporting materials should be included as Supplementary Documents, as necessary, and must be searchable. See Section V.A for additional information.

Preliminary proposals will be evaluated and ranked for Intellectual Merit and Broader Impacts and the additional solicitation-specific review criteria via external merit review panels and/or ad hoc reviews. The PIs of highly ranked preliminary proposals will be invited to submit full proposals. Additional NSF-organized Site Visits and a Reverse Site Visit may be part of the review process for proposals selected for further consideration; a Final Design Review may also be required before full funding is awarded.

Proposals will be funded for no more than five (5) years.

Prior to making a funding decision, additional steps may be required as part of NSF's compliance 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 oversight may be appropriate, preliminary proposals and 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-2 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.

III. AWARD INFORMATION

Anticipated Type of Award: Cooperative Agreement

Estimated Number of Awards: 2 to 6

Anticipated Funding Amount: \$150,000,000 to \$200,000,000

Total funds available are anticipated to be approximately \$150 million to \$200 million over five years.

Individual awards from \$20 million up to but not including \$100 million are anticipated for advanced design and implementation, pending availability of funds. Duration of the award may be up to five (5) years.

Estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

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-2 submission-eligible organizations (items 1 and/or 2 above) as lead investigators in the consortium. These consortium proposals may also include as partners other U.S. and non-U.S. organizations that are not eligible to submit Mid-scale RI-2 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 development 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-2 submission-eligible organization(s). Unless otherwise specified in the award, the title to the resulting infrastructure should be retained by the Mid-scale RI-2-eligible performing organization(s). Prospective PIs may contact the cognizant Mid-scale RI-2 program officer regarding organizational eligibility, and for information on other NSF funding opportunities for instrumentation and research infrastructure.

Additionally:

- **Major Facilities-related Proposals:** The Mid-scale RI-2 program will not accept proposals for an instrument or other infrastructure that augments an ongoing NSF Major Multi-user Research Facility (Major Facility) project in the construction stage since the scope of those projects is already defined. A list of such facilities can be found at <https://www.nsf.gov/bfa/lfo/>.
- **FFRDC-related Proposals:** Although 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 its FFRDCs can only be submitted as a consortium proposal by a Mid-scale RI-2 submission-eligible organization under item 3(b) above. In addition to at least two Mid-scale RI-2 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-2 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:

There is no limit on the number of preliminary proposals an organization may submit 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: 2

An individual may serve as the Principal Investigator (PI) or a co-Principal Investigator (co-PI) for no more than two (2) proposals. 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.

Additional Eligibility Info:

Although more than one institution 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; use of the separately submitted collaborative proposal method is not permitted.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Letters of Intent (required):

A compliant Letter of Intent (LOI) submitted by only the lead institution is required for subsequent preliminary proposal submission. LOIs are used by NSF to gauge the level of effort for review. They will not be used as pre-approval mechanisms for the submission of proposals, and no feedback will be provided to the submitters. However, the LOI is specific to the project, project title and PI; both preliminary proposal and full proposal review requires that a compliant LOI be submitted by the deadline.

LOI may only be submitted through FastLane.

The LOI may be up to three pages in length and must be submitted through FastLane by the due date with the following information:

- Project Title: The title must begin with "Mid-scale RI-2: TITLE", or "Mid-scale RI-2 Consortium: TITLE", as applicable.
- Project Synopsis (up to 2500 text characters including project organization structure): Provide a brief summary of the project, anticipated impact to the research community, and the need for the project.
- OTHER COMMENTS section must list the name(s) and affiliation(s) of all senior personnel, including those of the Principal Investigator (PI) and Co-PIs.
- POINT OF CONTACT FOR NSF INQUIRIES section must list the relevant information for the PI.
- ADDITIONAL INFORMATION section should list up to 5 primary Target Disciplines that contribute to the research focus.
- PARTICIPATING ORGANIZATIONS section must list the names(s) of any other (non-lead) participating institutions or organizations, including all sub-awardees.

Submission of multiple LOIs for a single project is not allowed and each LOI is specific to the project, project title and PI.

Letter of Intent Preparation Instructions:

When submitting a Letter of Intent through FastLane in response to this Program Solicitation please note the conditions outlined below:

- Submission by an Authorized Organizational Representative (AOR) is required when submitting Letters of Intent.
- A Minimum of 0 and Maximum of 20 Other Participating Organizations are permitted
- Target discipline/s that contribute to the research focus is required when submitting Letters of Intent
- Submission of multiple Letters of Intent is permitted

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.

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 preliminary 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, February 1, 2023 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.

The project title must be concise and include the primary Mid-scale RI-2 purpose of the proposal, e.g., "Mid-scale RI-2: TITLE", or "Mid-scale RI-2 Consortium: TITLE". **Proposal titles must be identical to the corresponding LOI title that was previously submitted.**

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.

Project Summary. (1 page maximum) **The first line of the Project Summary should list the most relevant Directorates(s)/Division(s) for review of the preliminary 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 or Divisions for review is advisory to NSF. Required elements include an overview of the proposed program, and separate entries addressing the intellectual merit and broader impacts. The summary should be written in the third person, informative to those working in the same or related field(s), and understandable to a scientifically or technically literate reader. Please follow guidance in the NSF PAPPG.

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). The Project Description must address the review criteria **including the solicitation-specific criteria**, and include the following:

- As part of the **Intellectual Merit**, describe the scientific justification, including the unique research capabilities relative to what is currently available to the general U.S. research community, or lack of general availability of the requested research infrastructure and its potential to significantly advance the Nation's research infrastructure.
- As part of the **Intellectual Merit**, include a description of the proposed research infrastructure.
- As part of the **Intellectual Merit**, include a description of the research community's priority of the research infrastructure that will fulfill a community-defined national need that enables U.S. researchers to be competitive in a global research environment. Describe, if applicable, how the proposed research infrastructure responds to identified high-priority needs of a research community at a national level – such as those called out in National Academies reports and decadal surveys or identified through research community planning and prioritizing exercises or other emerging national priorities – using new technologies, techniques, and concepts. Describe how the proposed research infrastructure is uniquely innovative and/or potentially transformative.
- Along with the **Broader Impacts**, include a discussion of plans for student training and increasing participation of underrepresented minorities and women *in the design and implementation of research infrastructure*.
- Preliminary proposals *must* include an outline of operations and maintenance plans for the first five years of operation, including an estimate of any needs for ongoing, NSF-supported operations and maintenance that may be requested outside of the Mid-scale RI program.

Results from Prior NSF Support should not be included and links to URLs may not be used.

Preliminary proposals with an international component should include a description of the foreign collaborator's role in the project.

References Cited. See 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 institutions. See PAPPG for details.

Budget and Budget Justification. including budgets for any subawards. For preliminary proposals cost estimates may be preliminary estimates with the Bases of Estimate (BoE) included. Vendor quotations should not be included in preliminary proposals. If the budget includes contingency, that contingency should cover the known risks and be appropriate for risk mitigation.

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 the organization and its collaborators will provide to the project, should it be funded. 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). All Supplementary Documents must be searchable.

1. A list of all Senior Personnel (funded and un-funded, U.S. and non-U.S., advisory board members, etc.) who will collaborate on the project, their affiliations, and their role in the project. Clearly indicate any changes in Senior Personnel since the LOI was submitted.
2. A list of Partner Institutions to be funded via subawards, and the role of each in the project.
3. Biographical Sketches for foreign collaborators and letters of collaboration from foreign institutions and organizations should be included as supplemental documents to ensure commitment to the collaboration.
4. A project Work Breakdown Structure (WBS) to level three and a brief description of the project management plan. See the 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 "Current and Pending Support", "Data Management Plan", and "Postdoctoral Mentoring Plan" is not required for preliminary proposals and should **not** be included. Do not include a list of potential users of the proposed research infrastructure. **Preliminary proposals containing items other than those required above may be returned without review.**

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

Required: Collaborators & Other Affiliations (COA). This information must be submitted for all Senior Personnel (funded and un-funded, U.S. and non-U.S.) who will collaborate on the project. Information specified in the PAPPG should be submitted using the instructions and spreadsheet template found at <https://nslf.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.

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) 292-8134 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) 292-8134 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 may be submitted only 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 scope, cost, schedule, and management of the project. 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 must be comparable in scope and cost 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.

Proposal Contents

The proposal should consist of the following elements:

Cover Sheet: For planning purposes, February 1, 2023 should be shown as the start date. Identify the program solicitation number in the program announcement/solicitation block.

FastLane Users: Select this Mid-scale RI-2 program solicitation number from the pull-down list.

Grants.gov Users: The program solicitation number will be pre-populated by Grants.gov on the NSF Grant Application Cover Page. Select "Mid-scale Research Infrastructure" as the program for your proposal.

The project title must be concise and convey the primary purpose of the proposal, e.g., "Mid-scale RI-2: Title." Consortium project titles must also be identified in the title: "Mid-scale RI-2 Consortium: Title." Proposal titles must be identical to the corresponding preliminary proposal title and corresponding LOI title that were previously submitted.

NSF proposals identify only a single PI and up to four co-PIs with those titles. For the purposes of the Mid-scale RI-2 program, other major participants may be indicated as "Senior Personnel." Please see the NSF PAPPG for definitions of Senior Personnel.

Project Summary (1 page maximum): See guidance for Preliminary Proposals. **The first line of the Project Summary should list the most relevant Directorates(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 system. The proposer cannot edit this form.

Project Description (25 pages maximum unless otherwise specified in the invitation letter): Must include the following (required section headings are highlighted in boldface):

- **Science Drivers:** Describe the potential for addressing one or more identified high-priority science goals within the relevant research community, its potential for advancing scientific discovery, and the project's potential benefit to the broader U.S. research community. Explain how the proposed infrastructure provides unique research capability and/or increased general access to major research infrastructure. Discuss relationship to emerging national research priorities, if applicable. Discuss benefits to the research community (access to instrumentation, new research resources, data products, etc.). Identify how the proposed instrumentation responds to identified high-priority needs of a research community.
- **Quality and Uniqueness:** Describe the proposed cutting-edge research infrastructure and how it will provide research capabilities not otherwise

available in the United States.

- **Pre-implementation Activities Accomplished:** 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 proposals for which preliminary design documents are available, those documents should be uploaded in the Supplementary Documents section.
- **Implementation Plan:** Discuss the management and technical activities that will be accomplished to prepare, initiate, execute and conclude implementation of the project through commissioning. This section should include a summary of the Project Execution Plan including a description of technical readiness and project management, and an organizational chart or list of senior personnel and their roles (see Supplementary Documents).
- **Operations and Utilization Plan:** Discuss the overall plan for operating the infrastructure including at 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 that may be requested outside of the Mid-scale RI-2 program during the first five years of operations.
- **Lifecycle Cost Estimation summary:** Summarize the lifecycle cost estimation (see Supplementary Documentation). Include a summary of activities and key cost drivers for each future lifecycle stage starting with implementation and ending with divestment.
- **Broader Impacts:** This section should describe the anticipated broader impacts of the infrastructure, and specifically include how the implementation of the proposed infrastructure contributes to student training and involvement of a diverse workforce *in design and implementation of mid-scale research infrastructure*. Education and outreach activities beyond student training for state-of-the-art research infrastructure design and implementation are not allowed. Provide an estimate of the size of the anticipated user base for the proposed research infrastructure and the basis of this estimate, but do not include names or organizations of potential users.
- **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. See the PAPPG for details.

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

References Cited: See NSF PAPPG for guidance.

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

Budget and Budget Justification: Include budgets for any subawards. Projects must submit their budgets in accordance with the PAPPG. Budgets should be supported by the four characteristics of a high-quality estimate: well-documented; comprehensive; accurate; and credible (see the MFG). Schedules should be developed following the best practices. If the budget includes contingency, that contingency should cover the known risks and be appropriate for risk mitigation. (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. Use of Earned Value Management (EVM) should be considered. PIs should consult the NSF Major Facilities Guide (MFG) for discussion of risk, EVM, and fee. The payment of fee is authorized for this announcement. Refer to the NSF MFG for further information, including limitations.

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

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

Supplementary Documents (to be entered in the Supplementary Documents section of FastLane or Grants.gov): All Supplementary Documents must be searchable.

A. For all proposals: List of all Senior Personnel (funded and un-funded, U.S. and non-U.S., advisory board members, etc.) who will collaborate on the project, their affiliations, and their role in the project. Clearly indicate any changes in Senior Personnel since the preliminary proposal was submitted.

B. For all proposals: List of partner Institutions including those to be funded via subawards, and the role of each in the project.

C. For all proposals: Project Execution Plan (PEP). Mid-scale projects should be executed using well-established project management methodology. The specific project management approach used should be scaled to the needs of the project. The PEP should demonstrate the readiness of the project to be executed when an award is made, and will be accordingly assessed during merit review. The following list provides the minimum required components of the PEP for a mid-scale project. The content for each of these PEP components is defined in the NSF MFG. The PEP should be appropriate for the complexity of the project, and may not require all of the elements described in the MFG. Should the PI believe that some elements of the PEP are not applicable or need modification, an associated justification for modification or exclusion of a section listed below should be provided. Some material may be a duplication from other sections of the Mid-scale RI-2 proposal but should nevertheless be included in the PEP for completeness and reference as the project proceeds. Concurrence on an initial PEP must be reached between NSF and the proposing organization prior to any award. It is expected that the PEP will evolve during the execution of the award.

A template for the Mid-scale RI-2 PEP will be sent to the PI with the invitation to submit a full proposal.

1. Introduction
2. Organization
3. Project Definition
4. Risk and Opportunity Management
5. Configuration Control
6. Acquisitions
7. 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.)
8. Cyberinfrastructure (Note: Proposed Mid-scale RI-2 projects that are focused on Cyberinfrastructure should use sections 2 and 3 to fully describe the project. In all cases, proposals that include use of existing external shared cyberinfrastructure including computing, data, software, and networking infrastructure and resources should discuss that utilization here.)
9. 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.)

D. For all proposals: Cost and schedule for all stages of the project lifecycle: development, design, implementation, operations, and divestment. Actual costs incurred should be included for development and design prior to the Mid-scale RI-2 proposal submission. Detailed budgets for implementation must be supported by well-documented bases of estimate (BoE) in accordance with Section 4.2 of the MFG. Budget estimates should also be included for the first year

Other Budgetary Limitations:

Please see the Program Description for more information.

C. Due Dates

- **Letter of Intent Due Date(s) (required)** (due by 5 p.m. submitter's local time):
February 03, 2021
- **Preliminary Proposal Due Date(s) (required)** (due by 5 p.m. submitter's local time):
March 05, 2021
- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):
September 20, 2021

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: <https://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

In addition to the general NSF merit review criteria (Intellectual Merit and Broader Impacts), reviewers will address the following:

1. **Science drivers:** the proposal will be evaluated on its potential for addressing one or more identified high-priority science goals within the relevant research community, its potential for advancing scientific discovery, and the project's potential benefit to the broader U.S. research community. Examples of benefit include, but are not limited to, new and unique research capability, access to the infrastructure, access to data products and software, and cooperation and sharing of technology with other projects.
2. **Quality and Uniqueness:** the proposal will be evaluated on its potential to deliver cutting-edge research infrastructure that provides capabilities not otherwise available in the United States.
3. **Pre-implementation activities accomplished:** the proposal will be evaluated on completeness of the development and design activities that have led to the project being ready for mid-scale support and the breadth of a potential user base for the completed instrumentation.
4. **Technical readiness:** the proposal will be evaluated on the technical readiness of the project to be implemented within the proposed award duration.
5. **Project management:** the proposal will be evaluated on the strength and maturity of the Project Execution Plan (PEP) 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, as described in Section V.A., Proposal Preparation Instructions for Full Proposals.
6. **Operations plan and project lifecycle:** the proposal 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. Cost estimates for i) implementation, ii) operation and maintenance, and iii) decommissioning and divestment will be evaluated.
7. **Training of a diverse workforce:** The proposal will be evaluated on how it will contribute to student training *in the design and implementation of mid-scale research infrastructure*, and involve a diverse workforce in mid-scale facility development, and/or associated data management.

The readiness of Mid-scale RI-2 projects for implementation will be assessed using a similar philosophy to the Final Design Review for an NSF major facility but scaled appropriately to the project.

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review, Site Visit Review, or Reverse Site Review.

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review, Site Visit Review, Reverse Site Review, and Cost, Schedule, & Management Review. Mid-scale RI-2 awards will be funded through the MREFC budget line and will require authorization from the National Science Board.

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 or the Division of Acquisition and Cooperative Support 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 and Agreements Officer in the Division of Grants and Agreements or the Division of Acquisition and Cooperative Support. 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), the Modifications and Supplemental Financial and Administrative Terms and Conditions for Major Multi-User Research Facility Projects and Federally Funded

Research and Development Centers 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) 292-8134 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:

Prior to making an award, NSF will conduct a cost analysis to verify the total amount of the award, which must be within the funding limits of this program, i.e. from \$20 million and up to but not including \$100 million.

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.

Awardees 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 Award No. (Awardee enters NSF award number.)"

Awardees 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.

TBD - Programmatic Terms and Conditions:

Programmatic Terms and Conditions will be appropriate to the complexity of the award and be determined by the cognizant PO.

TBD - Financial and Administrative Terms and Conditions:

Financial and Administrative Terms and Conditions will be appropriate to the complexity of the award and will be determined by the cognizant PO with assistance from the NSF Office of Budget, Finance, and Award Management or with assistance from an NSF Integrated Project Team, as appropriate.

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 and possible site visits to enable NSF oversight of the funded project may be required as part of the terms and conditions of the cooperative agreement. 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:

- Brian Midson, GEO, telephone: (703) 292-8145, email: bmidsn@nsf.gov
- Allena K. Opper, telephone: (703) 292-8958, email: aopper@nsf.gov
- William L. Miller, CISE, telephone: (703) 292-7886, email: wlmiller@nsf.gov
- Joy M. Pauschke, ENG, telephone: (703) 292-7024, email: jpauschk@nsf.gov

Sridhar Raghavachari, BIO, telephone: (703) 292-4845, email: sraghava@nsf.gov

- Joseph M. Whitmeyer, telephone: (703) 292-7808, email: jwhitmey@nsf.gov
- Lee L. Zia, EHR, telephone: (703) 292-5140, email: lzia@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 <https://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 (FASSED) 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.

To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at <https://www.nsf.gov>

- **Location:** 2415 Eisenhower Avenue, Alexandria, VA 22314
- **For General Information** (NSF Information Center): (703) 292-5111
- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**

Send an e-mail to: nsfpubs@nsf.gov

or telephone: (703) 292-8134

- **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 [System of Record Notices](#), NSF-50, "Principal Investigator/Proposal File and Associated Records," and NSF-51, "Reviewer/Proposal File and Associated Records." 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
Alexandria, VA 22314

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