Broadening Participation in Engineering (BPE)

PROGRAM SOLICITATION
NSF 22-514

REPLACES DOCUMENT(S):
PD 19-7680

National Science Foundation

Directorate for Engineering
   Engineering Education and Centers

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

December 03, 2021

September 21, 2022

Third Wednesday in September, Annually Thereafter

> LOIs are strongly recommended for Track 4.

Full Proposal Target Date(s):

January 28, 2022

November 16, 2022

Third Wednesday in November, Annually Thereafter

> These target dates are for BPE proposals submitted to Tracks 3 and 4 ONLY. Proposals will be accepted at ANYTIME for BPE Tracks 1 and 2.

IMPORTANT INFORMATION AND REVISION NOTES

Revision Notes

- This solicitation builds upon the prior Broadening Participation in Engineering (BPE) Program Description (PD 19-7680) and encompasses multiple pathways for engaging the engineering community:
  - *Track 1: Planning and Conference Grants,*
  - *Track 2: Research in Broadening Participation in Engineering,*
  - *Track 3: Inclusive Mentoring Hubs (IM Hubs), and*
  - *Track 4: Centers for Equity in Engineering (CEE).*
- Proposals in Tracks 1 and 2 can be accepted at any time. However, it is encouraged that projects seeking possible funding for the current Fiscal Year submit their proposals no later than June 30th. Proposals submitted after this date will be considered for funding in the subsequent Fiscal Year.
- Proposals submitted to other program announcements and solicitations for consideration in BPE, including the Faculty Early Career Development Program (CAREER), must meet their respective deadlines; please refer to the deadline dates specified in the appropriate announcement or solicitation. Proposals for EArly-concept Grants for Exploratory Research (EAGER) or Rapid Response Research (RAPID) can be submitted at any time but Principal Investigators must contact the cognizant BPE Program Director prior to submission. Supplemental funding requests and proposals for planning or conference grants can be submitted at any time, and Principal Investigators are encouraged to contact the cognizant Program Director prior to submission.
- The BPE program does not provide support for undergraduate tuition.

Important Information

Innovating and migrating proposal preparation and submission capabilities from FastLane to Research.gov is part of the ongoing NSF information technology modernization efforts, as described in Important Notice No. 147. In support of these efforts, research proposals submitted in response to this program solicitation must be prepared and submitted via Research.gov or via Grants.gov, and may not be prepared or submitted via FastLane.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) (NSF 22-1), which is effective for proposals submitted, or due, on or after October 4, 2021.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Broadening Participation in Engineering (BPE)

Synopsis of Program:

Through the Broadening Participation in Engineering (BPE) Program, NSF seeks to strengthen the future U.S. engineering workforce by enabling and encouraging the participation of all citizens in the engineering enterprise. The BPE Program seeks to support not only research in the science of broadening participation and equity in engineering, but also collaborative endeavors which foster the professional development of a diverse and well-prepared engineering workforce *as well as* innovative, if not revolutionary, approaches to building capacity through inclusivity and equity within the engineering academic experience.

To solicit the best ideas for these activities, both in formation and enactment, the BPE Program will support projects at various levels of readiness and complexity through the following four tracks: Planning and Conference Grants; Research in Broadening Participation in Engineering; Inclusive Mentoring Hubs (IMHubs); and Centers for Equity in Engineering (CEE). Specific details regarding these pathways can be found in the Program Description.

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.

- Christine S. Grant, telephone: (703) 292-7107, email: cgrant@nsf.gov

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

- 47.041 --- Engineering

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 25 to 40

- Track 1: Planning and Conference Grants (as described in Chapter II.E of the PAPPG) - 12 to 16 estimated awards.
- Track 2: Research in Broadening Participation in Engineering – 6 to 8 estimated awards.
- Track 3: Inclusive Mentoring Hubs (IMHubs) - up to 10 estimated awards.
- Track 4: Centers for Equity in Engineering (CEE) – 4 to 6 estimated awards.

Anticipated Funding Amount: $13,000,000

Subject to the availability of funds and number of submitted proposals.

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.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.
- State and Local Governments: State educational offices or organizations and local school districts.

Who May Serve as PI:

There are no restrictions or limits for BPE Tracks 1-3. For proposers submitting to BPE Track 4 (*Centers for Equity in Engineering*), the PI must be the Dean of the College of Engineering (or equivalent) or Higher of the submitting Lead Institution.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or co-PI:

There are no restrictions or limits.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Submission of Letters of Intent is optional. Please see the full text of this solicitation for further information.

- **Preliminary Proposal Submission:** Not required

- **Full Proposals:**

    - 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

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

    December 03, 2021

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    Third Wednesday in September, Annually Thereafter

    > LOIs are strongly recommended for Track 4.

- **Full Proposal Target Date(s)**:

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Proposal Review Information Criteria

Merit Review Criteria:

National Science Board approved criteria apply.

Award Administration Information

Award Conditions:

Standard NSF award conditions apply.

Reporting Requirements:

Standard NSF reporting requirements apply.

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I. INTRODUCTION

Broadening participation and equity in Science and Engineering (S&E) is critical to the Nation's present and future role as a world leader in technical innovation. According to the 2020 National Science Board's (NSB) *Vision 2030* report, "*progress in creating a diverse and inclusive S&E enterprise has not kept pace with demographic trends or with the increasing centrality of S&E to our economy, national security, and jobs of the future. America's diversity is a great strength. Leveraging that strength by broadening participation in the U.S. S&E enterprise will be crucial to fostering individual opportunity and a thriving economy.*"

NSF's own commitment to broadening participation is embedded in its Strategic Plan through a variety of investment priorities, including:

- Preparing a diverse, globally engaged science, technology, engineering, and mathematics (STEM) workforce;
- Integrating research with education; and
- building capacity.

A skilled, innovative and advanced engineering workforce relies on the talents of a diverse community reflective of the U.S. population. Diverse teams drive the development of new approaches, new ideas and new solutions. If the Nation is to remain globally competitive, the engineering enterprise must continue to increase the participation of diverse students, faculty, educators, entrepreneurs, and professionals – and support activities which address, if not remove, the barriers encountered by those traditionally underserved in S&E. (*The Skilled Technical Workforce: Crafting America's Science & Engineering Enterprise*, NSB, 2019; *Biennial Report to Congress: Broadening Participation in America's STEM Workforce*, Committee on Equal Opportunities in Science and Engineering (CEOSE), NSB, 2019)

II. PROGRAM DESCRIPTION

The BPE program seeks to strengthen the future U.S. Engineering workforce and catalyze research innovation by enabling the participation of all citizens in STEM, thus reflecting the diversity and true intellectual capacity of the Nation's population. BPE focuses on the inclusion of all traditionally underserved populations in engineering, including but not limited to, Blacks/African Americans, Latino/Hispanic Americans, American Indians, Alaska Natives, Native Hawaiians and Other Pacific Islanders, women and girls, and persons with disabilities. Other populations might include English-language learners, veterans, individuals from low-resourced areas, individuals that identify as members of the lesbian, gay, bisexual, transgender, queer (LGBTQ) community, and/or individuals facing challenging socio-economic circumstances. While race, ethnicity, gender, ability, and other identities are listed separately in the previous two sentences, the BPE program recognizes that these identities do not exist in isolation from each other.

At its core, the BPE program aims to support innovative and convergent research, curriculum, collaborations, and strategies in broadening participation and equity as they relate to engineering and the engineering profession. Communities served by the BPE program (K-12, Higher Education, Non-Profit, and Industry) are intentionally broad. *The BPE Program is not overly prescriptive by design* – and supports projects at various levels of readiness and complexity through the following four pathways or tracks:

- Track 1: Planning and Conference Grants,
- Track 2: Research in Broadening Participation in Engineering,
- Track 3: Inclusive Mentoring Hubs (IM Hubs), and
- Track 4: Centers for Equity in Engineering (CEE).

Track 1: Planning and Conference Grants (proposals accepted at anytime).

Planning and Conference Grants support efforts necessary to build capacity and establish collaborations endeavoring to address broadening participation and equity challenges in engineering at scale. *Conference Grants* focus on engaging communities and/or identifying synergies which can inform the development of a Planning Grant in the future. *Planning Grants* are designed to foster and facilitate the engineering community into thinking about how to form convergent research in BPE and/or collaborative BPE relevant projects. A BPE Planning Grant *is not a prerequisite* for submitting proposals to BPE Tracks 2 through 4.

Track 1 proposals must follow the proposal preparation instructions for "Planning Proposals" or "Conference Proposals" contained in Chapter II.E the PAPPG. A BPE Planning Grant may request up to $100,000 for a period of 1 year. Planning proposals must be prepared and submitted via Research.gov. A BPE

Conference Grant is also for 12 months in duration with an expected budget between $50,000-$100,000.

Track 2: Research in Broadening Participation in Engineering (proposals accepted at anytime).

BPE supported research activities provide scientific evidence that engineering educators, administrators, employers, and policy makers need to make informed decisions regarding the implementation of effective programs that broaden participation and in the engineering discipline and workforce.

BPE funds research to:

- Understand the systemic barriers that prevent traditionally underserved communities from pursuing and succeeding in engineering.
- Analyze factors that enhance our ability to increase access to engineering by creating support systems and social networks that raise career awareness about different engineering pathways.
- Develop innovative methods and projects to significantly impact the recruitment and retention of engineering students, faculty and employees from traditionally underserved communities.
- Design and transform culture to make diversity, equity and inclusion a priority in the engineering enterprise.

Such research spans K-12 to the professional and academic workforce. BPE funded research should produce outcomes that are scalable, sustainable and applicable to various contexts, settings and demographics within the engineering enterprise. BPE is particularly interested in research that employs intersectional approaches in recognition that gender, race and ethnicity do not exist in isolation from each other and from other categories of social identity.

To offer the greatest impact to the engineering community, BPE proposed research activities must be supported by relevant data, leverage BP foundational work where appropriate, and have the capability to produce a model that can be replicated in across the ENG community. *Well defined research questions should also form the backbone and substance of the proposed work.*

In addition, BPE is equally interested in research activities that align with and provide meaningful connections to the NSF INCLUDES National Network. The overarching goal of NSF INCLUDES is to achieve significant impact at scale in transforming STEM education and workforce development by educating a diverse, STEM-capable workforce that includes talented individuals from all sectors of the Nation's population. Collaborations are encouraged between BPE proposals and existing NSF INCLUDES projects (for example, the NSF INCLUDES Alliances and Coordination Hub), provided these collaborations strengthen both the BPE and NSF INCLUDES projects and enable mutually beneficial outcomes through leveraged resources.

The average award size for a BPE research grant is $400,000 for up to 36 months. Principal Investigators who wish to submit a proposal with a budget greater than $400,000 must contact the cognizant NSF BPE Program Director prior to submission.

Track 3: Inclusive Mentoring Hubs (IMHubs) (proposals to be submitted by Target Date).

According to a recent report from the National Academies of Sciences, Engineering, and Medicine (NASEM), mentoring "is a catalyst capable of unleashing one's potential for discovery, curiosity, and participation" and "serves an essential role in developing science, technology, engineering, mathematics, or medicine (STEMM) professionals" (*The Science of Effective Mentorship in STEMM*, NASEM, 2019). NSF celebrates excellence in mentoring in a number of initiatives, including the Presidential Award for Excellence in Science, Math and Engineering Mentoring (PAESMEM) – include link.

The BPE Program encourages proposals *from all engineering disciplines* that investigate or leverage promising approaches to STEM related mentoring in an effort to establish all-access, open-platform racially and ethnically Inclusive Mentoring Hubs (IMHubs). "All access" refers to a platform which permits full, rather than limited, access. "Open platform" is a platform in which any willing party can build applications upon it that work together. The goal of these IMHubs is to connect and dynamically build networks for racial and ethnic groups not sufficiently represented in STEM or, more specifically, the engineering profession. Communities served by the IMHubs may include one or more of the following:

- Students (K-12, undergraduate and graduate);
- University and College Faculty and Leaders;
- Postdoctoral and Career Transitioning Researchers;
- Small Businesses and Industry Professionals;
- K-12 Educators and Practitioners; and
- Researchers from National Labs.

An IMHub is expected to offer free access to mentoring and networking opportunities; provide professional development programs for members to participate in; and coordinate institutional and organizational involvement in order to curate, develop and expand mentoring programs. IMHub activities could include participation in curriculum-based modules focused on engineering as a career; grant writing (NSF proposal preparation); entrepreneurship; transitioning between academia and industry (or government); and mentor/mentee training and skills development. IMHub activities may also include structured individual professional development (IPD) assignments for those who plan to enter, or who have recently entered, the engineering workforce or academia (such as engineering graduate students, postdoctoral researchers and early career faculty). Although IMHUbs proposals can leverage or build upon existing mentoring resources, it is recommended that such activities also be creative, innovative and distinct in their approach.

An IMHub may represent one or multiple engineering fields, depending on its targeted network and community/communities. IMHubs will be encouraged to share best practices and connect, at a larger scale and where appropriate, to the NSF INCLUDES National Network as well as other NSF/ENG Divisions or Programs relevant to the IMHub's community.

IMHub projects are expected to have a duration of at least 5 years and a proposed budget not to exceed $800K. IMHub proposals should be submitted by the lead Institution with at least two partnering institutions (as sub-awards to the submitted budget). The first two years of the grant would focus funds and efforts for design, development and deployment of the IM Hub, with the remaining years focused on fostering additional partnerships and charting a path towards sustainability). Expansion supplements will be available in years three through five to catalyze and support these additional partnerships, as appropriate.

Track 4: Centers for Equity in Engineering (CEE) (proposals to be submitted by Target Date).

In recent years, there has been a growing recognition of the need to create and support an inclusive and innovative engineering profession for the 21st Century. (*Vision 2030*, NSB, 2020; (*Engineering Diversity: Fixing the Educational System to Promote Equity*, NAE, 2013; NSF Strategic Plan for Fiscal Years 2018-2022, *2018 Status Report on Engineering Education*, APLU, 2018). Doing so requires an understanding of how engineers from all communities are formed and how they can be supported to successfully obtain both the technical and professional skills needed to solve complex, often critical, problems facing today's society. Since 2017, over 220 engineering colleges from across the county have committed their resources, through the *ASEE Deans Diversity Pledge*, to fostering programs, pipelines, partnerships, and proactive strategies which increase "diversity in enrollments, retention and graduation rates of engineering and engineering technology students [as well as] diversity in our faculty and in the engineering workforce, over the next decade" (ASEE Diversity Recognition Program, 2021).

Through this track, the BPE Program seeks to catalyze (through the development of *Centers for Equity in Engineering*) a culture change in the education of next generation of engineers as it relates to creating equitable and inclusive practices which both recruit and retain a diverse community of students. Proposers to this track must consider the cultural, organizational, structural, and pedagogical changes needed to transform their institution's College of Engineering to one in which all students are equally:

- Included and engaged;
- Provided with opportunities to develop and hone their technical and professional skills;
- Enabled to establish their identities as professional engineers.

All activities proposed in this track should be at the engineering college level (including community, two year and associate) or higher, and not through a singular office or engineering department. Additionally, in an effort to support the evolution and sustainability of these centers, proposers to this track will first be expected to submit a "**Phase I**" CEE proposal. **Phase I projects** and funding are focused on (1) establishing the infrastructure necessary to "stand up" the CEE within their College of Engineering and (2) deploying curricular and training related activities across the submitting institution's College of Engineering which align with the CEE co-dependent goals of inclusion and professional preparation in engineering.

BPE CEE **Phase I** projects are expected to have a duration of at least 24 months and a proposed budget not to exceed $1.2M. Phase I proposals will require an Institutional Letter from the Dean (or equivalent) of the submitting institution's College of Engineering (as described in the supplementary documents section of this solicitation).

Once the Phase I activities have been established (i.e. CEE projects coming into their second year of funding), completion of site visit, and upon discussing the proposing institution's intent to submit a CEE proposal to the next phase with their cognizant NSF BPE Program Director, proposers may submit a CEE Phase II proposal. A Phase I award is a pre-requisite for a Phase II BPE CEE proposal.

The Phase II proposal builds upon the newly established center's Phase I activities and focuses on the center partnering with additional universities and colleges to expand, enrich and sustain the program. Phase I institutions are encouraged to partner with at least two other institutions. It is highly encouraged that at least one of these partners include an institution from an EPSCoR state, minority-serving institution (MSI), or community college (for example 3-2, dual or combined programs). Phase II proposals must be submitted by the Phase I awardee (PI and institution) with partnering institutions as sub awardees. A clear plan for sustainability must be outlined in the Phase II proposal, as well as a detailed plan for resource sharing among the partnering institutions.

Additionally, both Phase I and Phase II BPE CEE proposals should include a comprehensive:

- Evaluation & Assessment Plan to be overseen by an independent evaluator (proposers are encouraged to include social scientists in their evaluation),
- Management Plan, and
- Dissemination Plan.

BPE CEE **Phase II** projects are expected to have a duration of at least 36 months and a proposed budget not to exceed $4.0 M. Phase II proposals require an Institutional Letter from the Dean (or equivalent) of the submitting institution's College of Engineering as well as the Dean (or equivalent) of the partnering institution(s) College of Engineering (as described in the "Supplementary Documents" section of this solicitation).

III. AWARD INFORMATION

Anticipated Type of Award: Continuing Grant or Standard Grant

Estimated Number of Awards: 35

Anticipated Funding Amount: $13,000,000

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:

- 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.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.
- State and Local Governments: State educational offices or organizations and local school districts.

Who May Serve as PI:

There are no restrictions or limits for BPE Tracks 1-3. For proposers submitting to BPE Track 4 (*Centers for Equity in Engineering*), the PI must be the Dean of the College of Engineering (or equivalent) or Higher of the submitting Lead Institution.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or co-PI:

There are no restrictions or limits.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Letters of Intent *(optional)*:

- Not required for Tracks 1-3, recommended for Track 4.

Letter of Intent Preparation Instructions:

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

- Submission by an Authorized Organizational Representative (AOR) is not required when submitting Letters of Intent.

- Submission of multiple Letters of Intent is not permitted

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

- 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.

In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via Research.gov. PAPPG Chapter II.D.3 provides additional information on collaborative proposals.

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.

The following instructions supplement the PAPPG or NSF Grants.gov Application Guide guidelines.

I. Instructions for BPE Proposal Preparation

Track 1 proposals must follow the proposal preparation instructions for "Planning Proposals" or "Conference Proposals" contained in Chapter II.E the PAPPG.

Proposal Title. To assist NSF staff in sorting proposals for review, proposal titles should begin with a title that identifies the BPE track (1-4) being addressed.

- "Track 1" for Planning or Conference Grants,
- "Track 2" for Research Grants in Broadening Participation in Engineering,
- "Track 3" for Inclusive Mentoring Hubs, and
- "Track 4" for Centers for Equity in Engineering.

Project Summary Content. The Project Summary must contain a list of at least 5 keywords. Place the keywords on a separate line at the end of the "Overview" section of the Project Summary.

Project Description Content. The Project Description should clearly detail the objectives and strategies of the proposed activities with respect to their associated BPE Track. The Project Description also should demonstrate an understanding of the issues and research relevant to the proposed project.

All BPE proposals should:

- Be informed by the current theoretical and scientific literature as well as add to the extant knowledge base.
- Directly address how the work will broaden the participation of one or more groups traditionally underserved in engineering.
- Describe how the outcomes have the potential to directly impact diversity, equity, and the inclusion of all communities in engineering.

Track 2, 3, and 4 proposals should:

- Provide appropriate justification to support selection of the targeted group(s), with specific and applicable objectives, and demonstrate applicable

knowledge of the relevant literature and current practices (benchmarking).
- Provide evidence of clear, measurable outcomes and consideration of how the strategy will advance knowledge beyond localized contexts.
- Include a mechanism to assess and evaluate how well the project has achieved the stated objectives. To be competitive, proposals should include evaluation and assessment components that can effectively document both successes and failures. Awardees must set (and meet) measurable goals and collect evidence to determine progress toward those goals.)
- Incorporate a strategy for dissemination that goes beyond publishing research papers and presenting at conferences. PIs should think creatively about who needs to hear about the research or supported activity for it to have a lasting effect - and develop a strategy to reach that audience.

Track 4 proposals should also include a comprehensive:

- Evaluation & Assessment Plan - *to be overseen by an independent evaluator (proposers are encouraged to include social scientists in their evaluation),*
- Management Plan, and
- Dissemination Plan.

Supplementary Documents:

- All partnerships should be documented in the proposal and letters of collaboration should be included as "Supplementary Documents" for any partners not explicitly represented by the PIs, co-PIs, and Senior Personnel. The letter(s) should express commitment, but should not praise or advocate for the project, and must follow the format for letters of collaboration given in the PAPPG. The letter(s) should be no more than 1 page.
- *A list of Project Personnel and Partner Organizations (only required for Tracks 2, 3 and 4) (Note: In collaborative proposals, the lead organization should provide this information for all participants):* Provide current, accurate information for all personnel and organizations involved in the project. NSF staff will use this information in the merit review process to manage reviewer selection. The list **must** include all PIs, co-PIs, Senior Personnel, paid/unpaid Consultants or Collaborators, Subawardees, Postdocs, and project-level advisory committee members. This list should be numbered and include (in this order) Full name, Organization(s), and Role in the project, with each item separated by a semi-colon.
- *Institutional Letter* - For Track 4 (CEE) proposals, both Phase I and Phase II proposals require a letter from the Dean of the submitting institution's College of Engineering. Phase II proposals also require a letter from the Dean of the College of Engineering from the partnering institution(s). The letter(s) should express commitment, but should not praise or advocate for the project, and must follow the format for *letters of collaboration* given in the PAPPG. The letter(s), which will be included as part of the consideration and commitment of the overall merits of the proposal, should demonstrate an understanding of, and a commitment to, building institutional and/or organizational capacity to enable the proposed work as indicated in the proposal submission. The letter(s) should be no more than 1 page in length and include the dean's (or equivalent organizational official's) name and title below the signature.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Budget Preparation Instructions:

A Budget Justification prepared in accordance with the guidance in the PAPPG must be included.
PI Meeting Attendance: Include travel funds in the budget for attendance at an annual PI meeting (at NSF).

C. Due Dates

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

    December 03, 2021

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    Third Wednesday in September, Annually Thereafter

    LOIs are strongly recommended for Track 4.

- **Full Proposal Target Date(s)**:

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PLEASE NOTE: The Target Date is for BPE proposals submitted to Tracks 3 and 4 only. Proposals will be accepted at any time for BPE Tracks 1 and 2.

D. Research.gov/Grants.gov Requirements

For Proposals Submitted Via Research.gov:

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

Research.gov user support, call the Research.gov Help Desk at 1-800-673-6188 or e-mail rgov@nsf.gov. The Research.gov Help Desk answers general technical questions related to the use of the Research.gov system. 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 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 *Leading the World in Discovery and Innovation, STEM Talent Development and the Delivery of Benefits from Research - NSF Strategic Plan for Fiscal Years (FY) 2022 - 2026*. 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 other underrepresented groups 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.

B. Review and Selection Process

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

All BPE proposals from Tracks 2, 3, and 4 will be externally reviewed.

Site visits may be incorporated as part of the review for Track 4 Phase II proposals.

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 an NSF Grants and Agreements Officer. 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:

- Christine S. Grant, telephone: (703) 292-7107, email: cgrant@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.

General inquiries may be addressed to eng-bpe@nsf.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 (FASED) provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See the *NSF Proposal & Award Policies & Procedures Guide* Chapter II.E.6 for instructions regarding preparation of these types of proposals.

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

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

> The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.
>
> 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**   (703) 292-5111
>   (NSF Information Center)**:**
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> - **TDD (for the hearing-impaired):**   (703) 292-5090
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>   or telephone: (703) 292-8134
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> - **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
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