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National Science Foundation
Directorate for Engineering
4201 Wilson Boulevard
Arlington, Virginia 22230

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Dear Colleague:

Effective October 1, 2006, the Engineering Directorate (ENG) of the National Science Foundation (NSF) will put in place a new organizational structure to further enhance agility within disciplines, broaden multidisciplinary research, and enable discovery at the emerging frontiers of engineering.

ENG investments in engineering research and education build and strengthen our nation's capacity to lead the world in innovation. This capacity will continue to grow as ENG and NSF push the frontier with the creation of new knowledge and disruptive technologies that have the potential to secure our nation and enhance our quality of life. These investments include such emerging technologies as bioengineering, cyberinfrastructure, manufacturing innovation, metabolic engineering, molecular electronics, nanotechnology, photonics, and sensors and sensor systems.

The new structure – which merges many of the current divisions' existing disciplines under broader themes and clusters – will help ensure that ENG continues to support cutting-edge engineering research and education, while addressing the emerging and perennial needs of the nation. For over a decade and a half, the current structure for ENG has effectively met these goals by 1) serving this nation's community of engineers, and 2) supporting the most outstanding proposals from all fields of engineering.

Over that time, ENG has helped to catalyze advances in emerging fields, while a new era of international competition and global innovation has evolved. These conditions compelled ENG to reassess how to best position itself to respond proactively to new challenges both domestically and abroad.

ENG's new structure is an outgrowth of these conditions and assessments. It was developed through thorough strategic planning, self-examination, and community feedback. The result is a directorate better able to support the future of research, education, and innovation.

The following outcomes are anticipated through the reorganized directorate:

- Leadership at the frontiers of engineering discovery, innovation, and education;
- Enhanced flexibility for change;
- Enhanced interdisciplinary research;
- Greater opportunities for exploring new areas not yet recognized to their full potential;
- Greater ability to integrate research across priority areas;
- Enhanced synergy between education and basic research; and,
- Programs that facilitate the continuum from discovery through innovation.

Included in this vision is the ability to support broad, foundation-wide investments in a number of areas, including NSF's multidisciplinary priority areas and the Administration's interagency R&D priorities.

The Engineering Directorate will also utilize this new structure to further advance the frontier in the key priority areas for ENG and NSF.

Organizational Elements

The new structure will entail consolidating ENG's five current disciplinary divisions into three, and establishing three crosscutting units. The specific outcomes of this reorganization are as follows:

Disciplinary Divisions:

1. The divisions of *Chemical and Transport Systems* (CTS) and *Bioengineering and Environmental Systems* (BES) will merge to form the division of *Chemical, Bioengineering, Environmental, and Transport Systems* (CBET).

   CBET will support research and education in the rapidly evolving fields of chemical engineering, bioengineering, and environmental engineering, and in areas that involve the transformation and/or transport of matter and energy by chemical, thermal, or mechanical means. CBET will also make investments contributing significantly to the knowledge base and the development of the workforce for major components of the U.S. economy, including chemicals, pharmaceuticals, medical devices, forest products, metals, petroleum, food, textiles, utilities, and microelectronics.

   CBET will have two windows for unsolicited proposals: August 15, 2006 through September 15, 2006, and February 1, 2007 through March 1, 2007.

2. The divisions of *Civil and Mechanical Systems* (CMS) and *Design and Manufacturing Innovation* (DMI) will merge to form the division of *Civil, Mechanical, and Manufacturing Innovation* (CMMI).

   CMMI will support fundamental, frontier disciplinary and interdisciplinary research needed to design, build, and secure the nation's critical infrastructure, manufacturing, and service enterprise systems. CMMI's investments also will advance the integration of education and research, which enables the development of a diverse, adaptable, and globally competitive engineering workforce.

   CMMI will have two windows for unsolicited proposals: September 1, 2006 through October 1, 2006, and January 15, 2007 through February 15, 2007.

3. The division of *Electrical and Communications Systems* (ECS) will add cyber systems to its portfolio to become the division of *Electrical, Communications and Cyber Systems* (ECCS).

   ECCS will address fundamental research issues underlying component and device technologies, power, controls, networking, communications and cybersystems technologies. The division will also support the integration and networking of systems principles across all scales. ECCS will also ensure the education of a diverse workforce prepared to continue the rapid development of emerging technologies as drivers of the global economy.

   ECCS will have two windows for unsolicited proposals: September 7, 2006 through October 7, 2006, and January 7, 2007 through February 7, 2007.

Crosscutting Units:

4. The *Engineering Education and Centers* (EEC) will now provide more emphasis on its role as a crosscutting division within the directorate.

   The EEC's programs will enable the continual evolution of the engineering education and research enterprise at U.S. universities, provide a unifying link across all engineering disciplines for programs that cut across all disciplines, and provide comprehensive oversight for projects of a scale requiring such oversight.

5. The *Office of Industrial Innovation* (OII), which houses SBIR/STTR, will broaden to include new partnerships, and become the division of *Industrial Innovation and Partnerships* (IIP).

   IIP will accelerate industrial innovation in the United States by leveraging fundamental scientific and engineering research through small businesses in alignment with the statutory purpose of the Small Business Program and the NSF Vision.

6. A crosscutting *Office of Emerging Frontiers in Research and Innovation* (EFRI) will be added and report to the Office of the Assistant Director (OAD).

   EFRI is a new component of the Directorate for Engineering. It will serve the critical role of helping the directorate focus on important emerging areas in a timely manner. Each year, EFRI will recommend, prioritize, and fund interdisciplinary initiatives at the emerging frontier of engineering research and education. These investments will represent transformative opportunities, potentially leading to: new research areas for NSF, ENG, and other agencies; new industries or capabilities that result in a leadership position for the country; and/or significant progress on a recognized national need or grand challenge.

   The EFRI process of selecting, announcing, and funding new frontier areas will function throughout the year, ensuring continual input and feedback from the engineering community on promising future research opportunities. This input will come from such diverse sources as workshops, advisory committees, technical meetings, professional societies, proposals and awards, and NSF committees of visitors.

   From this comprehensive input, ENG will identify, evaluate, and prioritize those frontier topics that best match the EFRI criteria (transformative, addressing a national need or grand challenge, going beyond one division, an area where the community is poised to respond, and clearly demonstrating ENG's leadership role).

<u>EFRI 2007</u>

Two potential research areas have been identified for development into a 2007 EFRI solicitation, which will go through the appropriate NSF preparation and clearance processes.

1) The first is *Auto-reconfigurable Engineered Systems Enabled by Cyberinfrastructure* (ARES-CI).

   The central idea of ARES-CI is to develop autonomously reconfigurable engineered systems that remain robust in the face of unexpected high-consequence natural or intentional failure events (e.g. hurricanes, pandemics, or terrorist attacks) that could impact critical infrastructures in unforeseen ways. Cyberinfrastructure and other advances in engineering and information sciences provide unprecedented capabilities to embed reconfigurability into systems. Auto-reconfigurability will provide robustness to unplanned failure events in the same way "complexity" provides robustness to anticipated failure events. EFRI plans to fund advances that lead to a fundamental understanding of reconfigurability and allow the design of autonomously reconfigurable engineered systems integrating physical, information, and knowledge domains.

These autonomously reconfigurable engineered systems will be able to sense, self-diagnose, and reconfigure the system to function uninterruptedly when subject to unplanned failure events.

2) The second potential research area is *Cellular and Biomolecular Engineering* (CBE), which will focus on the following research thrusts:

   The key idea for CBE is to establish an experimental and computational understanding of the interactive effects of mechanical, electrical, chemical, and biological factors that impact molecular, cellular, and interfacial behavior in healthy, stressed, and diseased states. This will provide the fundamental understanding of genes and other molecules, and cells and their responses to internal and external stimuli, and biomolecular interfaces both internal and external to the cell. The transformative research outcomes will lead to new biomaterials, new sensing technologies, new medical diagnostic tools and treatment technologies, new drug delivery systems, alternative energy sources, new cell-based manufacturing processes, new technologies for detecting environmental pollutants and bio/chemical terrorism agents, and new products yet to be discovered.

The preliminary plan for 2007 is to combine both research areas into a single solicitation, which will encourage team proposals (3 or more principal investigators from 3 or more disciplines). EFRI awards will be up to 4 years in duration, and up to $500,000 a year. Pre-proposals will be required to better manage and focus invited full proposals.

Additional information can be found on the NSF website, or by contacting the Directorate for Engineering.

Sincerely,

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Directorate for Engineering