Partnerships for Innovation (PFI)

PROGRAM SOLICITATION
NSF 18-511

REPLACES DOCUMENT(S):
NSF 16-583, NSF 16-591

National Science Foundation

Directorate for Engineering
Industrial Innovation and Partnerships

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

February 01, 2018

IMPORTANT INFORMATION AND REVISION NOTES

1. The Partnerships for Innovation (PFI) Program previously had three components: PFI: AIR-TT, PFI: AIR-RA and PFI: BIC. These components have now been subsumed under the revised Partnerships for Innovation Program.
2. This new solicitation contains two new tracks for submission, PFI-Technology Translation (PFI-TT), which is approximately equivalent to the prior PFI:AIR-TT solicitation (NSF 16-583.), and PFI-Research Partnerships (PFI-RP), which requires broad multi organization and multidisciplinary partnerships. The smart services systems focus of the PFI:BIC (NSF 16-591) has been discontinued.
3. The list of eligible organizations that can submit to this solicitation has been expanded.
4. For PFI-TT, if the PI is submitting a revision to a proposal previously submitted to any prior version of the PFI: AIR-TT program, the PI must include a 1-2 page supplementary document that summarizes prior reviewer comments and the changes that have been made in response.
5. For PFI-TT, there must be a participant in the project who brings “technology commercialization experience in the targeted field(s) of application of the proposed technology to be developed.” This further clarifies the language in prior PFI: AIR-TT solicitations that stated, “person with explicit business experience.”
6. For PFI-TT, the proposal must include at least one Letter of Support that supports and validates the claim of market potential and broader societal impact for the proposed technology.
7. PFI-RP places a special emphasis on multi-organization collaborations driven by new partnerships that leverage the multi-disciplinary capabilities of existing research consortia to pursue new innovative technology development projects.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) (NSF 18-1), which is effective for proposals submitted, or due, on or after January 29, 2018. Please be advised that proposers who opt to submit prior to January 29, 2018, must also follow the guidelines contained in NSF 18-1.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Partnerships for Innovation (PFI)

Synopsis of Program:

The NSF Partnerships for Innovation (PFI) Program within the Division of Industrial Innovation and Partnerships (IIP) offers researchers the opportunity to transform new knowledge into societal benefits through translational research and technology development efforts which catalyze partnerships to accelerate innovations that address significant societal needs.

PFI has six broad goals: (1) identifying and supporting Foundation-sponsored research and technologies that have the potential for accelerated commercialization; (2) supporting prior or current Foundation-sponsored researchers, institutions of higher education, and non-profit organizations that partner with an institution of higher education to undertake proof-of-concept work, including the development of technology prototypes that are derived from NSF-funded research and have potential market value; (3) promoting sustainable partnerships between Foundation-

funded institutions, industry, and other organizations within academia and the private sector with the purpose of accelerating the transfer of technology; (4) developing multi-disciplinary innovation ecosystems which involve and are responsive to the specific needs of academia and industry; (5) catalyzing professional development activities, mentoring, and best practices in entrepreneurship and technology translation for faculty, students and researchers; and (6) expanding the participation of women and individuals from underrepresented groups in innovation, technology translation, and entrepreneurship.

This solicitation offers two broad tracks for proposals in pursuit of the six aforementioned goals.

The Technology Translation (PFI-TT) track offers an NSF-funded researcher the opportunity to advance his or her prior NSF-funded research results towards developing technological innovations with promising commercial potential and societal impact. Projects are supported to demonstrate proof-of-concept, prototype, or technology development and scale-up while exposing faculty and students (and engaging them in) in innovation and entrepreneurially-focused activities that could possibly lead to partnership opportunities, the creation of new intellectual property and technologically-driven commercialization outcomes that address societal needs. Potential pathways forward within the PFI-TT track could be broader collaborative activities and partnerships, technology licensing, technology spin-outs, and expanded entrepreneurial activity.

The Research Partnerships (PFI-RP) track provides an opportunity to support technology development activities through a multi-organization collaboration. NSF recognizes that interdisciplinary collaboration is often needed to achieve successful technology development. This proposal track supports a research consortium ecosystem focused on a clear project thrust. It allows for partnerships between academic researchers and a variety of third-party organizations (such as industry, non-academic research organizations, federal laboratories, public or non-profit technology transfer organizations, and/or other universities) to conduct applied research in highly collaborative, multidisciplinary teams, on problems typically beyond the reach of a single researcher. NSF currently supports numerous research consortia (e.g., Engineering Research Centers, Industry-University Cooperative Research Centers, Science and Technology Centers, Nanoscale Science and Engineering Centers, Materials Research Science and Engineering Centers, Centers for Chemical Innovation, and others). Such consortia could participate in PFI-RP proposals. The goal of the RP track is to catalyze robust and synergistic partnerships and collaborations between government, academia, and other public and private entities to drive and accelerate the translation of federally-funded fundamental research results into innovations that, through technology development and commercialization, will have a significant economic and societal impact.

WEBINARS: Webinars will be held to answer questions about the solicitation. Registration will be available on the NSF Division of Industrial Innovation and Partnerships website (https://www.nsf.gov/div/index.jsp?div=IIP). Potential proposers and their partners are encouraged to attend.

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.

- Jesus V. Soriano, telephone: (703) 292-7795, email: jsoriano@nsf.gov

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

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

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 45 to 55

PFI-TT projects will be funded for up to $200,000 for 18 months per award; approximately 30-45 awards are anticipated. PFI-RP projects will be funded for up to $750,000 for 36 months. Approximately 10-15 awards are anticipated.

Anticipated Funding Amount: $16,750,000

Anticipated Funding Amount is subject to the availability of funds and the quality of proposals received.

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Academic / Research US institutions; includes universities and two- and four-year colleges (including

community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members,
- Public or Non-profit, Non-academic US organizations located in the US that are directly associated with technology transfer activities,
- Non-profit US organizations located in the US that partner with an institution of higher education, or
- A US consortium of 2 or more of the organizations described above.

Who May Serve as PI:

The PI must have the technical skills required to execute the proposed research project.

Lineage Requirement: The PFI-TT proposal track has a lineage requirement under one or two of the following paths: (1) through NSF-supported research results, or (2) NSF-supported (National I-Corps™ Teams) customer discovery results.

1. **NSF-supported research results**: Principal Investigator (PI) or a co-PI must have had an NSF award that ended no more than six (6) years prior to the full proposal deadline date or be a current NSF award recipient. The proposed technology development project must be derived from the research results and/or discoveries from this underlying NSF award.

   OR

2. **National I-Corps™ Teams customer discovery results** The Principal Investigator (PI) or a co-PI must have been a member of an I-Corps ™, Team Grant from NSF under the I-Corps™ Teams Program (https://www.nsf.gov/news/special_reports/i-corps/teams.jsp). The PI or co-PI must have fully completed the I-Corps™ training provided as part of the I-Corps™ Team grant within the past three (3) years. The customer discovery activities performed under the NSF-funded I-Corps™ award must be based on the technology that is proposed to be translated within the PFI-TT proposal.

   Note: a proposal describing sole lineage to any of the following programs is not allowed and **may be returned without review**: Research Experiences for Undergraduates (REU), Research Experiences for Teachers (RET), the Graduate Research Fellowship Program (GRFP), any prior award through the PFI Program, Regional I-Corps™, and SBIR/STTR.

   The PFI-Research Partnerships (PFI-RP) proposal track does NOT have a lineage requirement.

   For a PFI-RP proposal, in addition to the PI, there must be at least (but not limited to) one other participant on the project serving as a co-PI, who brings technology commercialization experience in the targeted fields of application (or industry sector) of the proposed technology to be developed. This co-PI must have an active role that is explicitly described along with the specification of a time commitment on the project. Additional collaborators or organizations who bring needed multidisciplinary expertise, knowledge and commercialization experience may be involved as co-PI, Senior Personnel, Other Professional, subawardee, consultant, collaborator, etc., on the proposed project.

Limit on Number of Proposals per Organization: 2

An organization may submit no more than two (2) proposals to this solicitation. This eligibility constraint will be strictly enforced. In the event that an organization exceeds this limit, the first two proposals received will be accepted, and the remainder will be returned without review. An organization will not receive more than one (1) award from this solicitation.

Limit on Number of Proposals per PI or Co-PI: 2

A PI or co-PI may submit up to two proposals to the solicitation. These could be two proposals to PFI-TT, one proposal each to PFI-TT and PFI-RP or two proposals to PFI-RP. A PI or co-PI will not receive more than one award from this solicitation. The submission of duplicate or substantially similar or equivalent proposals concurrently for review to the solicitation will result in the return of the redundant proposals.

A PI or co-PI may resubmit a previously declined proposal; however, the proposal must be revised and have taken into account the major comments or concerns resulting from the prior NSF review. A resubmission of a previously declined proposal must include a summary of the previous NSF reviewer comments and the PI's response must be included in the supplemental documents (see Supplementary Documents, below). The revised proposal will be subject to NSF's merit review process.

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 Grants.gov: *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov* guidelines apply (Note: The *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide).

B. Budgetary Information

- **Cost Sharing Requirements:**

  Inclusion of voluntary committed cost sharing is prohibited.

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

  Not Applicable

- **Other Budgetary Limitations:**

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

C. Due Dates

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

  February 01, 2018

Proposal Review Information Criteria

Merit Review Criteria:

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

Award Administration Information

Award Conditions:

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

Reporting Requirements:

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

TABLE OF CONTENTS

I. INTRODUCTION

The National Science Foundation (NSF) supports fundamental research and education in all fields of science and engineering to advance basic knowledge, strengthen the national economy and provide a benefit to society. NSF-funded research supports the discoveries that enable innovation. It lays the foundation of scientific and engineering knowledge from which technological innovation can grow.

To further broaden the impact of fundamental research funded by NSF, the Division of Industrial Innovation and Partnerships (IIP) supports applied research in order to systematically accelerate the translation of basic research results into innovation - thus allowing research outcomes to realize their commercial potential and societal impact. In addition to the PFI Program (this solicitation), programs within IIP and NSF that contribute to this mission include Innovation Corps (I-Corps™), Industry-University Cooperative Research Centers (IUCRC), Small Business Innovation Research/Small Business Technology Transfer Research (SBIR/STTR), and Grant Opportunities for Academic Liaison with Industry (GOALI).

II. PROGRAM DESCRIPTION

The National Science Foundation (NSF) invites requests for funding under the Partnerships for Innovation (PFI) solicitation. The goals of the PFI program are: (1) identifying and supporting Foundation-sponsored research and technologies that have the potential for accelerated commercialization; (2) supporting prior or current Foundation-sponsored researchers, institutions of higher education, and non-profit organizations that partner with an institution of higher education to undertake proof-of-concept work, including the development of technology prototypes that are derived from NSF-funded research and have potential market value; (3) promoting sustainable partnerships between Foundation-funded institutions, industry, and other organizations within academia and the private sector with the purpose of accelerating the transfer of technology; (4) developing multi-disciplinary innovation ecosystems which involve and are responsive to the specific needs of academia and industry; (5) catalyzing professional development activities, mentoring, and best practices in entrepreneurship and technology translation for faculty, students and researchers; and (6) expanding the participation of women and individuals from underrepresented groups in innovation, technology translation, and entrepreneurship.

Two tracks are available for requesting funding from NSF through the PFI Program, as described below.

Partnerships for Innovation - Technology Translation (PFI-TT): This proposal track is aimed at supporting individual researchers seeking to develop new technological innovations based on prior NSF-funded basic research. PFI-TT is designed to support applied research and early prototyping activities that are aimed at solving significant technical challenges in the translation of fundamental science and engineering research results into market-valued innovations. The anticipated program outcomes from PFI-TT will be technological developments that inform a path toward commercial reality and societal impact (ideally under a SBIR/STTR-funded start-up company or under a license to an established corporation in the intended field of use); the development of collaborations between faculty, students and individuals knowledgeable about market need (e.g., potential customers, individuals with business and technology commercialization experience, potential investors, etc.); the engagement of faculty and students in technology translation and entrepreneurial/innovative thinking; and the inclusion of women and individuals from underrepresented groups in the technology development/entrepreneurial endeavor.

Technology Development

The development of basic research into deployed technology is often depicted as a sequence of phases from basic research through proof-of-concept, prototype iteration, product development and finally commercialization, with each phase having unique and often significant challenges to be overcome. While the sequence of events may not occur in a straightforward linear fashion, the knowledge associated with each phase is necessary for the transition from basic research towards commercialization to occur. PFI-TT is aimed at advancing knowledge along this continuum for projects with technology innovation(s) coming forth from the basic research/ discovery phase. The proposed research should identify the next stage of technology/knowledge gap(s) or barrier(s) that must be overcome as part of the path from the basic research discovery to eventual successful commercialization and societal benefit. The goal of the PFI-TT program is to provide funding support to overcome such significant technological challenges that have been identified as hurdles in the technology translation process towards commercialization. The proposed project should be aimed at reaching early proof-of-concept or prototype stage or technology scale-up demonstration, based on measurable outcomes that corroborate a clearly identified and substantiated potential market need or application, and inform the subsequent path towards technology commercialization. In other words, there should be new knowledge (Intellectual Merit) at the end of the award that has been used to solve a significant technical challenge(s) to move the technology closer toward commercialization and societal benefit. (Broader Impact)

Commercialization Potential

Another dimension of the path from basic discovery to successful commercialization involves an understanding of various business and commercial aspects of translating the innovation towards market application, such as market need, value proposition, target industry sector, potential customer segments, potential channels, and early understanding of the supply-chain, product-market fit, development of a preliminary intellectual property strategy (freedom to operate, patentability, copyright, trade secret, etc. as applicable), regulatory issues, etc. The proposal should demonstrate an initial, basic understanding of the relevant issues. The expectation is that, over the course of the project, the participant with “technology commercialization experience in the targeted field(s) of application/industry sector in the field of use of the proposed technology” will lead the effort to advance the team’s understanding of the business aspects of the project alongside the team’s technical progress. Together, this should inform the ensuing commercialization strategy (such as SBIR/STTR funding of a spin-out company, licensing to a more mature corporation, etc.)

It is important to note that a successful proposal **must** demonstrate both initial research results and an initial understanding of the target market segment. The proposal must present evidence of prior NSF-funded research results and discuss how these results lend credence to the proposed technology translation project that, in turn, will address the next significant technical hurdles. In addition,

proposers whose lineage is in NSF-supported research results, and not in the **National I-Corps™ Teams customer discovery results,** are strongly encouraged to have participated in some type of customer discovery program to achieve a greater understanding of the market potential of their technology. Evidence of market potential **must** be substantiated by at least one (but not more than three) Letter(s) of Support from a potential future commercialization partner (an entity interested in potentially partnering in the development, scale-up, manufacturing or sale of the future product or service) who is not a funded partner on the proposed project. The Letter(s) of Support must provide a specific discussion of the commercial and societal value and need for the proposed technology in a particular market and serves to provide a measure of external market validation for the proposed project. The Letter(s) of Support could also come from potential users (customers) for the proposed process, product or service.

Collaborations

Collaborations are encouraged and, depending on the nature of the collaboration, can help accelerate development of the proposed technology towards the anticipated market application. Collaborators may include individuals/entities internal and/or external to the proposing organizations and may be included in the budget or not. Any substantial collaboration with individuals/entities not included in the budget should be described in the Facilities, Equipment and Other Resources section of the proposal (see PAPPG). In either case, whether or not the collaborator is included in the budget, a letter of collaboration from each named participating entity must be provided at the time of submission of the proposal (see Supplementary Documents, below).

Partnerships for Innovation – Research Partnerships (PFI-RP): This proposal track seeks to accelerate the translation and transfer of research discoveries into competitive technologies that address societal needs through highly collaborative, multi-organization partnerships. In addition, the technological activities supported by the PFI-RP option a) promote the development and sustainability of an academia-based innovation ecosystem that fosters regional, technology-based economic development; b) will result in training of faculty and students in the practice of technological innovation; and c) seeks to include women and individuals from underrepresented groups in the technology development/early commercialization endeavor. To accomplish these goals, submissions to PFI-RP are expected to have an active partnership between an academic institution, and one or more separate additional entities.

Although one additional partner is the minimum requirement, NSF encourages the participation of as many entities as needed to build the relationships required to develop and sustain a strong team capable of rapid technological innovation towards addressing pressing societal needs. The entities that can participate in a PFI-RP proposal include a consortium involving academic, industrial, and/or investment entities, as well as public or non-profit technology transfer organizations to pursue complex and challenging projects that would far exceed the capabilities and resources of an individual researcher.

Special interest is focused on affording opportunities for:

- Interdisciplinary university-industry teams to conduct collaborative research projects, in which the industry research participant provides critical research expertise, without which the likelihood for success of the project would be diminished.
- Faculty, postdoctoral fellows, and students to conduct research and gain experience in an industrial setting; and industrial scientists and engineers to bring industry's perspective and integrative skills to academia, with a strong emphasis in the participation of women and individuals from under-represented groups.
- Participation of other non-profit organizations with deep research and development expertise to facilitate technology translation activities
- Leveraging the capabilities of consortia such as (but not limited to) NSF-funded consortia to develop technological innovations from prior funded basic research results. Examples of NSF research consortia include NSF centers, such as Engineering Research Centers, Industry University Cooperative Research Centers, Science and Technology Centers, Nanoscale Science and Engineering Centers, Materials Research Science and Engineering Centers, and Centers for Chemical Innovation. Other examples include, but are not limited to, large, multi-year, multi-faculty/institution awards such as NSF's Directorate for Computer and Information Science and Engineering (CISE) Expeditions in Computing, CISE Frontiers, and NSF's Directorate for Engineering (ENG) Emerging Frontiers in Research and Innovation (EFRI). Lead Organizations submitting proposals to the PFI-RP track could partner with such consortia to pursue technology development projects to address societal needs.

PFI-RP proposals should focus on research projects and activities where academic researchers and industrial partners can form strong collaborative partnerships or consortia. The proposed project should further scientific and engineering foundational outcomes to enable breakthrough technologies with the potential to address critical industrial and societal needs. Industry involvement assures that the research is industry-relevant. Principal Investigators are expected to integrate their research objectives with educational and industrial needs. Interdisciplinary research and education projects that enable researchers from different academic and non-academic organizations to interact with one or more industrial partners in industry-university groups or networks are encouraged. Proposals may include the participation of a non-profit organization that has research and technology translation experience. NSF funding can be used for university research/education activities and may support activities of faculty and their students and research associates in the industrial setting.

At least one of the partners in the proposed project must bring technology translation expertise to the project team. It is also allowable that an entity may serve as both a research partner and a technology transfer partner; however, in that case, the proposal must make clear how the entity performs both roles.

This PFI-RP track is aimed at technology development, translation and transfer, e.g., applied research activities necessary to accelerate technologies with a clear value proposition toward commercial realization. It is an opportunity to develop an innovation focus in existing research endeavors that have advanced beyond the fundamental research stage and which, for that reason, would no longer be competitive in a NSF academic research and education program; e.g., a specific set of technology translation efforts through strategic partnerships with third party investor(s), industrial partners and research partner(s).

Proposals submitted to the PFI-RP track should include one or more of the following partners.

Primary industrial partner(s). A minimum of one (1) industry partner of any size is required. This partner (i.e., either a for-profit or not-for-profit entity that fulfills the minimum requirement) must be U.S.-based and have commercial revenues that include sales, services, or licensing. Grants and government contracts may contribute to its revenues but may not constitute the entirety of its revenues. It is essential that the minimally qualifying industrial partner has experience with bringing a product, process, service or system to the marketplace in the area of the proposed technology development effort, in order to ensure that the proposal team incorporates a meaningful commercial and industrial perspective. Non-profit organizations involved in technology transfer may be primary industrial partners so long as they meet the commercial revenues requirement above. **Note:** In regard to industrial partners, subawards can only

be allocated to businesses that meet the Small Business Innovation Research (SBIR) program eligibility requirements: (https://www.sbir.gov/faqs/eligibility-requirements) and in which the submitting organization or the participants in the proposed project hold no financial, ownership or controlling interest.

Primary research partner(s). When the requirement of a minimum of one (1) primary industrial partner has been met, other partners, such as academic institutions, non-profit organizations including foundations, public sector organizations, and additional industry partners, including small businesses may be included as primary research partners. The lead institution in an NSF supported consortium can be selected as a primary research partner. Examples of NSF research consortia were listed earlier in the solicitation. Partners should be chosen with care so as to include explicit knowledge about the proposed technological research and/or to cover areas of expertise where the lead academic team is lacking. The purpose of the research partner(s) is to add a complementary skill set(s) to the proposing organization so that competitive technologies, which neither party could develop as well or as rapidly, are accelerated towards commercial reality and transferred into industrial spheres of activity at an accelerated pace. The proposal must clearly describe the role of the research partner(s), the skill set they add to the proposing organization and how this will help accelerate technology development and scale-up. The primary research partner may be a recipient of a subaward from the lead organization.

Third-party investor. In order for research to lead to competitive innovation and technology spinouts, it is important that third-party investors are engaged early in the project as a means to accelerate progress towards commercialization. The collaboration among the third-party investor, the proposing organization, and the research partner(s) will create an academic-based innovation ecosystem that accelerates the development of new products, processes, systems or services having high societal impact. A third-party investor may include such entities as a for-profit company, a venture capital firm, one or more individual accredited investor(s), or any combination of the above. Each third party investor/partner is strongly **encouraged to provide a Letter of Support for the proposed research project.**

Participants in the proposal should agree in advance as to how intellectual property (IP) rights will be handled. A signed cooperative research agreement (CRA) between the submitting organization and all collaborating partners involved needs to be presented to NSF before an award can be made (CRA; see example https://www.nsf.gov/eng/iip/pfi/air/Sample_CRA_PFI_AIR.docx. The agreement must cover intellectual property rights (including publication and patent rights) and must be submitted prior to issuance of an award. NSF is responsible neither for the agreement reached nor the IP information exchanged between the participants in the award. For purposes of proposal evaluation, it is sufficient to submit with the proposal a letter stating that the CRA will be provided as a condition for award. The signed CRA must be provided to NSF before the proposal is awarded.

Grantee Meeting: NSF plans to offer awardees one opportunity during the course of a PFI award to attend a grantee meeting organized by NSF in conjunction with a technology showcase to share their research and technology development results in a conference open to the general public that may involve investors and industry representatives. The showcase would be an opportunity to demonstrate a prototype and/or present a poster about the work supported under the PFI program. Applicants should budget travel for the PI and one student or post-doc to attend (approximately $2,500 per person).

Goals and objectives that are not responsive to this solicitation: Proposals that entail primarily basic research and do not involve technology development activity are not considered responsive to this solicitation and may be returned without review. This solicitation is not intended to fund efforts primarily directed toward only market research or business development activities; the commercial development of existing products or proven concepts; straightforward engineering design for packaging; incremental existing product or process improvements; the evolutionary optimization of existing products; or evolutionary modifications to broaden the scope of an existing product or application.

III. AWARD INFORMATION

Anticipated Type of Award: Continuing Grant or Standard Grant

Estimated Number of Awards: The budget for PFI-TT proposals is up to $200,000 for 18 months per award; approximately 30-45 awards are anticipated. The budget for PFI-RP proposals is up to $750,000 for 36 months. Approximately 10-15 awards are anticipated.

Anticipated Funding Amount: $16,750,000

Anticipated Funding Amount is subject to the availability of funds and the quality of proposals received.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Academic / Research US institutions; includes universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members,
- Public or Non-profit, Non-academic US organizations located in the US that are directly associated with technology transfer activities,
- Non-profit US organizations located in the US that partner with an institution of higher education, or
- A US consortium of 2 or more of the organizations described above.

Who May Serve as PI:

The PI must have the technical skills required to execute the proposed research project.

Lineage Requirement: The PFI-TT proposal track has a lineage requirement under one or two of the following paths: (1) through NSF-supported research results, or (2) NSF-supported (National I-Corps™ Teams) customer discovery results.

1. **NSF-supported research results**: Principal Investigator (PI) or a co-PI must have had an NSF award that ended no more than six (6) years prior to the full proposal deadline date or be a current NSF award recipient. The proposed technology development project must be derived from the research results and/or discoveries from this underlying NSF award.

   OR

2. **National I-Corps™ Teams customer discovery results** The Principal Investigator (PI) or a co-PI must have been a member of an I-Corps ™, Team Grant from NSF under the I-Corps™ Teams Program (https://www.nsf.gov/news/special_reports/i-corps/teams.jsp). The PI or co-PI must have fully completed the I-Corps™ training provided as part of the I-Corps™ Team grant within the past three (3) years. The customer discovery activities performed under the NSF-funded I-Corps™ award must be based on the technology that is proposed to be translated within the PFI-TT proposal.

   Note: a proposal describing sole lineage to any of the following programs is not allowed and **may be returned without review**: Research Experiences for Undergraduates (REU), Research Experiences for Teachers (RET), the Graduate Research Fellowship Program (GRFP), any prior award through the PFI Program, Regional I-Corps™, and SBIR/STTR.

   The PFI-Research Partnerships (PFI-RP) proposal track does NOT have a lineage requirement.

   For a PFI-RP proposal, in addition to the PI, there must be at least (but not limited to) one other participant on the project serving as a co-PI, who brings technology commercialization experience in the targeted fields of application (or industry sector) of the proposed technology to be developed. This co-PI must have an active role that is explicitly described along with the specification of a time commitment on the project. Additional collaborators or organizations who bring needed multidisciplinary expertise, knowledge and commercialization experience may be involved as co-PI, Senior Personnel, Other Professional, subawardee, consultant, collaborator, etc., on the proposed project.

Limit on Number of Proposals per Organization: 2

An organization may submit no more than two (2) proposals to this solicitation. This eligibility constraint will be strictly enforced. In the event that an organization exceeds this limit, the first two proposals received will be accepted, and the remainder will be returned without review. An organization will not receive more than one (1) award from this solicitation.

Limit on Number of Proposals per PI or Co-PI: 2

A PI or co-PI may submit up to two proposals to the solicitation. These could be two proposals to PFI-TT, one proposal each to PFI-TT and PFI-RP or two proposals to PFI-RP. A PI or co-PI will not receive more than one award from this solicitation. The submission of duplicate or substantially similar or equivalent proposals concurrently for review to the solicitation will result in the return of the redundant proposals.

A PI or co-PI may resubmit a previously declined proposal; however, the proposal must be revised and have taken into account the major comments or concerns resulting from the prior NSF review. A resubmission of a previously declined proposal must include a summary of the previous NSF reviewer comments and the PI's response must be included in the supplemental documents (see Supplementary Documents, below). The revised proposal will be subject to NSF's merit review process.

Additional Eligibility Info:

No collaborative proposals (defined as simultaneous proposal submissions for a joint project from different organizations, with each organization requesting a separate award) 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 Grants.gov or via the NSF FastLane system.

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

Failure to submit this information may delay processing.

- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov*. The complete text of the *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

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

The following instructions deviate from or supplement the requirements contained within the NSF Proposal & Award Policies & Procedures Guide (PAPPG) or NSF Grants.gov Application Guide. Where the solicitation specifications differ from the PAPPG, the guidance in the solicitation take precedence.

PFI: Technology Translation Proposal (PFI-TT)

A well-constructed PFI-TT proposal should convey how the project will accomplish the following goals:

1. **Technical** – Advancement of the state of knowledge of the underlying research discovery toward commercial application via a spectrum of possible activities. These could include proof-of-concept, early stage prototype, or technology scale-up development, demonstration and/or evaluation with results sufficient to determine initial technical feasibility and potential functional limitations of the innovation in the envisioned market application / opportunity. The proposed technical work should be the next logical phase on the spectrum of technology development activities and depends on the state of knowledge at the beginning of the project and the gaps to be overcome on the path toward the market application / opportunity. The technology hurdles to be overcome should be significant and challenging and worthy of NSF support.
2. **Commercial** – Although the predominance of effort is expected to be in the achievement of the technical goals, progress toward commercialization is also expected. The individual who brings technology commercialization experience should lead this effort. Types of issues that may be considered include: customer discovery activities, economic analysis, further assessment of market opportunity, market need and potential, competitive analysis, intellectual property protection, licensing opportunities and freedom to operate issues, and applicable environmental health, safety, and/or other regulatory issues.
3. **Educational** – Participants in this effort should demonstrate an enhanced understanding of innovation, technology translation, commercialization and/or entrepreneurship by the end of the project.

The proposal consists of the following parts:

A. **Cover Sheet**

The cover sheet is automatically generated by FastLane or Grants.gov based on information entered into the "Cover Sheet" module.

B. **Project Summary (one-page limit)**

The Project Summary should be written in the third person and consists of an overview, a statement on the intellectual merit of the proposed activity, a statement on the broader impacts of the proposed activity and shall begin as follows: "This PFI-TT project ...". Do not include proprietary information in the summary.

The summary MUST clearly address the following items:

Box 1: Overview: The Overview should consist of a summary paragraph that briefly discusses the societal need for the proposed technology, the areas of application, the key technological hurdles that need to be overcome, and the potential outcomes of the proposed activity. Also provide the NSF award number and award title that satisfies the lineage requirement. This can be an NSF research award or an NSF I-Corps™ Team award as described in the lineage requirements. There should be information presented to help identify the areas of technical expertise in science and engineering, which are to be considered in reviewing the proposal; and the areas of application that are the initial target markets of the technologies to be developed.

Box 2: Intellectual Merit: A summary paragraph addressing the intellectual merits of the proposed activity; e.g., areas where the project will advance knowledge.

Box 3: Broader Impacts: A summary paragraph that describes the potential societal, economic, commercial and educational outcomes of the project. Such outcomes include (but are not limited to) one or more of the following: (1) increasing the economic competitiveness of the United States, (2) advancing of the health and welfare of the American public, (3) supporting the national defense of the United States, (4) enhancing partnerships between academia and industry in the United States, (5) developing an American STEM workforce that is globally competitive through improved pre-kindergarten through grade 12 STEM education and teacher development, and improved undergraduate STEM education and instruction, (6) improving public scientific literacy and engagement with science and technology in the United States, (7) expanding participation of women and individuals from underrepresented groups in STEM.

C. **Table of Contents** The table of contents is automatically generated by FastLane or Grants.gov.
D. **Project Description (cannot exceed 15 pages)**

The project description must include the following sections in the order specified. The corresponding bullets are suggestions for the type of information to be discussed in each section and are meant to be a guide. Adjustments in exact content and length of each section are allowable as necessary for the PI to present his/her ideas as clearly as possible. **Please note that**

the instructions for this section of the proposal deviate from, and take precedence over, the guidance in the PAPPG.

Executive Summary (no more than one page)

- The Societal Need and the Customer: Describe the expected customer for the innovation. What societal needs or market pain points are you addressing?
- The Value Proposition: What are the benefits to the customer of your proposed innovation? What is the key differentiator of your proposed technology? What is the potential societal value of your innovation?
- The Innovation: Succinctly describe your innovation. This section can contain proprietary information that could not be discussed in the Project Summary. What aspects are original, unusual, novel, disruptive, or transformative compared to the current state of the art?

Overview and Motivation (suggested length: 1-2 pages)

- Briefly describe the existing research result or discovery to be translated and how it derived from prior NSF research funding.
- **Prior NSF Research Lineage for PFI-TT** PFI-TT proposals must include the NSF award number(s) that meet(s) the lineage requirements described earlier. This can be an NSF basic research award or an NSF I-Corps Team award.
- Describe the key features of the innovation. What is the target market space? What is the key differentiator(s) from the current state of the art and other competing technologies? How is this beneficial to a potential customer / end user? What is the intellectual merit of the proposed work?
- Explicitly identify the anticipated output of the project: proof-of-concept, prototype, or technology scale-up. What will likely be learned from the project? What are the knowledge gaps or technology transfer barriers to be addressed?

Market Opportunity and Intellectual Property (suggested length: 3-4 pages)

- Describe the broader impacts of the innovation in terms of societal, economic and/or commercial benefit. Discuss the market need(s) to be addressed and the preliminary market research that has been done to support that need. What are the existing competitive technologies, and what are their shortcomings?
- Describe how the innovation will meet an unmet need or offer a competitive substitute. What proposed features will make it competitive? What proposed features might keep potential competitors from circumventing the technology?
- Discuss the Intellectual Property landscape. Include elements such as results of a preliminary patent search, intellectual property status (e.g. invention disclosure, preliminary patent application, patent granted, etc.), and the feasibility of obtaining needed licenses and/or sufficient protection for the intellectual property developed. Discuss to the extent possible freedom to operate and blocking intellectual property issues.

Technical Challenges and Applied Research Plan (suggested length: 5-7 pages)

- Describe the current state-of-the-art knowledge about the underlying research discovery and include relevant data/results from the prior work. These results should provide evidence to the reviewers that the technology is ready to move beyond the basic research/discovery phase and that the translational research proposed has further potential towards successful technology development.
- Describe the envisioned next steps for successful development of the technology toward commercialization and societal use. Describe the knowledge gaps and technical barriers that must be overcome. What are the most challenging hurdles? Are there show-stoppers?
- Describe the research plan to address the knowledge gaps and technical barriers. What are the specific tasks/activities that will need to be undertaken in order to close the gaps so that the proof-of-concept, prototype or technology scale-up can be demonstrated?
- Who will be assigned to the identified research tasks? What critical milestones will need to be reached? What metrics will help assess that the proposed project has achieved a successful outcome? Present an R&D plan, with timeline. What are the objectives, and what experiments, computations, etc. are planned to reach those objectives? Note that a milestone chart is required as a supplemental document.

Project Team (suggested length: 1-2 pages)

- Describe the team members and the strengths they bring to the project. Are there partners and/or collaborators outside of the proposing organization? Describe their role and the value they add to the project.
- Describe the role of the project participant who brings technology commercialization experience. How will he/she help achieve the goals of the project?

Strategy Toward Commercialization (suggested length: 1-2 pages)

- Describe the overall commercialization strategy and plans going beyond completion of the proposed project.

Training and Involvement of Students / Post-doctoral Fellows / **Broadening Participation** (suggested length: 1-2 pages)

- Describe the plan for the involvement of undergraduate, graduate students and/or post-docs and how the project activities will enhance their knowledge of innovation and technology commercialization beyond the usual research experience.
- Describe the broader impacts of the work proposed in the context of the development of a diverse and globally competitive workforce.
- Describe a mentorship and education plan that shows how participating students and/or post-doctoral fellows will learn about innovation, entrepreneurship, and the process of research translation, technology development and commercialization. How will they be better trained to enter the workforce upon graduation?
- Describe a plan to broaden participation of women and individuals from under-represented groups in the proposed activities.

Commercial and Societal Impact Potential (1-2 pages)

- Describe the societal, economic, and/or commercial benefit and outcomes that would be derived from the proposed

activities. Such outcomes include (but are not limited to) one or more of the following:

- Increasing the economic competitiveness of the United States
- Advancing of the health and welfare of the American public
- Supporting the national defense of the United States
- Enhancing partnerships between academia and industry in the United States
- Developing an American STEM workforce that is globally competitive through improved pre-kindergarten through grade 12 STEM education and teacher development, and improved undergraduate STEM education and instruction
- Improving public scientific literacy and engagement with science and technology in the United States
- Expanding participation of women and individuals from underrepresented groups in STEM.

- In addition, the broader impacts on students should be discussed in terms of how students will gain innovation experience beyond their normal research activities by participation in the proposed project and help them train better to enter the workforce upon graduation.

Marking Proprietary Information: Patentable ideas, trade secrets, privileged or confidential commercial or financial information, disclosure of which may harm the proposer, should be included in proposals only when such information is necessary to convey an understanding of the proposed project. Such information must be clearly marked in the proposal and be appropriately labeled with a legend such as, "The following is (proprietary or confidential) information that (name of proposing organization) requests not be released to persons outside the Government, except for purposes of review and evaluation." Typically, proprietary information is marked in the text either with an asterisk at the beginning and end of the proprietary paragraph, underlining the proprietary sections, or choosing a different font type. An entire proposal should not be marked proprietary. The box for "Proprietary or Privileged Information" must be checked on the Cover Sheet when the proposal contains such information.

E. **References Cited**

Provide a comprehensive listing of relevant reference sources, including patent citations. If there are no references cited in the proposal, include a statement to that effect in this module.

F. **Biographical Sketches**

Include short bios (two pages maximum) of the PI, co-PIs and other key personnel, including graduate students and post-doctoral fellows, if known. Highlight their technical expertise and track records in successful technology and/or business development. All participants listed as either co-PIs or other "Senior Personnel" must submit a bio sketch of no more than two pages.

G. **Budgets and Subaward Budgets**

The NSF Summary Proposal Budget is generated in FastLane or Grants.gov. Prepare a budget for each year. The system will automatically generate a cumulative budget for the entire project. A budget justification is required for each non-zero item in the budget; it should explicitly state why the funds are needed as well as how and where the requested funds will be spent. Note that the costs of initial patent searches and marketing studies are allowable costs.

- Subawards are allowed. The purpose of the proposed subaward(s) should be to augment the capabilities of the submitting organization. In regard to subawards to industrial partners, subawards can only be allocated to businesses that meet the Small Business Innovation Research (SBIR) program eligibility requirements: (https://www.sbir.gov/faqs/eligibility-requirements) and in which the submitting organization or the participants in the proposed project hold no financial, ownership or controlling interest.
- If other participating organizations are proposed and there is the possibility of joint development of intellectual property between the partners, it is the responsibility of the award recipients to discuss the appropriate intellectual property policies, including patent disclosures and filings. NSF is not responsible for the type of agreement reached between the grantee and any participating organizations/partners. Proposal partners must agree in advance of any award as to how intellectual property and publication rights will be handled. The agreement would need to be documented in a Cooperative Research Agreement (CRA) between the submitting organization and each collaborating partner.
- For purposes of proposal evaluation, it is sufficient to submit with the proposal a letter stating that the CRA will be provided on NSF's request. The signed CRA(s) will need to be submitted to NSF as a prerequisite to NSF making an award. An example of CRA is available at https://www.nsf.gov/eng/iip/pfi/air/Sample_CRA_PFI_AIR.docx
- If there is a subaward to an organization with which a PI or co-PI has a Conflict of Interest, the PI's Organization must submit the conflict of interest plan for that individual covering the proposed work before NSF funding will be released. - (The Conflict of Interest plan is not required at the proposal stage, only upon recommendation of award.)
- It is intended to offer awardees one opportunity during the course of the award to attend a grantee meeting held in conjunction with a technology showcase to connect with potential industry collaborators and/or private -sector investors. The showcase would be an opportunity to demonstrate a prototype and/or present a poster about the work supported under the PFI award. Applicants should budget travel to the grantee meeting for the PI and one student or post-doc to attend (approximately $2,500 per person). Additional travel costs can be budgeted for a collaborators/partners on the project to travel for this same purpose.

Funding requests will be evaluated relative to the scope and balance of the research planned.

H. **Current and Pending Support**

- The proposal should provide information regarding all research to which the PI and co-PIs(s), or other senior personnel either have committed time or have planned to commit time. For all ongoing or proposed projects, the following information should be provided for the PI, co-PI(s), and senior personnel:
  - Name of sponsoring organization and award number;
  - Title and performance period of the award/proposal; and
  - Person-months/calendar months (per year) devoted to the project by the PI, co-PI(s), and each of the senior personnel.
  - Current and Pending Support must be uploaded into the system. The proposal being submitted under this

solicitation is considered "pending" and therefore MUST appear in the Current and Pending Support module.

I. **Facilities, Equipment, and Other Resources**

Describe the availability of facilities, equipment and other resources required for the proposed project. Describe the measures that will be taken to ensure compliance with applicable Environmental Health and Safety laws in the execution of the proposed work if awarded. This section of the proposal is used to assess the adequacy of the resources available to perform the effort proposed to satisfy the Intellectual Merit review criteria. Proposers should describe only those resources that are directly applicable. Proposers should include an aggregated description of the internal and external resources (both physical and personnel) that the organization and its collaborators will provide to the project, should it be funded. Such information must be provided in this section, in lieu of other parts of the proposal (e.g., Budget Justification, Project Description). The description should be narrative in nature and must not include any quantifiable financial information. Reviewers will evaluate the information during the merit review process and the cognizant NSF Program Officer will review it during review prior to award. Although these resources are not considered voluntary committed cost sharing as defined in 2 CFR §200.306, the Foundation does expect that the resources identified in the Facilities, Equipment and Other Proposal & Award Resources section will be provided, or made available, should the proposal be funded.

J. **Supplementary Documents**

Proposals missing any of these supplementary documents may be returned without review.

J1: Research Lineage: Provide up to two pages (maximum) to describe the source of funding ***and*** a summary of the intellectual merit and broader impact of the prior results (include a list of resulting publications) from the award that satisfies the lineage requirements. Provide title and number of the NSF award. In addition, state if the proposing team has participated as part of an NSF National I-Corps™ cohort and note the award number, if applicable.

J2: Letters of Collaboration: Collaborators are individuals or entities that work with the PI and his/her team to provide additional value to the project and may be paid or unpaid. Whether or not the collaborator is included in the budget, a letter of collaboration from each named participating entity must be provided at the time of submission of the proposal. Such letters must appear on the entity's letterhead and be signed by the appropriate representative of the entity/organization. The letter(s) must explicitly state the nature of the collaboration and how the collaboration brings additional value to the project.

J3: Letters of Support: At least one (and no more than three) letter(s) of support must be submitted that validates the PI's claim that the technology to be translated has a market application or need. The letter should be from an entity who is not funded as part of this proposal, such as a potential customer or a potential manufacturing/development partner, who would be interested in a future partnership assuming the PFI-TT project is successful. The letter should clearly state the problem the technology will address and the need for/ impact of that solution. The letter must signed and dated and contain affiliation and contact information for the signatory individual.

J4: Letter of Commitment for Cooperative Research Agreement: It is the responsibility of the award recipients to discuss the appropriate intellectual property policies, including patent disclosures and filings, with research partners. NSF is not responsible for the type of agreement reached between grantees, research partners and third-party investors. Submit with the proposal a letter of commitment stating that a cooperative research agreement (CRA; see example https://www.nsf.gov/eng/iip/pfi/air/Sample_CRA_PFI_AIR.docx will be provided upon recommendation of an award. If an award is recommended, the partners must follow-up by providing a signed, written CRA that has been negotiated with the partners and third-party investors before NSF funding will be released.

J5: Data Management Plan: A Data Management Plan is required for all proposals submitted to NSF. Consult the data management requirements in the PAPPG: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg

J6: Postdoctoral Research Mentoring Plan: If a proposal requests funding to support post-doctoral scholars at a research organization, a Postdoctoral Mentoring Plan MUST be uploaded to the system. Describe only the mentoring activities that will be provided to all postdoctoral researchers supported by the project. Information on what to include in the postdoctoral research mentoring plan is available in the PAPPG: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

J7: Resubmission Change Description (if applicable; two pages maximum): A declined proposal may be resubmitted, but only after it has been revised and taken into account the major comments or concerns from the prior NSF review. A supplementary document summarizing the prior major review comments and the response is required.

J8: **Milestone Chart:** A milestone chart with specific tasks, deliverables and estimated timelines.

J9: **Commercialization Sustainability Plan:** Describe a plan that will guide the sustainability of the commercialization efforts during, and especially after, the implementation of the research activities. The plan should be aimed at identifying and securing strategic commercialization partners, investors, licensees, if applicable the creation and funding of spin-out companies, etc.

J10. Human Subjects Documentation (if applicable): The grantee is responsible for the protection of the rights and welfare of human subjects involved in activities supported by NSF. Please refer to the PAPPG for specific guidance (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg)

J11. Vertebrate Animals Documentation (if applicable): Any project proposing use of vertebrate animals for research or education shall comply with the Animal Welfare Act (7 USC 2131, et seq.) and the regulations promulgated thereunder by the Secretary of Agriculture (9 CFR 1 .1 -4.11) pertaining to the humane care, handling, and treatment of vertebrate animals held or used for research, teaching or other activities supported by Federal awards. In accordance with these requirements, proposed projects involving use of any vertebrate animal for research or education must be approved by the submitting organization's Institutional Animal Care and Use Committee (IACUC) before an award can be made. For this approval to be accepted by NSF, the organization must have a current Public Health Service (PHS) Approved Assurance. See the relevant PAPPG section (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg for more information.

K. **Single Copy Documents**

Proposers are encouraged to supply an annotated list of suggested reviewers complete with contact information. Collaborators & Other Affiliations (COA) information specified in the PAPPG should be submitted using the instructions and spreadsheet template found at https://nsf.gov/bfa/dias/policy/coa.jsp.

PFI-RP: PFI: Research Partnerships

A well-constructed PFI-RP proposal should convey how the project will accomplish the following goals:

- The proposed work will accomplish translational or use-inspired research to enable the translation and transfer of research results and/or innovative technologies with clear value propositions towards commercialization activities seeking to address pressing societal needs – beyond what is capable at the individual researcher level.
- The proposed work will result in the development and/or enhancement of an academic-based, multidisciplinary innovation ecosystem that is based on a strategic network of sustainable connections between university researchers, the business community, and other actors or agencies in the innovation ecosystem.
- At the end of the proposed work, there will be measurable evidence of technological innovation and progress towards commercial impact potential.
- The proposed work will serve as training ground for students in preparation for entry into the professional workforce, with a strong emphasis in the participation of women and individuals from under-represented groups.

The proposal consists of the following parts:

A. **Cover Sheet** The cover sheet is automatically generated by FastLane or Grants.gov based on information entered into the "Cover Sheet" module.
B. **Project Summary [One (1) page MAXIMUM].** The Project Summary should be written in the third person, informative to other persons working in the same or related fields, and, insofar as possible, understandable to a scientifically or technically literate lay reader. It should not be an abstract of the proposal. Do not include proprietary information in the summary.

   Proposals that do not contain a complete Project Summary will not be accepted by FastLane or will be returned without review. The Project Summary is completed in FastLane by entering information into the three text boxes in the Project Summary module. **Information MUST be entered into all three text boxes, or the proposal will not be accepted. Do not upload your Project Summary as a PDF file.**

   The summary MUST clearly address the following items:

   Box 1: **Overview**: The Overview should consist of a summary paragraph that briefly discusses the societal need for the proposed technology, the areas of application, the key technological hurdles that need to be overcome, and the potential outcomes of the proposed activity. There should be information presented to help identify the areas of technical expertise in science and engineering, which are to be considered in reviewing the proposal; and the areas of application that are the initial target markets of the technologies to be developed. Also provide the number assigned to the corresponding LOI submission.

   Box 2: **Intellectual Merit:** A summary paragraph addressing the intellectual merits of the proposed activity, e.g. areas where the project will advance knowledge. Briefly describe the technical hurdle(s) that will be addressed by the proposed R&D (which should be crucial to successful technology translation of the innovation), the goals of the proposed R&D, and an overview of the plan to reach those goals. No proprietary information should be included in the summary.

   Box 3: **Broader Impact:** A summary paragraph that describes the potential societal, economic, commercial and educational outcomes of the project. Such outcomes include (but are not limited to) one or more of the following: (1) increasing the economic competitiveness of the United States, (2) advancing of the health and welfare of the American public, (3) supporting the national defense of the United States, (4) enhancing partnerships between academia and industry in the United States, (5) developing an American STEM workforce that is globally competitive through improved pre-kindergarten through grade 12 STEM education and teacher development, and improved undergraduate STEM education and instruction, (6) improving public scientific literacy and engagement with science and technology in the United States, (7) expanding participation of women and individuals from underrepresented groups in STEM.

   In addition, the broader impacts on students should be discussed in terms of how students will gain innovation experience beyond their normal research activities by participation in the proposed project and help them train better to enter the workforce upon graduation.

C. **Table of Contents** The table of contents is automatically generated by FastLane or Grants.gov.
D. **Project Description** (cannot exceed 15 pages) The project description must include the following:

   The project description must include the following sections in the order specified. The corresponding bullets are suggestions for the type of information to be discussed in each section and are meant to be a guide. Adjustments in exact content and length of each section are allowable as necessary for the PI to present his/her ideas as clearly as possible. Please note that the instructions for this section of the proposal deviate from, and take precedence over, the guidance in the PAPPG.

   Executive Summary (no more than two pages)

   - The Societal Need and the Customer. Describe the expected customer for the innovation. What customer needs or market pain points are you addressing?
   - The Value Proposition. What are the benefits to the customer of your proposed innovation? What is the key differentiator of your company or technology? What is the potential societal value of your innovation?
   - The Innovation: Succinctly describe your innovation. This section can contain proprietary information that could not be discussed in the Project Summary. What aspects are original, unusual, novel, disruptive, or transformative compared to the current state of the art?

   Overview and Motivation (suggested length: 1-2 pages)

   - Briefly describe the existing research result or discovery to be translated and how it derived from prior research support.

- Describe the key features of the proposed technology innovation. What is the target market space? What is the key differentiator(s) from the current state of the art and other competing technologies? How is this beneficial to a potential customer? What is the intellectual merit of the proposed work?
- Describe the partnership ecosystem that is being assembled to pursue the research project describing the key roles and contributions anticipated from each partner.
- Explicitly identify the anticipated output of the project: proof-of-concept, prototype, or technology scale-up. What will be learned from the project? What are the knowledge gaps being addressed?

Market Opportunity and Intellectual Property (suggested length: 3-4 pages)

- Describe the broader impacts of the innovation in terms of societal, economic and/or commercial benefit. Discuss the market need(s) to be addressed and the preliminary market research that has been done to support that need. What are the existing competitive technologies, and what are their shortcomings?
- Describe how the innovation will meet an unmet need or offer a competitive substitute. What features will make it competitive? What features keep potential competitors from circumventing the technology?
- Discuss the Intellectual Property landscape. Include elements such as results of a preliminary patent search, the state of the relevant background intellectual property (e.g. invention disclosure, preliminary patent application, patent granted, etc.), and the feasibility of obtaining needed licenses and/or sufficient protection for the intellectual property developed.

Technical Challenges and Research Plan (suggested length: 5-7 pages)

- Describe the current state-of-the-art knowledge about the underlying research discovery and include relevant data/results from the prior work. These results should provide evidence to the reviewers that the technology is ready to move beyond the basic research/discovery phase and that the translational research proposed has the potential to be successful.
- Describe the envisioned next steps for successful development of the technology toward commercialization and societal benefit. Describe the knowledge gaps and technical barriers that must be overcome. What are the most challenging hurdles? Are there show-stoppers?
- Describe the research plan to address the knowledge gaps and technical barriers. What are the specific tasks/activities that will be done in order to close the gaps so that the proof-of-concept, prototype or technology scale-up can be demonstrated? Who will be assigned to the identified tasks? What critical milestones will need to be reached? What metrics will help assess that the proposed project has achieved a successful outcome? Note that a milestone chart is required as a supplemental document.
- Describe how the envisioned partnerships will catalyze and accelerate technology development toward commercialization.

Project Team (suggested length: 1-2 pages)

- Identify and discuss the roles that each of the partners will play in executing the research plan and how each entity's capabilities enable the goals of the PFI-RP proposal to be achieved.
- Provide a discussion of the qualifications of the team and how the research partnership leverages the research and technology capabilities of the proposing team and of the industrial and research partner(s) to accelerate competitive innovation that neither party could develop as well or as rapidly working alone.
- If applicable, discuss the role of the collaboration with the third-party investor(s) and how that collaboration enables the acceleration of the transfer of innovative technologies from the research team to commercialization activity.

Commercialization Strategy (suggested length: 1-2 pages)

- A proposed assessment plan that will help gauge the success of the research partnership(s) and third-party collaboration(s) in more rapidly translating academic research and technologies into commercial use. Include a discussion of the choice and appropriateness of the stated success metrics.
- Describe the overall commercialization strategy and plans envisioned going beyond the duration of the proposed project.

Training and Involvement of Students / Post-doctoral Fellows / Broadening Participation (suggested length: 1-2 pages)

- Describe a mentorship and education plan that shows how participating students and/or post-doctoral fellows will learn about innovation, entrepreneurship, and the process of research translation, technology development and commercialization and get better trained to enter the workforce upon graduation.
- Describe a plan to broaden participation of women and individuals from under-represented groups in the proposed activities.

Commercial and Societal Impact Potential (1-2 pages)

- Describe the societal, economic, and/or commercial benefit and outcomes that would be derived from the proposed activities. Such outcomes include (but are not limited to) one or more of the following:
    - Increasing the economic competitiveness of the United States
    - Advancing of the health and welfare of the American public
    - Supporting the national defense of the United States
    - Enhancing partnerships between academia and industry in the United States
    - Developing an American STEM workforce that is globally competitive through improved pre-kindergarten through grade 12 STEM education and teacher development, and improved undergraduate STEM education and instruction
    - Improving public scientific literacy and engagement with science and technology in the United States
    - Expanding participation of women and individuals from underrepresented groups in STEM.
- In addition, the broader impacts on students should be discussed in terms of how students will gain innovation experience beyond their normal research activities by participation in the proposed project and help them train better to enter the workforce upon graduation.

Marking Proprietary Information

Patentable ideas, trade secrets, privileged or confidential commercial or financial information, disclosure of which may harm the proposer, should be included in proposals only when such information is necessary to convey an understanding of the proposed project. Such information must be clearly marked in the proposal and be appropriately labeled with a legend such as, "The following is (proprietary or confidential) information that (name of proposing organization) requests not be released to persons outside the Government, except for purposes of review and evaluation." Typically, proprietary information is marked in the text either with an asterisk at the beginning and end of the proprietary paragraph, underlining the proprietary sections, or choosing a different font type. An entire proposal should not be marked proprietary. The box for "Proprietary or Privileged Information" must be checked on the Cover Sheet when the proposal contains such information.

E. **References Cited**

Provide a comprehensive listing of relevant reference sources, including patent citations. If there are no references cited in this proposal, include a statement to that effect in this module.

F. **Biographical Sketches**

Include short bios (two pages maximum) of the PI, co-PIs and other key personnel, including graduate students and post-doctoral fellows, if known. Highlight their technical expertise and track records in successful technology and/or business development. All participants listed as either co-PIs or other "Senior Personnel" must submit a bio sketch of no more than two pages.

G. **Budgets and Subaward Budgets**

The NSF Summary Proposal Budget is generated in FastLane or Grants.gov. Prepare a budget for each year. The system will automatically generate a cumulative budget for the entire project. A budget justification is required for each non-zero item in the budget; it should explicitly state how and where the requested funds will be spent. Note that the costs of initial patent searches and marketing studies are allowable costs.

- Subawards are allowed. The purpose of the proposed subaward(s) should be to augment the capabilities of the submitting organization. In regard to subawards to industrial partners, subawards can only be allocated to businesses that meet the Small Business Innovation Research (SBIR) program eligibility requirements: (https://www.sbir.gov/faqs/eligibility-requirements) and in which the submitting organization or the participants in the proposed project hold no financial, ownership or controlling interest.
- If other participating organizations are proposed and there is the possibility of joint development of intellectual property between the partners, it is the responsibility of the award recipients to discuss the appropriate intellectual property policies, including patent disclosures and filings. NSF is not responsible for the type of agreement reached between the grantee and any participating organizations/partners. Proposal partners must agree in advance of any award as to how intellectual property and publication rights will be handled. The agreement would need to be documented in a Cooperative Research Agreement (CRA) between the submitting organization and each collaborating partner.
- For purposes of proposal evaluation, it is sufficient to submit with the proposal a letter stating that the CRA will be provided on NSF's request. The signed CRA(s) will need to be submitted to NSF as a prerequisite to NSF making an award. An example of a CRA is available at https://www.nsf.gov/eng/iip/pfi/air/Sample_CRA_PFI_AIR.docx.
- If there is a subaward to an organization with which a PI or co-PI has a Conflict of Interest, the PI's organization must submit the conflict of interest plan for that individual covering the proposed work before NSF funding will be released. - (The Conflict of Interest plan is not required at the proposal stage, only upon recommendation of award.)
- It is intended to offer awardees one opportunity during the course of the award to attend a grantee meeting held in conjunction with a technology showcase to connect with potential industry collaborators and/or private -sector investors. The showcase would be an opportunity to demonstrate a prototype and/or present a poster about the work supported under the PFI award. Applicants should budget travel to the grantee meeting for the PI and one student or post-doc to attend (approximately $2,500 per person). Additional travel costs can be budgeted for a collaborators/partners on the project to travel for this same purpose.

Funding requests will be evaluated relative to the scope and balance of the research planned.

H. **Current and Pending Support**

The proposal should provide information regarding all research to which the PI and co-PIs(s), or other senior personnel either have committed time or have planned to commit time. For all ongoing or proposed projects, the following information should be provided for the PI, co-PI(s), and senior personnel:

- Name of sponsoring organization and award number;
- Title and performance period of the award/proposal; and
- Person-months/calendar months (per year) devoted to the project by the PI, co-PI(s), and each of the senior personnel.
- Current and Pending Support must be uploaded into the system. The proposal being submitted under this solicitation is considered "pending" and therefore MUST appear in the Current and Pending Support module.

I. **Facilities, Equipment, and Other Resources**

Describe the availability of facilities, equipment, and other resources required for the proposed project. Describe the measures that will be taken to ensure compliance with applicable Environmental Health and Safety laws in the execution of the proposed work if awarded. This section of the proposal is used to assess the adequacy of the resources available to perform the effort proposed to satisfy the Intellectual Merit review criteria. Proposers should describe only those resources that are directly applicable. Proposers should include an aggregated description of the internal and external resources (both physical and personnel) that the organization and its collaborators will provide to the project, should it be funded. Such information must be provided in this section, in lieu of other parts of the proposal (e.g., Budget Justification, Project Description). The description should be narrative in nature and must not include any quantifiable financial information. Reviewers will evaluate the

information during the merit review process and the cognizant NSF Program Officer will review it during review prior to award. Although these resources are not considered voluntary committed cost sharing as defined in 2 CFR §200.306, the Foundation does expect that the resources identified in the Facilities, Equipment and Other Proposal & Award Resources section will be provided, or made available, should the proposal be funded.

J. **Supplementary Documents**

Proposals missing any of these documents will be returned without review.

J1: **Letters of Collaboration:** Collaborators are individuals or entities that work with the PI and his/her team to provide additional value to the project and may be paid or unpaid. Whether or not the collaborator is included in the budget, a letter of collaboration from each named participating entity must be provided at the time of submission of the proposal. Such letters must appear on the entity's letterhead and be signed by the appropriate representative of the entity/organization. The letter(s) must explicitly state the nature of the collaboration and how the collaboration brings additional value to the project.

J2: **Letter of Commitment for Cooperative Research Agreement:** It is the responsibility of the award recipients to discuss appropriate intellectual property policies, including patent disclosures and filings, with research partners. NSF is not responsible for the type of agreement reached between grantees, research partners and third-party investors. Submit with the proposal a letter of commitment stating that a cooperative research agreement (CRA; see example https://www.nsf.gov/eng/iip/pfi/air/Sample_CRA_PFI_AIR.docx will be provided upon recommendation of an award. If an award is recommended, the partners must follow-up by providing a signed, written CRA that has been negotiated with the partners and third-party investors before NSF funding will be released.

J3: Letters of Support: At least one (and no more than three) letter(s) of support must be submitted that validates the PI's claim that the technology to be translated has a market application or need. The letter should be from an entity who is not funded as part of this proposal, such as a potential customer or a potential manufacturing/development partner, who would be interested in a future partnership assuming the PFI-RP project is successful. The letter should clearly state the problem the technology will address and the need for/ impact of that solution. The letter must signed and dated and contain affiliation and contact information for the signatory individual.

J4: **Data Management Plan:** A Data Management Plan is required for all proposals submitted to NSF. Consult the data management requirements in the PAPPG: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

J5: Postdoctoral Research Mentoring Plan: If a proposal requests funding to support post-doctoral scholars at a research organization, a Postdoctoral Mentoring Plan MUST be uploaded to the system. Describe only the mentoring activities that will be provided to all postdoctoral researchers supported by the project. Information on what to include in the postdoctoral research mentoring plan is available in the PAPPG: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

J6: Resubmission Change Description (if applicable; two pages maximum): A declined proposal may be resubmitted, but only after it has been revised and taken into account the major comments or concerns from the prior NSF review. A supplementary document summarizing the prior major review comments and the response is required.

J7: **Milestone Chart:** A milestone chart with specific tasks, deliverables and estimated timelines.

J8: **Commercialization Sustainability Plan:** Describe a plan that will guide the sustainability of the commercialization efforts during, and especially after, the implementation of the research activities. The plan should be aimed at identifying and securing strategic commercialization partners, investors, licensees, if applicable the creation and funding of spin-out companies, etc.

J9: Human Subjects Documentation (if applicable): Human Subjects Documentation (if applicable): The grantee is responsible for the protection of the rights and welfare of human subjects involved in activities supported by NSF. Please refer to the PAPPG for specific guidance (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg)

J10. Vertebrate Animals Documentation (if applicable): Any project proposing use of vertebrate animals for research or education shall comply with the Animal Welfare Act (7 USC 2131, et seq.) and the regulations promulgated thereunder by the Secretary of Agriculture (9 CFR 1 .1 -4.11) pertaining to the humane care, handling, and treatment of vertebrate animals held or used for research, teaching or other activities supported by Federal awards. In accordance with these requirements, proposed projects involving use of any vertebrate animal for research or education must be approved by the submitting organization's Institutional Animal Care and Use Committee (IACUC) before an award can be made. For this approval to be accepted by NSF, the organization must have a current Public Health Service (PHS) Approved Assurance. See the relevant PAPPG section (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.) for more information.

K. **Single Copy Documents**

Proposers are encouraged to supply an annotated list of suggested reviewers complete with contact information. Collaborators & Other Affiliations (COA) information specified in the PAPPG should be submitted using the instructions and spreadsheet template found at https://nsf.gov/bfa/dias/policy/coa.jsp.

Please note that per guidance in the PAPPG, the Project Description of the PFI-TT and PFI-RP proposal must contain a discussion of the broader impacts of the proposed activities. For this solicitation, the discussion of the broader impacts should be integrated into appropriate sections in order to describe the societal, economic, and/or commercial benefit that would be derived from the proposed activities. Such outcomes include (but are not limited to) one or more of the following: (1) Increasing the economic competitiveness of the United States, (2) Advancing of the health and welfare of the American public, (3) Supporting the national defense of the United States, (4) Enhancing partnerships between academia and industry in the United States, (5) Developing an American STEM workforce that is globally competitive through improved pre-kindergarten through grade 12 STEM education and teacher development, and improved undergraduate STEM education and instruction, (6) Improving public scientific literacy and engagement with science and technology in the United States, (7) Expanding participation of women and individuals from underrepresented groups in STEM. In addition, the broader impacts on students should be discussed in terms of how students will gain innovation experience beyond their normal research activities by participation in the proposed project.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Other Budgetary Limitations:

NSF will not provide salary support for personnel employed by Federal Agencies or Federally Funded Research and Development Centers.

C. Due Dates

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

  February 01, 2018

D. FastLane / Grants.gov Requirements

For Proposals Submitted Via FastLane:

To prepare and submit a proposal via FastLane, see detailed technical instructions available at: https://www.fastlane.nsf.gov/a1/newstan.htm. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or e-mail fastlane@nsf.gov. The FastLane Help Desk answers general technical questions related to the use of the FastLane 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: http://www.grants.gov/web/grants/applicants.html. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

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

Proposers that submitted via FastLane are strongly encouraged to use FastLane 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 making the final award decisions, NSF also may consider the following:

- Geographic distribution and diversity of academic institutions
- Distribution of technology or industry sectors served

Additional Review Criteria for PFI-TT and PFI-RP:

- The strength of the discussion of the market need and how the innovation has the potential to offer a competitive solution or competitive advantage. (Note: strong Letter(s) of Support can help substantiate this)
- The demonstrated understanding of the technology barrier(s) or knowledge gap(s) and how the proof-of-concept, prototype or technology scale-up has the potential to overcome that gap(s).
- The intellectual merit of the proposed translational research to overcome the identified technological hurdles and knowledge gaps.
- The quality of the research plan to translate the existing research discovery to proof-of-concept, prototype or technology scale-up.
- The strength of the prior research results in supporting the assertion that the technology is ready to move beyond the basic research phase and that the translational research proposed has the potential to be successful.
- The quality and capabilities of the team to successfully complete the project.
- The quality of the discussion about the Intellectual Property landscape.
- The quality of the strategy for a path toward commercialization.
- The effectiveness of the assessment plan and the relevance of the proposer’s metrics to the anticipated results.
- The quality of the plan for involvement of undergraduate, graduate students and/or post-docs, incorporating an explanation of how the proposed effort will enhance their knowledge of innovation.
- The reasonableness of the budget and budget justification that indicate how and where the requested funds will be spent. Note, if there is an insignificant research component (i.e., most of the work is to generate a business plan or to understand market need), the proposal will not be accepted.
- The merits of the Broadening Participation plan to foster the inclusion of women and individuals from underrepresented groups in the proposed technology translation and in future commercialization endeavors.

Additional Review Criteria for PFI-RP only:

- The technical and commercial strengths and appropriateness of the proposed partnership(s) and its role in supporting and enabling the objectives of the proposal.
- The commitment of the proposed partners in reaching the stated goals of the proposal.
- To which extent the proposed project, if successful, will contribute to, or result in, the development of an innovation ecosystem.

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or 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) 292-7827 or by e-mail from nsfpubs@nsf.gov.

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

Special Award Conditions:

During the course of the award, a grantee meeting organized by NSF will be held in conjunction with a technology showcase to connect with potential industry collaborators and/or private -sector investors. The showcase is an opportunity to demonstrate a prototype and/or present a poster about the work supported under the PFI award. Applicants should budget travel for the PI and one student or post-doc to attend (approximately $2,500 per person).

Based on project progress, grantees may be requested to present a project status update via a webinar format to the NSF program officer and other NSF staff between 12 and 18 months after the start of the award. Details would be provided after award.

In order for NSF to comply with Federal environmental statutes, the proposer may be requested to submit supplemental post-proposal submission information to NSF in order that a reasonable and accurate assessment of environmental impacts by NSF may be made. In addition, if an award is made, Principal Investigators must comply with all applicable statutory and regulatory requirements, including those related to Environment, Safety, and Health.

C. Reporting Requirements

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

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

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

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

Additional Reporting Requirements for PFI-TT and PFI-RP. The annual and final reports must describe in detail the concrete efforts made, and results obtained, to assess and realize the commercialization potential of the funded technology, results of any customer discovery efforts undertaken, regulatory assessments, sources of revenue sought and obtained, outcomes of any partnerships established with commercialization partners (or in the case of PFI-RP, the industrial partners), investors, spinout companies, etc.

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:

- Jesus V. Soriano, telephone: (703) 292-7795, email: jsoriano@nsf.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: fastlane@nsf.gov.

For questions relating to Grants.gov contact:

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

IX. OTHER INFORMATION

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

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

ABOUT THE NATIONAL SCIENCE FOUNDATION

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

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

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

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

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

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

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.

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) 292-7827
- **To Locate NSF Employees:** (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

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

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

Suzanne H. Plimpton
Reports Clearance Officer
Office of the General Counsel
National Science Foundation
Arlington, VA 22230