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ENGINEERING RESEARCH CENTERS

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

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Program Announcement

ENGINEERING EDUCATION AND CENTERS DIVISION
DIRECTORATE FOR ENGINEERING

DUE DATES

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

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 system[1] 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.

LONG-TERM SELF-SUFFICIENCY

NSF expects ERCs to become self-sustaining and to maintain the ERC culture beyond the end of their term of NSF support. By that time, they will have developed an effective and productive collaboration with industrial and other stakeholders who are deriving a range of benefits from these partnerships. They should be prepared to continue that productive relationship with university, industrial, and other support when NSF funding ceases.

Former ERCs, as well as ongoing ERCs at the end of their term of NSF support, and other centers are eligible to submit proposals to establish new ERCs. Proposals with teams derived from these centers will be subjected to the same review process, under the same review criteria, as are teams who have no prior center-level experience. Thus, there is neither a negative nor a positive bias toward such teams in the proposal review and award decision processes.

DEVELOPMENT OF AN ERC PROPOSAL

The Vision, Rationale, and Supporting Infrastructure

A prospective team of faculty begins by developing a vision for a next-generation engineered system and corresponding educational innovations that will yield an exciting and compelling ERC in which to invest Federal and private sector funds. Industrial personnel are involved in the efforts to generate the vision and scope of an ERC. NSF has no preferences for topics and more than one proposal may be submitted by a university.

Having defined its vision, the prospective ERC team should carry out an analysis of the current state-of-the-art in research and education, including documentation of the contributions made in the field by the prospective ERC's faculty and others around the world. The team should determine the key intellectual challenges which pose barriers to advancements in knowledge, technology, and education and must be addressed to fulfill the vision. The rationale and the strategic plan for the ERC should be derived from this analysis. The strategic plan should be used to organize and integrate the resources of the center to achieve its vision and goals in research, technology, and education.

The team should carry out an analysis of the infrastructure needed to support the ERC to fulfill its vision and goals. This will include: a study of the needed mix of disciplines and fields of expertise of the faculty and students; the degree of synergy required among the disciplines; the capacity of the current team to work together and with industry to meet shared goals; the scope and timing of a flexible outreach program to involve faculty and students from other institutions; the extant and needed space to integrate the team; and the extant and needed experimental and enabling equipment.

ERC Team Selection and Value Added Over Prior Work

A center's team should be developed to involve faculty appropriate to achieving the vision. NSF will look for a major value added over the prior work of the team, to be achieved through a significant shift in vision and focus. NSF also will look for a major value added over the work of others in the field. Thus, ERC funding through this announcement will not be used to replace funding by NSF or other agencies to fulfill the past goals of an ERC or another type of center, of a group, or of separate individuals. ERC funds will not support a collection of unrelated, independent projects.

Broadened Connectivity of an ERC

As an ERC proceeds in its development, it should strive to make connections with other efforts in its field in this country and around the world. The purpose is fourfold: to strengthen the capacity of the ERC to fulfill its goals, to provide an opportunity for others to benefit from involvement in the ERC, to enhance the capacity of the ERC to involve a new generation in engineering and science, and to build complementary linkages to other significant efforts already underway. An ERC is free to explore a range of connections. Only the flexible program of outreach which is a part of the defining characteristics of an ERC is required. The following are some examples. The team should focus on developing mechanisms appropriate for its goals and needs. The timing of their inclusion in the ERC should mesh with the needs of the ERC and its stages of development.

An ERC may have a global dimension, as many research and educational challenges and opportunities require overseas collaboration to bring the best resources to bear for the benefit of the Nation. Foreign firms[2] may be involved in an ERC, if they agree to operate on a *quid pro quo* basis, exchanging personnel, sharing support, risk, benefits, information and their own facilities to the same degree as all other participating U.S. firms.

To enhance its role in human resource development, an ERC may develop collaborations with faculty and students in colleges and universities, some of which involve primarily populations underrepresented in engineering and some of which involve members of the technical workforce already on the job or in training at technical colleges.

[2] Foreign firms are strategically and financially governed and controlled by corporate headquarters outside the United States. Congress has defined a United States company as one that is more than 50%-owned by United States citizens.

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 laboratories[3] 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 theERC'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 tostisserve@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.

Post-award Oversight: The performance of the ERC will be reviewed periodically by teams of experts from academe, industry, and government. The purpose is to determine the quality of the effort, strengthen the capability of the team to fulfill its vision, and determine renewal or phase-out near the end of the initial cooperative agreement.

Reporting Requirements: Operating centers are required to submit annual reports on progress and plans, which will be used as a basis for performance review and determining the level of continued funding. To support this review and the management of a center, ERCs are required to develop a set of management and performance indicators for submission annually to NSF. These indicators are both quantitative and descriptive and may include, for example, the characteristics of center personnel; sources of financial and in-kind support; expenditures; characteristics of industrial participation; research activities; technology transfer activities; patents, licenses; publications; degrees granted to students involved in center activities; and descriptions of significant advances and other outcomes of the ERC's effort.

THE TWO-STAGE ERC COMPETITION

Proposers compete for support from the ERC program in a two-stage process. The first stage is a preproposal, which provides a brief summary of the proposed ERC. The second stage is a full-scale proposal, submitted as a result of an invitation from NSF following the review of the preproposals. No full proposals will be accepted from other teams without a preproposal and subsequent invitation

REVIEW PROCESS AND CRITERIA

Preproposals and full proposals will be evaluated in accordance with established NSF policies, using the four general criteria described in the Grant Proposal Guide (GPG) (NSF 95-27), the potential to develop the defining ERC characteristics successfully, and the value added by the center over ongoing work by the faculty and elsewhere. Panels of experts from academe, industry, and government will review the preproposals. Only those teams whose preproposals were judged to be most meritorious will be invited by NSF to submit a full proposal. Full proposals will be evaluated through a combination of mail and panel review, including site visits to a small subset of the most highly qualified finalists.

NOTICE OF INTENT

Teams intending to submit a preproposal should submit a notice of intent via **email to the ERC Program by December 5, 1996**. The notice should not exceed 500 words, and should give a brief summary of the vision of the center and the structure of its research, technology transfer, and education programs. The purpose of the notice is to enable NSF to determine the composition of its review panels. The notice should be sent via email to:ercintent@nsf.gov.

WHEN TO SUBMIT

Preproposals must be received at NSF **by 5:00 p.m. on March 7, 1997.** Center Directors will be notified of the results of the preproposal review in May 1997. **Full proposals may be submitted by invitation only, by 5:00 p.m. on September 10, 1997.**

THE FORMAT OF THE PREPROPOSAL AND FULL PROPOSAL

In preparing the preproposal and the full proposal, please use the following format and note the differences between the two stages of proposals. Each must contain **only the materials requested by this announcement.** *Copies of the required forms are contained in the NSF Grant Proposal Guide (GPG) (NSF 95-27).* Single copies of this brochure are available at no cost from the Forms and Publications unit of NSF -- telephone your request to 703-306-1130, or FAX your order to 703-644-4278. This brochure is also available via electronic mail: pubs@nsf.gov.

The outline for both the preproposals and full proposals is the same. The differences are:

(1) The narrative of the **preproposal** will consist of **no more than 15 pages of text in length, including** lists, charts, figures, and tables. The narrative of the **full proposal** will be **no longer than 35 pages of text in length, including** lists, charts, figures, and tables. Thus, the page numbering should run from the beginning to the end of the narrative section. The other requirements are outside these page limits. Both preproposals and full proposals must be prepared following the font and spacing requirements in Chapter II, page 3 of Grant Proposal Guide (GPG) (NSF 95-27).

The differences in the requirements for preproposals and full proposals are indicated in the format and summarized in the table at the end of the format section.

Format:

For Full Proposals Only: **Information about the Principal Investigator (NSF Form 1225)**

(2) **Cover Sheet** (NSF 95-27, Form 1207, page 1 and 2): This form must be signed by the Principal Investigator (Center Director), with EEC listed as the NSF Organization Unit and the Engineering Research Centers (ERC) Announcement Number NSF 97-5 listed as the Program Announcement Number in the upper-left hand corner of the form. It should list the proposed Director as the Principal Investigator.

(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)***

For the preproposal, indicate the expected annual level of total support for five years from each source, i.e., NSF, the university, industry, state and local governments, other Federal agencies, and other sources. On both tables, split each column, as needed, to indicate whether the support is in cash, or in kind (space, faculty and staff positions, time of industrial personnel spent in the ERC, capital equipment, and other in-kind commitments). **For the full proposal**, it should be clear from the table how much of the support is already committed and how much is projected. The financial plan should include a plan for creating a self-sustaining ERC in ten years, especially in the out years when ERCprogram support declines.

C. Biographical Sketches (NSF Form 1362): Biographical sketches of the Director, Deputy Director, other research team leaders, and other key participants in the center (maximum length, two pages each).

D. Facilities and Equipment (NSF Form 1363) ***(For Full Proposals Only)*** This form should support the description of the infrastructure of the ERC in the body of the proposal by describing the equipment and facilities available to support the ERC.

E. Current and Pending Support (NSF Form 1239) **(*For Full Proposals Only),*** for PI and other senior personnel.

F. Justification for Secretarial and Administrative Support. (*For Full Proposals Only)*, provide a brief statement justifying the need for secretarial and administrative support given the reporting requirements and other responsibilities of the ERC.

Table 1

Year 1 Financial Plan

Function \ Source	*NSF*	*University*	*Industry*	*Other Govt. $s*	*Other Sources*
Research Thrust 1					
*Research Thrust N**					
Total Research					
Education					
Industrial Collaboration					
Shared Equip & Infrastructure					
Management					
Total					

List Thrusts 1 -N each on a separate row.

Projected Funding by Source

Projected Funding	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Total*
NSF						
Industry						
University						
Other Govt.						
Other						
Total						

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

Table 2

SUMMARY OF REQUIREMENTS

Requirement	Preproposal	Full Proposal
Due Date	March 7, 1997	September 10, 1997
# of Copies	15	20
Info. About PI (NSF Form 1225)		X
NSF Cover Sheet (Form 1207)	X	X
List of Academic Participants	X	X
List of Potential Industrial & Other Partners	X	
List of Committed Industrial & Other Partners		X
Project Summary (Form 1358)	X	X
Executive Summary	X	X
Table Of Contents	X	X
Narrative	15 Pages, including charts, etc.	35 Pages, including charts, etc.
Appendices	X	X
Letters Confirming Academic Support	X	X
Letters Confirming Industrial Interest	X	
Letters Confirming Industrial Commitment & Support		X
Budget - Year 1 Only, Form 1030	X	
Budget - Years 1, 2, 3, 4, 5 separately, (Form 1030)		X
Budget - Sum of Years 1-5, (Form 1030)	X	X
Financial Plan	X	X
Projected Funding by Source	X	
Committed and Projected Funding by Source		X
Bio Sketches, (Form 1362)	X	X
Facilities & Equip., (Form 1363)		X
Current & Pending Support, (Form 1239)		X
Justification for Secretarial & Administrative Support		X

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 1995[4])
Center Director: Demetri Psaltis
Telephone: 818-395-6255
Deputy Director: Pietro Perona
http://www.erc.caltech.edu/
ERC Program Director: FrederickBetz

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: FrederickBetz

Biotechnology Process Engineering *at the Massachusetts Institute of Technology (MIT).* (An FY 1985 ERC reestablished in FY 1994)
Center Director: DanielI.C. Wang
Telephone: 617-253-2504
http://web.mit.edu/bpec/www/
ERC Program Director: FrederickBetz

Biofilm Engineering *at Montana State University.* (FY 1990)
Center Director: J. WilliamCosterton
Telephone: 406-994-4770
Deputy Director: JamesBryers
http//www.erc.montana.edu
ERC Program Director: FrederickBetz

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

[4] The date of establishment of the ERC.

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 1986[5])
Center Director: Daniel P.Siewiorek
Telephone: 412-268-3372
http://www.edrc.cmu.edu/
ERC Program Director: FrederickBetz

Systems Research *at the University of Maryland.* (An FY 1985 ERC reestablished in FY 1994[5])
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: FrederickBetz

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.hbnl
ERC Program Director: George Lea

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

Net Shape Manufacturing ***at The Ohio State University.*** (FY 1986[5])
Center Director: Taylan Altan
Telephone: 614-292-5063
http://nsmwww.eng.ohio-state.edu/
ERC Program Director: Jay Lee

Collaborative Manufacturing ***at Purdue University.*** (An FY 1985 ERC reestablished in FY 1994)
Center Director: James J. Solberg
Telephone: 317-494-7715
http://erc.www.ecn.purdue.edu/erc
ERC Program Director: Jay Lee

Optoelectronics, Microelectronics, and Information Technology

Data Storage Systems ***at Carnegie Mellon University.*** (FY 1990)
Center Director: Mark Kryder
Telephone: 412-268-3513
http://www.ece.cmu.edu/afs/ece/www/httpdoc/research/dssc.html
ERC Program Director: John Hurt

Optoelectronic Computing Systems ***at the University of Colorado and Colorado State University.*** (FY 1987)
Center Director: Kristina M. Johnson
Telephone: 303-492-1888
http://ocswebhost.colorado.edu/
ERC Program Director: Frederick Betz

Telecommunications Research ***at Columbia University.*** (An FY 1985 ERC, self-sustaining since FY 1996)
Center Director: Thomas E. Stern
Telephone: 212-854-2572
http://www.ctr.columbia.edu

ERC on Low-Cost Electronics Packaging ***at Georgia Institute of Technology.*** (FY 1995)
Center Director: Rao Tummala
Telephone: 404-894-9097
http://www.ece.gatech.edu/research/PRC/
ERC Program Director: John Hurt

Compound Semiconductor Microelectronics ***at the University of Illinois, Urbana-Champaign.*** (FY 1986[5])
Center Director: Stephen Bishop
Telephone: 217-333-3097
http://www.ccsm.uiuc.edu/ccsm/
ERC Program Director: John Hurt

Integrated Media Systems Center ***at the University of Southern California.*** (FY 1996)
Center Director: C.L. (Max) Nikias
Telephone: 213-740-0877
Deputy Director: Armand Tanguay
http://www.usc.edu/dept.imsc
ERC Program Director: Deborah Crawford

Civil Infrastructure Systems

Advanced Technology for Large Structural Systems ***at Lehigh University.*** (FY 1986[5])
Center Director: John W. Fisher
Telephone: 215-758-3535
http://www.lehigh.edu/~inatl/inatl.html
ERC Program Director: Joy Pauschke

Materials Processing for Manufacture

ERC for Particle Science and Technology ***at the University of Florida.*** (FY 1994)
Center Director: Brij M. Moudgil
Telephone: 904-392-6670
http://www.erc.ufl.edu
ERC Program Director: Tapan Mukherjee

Interfacial Engineering ***at the University of Minnesota.*** (FY 1988)
Center Director: D. Fennell Evans
Telephone: 612-625-6828
http://cie.umn.edu
ERC Program Director: Tapan Mukherjee

Advanced Electronic Materials Processing ***at North Carolina State University*** and other North Carolina Institutions. (FY 1988)
Center Director: John R. Hauser
Telephone: 919-515-3001
http://www2.ncsu.edu/ncsu/CIL/aemp/httnl/aemp.html
ERC Program Director: John Hurt

Plasma-Aided Manufacturing ***at the University of Wisconsin-Madison and the University of Minnesota*** (FY 1988)
Center Director: J. Leon Shohet
Telephone: 608-262-1191
http://www.engr.wisc.edu/centers/ercpam/
ERC Program Director: Tapan Mukherjee

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

Resource Recovery and Utilization

Advanced Combustion Engineering Research ***at Brigham Young University and the University of Utah*** (FY 1986[5])
Center Director: L. DouglasSmoot
Telephone: 801-378-4326
http://www-acerc.byu.edu
ERC Program Director: Tapan Mukherjee

Offshore Technology ***at Texas A&M University and The University of Texas at Austin***. (FY 1988)
Center Director: Richard J. Seymour
Telephone: 409-845-7252
http://otrc5.tamu.edu/
ERC Program Director: JoyPauschke

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

Descriptions of these ERCs are available in NSF 96-23, *Engineering Research Centers*, and descriptions of ERC Education Programs are available in NSF 95-56, *Highlights of Engineering Research Centers Education Programs*, both available from the NSF Publications office.

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