Training-based Workforce Development for Advanced Cyberinfrastructure (CyberTraining)

PROGRAM SOLICITATION
NSF 18-516

REPLACES DOCUMENT(S):
NSF 17-507

National Science Foundation

Directorate for Computer & Information Science & Engineering
 Office of Advanced Cyberinfrastructure
 Division of Computing and Communication Foundations
 Division of Information & Intelligent Systems

Directorate for Engineering

Directorate for Geosciences

Directorate for Education & Human Resources
 Division of Graduate Education

Directorate for Mathematical & Physical Sciences

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

February 14, 2018

January 25, 2019

Fourth Friday in January, Annually Thereafter

IMPORTANT INFORMATION AND REVISION NOTES

The revisions are as follows:

- PI/co-PI eligibility criteria have been revised, and an advisory board or a network of collaborators is required.
- The overarching goals of the CyberTraining program are clarified.
- Definitions of the submission tracks are streamlined.
- Programmatic areas of interest are updated with the current priorities of the participating directorates and divisions, with an additional program – the Big Data Regional Innovation Hubs and Spokes (BD Hubs and Spokes) – participating.
- The list of additional solicitation specific review criteria is updated.

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:

 Training-based Workforce Development for Advanced Cyberinfrastructure (CyberTraining)

Synopsis of Program:

 The overarching goals of this program are to (i) prepare, nurture, and grow the national scientific research workforce for *creating, utilizing,* and *supporting* advanced cyberinfrastructure (CI) that enables potentially transformative fundamental science and engineering research and contributes to the Nation's overall economic competiveness and security; (ii) ensure *broad adoption* of CI tools, methods, and resources by the fundamental science and engineering

research community to enable new modes of discovery; and (iii) integrate core literacy and discipline-appropriate advanced skills in advanced CI as well as computational and data science and engineering into the Nation's educational *curriculum/instructional material fabric* spanning undergraduate and graduate courses. For the purpose of this solicitation, advanced CI is broadly defined as the set of resources, tools, and services for advanced computation, data handling, networking, and security that collectively enable potentially transformative fundamental research.

This solicitation calls for developing innovative, scalable training and education programs to address the emerging needs and unresolved bottlenecks in scientific and engineering research workforce development, from the postsecondary level to active researchers. The resultant training and education programs, spanning targeted, multidisciplinary communities, will lead to transformative changes in the state of workforce preparedness for advanced CI-enabled research in the short and long terms. As part of this investment, this solicitation seeks to broaden CI access and adoption by (i) increasing or deepening accessibility of methods and resources of advanced CI and of computational and data science and engineering by a wide range of *scientific disciplines* and *institutions* with lower levels of CI adoption to date; and (ii) harnessing the capabilities of larger segments of diverse underrepresented groups. Proposals from, and in partnership with, the aforementioned communities are especially encouraged.

Prospective principal investigators (PIs) are **strongly encouraged** to engage all relevant stakeholders, to the extent possible within the budget, by forging alliances and forming backbones for *collective impact*; this is particularly necessary in order to inform forward-looking curriculum/instructional material development for the Nation's science and engineering workforce. At a minimum, each project shall have a board of expert advisors or a network of funded/unfunded collaborators representative of stakeholder communities to periodically scrutinize and help refine the curriculum/instructional material and project methods, and to inform professional associations and non-governmental organizations responsible for curriculum, accreditation, and professional examination.

The CyberTraining program is led by the Office of Advanced Cyberinfrastructure (OAC) in the Directorate for Computer and Information Science and Engineering (CISE) and has participation from several directorates and divisions as described in Section II – Program Description, *Programmatic Areas of Interest*. Not all directorates/divisions are participating at the same level and some have specific research and education priorities. The appropriate contact for the CyberTraining program in any directorate/division is the Cognizant Program Officer (PO) for the respective directorate/division/office/program listed.

All projects must advance CI training and education goals for CI-enabled fundamental research as described in the full text of this solicitation, in addition to addressing specific domain needs. Prospective PIs are **strongly encouraged** to contact the Cognizant Program Officers in CISE/OAC **and** in the participating directorate/division(s) relevant to the proposal to ascertain whether the focus and budget of the proposed activities are appropriate for this solicitation. Such consultations should be completed at least one month in advance of the submission deadline**.** PIs should include the names of the Cognizant Program Officers consulted in their Project Summaries as described in Section V.A – Proposal Preparation Instructions. The intent of the CyberTraining program is to stimulate co-funding between OAC and one or more domain directorates/divisions. (For this purpose, divisions of CISE other than OAC are considered "domain divisions.") To ensure relevance to community needs and to facilitate adoption, those proposals of interest to one or more domain divisions **must** include at least one PI/co-PI with expertise relevant to the targeted research discipline. All proposals shall include at least one PI/co-PI with expertise relevant to OAC.

Prospective PIs contemplating submissions that primarily target communities relevant to those directorates/divisions that are not participating in this solicitation are directed to instead explore the education and workforce development programs of the respective directorates/divisions.

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.

- Sushil K. Prasad, CISE/OAC, telephone: (703) 292-5059, email: sprasad@nsf.gov

- Almadena Y. Chtchelkanova, CISE/CCF, telephone: (703) 292-8910, email: achtchel@nsf.gov

- Fen Zhao, CISE/CNS, telephone: (703) 292-7344, email: fzhao@nsf.gov

- Victor P. Piotrowski, EHR/DGE, telephone: (703) 292-8670, email: vpiotrow@nsf.gov

- Joanne D. Culbertson, ENG/CMMI, telephone: (703) 292-4602, email: jculbert@nsf.gov

- Ronald Joslin, ENG/CBET, telephone: (703) 292-7030, email: rjoslin@nsf.gov

- Anthony Kuh, ENG/EECS, telephone: (703) 292-2210, email: akuh@nsf.gov

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- Bogdan Mihaila, MPS, telephone: (703) 292-8235, email: bmihaila@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
- 47.076 --- Education and Human Resources

Award Information

Anticipated Type of Award: Standard Grant

Estimated Number of Awards: 7 to 11

Each CyberTraining award shall range from $300,000 to $500,000 per award and shall be up to 3 years in duration. The number of awards will be based on quality of proposals, availability of funds, and responsiveness to the priorities of the participating directorates/divisions.

Anticipated Funding Amount: $3,500,000

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

Eligibility Information

Who May Submit Proposals:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), Chapter I.E.

Who May Serve as PI:

To ensure relevance to community needs and to facilitate adoption, those proposals of interest to one or more domain divisions *must* include at least one PI/co-PI with expertise relevant to the targeted research discipline. All proposals shall include at least one PI/co-PI with expertise relevant to OAC.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

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

An individual may serve as Principal Investigator (PI) or Co-PI on only one proposal submitted to the CyberTraining program per competition. In the event that an individual exceeds this limit, proposals will be accepted based on earliest date and time of proposal submission, i.e., the first proposal will be accepted and the remainder will be returned without review. No exceptions will be made.

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:**

    Not Applicable

C. Due Dates

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

    February 14, 2018

January 25, 2019

Fourth Friday in January, Annually Thereafter

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:

Standard NSF reporting requirements apply.

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I. INTRODUCTION

Advanced computing and big data analytics are increasingly at the center of scientific and engineering innovation and economic prosperity. In the near future, access to advanced cyberinfrastructure (CI) resources within a comprehensive and highly interoperable ecosystem will be commonplace. Ubiquitous cloud-based services will provide tailored access to application-specific heterogeneous resources, including resources for training, education, and research. The CyberTraining program intends to address emerging skills required in preparation and career growth of the *scientific and engineering research workforce* for innovation, development, maintenance, and utilization of such an *advanced CI ecosystem*. For the purposes of this solicitation, advanced CI is broadly defined as the set of resources, tools, and services for advanced computation, data handling, networking, and security that collectively enable potentially transformative fundamental research.

The need for such research workforce development programs has been highlighted by a number of recent activities and reports, including the (i) National Strategic Computing Initiative (NSCI), which is co-led by NSF and aims to advance the high-performance computing (HPC) ecosystem and develop workforce essential for scientific discovery; (ii) 2016 National Academies' report on *Future*

Directions for NSF Advanced Computing Infrastructure to Support U.S. Science and Engineering in 2017-2020 ; and (iii) *Federal Big Data Research and Development Strategic Plan,* which seeks to expand the community of data-empowered experts across all domains. As envisioned by the NSCI Strategic Plan, for advanced CI to be effective, it must be easily accessible to, and usable by, the broadest range of researchers. This requires skills training and outreach to new users, coupled with applications and a variety of innovative technologies as well as creative approaches, to ensure that overall productivity of an advanced CI-enabled science and engineering ecosystem is maximized and sustained.

Prospective principal investigators (PIs) are ***strongly encouraged*** to engage all relevant stakeholders, to the extent possible within the budget, by forging alliances and forming backbones for *collective impact*; this is particularly necessary in order to inform forward-looking curriculum/instructional material development for the Nation's science and engineering workforce (John Kania & Mark Kramer, "Collective Impact," *Stanford Social Innovation Review*, 2011). PIs may seek public-private partnerships for relevance, enrichment, pursuit of national and international dimensions, and sustainability. At a minimum, each project shall have a board of expert advisors or a network of funded/unfunded collaborators representative of the stakeholder communities to periodically scrutinize and help refine the curriculum/instructional material and project methods, and to help inform professional associations and non-governmental organizations responsible for curriculum, accreditation, or professional examinations.

All projects shall include training and instructional activities. In the short term, projects shall catalyze potentially transformative fundamental research in specific NSF-supported disciplines, and result in innovative, scalable, informal/formal training models and pilot activities; as well as curriculum/instructional material that is integrated into undergraduate and graduate courses, serving as templates for adoption by other institutions and informing best practices and institutional and disciplinary curriculum/instructional material. In the long term, projects should contribute to the larger goals of an educational ecosystem enabling computational and data science for all scientists and engineers, with an understanding of computation as the third pillar and data-driven science as the fourth pillar of the scientific discovery process (*Future Directions for NSF Advanced Computing Infrastructure to Support U.S. Science and Engineering in 2017-2020*), in addition to the traditional first and second pillars of theory and experimentation, respectively. Furthermore, in the long term, projects should contribute toward an ubiquitous educational cloud infrastructure for online, dynamic, personalized lessons and certifications in CI and other multidisciplinary areas that enable broad use by the NSF research communities of advanced CI tools and resources and catalyze potentially transformative fundamental research (*NSF Advisory Committee for Cyberinfrastructure Task Force on Cyberlearning and Workforce Development Report* , Chapter 1, Continuous Collaborative Computational Cloud in Higher Education, 2011).

The CyberTraining program focuses on three scientific communities, and, correspondingly, offers three tracks for project submission (these should be aligned with the research and education priorities of the domain directorates and OAC):

I. **CI Professionals (CIP):** This is the community of research CI and professional staff who explore, develop, deploy, manage, and support effective use of research CI. The **CIP** track is for technical and research CI professional skills development of future *CI professionals*, including undergraduate and graduate students, postdoctoral fellows, and research scientists, and for skills refinement and career development of current *CI professionals.*
II. **CI Contributors (CIC):** This is the community of computational and data scientists and engineers who research and develop new CI capabilities, approaches, and methods. The **CIC** track is for contributor-level CI skills and advanced domain skills development; the target population spans graduate and undergraduate students, postdoctoral fellows, and researchers who are current and future *CI Contributors.*
III. **CI Users (CIU):** This is the community of domain scientists and engineers who effectively exploit advanced CI capabilities and methods for research. The **CIU** track is for user-level core literacy in advanced CI as well as computational and data science and engineering skills; the target population spans undergraduate and graduate students, postdoctoral fellows, and researchers who are the current and future *CI Users.*

CI Professionals include the information technology professionals, scientists, and engineers who work closely with the computational and data-enabled scientific and engineering researchers at colleges and universities, supercomputing and other centers, and research laboratories. These include but are not limited to CI system administration and CI research support staff, and may include computational research scientists and engineers and non-tenure-track faculty.

CI Contributors include both computing as well as domain faculty and research scientists and engineers, including their undergraduate and graduate students and postdoctoral fellows, who develop new scalable models and simulations, as well as algorithms, software at various levels of the scientific software stack, and robust capabilities related to data, hardware, networking, and security aspects of CI to enable major advances in potentially transformative fundamental research.

CI Users include the much larger, diverse group of domain science and engineering faculty and researchers, including their undergraduate and graduate students and postdoctoral fellows, who are the current and potential users of new advanced CI capabilities for their research activities.

NSF anticipates proposals for informal/formal training and education, including retraining and cross-training and related curricular activities, on topics related to methods and resources of advanced CI as well as computational and data science and engineering. These proposals are anticipated to span all levels, from basic literacy to advanced, and focus on addressing the emerging needs of fundamental research communities and resolving the outstanding bottlenecks. The activities can include retraining and cross-training of the faculty mentors and course instructors themselves to keep up with the dynamic knowledge landscape, as one of the ways for obtaining a multiplier effect. For student training and education, a key concern is not to increase the time to degree.

II. PROGRAM DESCRIPTION

NSF invites proposals that identify the emerging and outstanding community needs in training and education that require significant innovations – including the challenge of broadening CI access and adoption by those disciplines and institutions with low CI adoption as well as underrepresented groups. These proposals shall engage the relevant set of partners required as investigators, collaborators, expert advisors, resource providers, and early adopters, and include plans for effective outreach to the stakeholder communities. A key challenge is to design or update suitable curriculum/instructional material that will receive buy-in from the larger community of stakeholders as relevant, of high quality and adoptable, and that can inform best practices and institutional and disciplinary

curriculum/instructional material. Proposals shall articulate well-designed programs with potential for significant impacts, including serving as templates and providing curriculum/instructional material that can be adopted by other institutions, communities, or disciplines.

As investigators conceive of novel training models and educational activities, they are challenged to explore the following aspects for short-term impacts: (i) preparing a better scientific research workforce for advanced CI-enabled research, enhancing research productivity and enabling NSF researchers to effectively address complex societal problems; (ii) broadening adoption and accessibility both as users and contributors of institutional, regional, and national shared computing and data resources by various disciplines, categories of institutions, and underrepresented groups; (iii) developing or updating curriculum/instructional material to feed into undergraduate and graduate courses, and in collaboration with key stakeholders, strategically advancing the goal of informing disciplinary or general education core curriculum/instructional material, or informing discipline-appropriate curriculum/instructional material for advancing skill sets in CI and computational and data science and engineering that will enable major advances in fundamental research; (iv) creating alliances and backbones for *collective impact;* (v) providing on-demand, personalized accessibility; (vi) exploring innovative ways of drawing students into computational studies ("X+Computing" and "Computing+X"); and (vii) leveraging and contributing to NSF-funded CI and research projects [such as the eXtreme Science and Engineering Discovery Environment (XSEDE), NanoHub, Laser Interferometer Gravitational-wave Observatory (LIGO), and Natural Hazards Engineering Research Infrastructure (NHERI)].

In the longer term, investigators should explore how their project contributes to one or more of the following program goals: (i) lead to an educational ecosystem enabling computational and data science for all scientists and engineers with understanding of computation as the third pillar and data-driven science as the fourth pillar of scientific discovery; (ii) lead to re-envisioning the advanced CI ecosystem as an integral and enabling element of a broader, richer, and dynamic scientific and engineering research enterprise; (iii) establish deeper engagement with and impact on various disciplines, institutions, and underrepresented groups; (iv) establish clear career pathways and employment opportunities for the scientific and engineering research communities of concern; and (v) result in an ubiquitous and scalable educational cloud infrastructure for online, dynamic, personalized lessons and certifications.

Investigators may explore various training modes and informal education models, in addition to formal classroom education models. Examples include but are not limited to: (i) summer institutes hosting participants for a few weeks employing logistics similar to Research Experiences for Undergraduates (REU) Sites (note that the CyberTraining solicitation will not accept submissions for REU Sites); (ii) intensive, short-duration training workshops; (iii) workshop and conference training/tutorial tracks; (iv) massive open online courses, small private online courses, and online self-paced training; (v) collaboratively taught courses with remote and local instruction; and (vi) programming and other competitions and awards.

PIs are encouraged to engage all stakeholders, including forging alliances and forming backbones for *collective impact.* Stakeholders may include colleges and universities (educators, researchers, and professional staff); supercomputing centers and related entities; professional/disciplinary associations; non-governmental organizations responsible for curriculum/instructional material development, accreditation, or professional examinations; public and private institutions; government and industry research labs; industry; authors and publishers; and federal, state, and local agencies. Stakeholders may also cross national boundaries; however, NSF funds may only be used to support US-based researchers. At a minimum, each project shall have a board of expert advisors or a network of funded/unfunded collaborators representative of the stakeholder communities to periodically scrutinize and help refine the curriculum/instructional material and project methods, and to help inform professional associations and non-governmental organizations responsible for curriculum, accreditation, or professional examination.

The overall quality of the recruitment and selection processes for the trainees (and trainers) will be important. The recruitment plan should include the types of institutions from which trainees will be recruited, along with the plan to reach out to individuals from disciplines and institutions with lower levels of CI adoption as well as from underrepresented groups.

Evaluation of a project is another crucial element. A project should include plans to evaluate its success, including the attainment of the planned short- and long-term goals. The PI team should identify the expected competencies, curriculum/instructional material, and outcomes, along with success measures and an evaluation timetable. There must be mechanisms for regular feedback from the evaluator, trainees, advisors, and early adopters to the PI team and for feedback to inform further project progress. Proposers may consult *The 2010 User-Friendly Handbook for Project Evaluation* for guidance on the elements of a good evaluation plan.

A sample project may include planning/coordination workshops of key stakeholder communities, advisors, and partners to crystallize needs and create a robust roadmap for creation, gathering, and refinement of curriculum/instructional material; a series of summer training workshops; and feedback loops among the phases. It may also include complementary activities for community engagement, new partnerships, backbone formation and strengthening, dissemination, adoption, and evaluation. Some example projects, serving only to exemplify the nature of the three submission tracks, are as follows:

I. **CI Professionals** track: (a) training and certification of *CI Professionals* in cybersecurity technology and management for advanced CI-enabled research; and (b) working with natural science researchers for advanced visualization, or for supporting scientific gateways;
II. **CI Contributors** track: (a) training geosciences graduate students to develop scalable, parallel, and distributed software for high-performance computing; and (b) training the next generation of researchers on the NHERI DesignSafe Cyberinfrastructure with holistic computational models for future, adaptive buildings; and
III. **CI Users** track: (a) instructor training for computational science literacy across all science, technology, engineering, and mathematics (STEM) disciplines in minimum core topics; and (b) software and big data literacy for natural science researchers.

Programmatic Areas of Interest

The CyberTraining program includes the Office of Advanced Cyberinfrastructure (OAC – the lead for the program), the Division of Computing and Communication Foundation (CCF), and the Division of Information and Intelligent Systems (IIS) within the Directorate for Computer and Information Science and Engineering (CISE); Directorate for Engineering (ENG); Division of Graduate Education (DGE) within the Directorate for Education and Human Resources (EHR); Directorate for Geosciences (GEO); and Directorate for Mathematical and Physical Sciences (MPS). All projects must advance CI training and education goals for CI-enabled fundamental research, in addition to addressing specific domain needs. Not all directorates/divisions are participating at the same level and some have specific research and education priorities as described below.

Within **CISE**, OAC is concerned about all the three communities of *CI Professionals, CI Contributors*, and *CI Users,* both current and future generations. OAC encourages proposals on technical and research CI professional skills development of future *CI Professionals* as well as on skill refinement and career development of current *CI Professionals*. These include technical skills such as network engineering, cybersecurity of advanced research CI, and software installation and maintenance, as well as research support skills such as porting legacy scientific research software and workflows to HPC and cloud platforms, advanced visualization, supporting scientific gateways, and required domain knowledge. OAC also encourages proposals, relevant to the domain directorates, for training as well as cross-training of the computational and data scientists and engineers who are current and future *CI Contributors* in contributor-level CI topics such as scalable scientific software development, modeling and simulation, and computer architecture, and in advanced domain topics such as domain-specific tools, datasets, and models. OAC is also interested in the larger goal of preparing the Nation's scientific and engineering research workforce - well-versed in basic CI and computational and data science and engineering literacy - with an understanding of computation as the third pillar and data-driven science as the fourth pillar of the scientific discovery process. This *CI User* workforce preparation starts with undergraduate students across all disciplines, and continues to graduate students and postdoctoral fellows, particularly in disciplines and areas with low levels of CI adoption.

CISE's CCF division supports research and education projects that develop new knowledge in three core programs: Algorithmic Foundations; Communications and Information Foundations; and Software and Hardware Foundations. CCF is not highlighting specific areas in the context of this solicitation. Rather, it welcomes proposals that broadly enhance the CCF-relevant communities of *CI Professionals, CI Contributors,* and *CI Users* in consultation with the Cognizant Program Officer.

CISE's IIS division encourages data science-related proposals conducted in collaboration with the NSF-funded Big Data Regional Innovation Hubs and Spokes (BD Hubs and Spokes). The BD Hubs and Spokes are a national network of multi-sector partnerships among academia, industry, and government, designed to stimulate innovations in big data and data science across the Nation. Education and training to enable a big data/data science research workforce aligns well with the education mission of each BD Hub or Spoke. Information about the NSF BD Hubs (and their related BD Spokes) can be found on their respective websites: Northeast BD Hub, Midwest BD Hub, South BD Hub, and West BD Hub.

EHR supports the development of a diverse and well-prepared workforce of scientists, technicians, engineers, mathematicians, and educators. EHR is interested in engaging the CI and education research communities to use advanced CI and other approaches to analyze, visualize, and harness data to better understand issues of workforce development in science and engineering. Topics of particular interest include preparation of the workforce in areas of data security and privacy in connection with EHR's investment in the CyberCorps(R): Scholarships for Service (SFS) and Secure and Trustworthy Cyberspace (SaTC) programs, as well as the other aspects associated with preparation of the technical workforce for proficiency in using advanced CI, which is supported by EHR's Advanced Technological Education (ATE) program. In this context, EHR is interested in supporting: (a) innovations in formal/informal educational settings that lead to the broadest participation by all learners; (b) advances in pedagogical curricular design, and introduction of research and internship opportunities; and (c) assessments of training, learning and program evaluation. CyberTraining especially welcomes proposals that will pair well with the efforts of NSF INCLUDES to develop STEM talent from all sectors and groups in our society. Collaborations are encouraged between CyberTraining proposals and existing INCLUDES projects, provided these collaboration strengthen both the CyberTraining and INCLUDES projects. Prospective PIs may wish to separately submit proposals to the EHR Core Research (ECR) program, which welcomes proposals seeking to advance fundamental research on the learning of challenging CI content in formal/informal settings, exploring the evaluation of models for broadening participation such as *collective impact,* and studying the development of the STEM professional workforce.

ENG is interested in supporting the training of students, postdoctoral fellows, and researchers in the areas of HPC software tools; advanced multi-scale, multi-physics computational models and algorithms; and data management and data analytics tools to advance fundamental research across the domain areas of ENG. Proposals should align with the engineering research domain's readiness in CI adoption and focus on training both in the development and use of CI tools as well as the integration of these tools and methods with the engineering domain research. Proposals are encouraged from all ENG research domains that address CI training needs. In support of the broader goals of this solicitation, proposals for workshops and summer institutes are encouraged, including those aimed at upper-level graduate students, postdoctoral fellows, and faculty. Examples of training topics may include effective use of parallel computing methods; effective integration of different models in multi-scale modeling; model validation and coupling models and experimental data; uncertainty quantification; an effective software development process; development of data tools, resources, and infrastructure to ensure accessibility, ease of use, and sustainability; effective data mining techniques and integration of different types of data; efficient extraction of dynamic models and real-time model updating using very large data sets; and/or real-time, finite, horizon-constrained optimal control (model-predictive control systems) for complex dynamic systems.

ENG's Division of Chemical, Bioengineering, Environmental and Transport Systems (CBET) has a special interest in proposals focused on (i) developing multi-scale models that enable fundamental understanding of the relationships between molecular-level and macroscopic chemical, biological, and physical phenomenon; (ii) establishing workflows and/or best practices for data generation, analysis, and storage that address the long-standing issues of reproducibility and uncertainty quantification; and (iii) effective implementation of advanced computational methods (e.g., machine learning) toward solving relevant engineering problems.

ENG's Division of Civil, Mechanical, and Manufacturing Innovation (CMMI) supports training to advance fundamental research across the CMMI portfolio on the topics listed for ENG. CMMI encourages proposals, in collaboration with the NHERI DesignSafe Cyberinfrastructure, focused on (i) creating holistic computational models for future, adaptive buildings for which experimental data and computational models for components are available at different scales, and sharing these models on the NHERI DesignSafe Cyberinfrastructure; and (ii) creating workflows that link computational building models with simulation codes and visualizations, and make them accessible to enable next-generation researchers on the NHERI DesignSafe Cyberinfrastructure.

ENG's Division of Electrical, Communications, and Cyber Systems (ECCS) has a special interest in proposals focused on (i) machine learning and big data analytics to enable real-time, efficient data learning and feature extraction from massive noisy data; (ii) secure communication and intelligent systems which facilitate real-time, distributed data processing and multi-level decisions in heterogeneous infrastructures; and (iii) hardware innovations including smart sensors as well as secure and reliable communication and control systems that are reconfigurable for rapid deployment in dynamic environments.

GEO supports fundamental research that advances the frontiers of knowledge and drives technological innovation while improving our understanding of the many processes that affect the global environment. These processes include the role of the atmosphere and oceans in our climate, the planetary water cycle, and ocean acidification. GEO supports interdisciplinary studies that contribute directly to national research priorities such as understanding, adapting to, and mitigating the impacts of global change; developing and deploying integrated ocean observing capabilities to support ecosystem-based management; and understanding future availability of

freshwater. GEO is not highlighting specific areas in the context of this solicitation. Rather, it welcomes proposal that broadly enhance the GEO-relevant communities of *CI Professionals, CI Contributors,* and *CI Users* in consultation with the Cognizant Program Officer.

MPS is interested in supporting workshops and summer schools focused on training students and postdoctoral fellows in computational methods on advanced computing architectures. High-performance computing and data analytics methods are to be introduced in the context of specific scientific applications relevant to the MPS communities. Lectures must be accompanied by problem sessions and hands-on activities on the actual machines. Online sharing of workshop materials and recorded presentations on dedicated websites is strongly encouraged.

Investments through this solicitation at the undergraduate and graduate levels complement NSF's Improving Undergraduate STEM Education (IUSE) and graduate education strategic frameworks, respectively. IUSE is NSF's comprehensive, Foundation-wide framework for an integrated vision of the agency's investments in undergraduate STEM education. Similarly, NSF has recently published a *Strategic Framework for Investments in Graduate Education*.

III. AWARD INFORMATION

Each CyberTraining award shall range from $300,000 to $500,000 per award and shall be up to 3 years in duration. The number of awards will be based on quality of proposals, availability of funds, and responsiveness to the priorities of the participating directorates/divisions. Estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

> The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), Chapter I.E.

Who May Serve as PI:

> To ensure relevance to community needs and to facilitate adoption, those proposals of interest to one or more domain divisions **must** include at least one PI/co-PI with expertise relevant to the targeted research discipline. All proposals shall include at least one PI/co-PI with expertise relevant to OAC.

Limit on Number of Proposals per Organization:

> There are no restrictions or limits.

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

> An individual may serve as Principal Investigator (PI) or Co-PI on only one proposal submitted to the CyberTraining program per competition. In the event that an individual exceeds this limit, proposals will be accepted based on earliest date and time of proposal submission, i.e., the first proposal will be accepted and the remainder will be returned without review. No exceptions will be made.

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.

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

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

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

The following provides additional guidance beyond that contained in the PAPPG or NSF Grants.gov Application Guide.

Cover Sheet: A short informative title that begins with "CyberTraining: CIP:", "CyberTraining: CIC:", or "CyberTraining: CIU:", corresponding to one of the three tracks of CI Professionals, CI Contributors, and CI Users, respectively, and identifying the main thrust of the project.

Project Summary (1-page limit): The Project Summary consists of an overview, a statement on the intellectual merit of the proposed activity, and a statement on the broader impacts of the proposed activity. The overview includes a summary description of the project, including the need for the activity and its short- and long-term goals for training, education, and workforce development; broadening CI access and adoption goals; curriculum/instructional material goals; innovative aspects; target communities; and estimated number of trainees. The overview also includes (i) **4-5 keywords** that specify the disciplines, topics, and themes targeted; and (ii) **Names of the Cognizant Program Officers consulted prior to submission**, pursuant to the guidance above. The Project Summary should be written in a manner that will be informative to STEM professionals working in the same or related fields, and understandable to a scientifically-literate lay reader.

Project Description (15-page limit): The project description should explicitly address the following additional items that will also be employed as additional solicitation-specific review criteria (see Section VI.A for details):

1. Challenges addressed in training, education, and workforce development;
2. New modes of discovery and use of advanced CI resources, tools, and services in fundamental research enabled;
3. Advances in integrating skills in advanced CI as well as computational and data science and engineering into institutional and disciplinary curriculum/instructional material;
4. Steps to broaden access and community adoption with respect to the Nation's scientific and engineering research workforce and advanced CI;
5. Stakeholders engaged and partnerships forged for collective impact;
6. Scalability to a large number of people directly and indirectly, and sustainability of key aspects beyond NSF funding; and
7. Plans for recruitment and assessment.

Please note that, per guidance in the PAPPG, the Project Description must contain separate sections labeled "Intellectual Merit" and "Broader Impacts."

Supplementary Documents

In addition to the Data Management Plan (please follow the CISE Data Management Plan Guidance available at https://www.nsf.gov/cise/cise_dmp.jsp) and the Postdoctoral Research Mentoring Plan (if required), the following items are the only items permitted as supplementary documents:

1. **Management and Coordination Plan (2 pages):** Each proposal must contain a clearly-labeled Management and Coordination Plan that includes: 1) the specific roles of the PI, co-PIs, other Senior Personnel and paid consultants at all institutions involved; 2) how the project will be managed across institutions and disciplines; 3) identification of the specific coordination mechanisms; and 4) pointers to the budget line items that support these management and coordination mechanisms.
2. **Letters of Collaboration:** Include documentation of funded or un-funded collaborative arrangements of significance to the proposal through letters of collaboration. Letters of collaboration should be limited to stating the intent to collaborate and should not contain endorsements or evaluation of the proposed project. The recommended format for letters of collaboration is as follows: "If the proposal submitted by [insert the full name of the Principal Investigator] entitled [insert the proposal title] is selected for funding by NSF, it is my intent to collaborate and/or commit resources as detailed in the Project Description or the Facilities, Equipment or Other Resources section of the proposal." Scan your signed letters of collaboration, containing only text similar to that above, and upload them into the Supplementary Documents section of FastLane or Grants.gov, but do not send originals. *Do not submit letters of support.* For example, letters of endorsement and letters of a laudatory nature for the proposed project are not acceptable.

Single Copy Documents

Collaborators and Other Affiliations Information:

Collaborators & Other Affiliations (COA) information specified in the PAPPG Chapter II.C.1.e should be submitted using the spreadsheet template found at https://www.nsf.gov/bfa/dias/policy/coa.jsp. For each proposal, a completed spreadsheet for each PI, co-PI, and Senior Personnel should be uploaded directly into Fastlane in .xls or .xlsx format as a "Collaborator and Other Affiliations" Single Copy Document. NSF will require the use of the spreadsheet for identifying COA information; the spreadsheet will ensure the COA information has a common, searchable format. *Submitters using grants.gov may upload this document as a PDF.*

No other items, emails, or appendices are to be included. Full proposals containing items other than those required above or by PAPPG will be returned without review.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Budget Preparation Instructions:

A significant portion of the proposed budget should be allocated for training, instructional, curricular, and outreach activities, and these and other activities should be budgeted as "Participant Support" to the extent allowable. In addition, each awardee is expected to participate in annual PI meetings near NSF with travel costs supported by the award; these travel costs should be included in the proposed budget.

C. Due Dates

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

    February 14, 2018

    January 25, 2019

    Fourth Friday in January, Annually Thereafter

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 *Investing in Science, Engineering, and Education for the Nation's Future: NSF Strategic Plan for 2014-2018*. 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

All proposals must clearly address the following solicitation-specific review criteria through well-identified proposal elements:

1. Are the training, education, and research workforce challenges identified sound?
2. What is the potential of the project to enable new modes of discovery and use of advanced CI resources, tools, and services in fundamental research?
3. How well would the project advance the goal of integrating skills in advanced CI as well as computational and data science and engineering into institutional and disciplinary curriculum/instructional material?
4. To what extent can the project meet its broadening access and community adoption challenges with respect to the Nation's scientific and engineering research workforce and advanced CI?
5. How well would the project engage key stakeholders and forge partnerships for collective impact?
6. What is the potential for the project to scale and for its key aspects to be sustained beyond NSF funding?
7. Are the plans for recruitment and evaluation sound?
8. Are the plans for management and collaboration effective?

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:

Awardees are expected to participate in annual PI meetings with travel costs supported by the award.

C. Reporting Requirements

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

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

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

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

VIII. AGENCY CONTACTS

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

General inquiries regarding this program should be made to:

- Sushil K. Prasad, CISE/OAC, telephone: (703) 292-5059, email: sprasad@nsf.gov

- Almadena Y. Chtchelkanova, CISE/CCF, telephone: (703) 292-8910, email: achtchel@nsf.gov

- Fen Zhao, CISE/CNS, telephone: (703) 292-7344, email: fzhao@nsf.gov

- Victor P. Piotrowski, EHR/DGE, telephone: (703) 292-8670, email: vpiotrow@nsf.gov

- Joanne D. Culbertson, ENG/CMMI, telephone: (703) 292-4602, email: jculbert@nsf.gov

- Ronald Joslin, ENG/CBET, telephone: (703) 292-7030, email: rjoslin@nsf.gov

- Anthony Kuh, ENG/EECS, telephone: (703) 292-2210, email: akuh@nsf.gov

- Eva Zanzerkia, GEO, telephone: (703) 292-4734, email: ezanzerk@nsf.gov

- Bogdan Mihaila, MPS, telephone: (703) 292-8235, email: bmihaila@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
Alexandria, VA 22314

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Text Only