

Planning Grants for Engineering Research Centers (ERC)

PROGRAM SOLICITATION

NSF 21-529

REPLACES DOCUMENT(S):

NSF 19-562



National Science Foundation

Directorate for Engineering
Engineering Education and Centers

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

February 16, 2021

IMPORTANT INFORMATION AND REVISION NOTES

In response to a 2017 study from the National Academies of Sciences, Engineering, and Medicine (NASEM), the Engineering Research Centers (ERC) program piloted a planning grant opportunity in 2018. This solicitation is a continuation of this pilot program. The ERC planning grants are intended to build capacity and increase preparedness in the engineering community for center-scale, high-risk/high-payoff convergent and socially relevant engineering research. The planning grant and the ERC competition are independent. Submitting or receiving a planning grant is not a requirement for participating in forthcoming ERC competitions. Prospective Principal Investigators are encouraged to read this solicitation carefully for planning grant proposal submission requirements and the ERC program priorities.

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:

Planning Grants for Engineering Research Centers (ERC)

Synopsis of Program:

The ERC program is placing greater emphasis on high-risk/high-payoff research, larger societal impact, convergent research approaches, engagement of stakeholder communities, and adoption of team science in team formation, in response to the 2017 NASEM study recommendation. The ERC program intends to support planning activities leading to convergent research team formation and capacity-building within the engineering community. This planning grant solicitation is designed to foster and facilitate the engineering community's thinking about how to form convergent research collaborations. To participate in a forthcoming ERC competition, one is not required to submit a planning grant proposal nor to receive a planning grant.

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.

- Sarit B. Bhaduri, telephone: (703) 292-2975, email: nsferc@nsf.gov
- Sandra Cruz-Pol, telephone: (703) 292-2928, email: nsferc@nsf.gov
- Dana L. Denick, telephone: (703) 292-8866, email: nsferc@nsf.gov
- Nadia A. El-Masry, telephone: (703) 292-4975, email: nsferc@nsf.gov
- Mehdi Ferdowsi, telephone: (703) 292-9051, email: nsferc@nsf.gov
- Deborah J. Jackson, telephone: (703) 292-7499, email: nsferc@nsf.gov
- Randy Duran, telephone: (703) 292-5326, email: nsferc@nsf.gov

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

- 47.041 --- Engineering

Award Information

Anticipated Type of Award: Standard Grant

Estimated Number of Awards: 20

The number of awards is dependent upon the proposals received and the degree to which proposals meet the solicitation goals, NSF merit review criteria, and solicitation-specific review criteria. The planning grant is for one year and the proposed budget for each planning grant should not exceed \$100,000.

Anticipated Funding Amount: \$2,000,000

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

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.

Who May Serve as PI:

The PI must be an engineering faculty whose main appointment is in an engineering department/school/college who has not previously been awarded an ERC Planning Grant as a PI. Co-PIs may be from any department.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

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

An individual may be listed as a PI or co-PI on only one planning grant proposal.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not required
- **Preliminary Proposal Submission:** Not required
- **Full Proposals:**
 - Full Proposals submitted via FastLane: *NSF Proposal and Award Policies and Procedures Guide* (PAPPG) guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.
 - Full Proposals submitted via Research.gov: *NSF Proposal and Award Policies and Procedures Guide* (PAPPG) guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.
 - Full Proposals submitted via Grants.gov: *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov* guidelines apply (Note: The *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide).

B. Budgetary Information

- **Cost Sharing Requirements:**

Inclusion of voluntary committed cost sharing is prohibited.
- **Indirect Cost (F&A) Limitations:**

Not Applicable
- **Other Budgetary Limitations:**

Not Applicable

C. Due Dates

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

February 16, 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:

Standard NSF award conditions apply.

Reporting Requirements:

Standard NSF reporting requirements apply.

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I. INTRODUCTION

The 2017 study from the National Academies of Sciences, Engineering, and Medicine [NASEM study], "A New Vision for Center-Based Engineering Research" (<https://www.nap.edu/catalog/24767/a-new-vision-for-center-based-engineering-research>), recommends that the National Science Foundation (NSF) place a greater emphasis on forming research centers focused on solving convergent problems that address challenges with significant societal impact. Convergent problems require the integration of knowledge, tools, and ways of thinking from life and health, physical, mathematical and computational sciences, social and other sciences, engineering disciplines, and beyond. A deeper explanation of the convergence concept can be found in a 2014 National Academies report, "Convergence: Facilitating Transdisciplinary Integration of Life Sciences, Physical Sciences, Engineering and Beyond" (<https://www.nap.edu/catalog/18722/convergence-facilitating-transdisciplinary-integration-of-life-sciences-physical-sciences-engineering>) and in the NSF's Big Idea: Growing Convergence Research at NSF website (https://www.nsf.gov/news/special_reports/big_ideas/convergent.jsp).

The NASEM study further recommends that NSF invest in a deliberate, early-stage process for the development and formation of the best research teams to tackle complex, high-impact societal problems using the Team Science best practices defined in "Enhancing Effectiveness of Team Science" by the National Academies (<https://www.nap.edu/catalog/19007/enhancing-the-effectiveness-of-team-science>). According to this 2015 report, challenges for team science arise from seven key features: (i) highly diverse team membership, (ii) deep knowledge across disparate disciplines, (iii) the large size of the team, (iv) alignment of goals across all members of the team, (v) wide geographic dispersion, (vi) permeability of team boundaries, and (vii) high task interdependence.

Following the NASEM study recommendations, the ERC program is placing greater emphasis on **societal impact, convergence, stakeholder community, and team formation**. The ERC program will support planning grants to facilitate the engineering community in forming and enhancing convergent research collaborations.

II. PROGRAM DESCRIPTION

Planning Grant Overview

The Planning Grants for ERC solicitation is a mechanism for increasing capacity across the engineering academic community to develop ideas, facilitate team formation, and foster stakeholder community networks. As a result of planning grant activities, potential ERC teams should be better equipped to carry out center-scale high-risk/high-payoff convergent engineering research with large societal impact. Proposers funded through this solicitation may use the funding to organize catalytic activities that can help crystallize the engineering research theme and strengthen the following four areas:

- societal impact,
- high-risk/high-payoff convergence research,
- stakeholder community engagement, and/or
- team formation, including effective leadership/management.

Given the complexity of the proposed endeavor, NSF recognizes that many teams will identify an important societal challenge but may not have the full complement of skills needed to successfully address the challenge or may lack effective relationships with their stakeholder community. For these types of challenges, the planning grants can be used to support team formation activities (e.g., filling expertise gaps), to develop and nurture relationships with the stakeholder community, or to access specialized frameworks or resources needed to address the proposed challenge.

ERC Program Overview

The goal of the ERC program has traditionally been to integrate engineering research and education with technological innovation to transform and improve national prosperity, health, and security. ERCs are expected to build capacity while creating an inclusive culture to support high-risk/high-payoff engineering research, discovery, education, and technological innovation producing significant outcomes within the 10-year timeframe of NSF support.

As illustrated in Figure 1, the impacts of the ERC program overall are expected to grow in scale from the engineering community, shown in the circle closest to the ERC, to the scientific enterprise, and then to society, where the largest impacts are felt. Potential outcomes of ERCs are organized within each of the four interconnected ERC foundational components: **research, engineering workforce development, diversity/culture of inclusion, and the innovation ecosystem**. These foundational components are carried out in concert through ERC activities and in alignment with the Center's strategic vision and targeted societal impact.

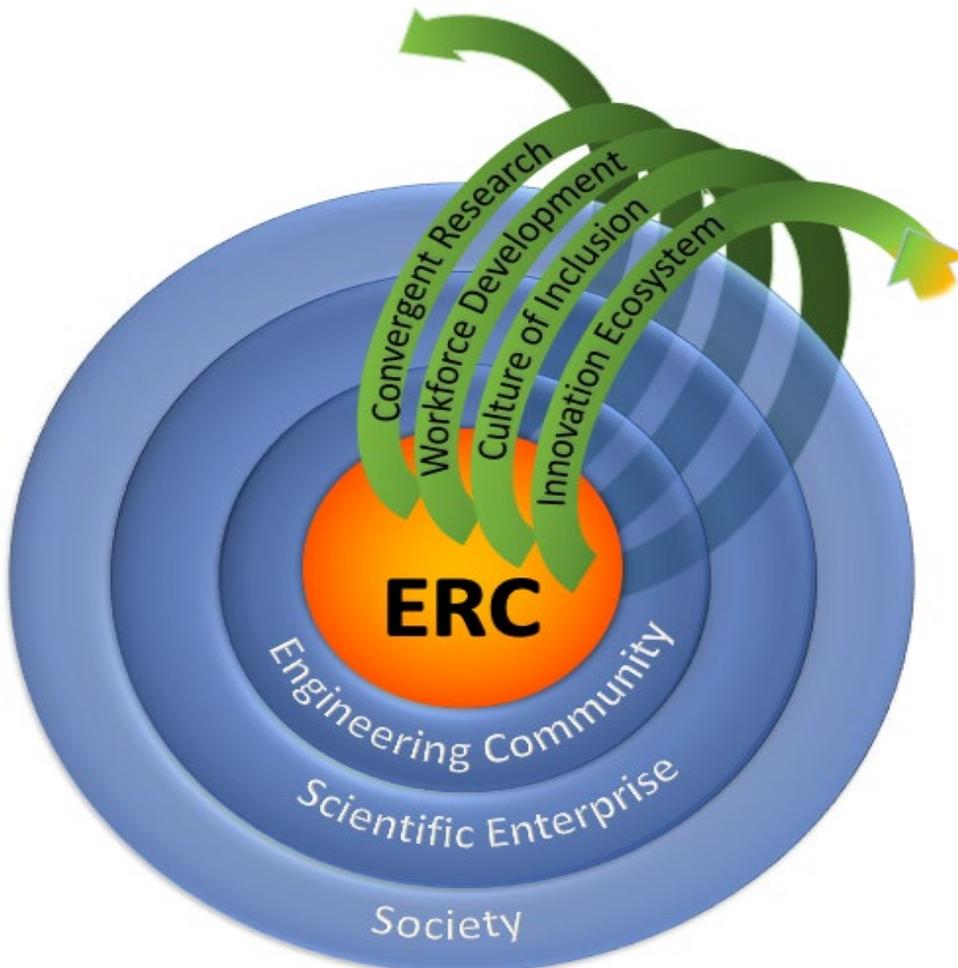


Figure 1: The NSF Gen-4 Engineering Research Center model.

In this context, NSF is interested in using ERCs to develop engineered systems, which, if successful, will have a high **societal impact**. The approach to the engineered systems challenges resonates with NSF's emphasis on **convergent research**, one of the "10 Big Ideas for NSF Future Investments" announced in May 2016. The complexity of convergent endeavors underscores the importance of purposeful **team formation**, including **effective leadership/management**, and the early engagement of **stakeholder communities**.

The bolded terms in the above paragraph are defined below.

Societal Impact represents opportunities and challenges that may be addressed through advances in engineering research and innovation for the benefit of society at large. Potential societal impact should be relevant and complex, and not limited to any specific schema of grand challenges.

Convergence is an approach to problem solving that cuts across disciplinary boundaries. It **deeply** integrates knowledge, tools, and ways of thinking from life/health sciences, physical, mathematical, and computational sciences, engineering disciplines, and beyond to form a comprehensive synthetic framework for tackling scientific and societal challenges that exist at the interfaces of multiple fields (NRC, 2014). This aligns with the NAE study's definition of convergent engineering as a deeply collaborative, team-based engineering approach for defining and solving important and complex societal problems (NAE, 2017). Convergent research has the strong potential to lead to transformative solutions or new fields of study.

Stakeholder Community includes all parties who may contribute to the ERC or may be impacted by the ERC along its capacity-building and value creation responsibilities. For example, stakeholders can include but are not limited to relevant researchers across partner institutions with complementary research and education expertise; industry leaders who can guide the innovation effort; partners for innovation, education, workforce development, and diversity; and beneficiaries of the ERC outcomes (community members, users, customers, patients, watchdog organizations, and policy-makers).

Team Formation is the process by which all necessary disciplines, skills, perspectives, and capabilities are brought together. Successful teams are interdependent, multidisciplinary, and diverse and can work and communicate effectively even when geographically dispersed. Team formation includes strategies to overcome barriers to effective, dynamic teaming, including the integration of members with different areas of expertise, different vocabularies and ways of approaching problems, different understanding of the problems to be addressed, and different working styles.

Effective Leadership/Management describes the skills needed by ERC leaders including intellectual vision and leadership, effective management of center activities, successful entrepreneurial experience, a track record of delivering results, and the ability to communicate clearly and effectively with diverse audiences, such as team members, sponsors, partners, host institutions, stakeholders, press and media, and the public. Effective ERC leadership and management teams may, for example:

- Empower all team members to contribute regardless of status and power differences;
- Establish a culture of deep collaboration and inclusion;
- Build consensus around goals and problem definition;
- Facilitate communication to ensure a common understanding; and
- Resolve conflicts and build trust.

It is rare that a single person will have all of these attributes; thus, a strong leader will need to assemble an executive team that covers this broad spectrum of skills. The Center Director should understand his/her strengths and limitations and be effective in assembling an executive leadership team that fills in any leadership/management gaps.

III. AWARD INFORMATION

Anticipated Type of Award: Standard Grant

The number of awards is dependent upon the proposals received and the degree to which proposals meet the solicitation goals, NSF merit review criteria, and solicitation-specific review criteria. The planning grant is for one year and the proposed budget for each planning grant should not exceed \$100,000.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.

Who May Serve as PI:

The PI must be an engineering faculty whose main appointment is in an engineering department/school/college who has not previously been awarded an ERC Planning Grant as a PI. Co-PIs may be from any department.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

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

An individual may be listed as a PI or co-PI on only one planning grant proposal.

Additional Eligibility Info:

No separately submitted Collaborative Proposals will be accepted.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

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

- 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 Research.gov: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal and Award Policies and 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. The Prepare New Proposal setup will prompt you for the program solicitation number.
- 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.

Planning grant proposals must contain the items listed below and adhere strictly to the specified page limitations. No additional information may be provided as an appendix or by links to Web pages. Figures and tables must be included within the applicable page limit (described below). Planning grant proposals that are not compliant with the guidelines will be returned without review. The submitting organization is responsible to ensure compliance with the guidelines. The initial team configuration at the planning grant proposal stage is recommended to include the Lead PI and up to four Non-Lead PIs who may come from any or all of the potential domestic partner universities for a future ERC proposal. No separately submitted collaborative proposals will be accepted.

Planning grant proposals should be submitted as Research proposals and follow the guidelines specified in the NSF PAPPG Chapter II.C.2, unless otherwise specified.

Title of Proposed Project: The title should begin with "Planning Grant: Engineering Research Center for" followed by the rest of the title and the Center acronym.

Project Summary (1 page): The Project Summary must be prepared in accordance with the guidance in the PAPPG, with the following supplemental guidance: The first paragraph in the Overview Section should begin with "Proposed Vision".

Project Description (maximum 6 pages total): In addition to separate section labeled "Broader Impacts" as required by the PAPPG, the Project Description must contain the following sections:

1. Currently Planned **Proposing Team**: The description must start with a table that has four columns: (1) Name of the PI or Co-PIs, (2) Institution(s), (3) Department(s), and (4) Most Relevant Field(s) of Expertise. There will be up to five rows, one for the PI and one each for up to four Co-PIs.
2. **Targeted Societal Impact**: Describe the specific societal impact(s) that the intended ERC will potentially target.
3. **Rationale**: Make the case for why an ERC is appropriate and why a convergent research approach is needed for the targeted societal impact. Identify some key, enabling ideas that will be built upon. Describe the intellectual approach and qualifications for carrying out the proposed strategies.
4. **Expected Benefits**: What would the planning grant enable that isn't currently in place?
5. **Stakeholder Community**: Describe the proposed strategies that will be used to better understand and engage the stakeholder community most appropriate for your ERC. The stakeholder community should be identified with consideration of all key components of the ERC.
6. **Team Formation**: Describe the proposed strategies that will be used to identify and bring together the best team, including effective leadership/management, to address engineering challenges for the targeted societal impact.
7. **Planning Procedures** Please describe in detail how you will use this planning grant. Include possible dates, locations, participants, objectives and outcomes of proposed planning meetings or activities, and any other relevant information. In addition, include a brief contingency plan in case in-person meetings are not possible.
8. **Anticipated Impacts**: What aspects of the proposed approach would be most likely to change as a result of the activities described in this planning grant? Where do you see the planning grant having the most impact? What are the anticipated impacts of the activities listed in the previous section? How do you assess these impacts?

Deviation from the PAPPG: Proposers are not required to include the results from prior NSF support in the Project Description.

References Cited (maximum 3 pages): See PAPPG for format guidelines; the submitting team may be asked to submit a BIBTEX file of the references at a later date.

Biographical Sketches (2-page limit for each): See PAPPG for guidelines. Should be included for the PI and up to four co-PIs responsible for managing the planning grant.

Budget: Budget justification should explain how the budget allocation supports the overall goal of the planning grant. Reviewers will closely examine all allowable expenses such as Salary/wages, Materials, Concept development, Facilitators, Teaming activities, Training, Travel, Participant support costs for planned workshops, and Other (specify). Proposal budgets should include travel funds to support one PI or co-PI to attend two NSF-sponsored cohort meetings. Note that the award funds are not meant to be used for research activities, such as preliminary research, or for proposal writing. The planning grant is for one year and the proposed budget for each planning grant should not exceed \$100,000.

The following sections should be included in the proposal, in accordance with the guidance in the NSF PAPPG: Current and Pending Support; Facilities, Equipment, and Other Resources; Data Management Plan; Postdoctoral Mentoring Plan; Collaborators & Other Affiliations Information.

No other items, letters of collaboration, appendices, or supplementary documents are permitted: If any supplementary documents and appendices are submitted, the planning grant proposal *will be returned without review*.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

C. Due Dates

- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):
February 16, 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 standard NSF Intellectual Merit and Broader Impacts Criteria, reviewers will be asked to consider the following questions:

- Is the proposed strategy appropriate for developing a potential ERC including all four foundational components defined above?
- Is a convergent research approach needed for the targeted societal impact?
- Is the proposed research idea a high-risk and potentially high-payoff?
- Are the proposed strategies for engaging and developing the stakeholder community appropriate?
- Are the proposed strategies for team formation and developing the ERC management structure appropriate?
- Does the proposal clearly identify what will change/improve as a result of the planning grant activities?

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by Panel Review.

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

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

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

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

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

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

B. Award Conditions

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

*These documents may be accessed electronically on NSF's Website at https://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 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.

Administrative and National Policy Requirements

Build America, Buy America

As expressed in Executive Order 14005, [Ensuring the Future is Made in All of America by All of America's Workers](#) (86 FR 7475), it is the policy of the executive branch to use terms and conditions of Federal financial assistance awards to maximize, consistent with law, the use of goods, products, and materials produced in, and services offered in, the United States.

Consistent with the requirements of the Build America, Buy America Act (Pub. L. 117-58, Division G, Title IX, Subtitle A, November 15, 2021), no funding made available through this funding opportunity may be obligated for an award unless all iron, steel, manufactured products, and construction materials used in the project are produced in the United States. For additional information, visit NSF's [Build America, Buy America](#) webpage.

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.

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:

- Sarit B. Bhaduri, telephone: (703) 292-2975, email: nsferc@nsf.gov
- Sandra Cruz-Pol, telephone: (703) 292-2928, email: nsferc@nsf.gov
- Dana L. Denick, telephone: (703) 292-8866, email: nsferc@nsf.gov
- Nadia A. El-Masry, telephone: (703) 292-4975, email: nsferc@nsf.gov
- Mehdi Ferdowsi, telephone: (703) 292-9051, email: nsferc@nsf.gov
- Deborah J. Jackson, telephone: (703) 292-7499, email: nsferc@nsf.gov
- Randy Duran, telephone: (703) 292-5326, email: nsferc@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
Policy Office, Division of Institution and Award Support
Office of Budget, Finance, and Award Management
National Science Foundation
Alexandria, VA 22314

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National Science Foundation, 2415 Eisenhower Avenue, Alexandria, Virginia 22314, USA
Tel: (703) 292-5111, FIRS: (800) 877-8339 | TDD: (703) 292-5090 or (800) 281-8749

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