IUSE / Professional Formation of Engineers: Revolutionizing Engineering Departments (RED)

PROGRAM SOLICITATION
NSF 14-602

National Science Foundation

Directorate for Engineering
Engineering Education and Centers
Division of Electrical, Communications and Cyber Systems
Division of Chemical, Bioengineering, Environmental, and Transport Systems
Division of Civil, Mechanical and Manufacturing Innovation
Industrial Innovation and Partnerships

Directorate for Computer & Information Science & Engineering

Directorate for Education & Human Resources

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

October 28, 2014

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

November 26, 2014

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

IUSE/Professional Formation of Engineers: Revolutionizing Engineering Departments (RED)

Synopsis of Program:

The NSF Engineering (ENG) Directorate is launching a multi-year initiative, the *Professional Formation of Engineers*, to create and support an innovative and inclusive engineering profession for the 21st Century. Professional Formation of Engineers (PFE) refers to the formal and informal processes and value systems by which people become engineers. It also includes the ethical responsibility of practicing engineers to sustain and grow the profession. The engineering profession must be responsive to national priorities, grand challenges, and dynamic workforce needs; it must be equally open and accessible to all.

In FY 2015 the PFE initiative in ENG is launching a pilot program aligned with the IUSE framework: *Revolutionizing Engineering Departments (herein referred to as RED)*, in partnership with the Directorates for Computer and Information Science and Engineering (CISE) and Education and Human Resources (EHR). This funding opportunity enables engineering departments to lead the nation by successfully achieving significant sustainable changes necessary to overcome long-standing issues in their undergraduate programs and educate inclusive communities of engineering students prepared to solve 21st century challenges. Computer science departments, whether administratively located in or outside an engineering program, are included in RED, as they share the same challenges as traditional engineering departments. (Note: “Engineering departments” in this solicitation will refer to engineering and computer science departments.)

Even as demographic and regional socio-economic factors affect departments in unique ways, there are certain tenets of sustainable change that are common across institutions. For instance, the development and engagement of the entire faculty within a department are paramount to the process, and they must be incentivized. Departmental cultural barriers to inclusion of students *and* faculty from different backgrounds must be identified and addressed. Finally, coherent technical and professional threads must be developed and woven across the four years, especially (1) in the core technical courses of the middle two years, (2) in internship opportunities in the private and public sectors, and (3) in research opportunities with faculty. These and other threads aim to ensure that students develop deep knowledge in their discipline more effectively and meaningfully, while at the same time, aim to build their capacities for 21st Century and “T-shaped” professional skills, including design, leadership, communication, understanding historical and contemporary social contexts, lifelong learning, creativity, entrepreneurship, and teamwork. It is hoped that, over time, the awardees of this program will create knowledge concerning sustainable change in engineering and computer science education that can be scaled and adopted nationally across a wide variety of academic institutions.

Note: Because it addresses undergraduate engineering education, the Revolutionizing Engineering Departments (RED) funding opportunity is offered in alignment with the NSF-wide undergraduate STEM education initiative, *Improving Undergraduate STEM Education (IUSE)*. More information about IUSE can be found in the Introduction of this solicitation.

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.

- Donna M. Riley, Solicitation Coordinator, Program Director, Engineering Education, Division of Engineering Education and Centers, Engineering Directorate, telephone: (703) 292-7107, email: driley@nsf.gov
- Susan C. Kemnitzer, Deputy Division Director, Chemical, Bioengineering, Environmental, and Transport Systems (CBET), Engineering Directorate, telephone: (703) 292-5347, email: skemnitz@nsf.gov
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- Pei Zhijian, Program Director, Manufacturing, Machines, and Equipment, Division of Civil, Mechanical, and Manufacturing Innovation (CMMI), Engineering Directorate, telephone: (703) 292-8611, email: zpei@nsf.gov
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- Glenn H. Larsen, Program Director, Industry/University Cooperative Research Program (I/UCRC), Division of Industrial Innovation and Partnerships (IIP), Engineering Directorate, telephone: (703) 292-4607, email: glarsen@nsf.gov
- Yvette Weatherton, Program Director, Division of Undergraduate Education (DUE), Education and Human Resources Directorate, telephone: (703) 292-5323, email: yweather@nsf.gov
- Jeff Forbes, Program Director, Division of Computer and Network System (CNS), Directorate for Computer and Information Science and Engineering, telephone: (703) 292-4291, email: jforbes@nsf.gov

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

- 47.041 --- Engineering
- 47.070 --- Computer and Information Science and Engineering
- 47.076 --- Education and Human Resources

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 5 to 10

Five to ten awards will be made, each in an amount from $1,000,000 to $2,000,000 total for a duration of up to 60 months. Estimated program budget, number of awards, and average award size/duration are subject to the availability of funds and the quality of proposals received.

Anticipated Funding Amount: $11,950,000

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

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Universities and Colleges - 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. Such organizations also are referred to as academic institutions.

Who May Serve as PI:

The Principal Investigator(s) must be a department chair/head (or equivalent) to establish institutional accountability. Additionally, there must be a RED team that includes (at a minimum) an expert in engineering education or computer science education research, who can ground the research plan in the literature, and a social science expert who can evaluate department dynamics and monitor change processes. The social scientist must have expertise to advise on strategies for developing a culture of change and on strategies for creating meaningful collective ownership of the effort among faculty, students, and staff.

Limit on Number of Proposals per Organization: 2

An organization is allowed up to two submissions per competition.

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

A Principal Investigator is allowed only one submission per competition.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Submission of Letters of Intent is required. Please see the full text of this solicitation for further information.
- **Preliminary Proposal Submission:** Not required

- **Full Proposals:**
  - Full Proposals submitted via FastLane: NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) Guidelines apply. The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg.
  - 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: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide)

B. Budgetary Information

- **Cost Sharing Requirements:** Inclusion of voluntary committed cost sharing is prohibited.
- **Indirect Cost (F&A) Limitations:** Not Applicable
- **Other Budgetary Limitations:** Not Applicable

C. Due Dates

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

  October 28, 2014

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

  November 26, 2014

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: Standard NSF award conditions apply.

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

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I. INTRODUCTION

Over the past several decades various studies, reports, and initiatives on science, technology, engineering, and mathematics, or STEM, education and diversity were led by the National Science Board, the National Academies, the President's Council of Advisors

on Science and Technology (PCAST), the President's Council on Jobs and Competitiveness, think tanks, and others. Yet, over time, the messages are similar, and in some cases identical. They have brought to the forefront the acute awareness of national grand challenges and of the structural disconnect between STEM workforce needs and student engagement and preparation to meet those needs. However, many of these studies explore STEM more broadly and not the unique aspects of "S," "T," "E," and "M."

The "E" in STEM, Engineering, has many unique aspects. Engineers' abilities in design and systems thinking enable them to utilize their integrative, creative capacity to leverage technology in improving quality of life for people and the planet. Because of engineers' immediate ability to contribute professionally upon graduation, the BS degree in engineering (including software engineering) is distinctive as a four-year professional degree with eligibility to qualify for the Professional Engineer (PE) license[1]. Furthermore, in the high-tech environment upon which the global economy is based, the perennial debate about workforce shortages of engineers and computer scientists requires a more precise understanding of dynamic industry needs and of the abilities of departments to address them. Finally, the inclusion of persons from groups underrepresented in most disciplines of engineering and computer science has remained a stubborn long-standing issue, especially in electrical engineering, mechanical engineering, computer engineering, and computer science, among others.

Thus, the Engineering Directorate is taking a holistic look at how engineers are being prepared for a lifelong career in the profession. It seeks to respond to the perennial calls from different stakeholders (e.g., industry, the public, government, and the profession itself) to form engineers and computer scientists with a broad set of professional abilities. It seeks to address the fact that the percentages of persons from underrepresented groups entering into – and remaining in – the practice of engineering and computer science are still unacceptably low, impacting the future health of the profession. Furthermore, engineering is a career with entry to licensure following completion of the baccalaureate degree; hence, the directorate seeks alignment and quality of experiences for engineers to achieve this status.

To address these and related matters, the Engineering Directorate (ENG) is launching a multi-year initiative, the *Professional Formation of Engineers*, to create and support an innovative and inclusive engineering profession for the 21st Century. The engineering profession must be responsive to national priorities, grand challenges, and dynamic workforce needs, and it must be equally open and available to all. In FY14 the PFE initiative in ENG is launching a pilot program aligned with the IUSE framework: *Revolutionizing Engineering Departments (herein referred to as RED)*. The CISE and EHR directorates are partnering with the Engineering Directorate in this pilot, as they also support formation of engineers and computer scientists as part of their overall strategies.

The National Science Foundation (NSF) *Improving Undergraduate STEM Education* (IUSE) initiative is a comprehensive, Foundation-wide effort to accelerate the quality and effectiveness of the education of undergraduates in all of the STEM fields. The importance of the undergraduate experience for preparing both a diverse STEM workforce equipped for innovation, and a STEM-literate public ready to support and benefit from the progress of science, is described in a number of key reports and documents (e.g., *Rising Above the Gathering Storm, Revisited*(National Research Council, 2010); *Expanding Underrepresented Minority Participation* (National Research Council, 2011); *Engage to Excel* (President's Council of Advisors on Science and Technology, 2012); *Discipline-based Education Research* (National Research Council, 2012); *Federal Science, Technology, Engineering, and Mathematics (STEM) Education 5-Year Strategic Plan* (National Science and Technology Council, Committee on STEM Education, 2013)). NSF, with its mission to advance science, engineering, and education, plans to invest over $100M in FY 2015 through coordinated investments across directorates within a coherent framework for improving undergraduate STEM learning. The *IUSE Framework* promotes new and exciting approaches to using research on STEM learning and education to address challenges across undergraduate STEM education, as well as within specific disciplines. The framework draws upon a knowledge base accumulated from decades of research, development, and best practices across the nation in STEM undergraduate education. NSF expects that investments within the IUSE portfolio will integrate theories and findings from education research with attention to the needs and directions of frontier science and engineering research. New knowledge about learning and implementation will be developed across all IUSE investments.

In FY 2015, NSF-IUSE serves as the framework for all investments in research and development that are critical for **curricular** improvement in undergraduate STEM education, within formal and informal learning environments. FY2015 IUSE programs call for proposals to:

- use and build evidence about improved STEM instructional practices;
- design and study innovative learning opportunities, including cyberlearning;
- create, implement, and test program, curricular, course, and technology-driven models;
- develop, implement, and test creative approaches for adoption of education research to improve disciplinary teaching;
- develop and validate assessments/metrics for undergraduate STEM learning and instructional practice; and
- conduct fundamental research on issues of undergraduate STEM teaching and learning.

The IUSE approach recognizes the dynamic landscape of individual STEM disciplines, new discoveries, emergence of new sub-fields, interdisciplinary needs for undergraduate STEM learning, evolving challenges in the higher education domain, changing technologies, and the STEM needs of academia, government, and the private sector. The interplay between STEM education research and STEM education practice are featured; coupling between education research and education practice (see *Innovation with Impact*, Jamieson and Lohman, 2012; *The Craft of Research*, 3rd edition, Booth, Colomb, and Williams, 2008) fosters a "cycle of innovation," iterating between new questions emerging from innovative practice to be solved by new research and new solutions derived from research to be implemented through modified practice. Ongoing changes in subject matter content, workforce needs, and theories of learning and educational practice drive new STEM education inquiry, development, testing, and implementation. Successful implementation around this cycle requires collaborations among STEM disciplinary experts, learning scientists, and STEM education practitioners.

The collection of projects in the IUSE portfolio are intended to: improve STEM learning and learning environments, broaden participation and institutional capacity for STEM learning, and build the professional STEM workforce for tomorrow. Investments will include foundational and exploratory research, design and development research, and impact research.

Note: RED is ***not primarily*** about curricular improvement but does relate to the IUSE goals of connecting education research to practice, building institutional capacity for large scale change in engineering and computer science education, and broadening participation in these fields.

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[1] See the National Council of Examiners for Engineering and Surveying, Professional Engineers exam, http://ncees.org/exams/pe-exam/.

II. PROGRAM DESCRIPTION

A. The Holistic Professional Formation of Engineers

The Revolutionizing Engineering Departments (RED) solicitation is the first project in the Engineering Directorate's (ENG) multi-year initiative, the *Professional Formation of Engineers*, established to create and support an innovative and inclusive engineering profession for the 21st Century.

Professional Formation of Engineers (PFE) refers to the formal and informal processes and value systems through which people become engineers. It also includes the ethical responsibility of practicing engineers to sustain and grow the profession in order to improve quality of life for all peoples. Professional Formation includes, but is not limited, to:

- Introductions to the profession at any age;
- Acquisition of deep technical and professional skills, knowledge, and abilities in both formal and informal settings/domains;
- Development of outlooks, perspectives, ways of thinking, knowing, and doing;
- Development of identity as an engineer (e.g., systems designer and integrator); and
- Acculturation to the profession, its standards, and norms.

Professional formation occurs within a Complex System that includes formal classrooms; informal settings such as Maker spaces (hands-on, do-it-yourself environments where community members gather to create, invent, and learn[2]; industry settings (including co-op and internship experiences); as well as early career (engineer-in-training (EIT)/engineering intern (EI)) work, research experiences, mentor/mentee, and sponsor/sponsoree relationships, etc. To facilitate such activities, engineers must understand and navigate this Complex System for successful professional formation and practice. They must oversee and participate in developing and maintaining this System, with smooth and clear pathways to and through the profession. Pathways may include formal and informal education, apprenticeship (in some states), credentialing, and licensure.

B. The Engineering Directorate PFE Initiative

The Engineering Directorate is committed to enabling a vibrant engineering profession for the 21st Century. To that end, the current PFE Complex System must be studied and understood. Gaps and barriers to PFE must be identified, and weak "target points" in the pathways through the profession must be strengthened or eliminated. A "target point" is a vulnerable transition, or perhaps even an undesirable climate, that impacts the preparation steps toward becoming an engineer. Example "target points" include the typical transitions from high school into a two-year or four-year engineering or computer science degree program; from two-year to four-year institutions; from a BS degree to industry or graduate school; or from a BS or graduate degree to professional licensure[3]. A "target point" also may reflect a formal or informal setting comprised of individuals of different backgrounds with little or no guidance on how to interact, or it may reflect narrow conceptions of what engineering is or should be that create strict and non-porous boundaries for the profession.

The Engineering Directorate, however, has identified one of the most critical "target points" to successful professional formation: it is the engineering "core" – i.e., the middle two years of the four year undergraduate experience, during which students receive the bulk of their formal technical preparation[4]. These middle years are also a critical transition point for transfer students from community colleges and a primary attrition point for engineering majors. During the middle two years, students often find themselves without context to grasp the big picture surrounding technically focused courses that are widely perceived as "real" engineering. Moreover, many professional skills - those that define what an engineer is and does in the workforce – are emphasized in the first year but de-emphasized or dropped entirely in the middle two years, only to be picked up again in upper level electives or capstone design experiences, where they often must be re-taught. These gaps in the middle years often limit the potential richness of intern/co-op experiences in industry or of research experiences with faculty during this timeframe, if indeed the student has such opportunities in the first place. These gaps often contribute to confusion and frustration among students during the middle years, and they impact disproportionately those typically underrepresented in engineering.

Hence, there is a need to build research capacity in PFE to better understand the complexity of the System and how to optimize it. There is a need to understand required change processes in the PFE System, and once understood, to clearly articulate and implement these change processes. Finally, there is a need to increase welcome and access for groups underrepresented in engineering practice.

C. Revolutionizing Engineering Departments

Prior engineering education research has led to successes in the introductory and capstone years. However, little research has been done to bridge the innovations in introductory- and capstone-level engineering and computer science education across the entire undergraduate experience, including extracurricular professional activities and student transitions in and out of the program. Furthermore, prior research also has revealed the need for faculty development, faculty reward systems, and academic cultures that encourage engagement of faculty and students of diverse backgrounds in the full undergraduate-level PFE process.

Thus, the goal of Revolutionizing Engineering Departments (RED) is to address the stated challenges and develop well-functioning departments that may overcome them with a focus on student success in their PFE attainment. Specific activities supported by the RED solicitation may include, but are not limited to:

- Establishing convergent technical and professional threads that must be woven across the four years, especially in core technical courses of the middle two years, in internship opportunities in the private and public sectors, and in research opportunities with faculty;
- Exploring strategies for institutional, systemic, and cultural change, including new approaches to faculty governance or department structures and to restructuring faculty incentive or reward systems;
- Exploring collaborative arrangements with industry and other stakeholders who are mutually interested in developing the best possible PFE environment and opportunities for students;
- Exploring strategies to bridge the engineering education research-to-practice gap, primarily through faculty development and adoption of best practices in the professional formation of engineers;
- Devising mechanisms to make change sustainable in the department beyond the award period; and
- Devising mechanisms to make change adaptable to other departments and institutions.

All these, and other, activities must focus on how they impact students of different backgrounds navigating the varied pathways through the undergraduate PFE process.

D. Key Features of RED

For the RED solicitation, proposed efforts for departmental change should be revolutionary, not incrementally reformist, and strategies should be developed with impact on the student as the focus. Revolutionary means radically, suddenly, or completely new; producing fundamental, structural change; or going outside of or beyond existing norms and principles. Proposed efforts must be grounded in sound educational theory and work to enable a continuous progression of professional formation through the four year experience. Efforts should address 21st Century skills and T-shaped skills (i.e. cross-disciplinary breadth), and they should be aligned with stakeholder expectations.

The intent of this solicitation is to focus on significant, systemic departmental change as it impacts student success in their PFE. Proposals should reflect:

- A clear demonstration of the PI, i.e., the chair/head (or equivalent), as an innovative leader of systemic change in the department to achieve the stated goals of the RED activities.
- An understanding of the role of each of the RED team members in creating change, demonstrating clear and significant contributions from the department head or dean, the engineering or computer science education expert, and the social scientist attuned to departmental dynamics.
- An understanding of the research on how students of diverse backgrounds learn engineering or computer science and what has been previously attempted.
- An understanding of how engineering education research connects to practice and of barriers to faculty adoption of engineering and computer science education innovations.
- An appreciation that faculty participation, engagement, development, and belief in the scholarship of learning are critical to success.
- An understanding of the importance of linking to professional practice through involvement of the department's or college's existing Industrial Advisory Board (or equivalent);
- An acknowledgement of additional example strategies, such as increasing the stature of professor(s) of engineering practice and their role as change agents or connecting the work with professional masters programs.
- An incorporation of scalability and adaptability considerations. Often, successful innovations in engineering education do not spread much beyond their origin. This can be seen in large variations in retention, diversity, and preparation across departments and institutions. Scalability and adaptability are two fundamental characteristics that are necessary for local innovations to have large scale impacts. It is therefore critical that proposed approaches incorporate scalability and adaptability by design. In addition, it would be important to adapt best practices and strategies from scaling of social innovations, leverage potential power of social and professional networking tools, and synergistic connections with stakeholder networks such as NSBE, SWE, SHPE, ASME, IEEE, NCTM, NCWIT, iAAMCS, and other organizations. Successful proposals would include creative strategies that maximize probability of scaling and adaptation for large scale national impacts.

E. References that may be helpful

Below is a list of example references that may be useful to the RED team as they develop their RED strategies:

- *Journal of Engineering Education* Special Issue: The Complexities of Transforming Engineering Higher Education, April 2014, 103(2): 183-361.
- Johri, A. and Olds, B. (2014). *Cambridge Handbook of Engineering Education Research.* New York: Cambridge University Press.
- National Academy of Engineering. (2013). *Educating Engineers: Preparing 21st Century Leader in the Context of New Modes of Learning*. Washington, DC: National Academies Press.
- ASEE. Transforming Undergraduate Education in Engineering: Phase I: Synthesizing and Integrating Industry Perspectives, May 9-10, 2013. Workshop Report. http://www.asee.org/TUEE_PhaseI_WorkshopReport.pdf
- Jamieson, L., and Lohman, J. (2012). *Innovation with Impact: Creating a Culture for Scholarly and Systematic Innovation in Engineering Education*. Washington, DC: American Society for Engineering Education.
- Watson, K. (2009). Change in Engineering Education: Where does Research Fit? *Journal of Engineering Education*, 98(1): 3-4.
- Spalter-Roth, R., Fortenberry, N., and Lovitts, B. (2007). The Acceptance and Diffusion of Innovation: A Cross-Curricular Perspective on Instructional and Curricular Change in Engineering. Washington, DC: American Sociological Association and National Academy of Engineering Center for the Advancement of Scholarship in Engineering Education.
- National Academy of Engineering (2005). *Educating the Engineer of 2020: Adapting Engineering Education to the New Century*. Washington, DC: National Academies Press.

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[2] http://oedb.org/ilibrarian/a-librarians-guide-to-makerspaces

[3] For a review of the literature on target points see Sheppard, S.D., Antonio, A.L, Brunhaver, S.R., and Gilmmartin, S.K. "Studying the Career Pathways of Engineers," *Cambridge Handbook of Engineering Education Research*, Johri and Olds, eds. New York: Cambridge University Press, 2014; and Jamieson, L., and Lohman, J. (2012). *Innovation with Impact: Creating a Culture for Scholarly and Systematic Innovation in Engineering Education*. Washington, DC: American Society for Engineering Education.

[4] For a review of the literature on the middle two years, see Lord, S.M. and Chen, J.C. "Curriculum Design in the Middle Years," *Cambridge Handbook of Engineering Education Research*, Johri and Olds, eds. New York: Cambridge University Press, 2014.

III. AWARD INFORMATION

Five to ten awards will be made, each in an amount from $1,000,000 to $2,000,000 total for a duration of up to 60 months. Estimated program budget, number of awards, and average award size/duration are 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:

- Universities and Colleges - 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. Such organizations also are referred to as academic institutions.

Who May Serve as PI:

The Principal Investigator(s) must be a department chair/head (or equivalent) to establish institutional accountability. Additionally, there must be a RED team that includes (at a minimum) an expert in engineering education or computer science education research, who can ground the research plan in the literature, and a social science expert who can evaluate department dynamics and monitor change processes. The social scientist must have expertise to advise on strategies for developing a culture of change and on strategies for creating meaningful collective ownership of the effort among faculty, students, and staff.

Limit on Number of Proposals per Organization: 2

An organization is allowed up to two submissions per competition.

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

A Principal Investigator is allowed only one submission per competition.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Letters of Intent*(required):*

A one-page Letter of Intent is required to be submitted by the lead institution for each proposal. Letters of Intent are not reviewed. They are used to gauge the submission of proposals and the review requirements. No feedback will be given.

The LOI should be submitted through FastLane or Grants.gov. The format of the letter is as follows:

Institution:

Engineering Department:

PI (Dept. Head/Chair or equivalent), with contact information:

RED team members and their roles:

Partners/Collaborators:

Project Title: The title should begin with “IUSE/PFE:RED:”

Synopsis (200-word limit): Provide a brief summary of the vision for the department, goals of the proposed RED project, and preliminary plans for sustainability after NSF funding.

Letter of Intent Preparation Instructions:

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

- Sponsored Projects Office (SPO) Submission is not required when submitting Letters of Intent
- A Minimum of 0 and Maximum of 4 Other Senior Project Personnel are allowed
- Submission of multiple Letters of Intent is not allowed

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 Grant Proposal Guide (GPG). The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg. Paper copies of the GPG 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: (http://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. Chapter II, Section D.4 of the Grant Proposal Guide provides additional information on collaborative proposals.

Important Proposal Preparation Information: FastLane will check for required sections of the full proposal, in accordance with *Grant Proposal Guide* (GPG) instructions described in Chapter II.C.2. The GPG requires submission of: Project Summary; Project Description; References Cited; Biographical Sketch(es); Budget; Budget Justification; Current and Pending Support; Facilities, Equipment & Other Resources; Data Management Plan; and Postdoctoral Mentoring Plan, if applicable. If a required section is missing, **FastLane will not accept the proposal.**

Please note that the proposal preparation instructions provided in this program solicitation may deviate from the GPG instructions. If the solicitation instructions do not require a GPG-required section to be included in the proposal, insert text or upload a document in that section of the proposal that states, "Not Applicable for this Program Solicitation." Doing so will enable FastLane to accept your proposal.

Please note that per guidance in the GPG, the Project Description must contain, as a separate section within the narrative, a discussion of the broader impacts of the proposed activities. Unless otherwise specified in this solicitation, you can decide where to include this section within the Project Description.

Full Proposal Contents

This program solicitation contains supplemental instructions to the Grant Proposal Guide (GPG) and NSF Grants.gov Application Guide. All standard sections of the proposal are required (i.e., the cover sheet, project summary, table of contents, project description, references cited, biographical sketch, budget, budget justification, current and pending support, facilities/equipment/other resources, and supplementary documentation). The following instructions supplement the guidelines in the GPG and NSF Grants.gov Application Guide for the specified sections.

The proposal should include the following information in the project description:

Institutional Information – Provide full descriptive demographics for your institution and department(s).

- Describe the undergraduate, graduate, and faculty populations. This should include information about race/ethnicity, gender, disabilities, and academic level or rank.
- Provide current retention data for undergraduates (separately for both first-time-full-time first-year and transfer students) and how these data were calculated. Of particular interest are the 2nd to 3rd year retention rate and the 5-year graduation rate. This information should include racial/ethnic, gender, and persons with disabilities breakdowns, as appropriate.
- Provide an overview of department instructional activities including who teaches the courses, labs, and recitation sections, the faculty teaching load, and class sizes.
- Describe current department processes, policies, and roles related to faculty development, professional formation of students, and department governance.
- Describe the department's prior efforts in enhancing teaching and learning practices or in department level reform of engineering or computer science education, including strengths and weaknesses and areas targeted for improvement.

Vision for Revolutionizing the Engineering Department – Describe the department and the student professional formation experience "after the revolution." How is success defined? Provide a concise answer to the question, "What will be different?"

Project Plan and evaluation framework – Informed by the department's vision for revolution, provide:

- Goals: What outcomes at the end of this project will move the department toward the vision? What will change about the department? What will change about the faculty? What will change about the professional formation of students? What will change nationally? Who will be impacted?
- Objectives: What specific targets will impact achieving the stated goals? For example, if a goal is a faculty both well-equipped and enthusiastic to engage best practices in professional formation, what incentives are intended to be provided?
- Specific Actions: How will objectives be accomplished? For example, what will the process be for changing the faculty development incentive system? What is the ***theory of change***; that is, substantiate how and why should these activities effect lasting change? How will the impacts of the activities be measured? How will the efforts be sustained in the long term, especially if there are changes in department leadership over time? Explain who will be responsible for which elements of the project. Be sure to cover what has been attempted previously in the literature, such that the proposed innovations of the RED activities are not repeated.
- Research Plan: What will this project add to the knowledge base about creating change at the department level in engineering or computer science? What are the research questions you seek to answer? What educational or sociological theories speak to your research questions and the methodologies one might use to shape appropriate methods to answer the research questions posed? How will the achievement of the objectives and goals be measured? These measures can be qualitative or quantitative as appropriate to the question and theoretical orientation.
- Barriers: What are the anticipated barriers in carrying out the project plans and achieving the specific objectives? What are the anticipated barriers to connecting research to practice? What contingency plans are in place to address these barriers?
- External Advisory Board (Required): How will an external advisory board (for the department or college) be used to advance the proposed plan? Who will be included and why, and how will they contribute to the project?
- Evaluation Plan Based on the theory of change and the desirable outcomes of the proposed revolution, enumerate appropriate indicators of success related to accomplishing the goals and objectives and a timeframe to seek measurable change.
- Mentoring Plans: Explain how faculty will be mentored over the course of this project; what faculty development opportunities will be provided; and how they will be incentivized. Explain how graduate and undergraduate students will be

involved in the project and how they will be mentored as part of the proposed departmental vision for revolution.
- Roadmap for Scaling and Adaptation: How will the new knowledge generated about departmental change be received and adapted by others? (This effort must go beyond traditional "dissemination" and include considerations of scalability and adaptability to achieve larger scale impacts.) How will partnerships be built and used to extend the work of this project to others?

Supplementary Documentation:

Scan the signed original(s) of the following document(s) and upload the scans as a PDF file into the Supplementary Documents section of the proposal. Do not send paper copies to NSF. All documents must be submitted with the proposal in Fastlane or Grants.gov by the deadline.

Letter(s) from Institutional Leadership – Provide letters of commitment from the Dean, Provost, and/or President (as appropriate for your project) to ensure support and feasibility in the short and long term. The Letter(s) should be no more than 2 pages in length, and it must include the individual's name and title below the signature.

B. Budgetary Information

Cost Sharing: Inclusion of voluntary committed cost sharing is prohibited

Budget Preparation Instructions:

A Budget Justification prepared in accordance with the guidance in the GPG must be included. PI Meeting Attendance: Include travel funds in the budget for (required) team attendance at a yearly PI meeting at NSF.

C. Due Dates

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

  October 28, 2014

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

  November 26, 2014

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 the GPG as Exhibit III-1.

A comprehensive description of the Foundation's merit review process is available on the NSF website at: http://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. (GPG 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 GPG 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

- **Vision:** How revolutionary is the vision in light of a well-grounded understanding of the history, context, and culture of the department? Revolutionary means radically, suddenly, or completely new; producing fundamental, structural change; or going outside of or beyond existing norms and principles.
- **PI Team:** Is the RED team complete, with all required expertise? Is each member fully qualified to perform the proposed work?
- **Institutional Commitment:** Do the letter(s) of commitment provide evidence of support for the project sufficient to achieve the goals and objectives?
- **Connection to Professional Practice:** Is there a sufficient connection in the proposed project to professional practice? For example, what is the extent of involvement of the industrial advisory board, and how has the department involved professors of practice, a professional master's program, or other elements that bridge the gap between engineering or computer science education and practice?
- **Faculty Development Plan:** Is faculty development well planned and properly incentivized to build department cultures that support the holistic professional formation of engineers or computer scientists?
- **Potential for Success and Scalability:** How achievable and significant are the proposed changes in the middle two years of the technical core? Is the theory of change valid and well justified? How responsive are the changes to the call to focus on professional skills? Reviewers will take into account justification of the research plan using the literature, comprehensiveness of the plan, institutional leadership commitments, sustainability of change (including leadership changes and financial sustainability), and the propagation roadmap/transferability of change strategies.
- **Connection to Research on Engineering Education**: How well informed are the vision and execution plan by the literature and prior attempts, if applicable, to implement change. Is the expectation of success well-justified?
- **Scaling and Adaptation:** How likely is the new knowledge generated about how to change department culture to be received and utilized by others? How well conceived are the plans for accomplishing this goal?

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 be completed and submitted by each reviewer. 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 http://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 *Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

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 at least 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). Within 90 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 *Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

Additional Reporting

As part of the annual report, PIs should include updated institutional profile data as requested in this proposal. PIs should also include discussion of department dynamics and obstacles or progress in establishing a culture supportive of holistic professional formation of engineers.

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:

- Donna M. Riley, Solicitation Coordinator, Program Director, Engineering Education, Division of Engineering Education and Centers, Engineering Directorate, telephone: (703) 292-7107, email: driley@nsf.gov
- Susan C. Kemnitzer, Deputy Division Director, Chemical, Bioengineering, Environmental, and Transport Systems (CBET), Engineering Directorate, telephone: (703) 292-5347, email: skemnitz@nsf.gov
- Gregory L. Rorrer, Program Director, Energy for Sustainability, Division of Chemical, Bioengineering, Environmental, and Transport Systems (CBET), Engineering Directorate, telephone: (703) 292-8045, email: grorrer@nsf.gov
- Pei Zhijian, Program Director, Manufacturing, Machines, and Equipment, Division of Civil, Mechanical, and Manufacturing Innovation (CMMI), Engineering Directorate, telephone: (703) 292-8611, email: zpei@nsf.gov
- George A. Hazelrigg, Deputy Division Director, Division of Civil, Mechanical, and Manufacturing Innovation (CMMI), Engineering Directorate, telephone: (703) 292-7068, email: ghazelri@nsf.gov
- Glenn H. Larsen, Program Director, Industry/University Cooperative Research Program (I/UCRC), Division of Industrial Innovation and Partnerships (IIP), Engineering Directorate, telephone: (703) 292-4607, email: glarsen@nsf.gov
- Yvette Weatherton, Program Director, Division of Undergraduate Education (DUE), Education and Human Resources Directorate, telephone: (703) 292-5323, email: yweather@nsf.gov
- Jeff Forbes, Program Director, Division of Computer and Network System (CNS), Directorate for Computer and Information

Science and Engineering, telephone: (703) 292-4291, email: jforbes@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 at https://public.govdelivery.com/accounts/USNSF/subscriber/new?topic_id=USNSF_179.

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 provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See Grant Proposal Guide Chapter II, Section D.2 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 http://www.nsf.gov

- **Location:** 4201 Wilson Blvd. Arlington, VA 22230
- **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