

ENGINEERING RESEARCH CENTERS

Partnerships with Industry and
Academe for
Next-Generation Advances in
Knowledge, Technology, and
Education

Program Announcement

ENGINEERING EDUCATION AND CENTERS DIVISION
DIRECTORATE FOR ENGINEERING

DUE DATES

Notice of Intent:	<i>December 5, 1996</i>
Preproposal Deadline:	<i>March 7, 1997</i>
Notification to Finalists:	<i>May 1997</i>
Full Proposal Deadline:	<i>September 10, 1997</i>
Site Visits:	<i>November-December 1997</i>
Awards Announcement:	<i>March 1998</i>

Next anticipated preproposal deadline is the spring of 1998 for awards in the summer of 1999



NATIONAL SCIENCE FOUNDATION

**The Division of Engineering Education and Centers is accepting proposals from
academic institutions to establish three or four Engineering Research Centers
(ERC) in FY 1998.**

THE ERC CONCEPT

Engineering Research Centers provide an integrated environment for academe and industry to focus on next-generation advances in complex engineered systems important for the Nation's future. Activity within ERCs lies at the interface between the discovery-driven culture of science and the innovation-driven culture of engineering, creating a synergy between science, engineering, and industrial practice. ERCs provide the intellectual foundation for industry to collaborate with faculty and students on resolving generic, long-range challenges producing the knowledge base for steady advances in technology and their speedy transition to the marketplace. ERCs integrate engineering education and research and expose students to industrial views in order to build competence in engineering practice and to produce engineering graduates with the depth and breadth of education needed for leadership throughout their careers. Thus, ERC graduates enjoy the capacity to contribute to the Nation's global future through a rich spectrum of career paths at the cutting edge of technical progress and innovation. The interface between research and education in an ERC is seamless at both the undergraduate and graduate levels, producing curriculum innovations derived from the systems focus of the ERC's strategic goals.

In its first decade of operation, the ERC Program has validated the Foundation's strategic interests in the integration of research and education, trusted partnerships with industry, the development of shared infrastructure, and enablement of the capacity of science and engineering graduates to contribute to the Nation. The Program has been a model for the development of centers programs in the U.S. and around the world. While various components of the ERC Program have been emulated by others, it still fills a special niche. This position derives from the systems perspective of ERCs and from their research and education strategies designed to produce fundamental advances that lead to further innovation in industry. Together, NSF and industry have developed and fulfilled a shared vision for long-term engineering research and education that enables next-generation technologies, productive engineering processes, and innovative products and services. Thus ERCs contribute to industry's ability over the long run to create new shared wealth and rewarding employment opportunities, compete well in global markets, and produce products and services that improve the quality of life, while avoiding harm to the environment.

DEFINING CHARACTERISTICS OF AN ERC

- A guiding vision to produce advances in a complex, next-generation engineered system¹ and a corresponding new generation of engineers with the depth and breadth needed for leadership throughout their careers in a global economy;
- A strategic plan to realize the vision through the integration of research and education;
- A research paradigm promoting synthesis of engineering, science, and other disciplines, spanning the continuum from discovery to proof-of-concept;
- An educational paradigm enabling an integrative, systems-oriented intellectual environment and curriculum innovations for students at all levels, including undergraduates;
- A trusted partnership with industry and other interested partners in planning, research, and education to strengthen the ERC and achieve a more effective flow of knowledge into innovation to benefit the Nation;
- A cohesive team effort, integrating diverse engineering and scientific backgrounds with industrial views, which also is diverse in gender, race, and ethnicity;
- A dynamic, flexible program for outreach involving faculty and students from other universities and colleges to enhance the capacity of the ERC to fulfill its vision and develop connections with the community in its field;
- Leadership, management, and an infrastructure of space, experimental, and enabling equipment to support the complex goals of an ERC;
- A commitment from the academic, industrial, and other partners to substantially leverage NSF's funds and sustain the ERC during and after the period of NSF support; and
- A synergy of perspectives from science and engineering, research and education, academe and industry, yielding collective properties that are greater than each could achieve alone and greater than the current state-of-the-art and practice.

¹ An engineered system is derived from a number of components, processes, and devices that are integrated together to serve a function. Analysis and modeling of the individual components of a system, without their integration into a complex engineered system, is not sufficient for the research program of an ERC.

An ERC may add components that would improve the synergy between NSF's and other government investments in academe for research, education, human resource development. Thus, an ERC may wish to develop a collaboration with an NSF Engineering Education Coalition, NSF CAREER awardees, awardees of the NSF GOALI (Grant Opportunities for Academic Liaison with Industry) initiative, or NSF or other-agency supported centers or facilities. An ERC may develop partnerships with Federal laboratories³ to take advantage of the investment in staff and equipment at these laboratories.

The ERC may develop partnerships with State and local governments and industry to enhance local economic development and the effectiveness of the technical workforce. It may develop partnerships with local small businesses or establish spin-off businesses to explore development of ERC-based innovations. Support is available on a competitive basis through the NSF Small Business Innovation Research (SBIR) Program or state-level SBIR programs. To facilitate the exploitation of ERC-based research developments, some ERCs, in partnership with their state government and their industrial partners, may develop prototyping facilities, pilot plants, or project-based educational centers where industry guides the exploration of the development of technology.

Leadership And Management of the ERC

An ERC requires a Director who can develop and lead a team to fulfill a shared vision. It is expected that the Director will be supported in this role by a management team that typically is comprised of a key faculty associate or deputy who will share some of the leadership responsibilities, the leaders of the research teams, an education coordinator, an industrial liaison coordinator and an administrative and financial manager.

The Center Director is the NSF Principal Investigator (PI) and has primary responsibility for administering the award in accordance with NSF's Grant General Conditions (GC-1) and the special terms of the Cooperative Agreement to be issued by the NSF in the event of an award. Since one of the primary objectives of an ERC is to impact engineering education, the Center Director should be affiliated with an Engineering Department but need not hold an engineering degree.

WHO MAY SUBMIT

U.S. academic institutions with **undergraduate and graduate engineering programs, granting the Ph.D. degree**, may submit proposals as the lead or home institution of the ERC. **The lead institution of the ERC must be an engineering Ph.D. degree-granting institution but the**

partner or associated institutions need not be. The lead institution accepts the overall management responsibility for the center. A single institution may be involved in more than one ERC. An ERC may involve more than one institution on a permanent or flexible basis; in that case, the lead institution receives the funds from NSF and other sources and is responsible for fulfilling the ERC's goals and objectives.

AWARDS, OVERSIGHT, AND RENEWAL

Number of Awards: NSF expects to make awards to initiate three to four ERCs as an outcome of this competition.

Award Instrument: Awards will be administered under a Cooperative Agreement in accordance with the NSF Grant General Conditions (GC-1), and Cooperative Agreement General Conditions (CA-1), copies of which may be requested from the NSF Forms and Publications Unit cited below. More comprehensive information is contained in the NSF Grant Policy Manual (NSF 95-26), available on the NSF Home Page or through a subscription offered by the Superintendent of Documents, Government Printing Office, Washington, DC 20402. Information can be accessed quickly through STIS (Science and Technology Information System), NSF's on-line publishing system, described in NSF 95-64, the "STIS Flyer." To obtain a paper copy of the Flyer, call the NSF Publications Section at 703-306-1129. For an electronic copy, send an e-mail message to stisserve@nsf.gov.

Award Duration: A new ERC begins operation under a cooperative agreement for five years, with a potential duration of ten years determined by an interim renewal review. In certain cases, initial awards for fewer than five years duration may be made. If a center's renewal request is not successful, phase-out support would be provided at a reduced level. NSF may begin to phase out its support of an ERC at any time if the performance review indicates that the ERC is not making adequate progress toward fulfilling its vision.

Award Size: The level of support provided by NSF will be commensurate with the funding needed to build the ERC. NSF expects to share the support of the ERC with other investment partners at all times, with the NSF share declining in the latter half of its term of NSF support. First-year levels of NSF support may be as low as \$1.5 million and may not exceed \$2 million. The award size will be based, in part, on the level of technical challenges, the infrastructure already in place, the size of the team, the scope and timing of the flexible outreach program to involve faculty from other universities, and other plans for connectivity. NSF support may grow over time, depending on the need, the start-up level, and the availability of funds; however, it will decline monotonically in the last five years. The purpose of this reduction in support is to shift the balance of support to industry and other sources as the ERC becomes a self-sustaining ERC at the end of 10 years.

³ NSF funds may not be used to support personnel at these labs.

- (3) **Lists of Academic Participants, Industrial, and Other Partners:** Provide two lists: (a) a List of Academic Participants and (b) a List of Industrial and Other Partners: For both the preproposal and the full proposal, begin the List of Academic Participants, with the name of the institution which will lead the ERC. Provide a list of faculty committed to involvement in the ERC, with their school, departmental, and institutional affiliations. Any participants affiliated with government laboratories should be included on this list.

For the Preproposal, on the List of Industrial and Other Partners, provide the names and corporate, agency, or other affiliations of industrial and other personnel who contributed to the development of the preproposal and are interested in joining and financially supporting the center.

For the Full Proposal, on the List of Industrial and Other Partners, provide the names and corporate, agency, or other affiliations of industrial and other personnel who are committed to participating in and financially supporting the center.

- (4) **Project Summary (NSF Form 1358):** A one-half page statement of the vision and key components of the ERC.

- (5) **Executive Summary (two pages):** The top of the first page of the Executive Summary should include the title of the ERC, the name of the Director, and the name of the institution leading the ERC.

- (6) **Table of Contents:** Organize the Table of Contents to follow the outline requested by the preproposal format not the outline specified by the official NSF Table of Contents in the NSF GPG (NSF 95-27).

- (7) **Narrative:** The narrative should be structured according to the following outline:

- **Vision of the ERC and its Engineered Systems Focus;**
- **Analysis of the State-of-the-Art and Practice in Research and Education;**
- **Rationale for the Value Added by the ERC over Current Efforts in Research and Education;**
- **Strategic Plan for the ERC** (Include a chart depicting the desired advances, the integration of knowledge between key research efforts, and the flow into the desired educational and technology outcomes over the 10-year scope of the center);
- **Research Program** (Structure into coherent thrusts of projects, their interconnections and relation to the engineered system goals, the flow from discovery to

proof-of-concept, examples of key research challenges and the methodology to be used to address them);

- **Education Program** (Goals and structure);
- **Industrial Collaboration Program** (Goals and structure);
- **Outreach and other Connectivity** (Goals, strategy, and structure);
- **Leadership and Organization, Research and Education Team, Management Team, and Supporting Space and Equipment Infrastructure;**
- **Role of the ERC Within the University** (Factors affecting its integration with the university, tenure and promotion policies impacting ERC faculty, etc.); and
- **References Cited** (NSF Form 1361).

Appendices: All the appendices below are required for both the preproposal and the full proposal, unless otherwise noted. (Preproposals or full proposals containing appendices other than those required below will be returned to the proposer without review.)

A. Letters of Interest and Support from the Partners of the ERC. Letters are required from the university, signed by the Dean of Engineering and Provost, committing support to the ERC during its 10-year life span for both the preproposal and the full proposal. Letters from industrial and other partners expressing interest and plans for involvement are welcome in the preproposal and letters committing industrial and other partners to involvement and financial support are required in the full proposal.

B. Budget Estimates and Financial Plan. For preproposals only, complete one budget estimate for the expected support from NSF for year 1 and one for the sum of years 1-5, using NSF Form 1030. Cost sharing specified on the NSF Budget Form 1030, line M, is limited to the academic contribution to the ERC.

For full proposals only, complete one budget estimate for the expected support from NSF for each of years 1-5 and one for the sum of years 1-5, using NSF Form 1030. Cost sharing specified on the NSF Budget Form 1030, line M, is limited to the academic contribution to the ERC.

For both preproposals and full proposals, provide information on the strategy for gaining support beyond that provided by NSF. Include a financial plan for year 1 and a projection of the allocation of funding by function and by source for the first five years. Use the following formats as a guide. (See Table 1)

SUBMISSION OF THE PREPROPOSAL

Fifteen copies of the preproposal must be mailed to arrive at the following address by the deadline, **5:00 p.m., March 7, 1997**. Please send the preproposals in a box clearly marked "Preproposal: Not a New Proposal" to:

Lynn Preston, Deputy Division Director
and ERC Program Coordinator
Engineering Education and Centers
(EEC) Division
National Science Foundation
4201 Wilson Blvd., Suite 585
Arlington, VA 22230.

Please note that the submission of a preproposal is a prerequisite to, but does not obligate the submission of a full proposal. **All preproposals submitted in response to this announcement that are received after the deadline will be returned to the proposer without review. All preproposals submitted in response to this announcement which do not follow page, font, and appendix requirements will be returned to the proposer without review.**

SUBMISSION OF THE FULL PROPOSAL

Full proposals may be submitted only by invitation, as an outcome of the review of the preproposals. Twenty copies, including one copy bearing the signed cover page, are required. The original signed copy should be printed on one side only and not bound. The remaining copies should be printed on both sides of the page and bound or stapled in the upper left corner; they should not be fastened with an elastic band or other temporary means.

The full proposal must be mailed to arrive at the following address by the deadline, **5:00 p.m., September 10, 1997**:

National Science Foundation (PPU)
Announcement Number NSF 97-5,
Engineering Research Centers
4201 Wilson Boulevard, Room P60
Arlington, VA 22230

All full proposals submitted in response to this announcement which do not follow page, font, and appendix requirements will be returned to the proposer without review. (See Table 2)

INQUIRIES

For program inquiries, contact:

Lynn Preston, Deputy Division Director
and ERC Program Coordinator
Engineering Education and Centers Division (EEC)
Directorate for Engineering
National Science Foundation
Telephone: 703- 306-1381
FAX: 703-306-0326 or 0290
email: lpreston@nsf.gov

or the following ERC Program Directors:

Frederick Betz, EEC (fbetz@nsf.gov)
703-306-1381

Deborah Crawford, Electrical and
Communications Systems (ECS) Division
(dcrawfor@nsf.gov)
703-306-1339

John Hurt, EEC (jhurt@nsf.gov)
703-306-1380

George Lea, ECS (glea@nsf.gov)
703-306-1339

Jay Lee, Design, Manufacture, and
Industrial Innovation Division, (jalee@nsf.gov)
703-306-1330

Tapan Mukherjee, EEC (tmukherj@nsf.gov)
703-306-1383

Joy Pauschke, EEC (jpauschk@nsf.gov)
703-306-1380

Mary Poats, EEC (for information on ERC
Educational Supplements) (mpoats@nsf.gov)
703-306-1380

Engineering Research Centers Currently Supported by NSF

(Listed alphabetically by category and by institution within each category)

Biotechnology and Bioengineering

Neuromorphic Systems Engineering at California Institute of Technology. (FY 1995⁴)

Center Director: Demetri Psaltis
Telephone: 818-395-6255
Deputy Director: Pietro Perona
<http://www.erc.caltech.edu/>
ERC Program Director: Frederick Betz

Emerging Cardiovascular Technologies at Duke University. (FY 1987)

Center Director: Olaf von Ramm
Telephone: 919-660-5137
<http://bme-www.mc.duke.edu/cect/cect.html>
ERC Program Director: Frederick Betz

Biotechnology Process Engineering at the Massachusetts Institute of Technology (MIT). (An FY 1985 ERC reestablished in FY 1994)

Center Director: Daniel I.C. Wang
Telephone: 617-253-2504
<http://web.mit.edu/bpec/www/>
ERC Program Director: Frederick Betz

Biofilm Engineering at Montana State University. (FY 1990)

Center Director: J. William Costerton
Telephone: 406-994-4770
Deputy Director: James Bryers
<http://www.erc.montana.edu>
ERC Program Director: Frederick Betz

Engineering Biomaterials at the University of Washington. (FY 1996)

Center Director: Buddy D. Ratner
Telephone: 206-685-1005
Deputy Director: Thomas A. Horbett
<http://bioeng.washington.edu/esca/uweb.html>
ERC Program Director: Tapan Mukherjee

Design, Systems, and Manufacturing

Environmentally Benign Semiconductor Manufacturing at the University of Arizona in partnership with *MIT* and *Stanford University*, an ERC supported by NSF and the Semiconductor Research Corporation (SRC). (FY 1996)

Center Director: Farhang Shadman
Telephone: 520-621-6052
<http://www.erc.arizona.edu>
ERC Program Directors: John Hurt (NSF) and Daniel Herr (SRC)

Engineering Design Research at Carnegie Mellon University. (FY 1986⁵)

Center Director: Daniel P. Siewiorek
Telephone: 412-268-3372
<http://www.edrc.cmu.edu/>
ERC Program Director: Frederick Betz

Systems Research at the University of Maryland. (An FY 1985 ERC reestablished in FY 1994⁵)

Center Director: Gary W. Rubloff
Telephone: 301-405-2949
<http://www.isr.umd.edu/>
ERC Program Director: Jay Lee

Competitive Product Development at the Massachusetts Institute of Technology. (FY 1996)

Center Director: Warren P. Seering
Telephone: 617-253-9637
Deputy Director: John R. Hauser
ERC Program Director: Frederick Betz

Reconfigurable Machining Systems at the University of Michigan. (FY 1996)

Center Director: Yoram Koren
Telephone: 313-936-3596
Deputy Director: A. Galip Ulsoy
<http://erc.engin.umich.edu/>
ERC Program Director: Jay Lee

Computational Field Simulation at Mississippi State University. (FY 1990)

Center Director: Donald Trotter
Telephone: 601-325-3671
<http://www.erc.msstate.edu/index.hbml>
ERC Program Director: George Lea

⁴ The date of establishment of the ERC.

⁵ Indicates that the ERC will graduate from ERC Program support after FY 1997.

