Engineering Research Centers (ERC)

Partnerships in Transforming Research, Education and Technology

Program Solicitation

NSF 02-24

DIVISION OF ENGINEERING EDUCATION AND CENTERS

LETTER OF INTENT DUE DATE(S) (*required*): March 15, 2002

PRELIMINARY PROPOSAL DUE DATES(S) (*required*): May 15, 2002

FULL PROPOSAL DEADLINE(S): December 3, 2002

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SUMMARY OF PROGRAM REQUIREMENTS

GENERAL INFORMATION

Program Title: Engineering Research Centers (ERC)

Synopsis of Program:

The Engineering Research Centers (ERC) Program is soliciting pre-proposals to establish at least two new ERCs in FY 2003. Each new center will focus on the definition, fundamental understanding, development, and validation of the technologies needed to realize a well-defined class of engineered systems with the potential to spawn whole new industries or radically transform the product lines, processing technologies, or service delivery methodologies of current industries. ERC faculty, students and industry partners integrate discovery and learning in an interdisciplinary environment that reflects the complexities and realities of real-world technology and product development. This environment adds an integrative dimension that is enabled by the critical size of ERCs. Therefore, the National Science Foundation views ERCs as change agents for academic engineering programs and the engineering community at large. ERC innovations in research and education are expected to impact curricula at all levels from pre-college to

life-long learning, to employ and reach out to a population that reflects the diversity of the United States, and to be disseminated to and beyond academic and industry partners. ERCs play critical roles in research, education, diversity, outreach and industrial collaboration. The absence of a compelling strategy for achieving demonstrable impact in any one of these areas is sufficient reason to deny funding.

Cognizant Program Officer(s):

- Lynn Preston, Leader of the ERC Program and Deputy Division Director, Division of Engineering Education and Centers, Suite 585, telephone: 703-292-8381, e-mail: lpreston@nsf.gov.
- Bruce Kramer, Director, Division of Engineering Education and Centers, Suite 585, telephone: 703-292-8380, e-mail: bkramer@nsf.gov.
- Mita Desai, ERC Program Director, Division of Engineering Education and Centers, Suite 585, telephone: 703-292-5346, e-mail: mdesai@nsf.gov.
- Tapan Mukherjee, ERC Program Director, Division of Engineering Education and Centers, Suite 585, telephone: 703-292-8381, e-mail: tmukherj@nsf.gov.
- Mary Poats, ERC REUs, pre-college outreach, education, Program Manager, Engineering Education and Centers, Suite 585, telephone: 703-292-8380, e-mail: mpoats@nsf.gov.
- Sohi Rastegar, Program Director, Engineering Education and Centers, Suite 585, telephone: 703-292-8381, e-mail: srastega@nsf.gov.

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

- 47.041 --- Engineering

ELIGIBILITY INFORMATION

- **Organization Limit:**

  Only U.S. academic institutions with undergraduate and doctoral engineering programs may submit pre-proposals as the lead institution. If the ERC is a multi-university effort, the lead university will be joined by long-term core partner institutions that share the responsibility for the ERC. These core partner institutions must have undergraduate and graduate engineering programs. Whether a single or multi-university center, short-term outreach in research and education involving a limited number of faculty, other investigators, and teachers from other universities or colleges and pre-college institutions outside the lead and core partner institutions is required.

  Pre-proposals will not be accepted from universities that are already the lead institution for two ongoing ERCs.

- **PI Eligibility Limit:**

  The Center Director must be a tenure-track or tenured faculty member in an engineering department at an eligible institution. In the case of a multi-institution ERC, the Director must be a tenure-track or tenured member of the faculty of the lead university. The Director's doctoral degree must be in engineering or a field of science.

  Proposing teams involving faculty who are members of ERCs or other NSF-funded centers that have graduated from NSF support are eligible to submit proposals to establish new ERCs. However, it is imperative that the proposed ERC demonstrate a substantially new vision in research and education and there be a substantial value added over all aspects of the prior Center's work to justify an NSF investment.

- **Limit on Number of Proposals:** None

AWARD INFORMATION

- **Anticipated Type of Award:** Cooperative Agreement
- **Estimated Number of Awards:** At least 2
- **Anticipated Funding Amount:** Up to $2.5 M each for a total of at least $5 M in FY 2003; out years funding for each award is anticipated to be up to $3.0 M (year 2), $3.5 M (year 3), and $4.0 M (years 4 and 5), subject to the availability of funds.

PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

- **Letters of Intent:** Submission of Letters of Intent is required. Please see the full program announcement/solicitation for further information.
- **Preliminary Proposals:** Submission of Preliminary Proposals is required. Please see the full program announcement/solicitation for further information.
- **Full Proposals:** Deviations From Standard Preparation Guidelines
    - The program announcement/solicitation contains deviations from the standard Grant Proposal Guide (GPG) proposal preparation guidelines. Please see the full program announcement/solicitation for further information.

B. Budgetary Information

- **Cost Sharing Requirements:** Cost Sharing is required (Percentage).
- **Cost Sharing Level/Amount:** 10
- **Indirect Cost (F&A) Limitations:** Not Applicable.
- **Other Budgetary Limitations:** Other budgetary limitations apply. Please see the full program announcement/solicitation for further information.

C. Deadline/Target Dates

- **Letters of Intent (*required*):** March 15, 2002
- **Preliminary Proposals (*required*):** May 15, 2002
- **Full Proposal Deadline Date(s):** December 3, 2002

D. FastLane Requirements

- **FastLane Submission:** Required

- **FastLane Contact(s):**
    - Esther Bolding, Administrative Manager, Division of Engineering Education and Centers, Suite 585, telephone: 703-292-5342, e-mail: ebolding@nsf.gov.

PROPOSAL REVIEW INFORMATION

- **Merit Review Criteria:** National Science Board approved criteria. Additional merit review considerations apply. Please see the full program announcement/solicitation for further information.

AWARD ADMINISTRATION INFORMATION

- **Award Conditions:** Additional award conditions apply. Please see the program announcement/solicitation for further information.
- **Reporting Requirements:** Additional reporting requirements apply. Please see the full program announcement/solicitation for further information.

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I. INTRODUCTION

The National Science Foundation (NSF) strives to enhance the leading edge capability of the United States in all aspects of science, mathematics, and engineering by promoting the discovery and use of new knowledge in service to society and the education of our populace. In pursuit of its historic mission, the NSF invests in *people* to develop a diverse, internationally competitive and globally-engaged workforce of engineers, scientists, and well-prepared citizens; in *ideas* to provide a deep and broad fundamental science and engineering knowledge base; and in *tools* to provide a widely accessible, state-of-the-art science and engineering infrastructure.

The 37 Engineering Research Centers established since program initiation in 1985 have innovated many effective mechanisms for the creation of new knowledge and technology, for the education of a diverse and capable engineering workforce, and for the leadership and management of an ERC. These innovations are documented by ERC participants in the *ERC Best Practices Manual* (http://www.erc-assoc.org/manual/bp_index.htm) and information on contacts at and the activities of individual ERCs can be obtained from the fact sheets available at http://www.nsf.gov/pubs/2000/nsf00137/start.htm. The operations of ERCs have evolved continuously as the complexity of their mission and the breadth of fundamental knowledge needed to perform cutting-edge engineering research has increased; proposals submitted to this solicitation are expected to show strong promise of advancing this evolution. Therefore, proposers should view current ERC practices as a baseline for further innovation in the proposed structures of their centers, rather than as constraints.

II. PROGRAM DESCRIPTION

A. GOAL AND KEY FEATURES

The goal of the Engineering Research Centers (ERC) Program is to educate a globally competitive engineering workforce in an integrated, interdisciplinary research environment where academe and industry join in partnership to advance fundamental engineering knowledge and engineered systems.

All ERCs share the following key features:

- Long-term, strategic vision for an emerging engineered system with the potential to spawn a new or transform a current industry, service delivery system, or infrastructural element;
- Strategic plan to realize the vision;
- Director and a leadership team to implement the plan and manage the Center;
- Research program conducted by a committed, cross-disciplinary faculty team to integrate fundamental and technology research with proof-of-concept test-beds designed to test theory in functioning systems;
- Leadership, faculty, and student teams diverse in gender, race, and ethnicity;
- Partnerships with industry and other practitioners to formulate, evolve, and strengthen the ERC and speed technology transfer;
- Education program which teams undergraduate and graduate students and integrates research results into curricula for pre-college and college students and practitioners;
- Outreach in research and education to involve college and pre-college students, their faculty and

teachers in the ERC;

- Management and associated performance and financial management information systems needed to deploy the Center's resources to achieve its goals;
- Mechanisms for securing external advice from academic and industrial experts to set strategic directions, select and assess projects, and develop internal policies, including cross-university policies for multi-university ERCs;
- Experimental, computational, and other equipment, facilities, and laboratory space required to perform the proposed research and enable a robust learning environment;
- Institutional commitment to facilitate and foster the culture of the ERC and provide headquarters space appropriate to promoting interdisciplinary collaboration and supporting Center-level activities; and
- Cash cost-sharing from academic institutions plus cash and in-kind support from industry and other sources to substantially leverage NSF's support.

B. SCOPE AND FOCUS

Vision and Rationale: Broadly defined, an engineered system integrates materials, devices, processes, components, control algorithms, and cognitive or other enabling elements to perform a well-defined function. A prospective ERC team should develop a ten-year vision for advances in an emerging, potentially revolutionary or transforming engineered system. While high quality research on one or more of the enabling technological components of the system will be required to enable the functioning of the system, a focus on the individual components without their integration into an engineered system is not appropriate for an ERC. Part of the complexity of systems is the factors associated with their use in industry and society, including their impacts on natural or societal systems. This complexity should be factored into the development of the vision, the strategic plan, the research and education programs, and the composition of the team of faculty, students, and industrial partners.

NSF has no preference regarding the technological focus of a proposed ERC. However, if there is an ongoing ERC or other major center working in the proposed topic area, the proposing team should explain how it will pursue the topic from a radically different point of view and indicate how their efforts will be coordinated with the efforts of any such centers. Descriptions of ongoing ERCs and access to their web sites can be obtained at http://www.erc-assoc.org/centers.htm.

Strategic Research Plan: An ERC must have a compelling research plan incorporating a thorough analysis of the state-of-the-art. It is understood that, since the focus will be on emerging, highly speculative technological opportunities, the ultimate implementation at the systems level may be uncertain. Therefore, the objective of the research plan is to demonstrate the existence of a critical path to the realization of the system goals. Specific knowledge gaps, technology goals/deliverables, and barriers to achieving these goals are clearly identified. These barriers motivate and guide the selection of proposed research projects and test-beds. The description of each project explains the approach taken in the context of known results and theory to demonstrate that the desired results are attainable. It is understood that the strategic plan will evolve with the progress of the Center and the field. However, the quality of the plan, as presented in the proposal, will be a key selection factor in the ERC competition.

Proposers must provide a conceptual diagram showing how major research goals and test-beds contribute to the systems goals and a 10-year, milestone chart indicating the critical paths through key research projects

and testbeds to major research goals and deliverables.

Research Program: The research program of an ERC merges the research culture of academe and the product development culture of industry. Deliverables include both long-term contributions to fundamental knowledge and technology and nearer-term results to meet industry's impending needs. The research program is cross-disciplinary in nature, encouraging teaming among faculty and students, and including a significant commitment to involving undergraduate students. The projects are organized into thrusts focused on each of the major research goals. It is expected that synergies across thrusts will lead to the inclusion of some projects in multiple thrusts.

Education Program: ERCs are expected to develop a team-based, research-inspired, and industrial practice-oriented culture for the education of graduate and undergraduate students. They enrich education at the university, pre-college, and practitioner levels by integrating their research findings and knowledge of cognitive science into new courses, course modules for insertion into existing courses, and new degree programs or degree options, where appropriate. All ERCs must evaluate their curricular contributions and disseminate those that are successful. In multi-university ERCs, the education mission is shared among the universities, with each partner contributing to the education effort and the students from each deriving educational benefit from the multi-university nature of the Center.

Outreach: ERCs are required to have educational and research outreach programs involving college and pre-college level students and their faculty and teachers in the ERC's research and education programs. The purpose of pre-college outreach is to motivate students to study engineering and to bring engineering concepts into pre-college classrooms by involving their teachers in research.

Industrial Collaboration: Partner companies should be carefully selected for their abilities to contribute to the development and execution of the strategic and operational plans of the ERC. Industry members are expected to serve on the Center's Industrial Advisory Board and provide access to key facilities and personnel, knowledge of industrial practice, needs, and plans for future technological innovation, speed knowledge and technology transfer, and provide instructors, advisors, mentors and faculty and student internships. The anticipated roles of individual member companies should be integrated into the proposal so that it is clear how they will contribute to Center plans.

An ERC is required to formalize partnerships with industry and other user communities through a center-wide, written membership agreement. Membership agreements specify the terms, fees, and benefits of membership and intellectual property rights. Foreign firms may be ERC members, as long as they execute membership agreements with the same conditions and expectations as those for domestic firms. If the ERC is multi-institutional, the firms must participate as members of the whole ERC, not just as campus-level affiliates.

Member firms pay cash membership fees, which are pooled at the Center level. Generally, there are sliding scales of fees geared to large, medium, and small-scale firms. Member firms may also provide in-kind and directed project support, in addition to membership fees. Some ERCs also allow non-member firms to provide Center-affiliated faculty with support for individual projects that contribute directly to the strategic plan of the Center.

The proposed fee and benefit terms of the membership agreement and the general terms of the intellectual property policy will be summarized in the full proposal, but not in the pre-proposal. If the full proposal is funded, a membership agreement including the ERC's intellectual property policy will be finalized early in the first post-award year. Guidelines for drafting membership agreements and intellectual property policies developed from the experience of ongoing ERCs will be made available, post-award.

C. INFRASTRUCTURE, MANAGEMENT, AND ORGANIZATION

Institutional Configuration: ERCs may be single university or multi-university efforts. Multi-university ERCs are required to have a lead university and a manageble number of core partner universities. They form a team of faculty from the lead and core partner universities that functions as an integrated whole, with shared research, education, diversity, and industrial collaboration programs. Ongoing multi-university ERCs have developed agreements among the partners which specify their responsibilities and obligations and these will be made available to awardees. In multi-university ERCs, the lead university assumes overall management and financial responsibility, accepts funding from NSF and other sources, and allocates funds among partner universities based on their respective roles in the strategic plan and their performance.

All ERCs are required to involve a limited number of faculty, other investigators, teachers, and students from outside the lead and core-partner institutions in their research and education programs. This outreach must be budgeted for and the specific intellectual contributions of outreach partners to the ERC must be identified in the pre-proposal and invited full proposal. Foreign faculty and staff from federal laboratories can be part of this outreach. However, NSF funds may not be used to support federal laboratory staff, and may not support foreign faculty for work that is not performed on site, at the ERC lead or a core-partner institution, in the United States. It is expected that outreach affiliations will change over time, according to their success and the needs of the Center. To facilitate the review process, please include in the pre-proposal and invited full proposal only the names of university or federal laboratory personnel proposed to be involved in outreach during Year 1. The names of specific pre-college partner schools and school systems are required at both proposal stages, but the names of pre-college personnel are not.

Leadership Team, Management, and Organization: Each ERC must have the following members of its leadership team or their equivalent:

- Center Director, a faculty member and the NSF Principal Investigator (PI), responsible for leading the ERC and administering the award in accordance with the terms and conditions of the Cooperative Agreement issued by the NSF in the event of an award;
- Deputy or Associate Director(s), also faculty, sharing the leadership responsibility;
- Faculty members responsible for leading and managing major research thrusts;
- Administrative Director, responsible for management and administration;
- Industrial Liaison Officer, responsible for developing and coordinating industrial involvement, industrial support, and technology transfer;
- Education Program Director, responsible for curriculum development and educational outreach;
- Student Leadership Council (SLC), responsible for coordinating student activities;
- Advisory board of outside experts and Industrial Advisory Board of ERC member companies to advise the Director; and
- Internal academic policy board to coordinate ERC plans and policies with departmental and university leaders and committees.

The designation of individuals serving as the Administrative Director, the Industrial Liaison Officer, the members of the Student Leadership Council, and on the advisory boards may occur after notification of

award.

The ERC must report to the Dean of Engineering of the lead institution, who is advised by a Council of Deans in a multi-university ERC and works with Deans from outside the Engineering School in ERCs that involve faculty from such schools.

Team Diversity: NSF expects the leadership, faculty, and students involved in an ERC to be diverse in gender, race, and ethnicity. This diversity is expected of the participants from the lead and any core partner institutions and it may be enhanced through affiliations with minority or womens institutions, either as core partners or outreach affiliates.

Experimental Equipment and Center Headquarters Infrastructure: The pre-proposal and invited full proposal will include an analysis of the available and needed equipment and laboratory space. An ERC must be provided with a physical and communications infrastructure that enables efficient headquarters operation and the collaboration of faculty and students across laboratory, departmental and institutional lines. The lead university is expected to provide a detailed specification of the proposed headquarters infrastructure in the invited full proposal.

D. FINANCIAL SCALE OF THE ERC

NSF Award Size: Proposed budgets for the first three years may not exceed $2.5, $3.0 and $3.5 million, respectively and proposed budgets for years four and five may not exceed $4.0 million. The actual funding level in any given year will depend upon a detailed analysis of proposed work, progress to date, financial need, and the availability of funds.

Total Support: Cash cost-sharing must total 10 percent of the amount of NSF support. It will be provided by the lead institution and any or all of the long-term core partner institutions. Cash cost-sharing contributions must be detailed by institution and by year and in a cumulative amount in pre-proposals and invited full proposals. Outreach institutions are not required to provide cost-sharing. The cost of headquarters space provided by the lead university is not considered cost-sharing and is not counted as leverage. Cost sharing is considered an eligibility criterion rather than a review criterion, while the provision and quality of headquarters space is a review criterion for full proposals.

ERCs are required to have industry members paying cash membership fees. Most also receive in-kind support from industry and additional support from other federal agencies, and some receive support from state and local government, other parts of NSF, or private foundations. By the full proposal stage, NSF expects the level of industrial support from firms committed to ERC membership to demonstrate strong industry interest in the proposed ERC.

III. ELIGIBILITY INFORMATION

Proposals substantially duplicating the research scope of ongoing ERCs will not be supported.
Pre-proposals will not be accepted from universities that are already the lead institution for two ongoing ERCs.

Only universities proposing to provide cash cost sharing of 10 per cent of NSF funds may submit pre-proposals and invited full proposals as lead and core partner institutions. In addition, only universities willing to provide headquarters for a proposed ERC may submit an invited full proposal as the lead institution.

IV. AWARD INFORMATION

Awards: At least $5.0 M is expected to be available to support at least two ERCs in FY 2003 with start-up budgets of up to $2.5 M each. The actual number of centers funded will depend on the scale and scope of the proposed centers, the level of funding provided in the FY 2003 NSF budget, and the quality of the proposals submitted. Awards are made through cooperative agreements between NSF and the lead university, with subawards to other institutions involved.

Life Cycle under NSF Support: An ERC is supported under a cooperative agreement between the lead university and NSF, the duration of which is potentially 10 years. The first award under the agreement is for five years. Each ERC submits annual reports of progress and plans. Based on these reports, a Center's performance and plans are reviewed annually through merit review by outside experts. Continuing support levels are based on the outcomes of the annual reviews. In the third and sixth years, an ERC may submit a renewal proposal, which will undergo merit review by outside experts. If the third-year renewal review is successful, five years of support is provided at the beginning of year four; and if the sixth-year renewal rview is successful, four years of support is provided at the beginning of year seven. If a renewal review is not successful, NSF support is phased down for up to two years to protect the graduate students. The frequency of annual reviews between years four and nine depends upon the progress of the Center and the outcome of the third and sixth-year renewal reviews. NSF support for successful ERCs also is phased-down in years nine and ten to prepare the Center for self-sufficiency, since ERCs are expected to be self-sustaining after ten years when NSF support ceases.

Post-Award Guidance and Oversight: NSF provides assistance in developing an ERC through program oversight, the ERC Annual Meeting, and the annual and renewal review process. NSF also supports small teams of experienced staff from ongoing ERCs (the ERC Consultancy) to visit start-up ERCs to help establish effective programs of administration, industrial collaboration, and education. In addition, NSF staff comes on campus at start-up to brief the new ERC on program and performance expectations.

NSF requires annual reports from ERCs that are more extensive in scope than those required of single investigator awards. NSF also requires that ongoing ERCs collect and submit to NSF data on indicators of progress and impact. NSF provides templates for the recording and submission of these data through a secure web site.

Members of all ERCs' leadership teams are required to meet annually in the Washington, DC area to share successes and failures, receive updates on the ERC Program, and provide input for future Program improvements. Prospective centers should include funds in their travel budgets to support the participation of the Director, the Associate Director, the Administrative Director, the Education Program Director and key education staff, the Industrial Liaison Officer for a two-day meeting and at least one undergraduate and one graduate student representing their Student Leadership Council for a three-day meeting.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Letters of Intent: A notice of intent is required to facilitate the NSF review process. The notice should be submitted by e-mail to ercintent@nsf.gov no later than the date specified in this solicitation. Each notice must include the following:

1. Name of the proposed ERC, the name of the lead/submitting university, the names of any core partner universities, and the names of the outreach universities.

2. Brief statement of the vision and goals of the Center and description of its research and education programs at a sufficient level of detail to allow potential reviewers to be selected.
3. List of faculty participants, beginning with the Director and Deputy Director, including their full names, roles in the ERC, disciplines, departmental and institutional affiliations.
4. List of individuals, with their affiliations, who are not members of the proposing team and whose selection as reviewers might constitute a conflict of interest due to involvement in proposal development, thesis supervision, co-publication or authorship, co-PI relationships, etc.
5. List of suggested reviewers, with their institutional affiliations, who have the expertise to review the proposal and have no affiliations that would cause conflicts.

Preliminary Proposals: The full proposal preparation instructions below specify the format for both pre-proposals and full proposals and the differences between them.

Full Proposal:

Proposals submitted in response to this program announcement/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 Web Site at: http://www.nsf.gov/cgi-bin/getpub?gpg. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (301) 947-2722 or by e-mail from pubs@nsf.gov.

All pre-proposals and full proposals must be submitted via NSF FastLane. Detailed instructions for proposal preparation and submission via FastLane are available at http://www.fastlane.nsf.gov/a1/newstan.htm and FastLane support is available at (800)673-6188 or fastlane@nsf.gov.

Pre-proposals and invited full proposals must be single-spaced in 12-point type and include the items listed below in the order indicated. Pre-proposals and invited full proposals for multi-university ERCs must be submitted as integrated proposals by the lead institutions, with proposed sub-awards to the other institutions. Separate pre-proposals and full proposals from each partner will not be accepted.

The page limit for the project description is 15 pages for pre-proposals and 35 pages for invited full proposals, including all charts, tables, and figures. Pre-proposals and invited full proposals that exceed the page limitations, do not comply with the font restrictions, contain items other than those required below or by the NSF FY 2001 Grant Proposal Guide (NSF 01-2, *http://www.nsf.gov/pubs/2001/nsf012/nsf0102_2.html*)**, or do not contain the required cost-sharing or other institutional commitments will not be considered for funding**.

The required format for pre-proposals and invited full proposals is indicated below. Sections required in the full proposal but not in the pre-proposal are noted.

1. Cover Sheet. - NSF FastLane Form 1207

2. Project Summary. Concisely describe the overall objectives of the ERC and of the proposed research, education, diversity, outreach, and industrial collaboration programs (1 page)

3. Table of Contents will be generated automatically by FastLane.

4. List of Participants. List the information requested below in the "Add/modify Non-Co-PI Senior Personnel" FastLane form. This list will be used primarily by NSF to eliminate individuals with potential conflicts-of-interest as reviewers. Therefore, please include only those individuals whose proposed

involvement with the ERC would be significant enough to result in personal benefit to them or their relatives, or financial benefit to the institutions employing them.

Head the list with the title of the ERC, the lead university and any core partner universities. Order the list by the role of the individuals in the ERC in the following order: leadership team, core faculty members, research outreach, educational outreach, industry/agency representatives whose organizations are committed to membership in the ERC if awarded, and any already-designated advisory board members. Include their names, titles, roles in the ERC, disciplines, academic schools (e.g. engineering) for university participants, and institutional affiliations.

5. Project Description (Maximum length: 15 pages for pre-proposals and 35 pages for full proposals, including all figures, tables, and charts). The project description should be prepared with reference to the review criteria and the guidance provided in this and the preceding sections of this announcement.

- **Vision and rationale** for the proposed engineered system(s) as a potentially transforming technology. Proposals based on the work of pre-existing centers must explain the new vision and value-added of the proposed work.

- **Engineered systems focus**.

- **Research plan and program**, including a graphical depiction of the strategic plan and a milestone chart.

- **Education and educational outreach**.

- **Industrial collaboration and technology transfer**. The pre-proposal and invited full proposal may include up to five support letters from industry. Letters of commitment to or interest in fee-paying ERC membership should be included in the full proposal only. All letters should be included in section 12 (Letters).

- **Management and resource plan.** Description of headquarters space and specification of industrial funding are required only in invited full proposals.

6. References.

7. Equipment and Facilities. Describe equipment and facilities, including laboratories, computational, and visualization equipment/facilities. Use NSF Standard FastLane Form 1363.

8. Biographical Sketches of the Director, Deputy Director and all other core faculty members, including outreach investigators and teachers, in accordance with GPG Chapter II, Sections 5a. through 5e. (*http://www.nsf.gov/pubs/2001/nsf012/nsf0102_2.html*) using the standard FastLane form. Length must not exceed 2 pages per person. Up to 5 publications of high relevance to the proposal may be listed in each biographical sketch.

9. Budgetary Information.

- **Budget Pages:** Submit a budget page for each of the first 5 years of the proposed project and a cumulative summary budget justification. Enter the anticipated total level of subcontract support on line G5, Subawards. Pre-proposals should not include separate subcontracts for each core partner and outreach institution, but these are required for full proposals.

(Prepare the University Cost-Sharing and Allocation of NSF and Other Committed Funds sections described below so they can be uploaded as a single file.)

- **University Cost-Sharing:** There must be commitment to provide total cash cost-sharing in the amount of 10 percent of NSF base support at both the pre-proposal and full proposal stages. All cost-sharing must be provided from non-Federal sources. Provide in the budget justification, as a single file, a table showing committed cash cost-sharing by institution and year, including cumulative totals.

- **Allocation of NSF and Other Committed Funds** (for invited full proposals only). Provide in the budget justification, as a single file, pie charts or tables showing:

  - The planned allocation of funds from all sources committed to the Year 1 efforts in research, education, industrial collaboration, equipment, administration, etc. Clearly indicate funds devoted to outreach in each category.

  - The planned distribution of funds in Year 1 among the lead, any core partner, and outreach institutions.

- **Indirect Cost (F&A) Limitations**: none

10. Reviewer Information . Use FastLane to enter a "List of Suggested Reviewers," if desired.

11.Current and Pending Support . List for the Director, Deputy Director and key faculty.

12. Letters. Include letters of support and commitment from industry, as instructed above. **Letters of commitment to cost-sharing by the lead and core partner institutions, signed by authorized officials, must be included in both pre-proposals and invited full proposals**. All letters should be addressed to Lynn Preston, Leader of the ERC Program, Division of Engineering Education and Centers, Suite 585, National Science Foundation, 4201 Wilson Boulevard, Arlington, VA 22230. All letters must be scanned into the Supplementary Documents section of the FastLane proposal and submitted electronically, as part of the proposal. **Please do not mail, fax or e-mail hard copies to the NSF.**

SUMMARY OF REQUIREMENTS

Topic	**Pre-Proposal**	**Full Proposal**
Proposal Requirements		
Commitment of industrial funds	No	Yes
10% cash cost-sharing	Yes	Yes
Cost-sharing by outreach institutions	No	No
Identification of participating faculty members at research and education outreach affiliates	Year 1 only	Year 1 only
Names and affiliations of industry/agency personnel committed to membership in the ERC	Yes	Yes

Names of persons committed to serving on ERC advisory committees	Yes	Yes
Proposed terms of proposed membership agreement and intellectual property policy	No	Yes
Submission Requirements		
FastLane	Yes	Yes
Notice of Intent	Yes	No
Pre-Proposal and Full Proposal	Submission	By Invitation Only
Mailing of One Paper Copy to NSF	Yes	Yes
Format		
Information About PI (NSF Form 1225)	Yes	Yes
NSF Cover Sheet (Form 1207)	Yes	Yes
FastLane Submission of 1207	Yes	Yes
FastLane Submission of Proposals	Yes	Yes
Table of Contents	Yes	Yes
List of Academic Participants	Yes	Yes
List of Committed Industrial & Other Partners	Yes	Yes
Project Summary (Form 1358)	Yes	Yes
Narrative	15 pages, including charts, etc.	35 pages, including charts, etc.
Appendices		
Letters committing to cost-sharing	Yes	Yes
Letter committing to HQ space	No	Yes
Support letters from industry/other users	Yes	Yes
Letters of industry commitment to membership	No	Yes
Separate budgets for years 1-5 (Forms 1030)	Yes	Yes
Summary budget for years 1-5 (Form 1030)	Generated by FastLane	Generated by FastLane
Allocation of Funds by Function (Year 1 only)	No	Yes

Allocation of Funds by Institution (Year 1 only)	No	Yes
Allocation of Funds to Outreach (Year 1 only)	No	Yes
Biographical Sketches (Form 1362)	Yes	Yes
Facilities & Equipment (Form 1363)	Yes	Yes
Current & Pending Support (Form 1239)	Yes	Yes
Justification for Secretarial & Admin. Support	No	Yes

Proposers are reminded to identify the program solicitation number (NSF 02-24) in the program announcement/solicitation block on the proposal Cover Sheet (NSF Form 1207). Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

B. Budgetary Information

Cost sharing at a level of 10 percent of the requested total amount of NSF funds is required for all proposals submitted in response to this solicitation. The proposed cost sharing must be shown on Line M on the proposal budget. Documentation of the availability of cost sharing must be included in the proposal. Only items which would be allowable under the applicable cost principles, if charged to the project, may be included in the awardee's contribution to cost sharing. Contributions may be made from any non-Federal source, including non-Federal grants or contracts, and may be cash or in kind (see OMB Circular A-110, Section 23). It should be noted that contributions counted as cost sharing toward projects of another Federal agency may not be counted towards meeting the specific cost sharing requirements of the NSF award. All cost sharing amounts are subject to audit. Failure to provide the level of cost sharing reflected in the approved award budget may result in termination of the NSF award, disallowance of award costs and/or refund of award funds to NSF.

Other Budgetary Limitations: Proposed budgets for the first three years may not exceed $2.5, $3.0,$3.5 million, respectively, and proposed budgets for years four and five may not exceed $4.0 million. The actual funding level in any given year will depend upon a detailed analysis of the proposed work, progress to date, financial need, and the availability of funds.

C. Deadline/Target Dates

Proposals must be submitted by the following date(s):

Letters of Intent (*required*): March 15, 2002
Preliminary Proposals (*required*): May 15, 2002
Full Proposals *by 5:00 PM local time*: December 3, 2002

D. FastLane Requirements

Proposers are required to prepare and submit all proposals for this Program Solicitation through the FastLane system. Detailed instructions for proposal preparation and submission via FastLane are available at: http://www.fastlane.nsf.gov/a1/newstan.htm. For FastLane user support, call 1-800-673-6188 or e-mail fastlane@nsf.gov.

Submission of Electronically Signed Cover Sheets. The Authorized Organizational Representative (AOR) must electronically sign the proposal Cover Sheet to submit the required proposal certifications (see Chapter II, Section C of the Grant Proposal Guide for a listing of the certifications). The AOR must provide the required certifications within five working days following the electronic submission of the proposal. Further instructions regarding this process are available on the FastLane website at: http://www.fastlane.nsf.gov.

VI. PROPOSAL REVIEW INFORMATION

A. NSF Proposal Review Process

Reviews of proposals submitted to NSF are solicited from peers with expertise in the substantive area of the proposed research or education project. These reviewers are selected by Program Officers charged with the oversight of the review process. NSF invites the proposer to suggest, at the time of submission, the names of appropriate or inappropriate reviewers. Care is taken to ensure that reviewers have no conflicts with the proposer. Special efforts are made to recruit reviewers from non-academic institutions, minority-serving institutions, or adjacent disciplines to that principally addressed in the proposal.

Proposals will be reviewed against the following general review criteria established by the National Science Board. Following each criterion are potential considerations that the reviewer may employ in the evaluation. These are suggestions and not all will apply to any given proposal. Proposers are reminded that both the intellectual merit and the broader impacts of the work to be accomplished should be addressed. While reviewers are expected to address both merit review criteria, each reviewer will be asked to address only considerations that are relevant to the proposal and for which he/she is qualified to make judgements.

What is the intellectual merit of the proposed activity?
How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of the prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

What are the broader impacts of the proposed activity?
How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

Principal Investigators should address the following elements in their proposal to provide reviewers with the information necessary to respond fully to both of the above-described NSF merit review criteria. NSF staff will give these elements careful consideration in making funding decisions.

Integration of Research and Education
One of the principal strategies in support of NSF's goals is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the

diversity of learning perspectives.

Integrating Diversity into NSF Programs, Projects, and Activities
Broadening opportunities and enabling the participation of all citizens -- women and men, underrepresented minorities, and persons with disabilities -- 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.

Additional Review Criteria

Additional review criteria for pre-proposals and full proposals are as follows:

- Proposal defines an emerging engineered system with strong potential to spawn new industries, transform our current industrial base, service delivery system or infrastructure, and have a broad societal impact;
- Research plan targets critical systems goals, identifies challenging scientific and technical barriers to be overcome and proposes research projects and proof-of-concept test-beds to address these barriers;
- Proposal demonstrates a clear knowledge of the state-of-knowledge and the state-of-the-art and presents a persuasive strategy for advancing them;
- Education plan integrates the ERC's research activities and results into curricula at all levels, achieves a team-based, cross-disciplinary culture for undergraduate and graduate students, and incorporates effective plans for implementation, assessment and dissemination of curricular materials;
- Outreach will expose a broad spectrum of faculty, teachers and students to the ERC's research culture, impact pre-college curricula and motivate students to study engineering;
- Proposal provides a convincing rationale for the selection of industrial/user partners and engages these partners in planning, research, education, and technology transfer.
- Institutional configuration is appropriate to the goals of the ERC and, for multi-university ERCs, collaboration is integrated across the participating universities;
- ERC has expertise in all disciplines required to attain its goals, a capable leadership team, and leadership, faculty and student teams diverse in gender, race, and ethnicity;
- Organizational structure and management plan effectively organize and integrate the resources of the ERC to achieve its goals and include strong advisory and project selection/evaluation systems. In a multi-university proposal, the resources of all institutions must be effectively integrated;
- Experimental, computational, and other required equipment, facilities, and laboratory space are in place or proposed to support the research of the Center;
- The participating institutions have committed to encourage, support and facilitate the dissemination of the interdisciplinary research, educational and diversity programs of the ERC.

For full proposals only:

- Headquarters space proposed for the Center will effectively encourage and facilitate interdisciplinary collaboration and house the management functions of the ERC.
- Commitments from firms to be fee-paying members of the ERC, if an award is made.
- Proposed terms of the industrial membership agreement will structured a center-wide program of industrial collaboration to support overall ERC goals, as opposed to a collection of individual sponsored projects; proposed terms of the intellectual property policy will facilitate technology transfer.

A summary rating and accompanying narrative will be completed and submitted by each reviewer. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers, are sent to the Principal Investigator/Project Director by the Program Director. In addition, the proposer will receive an explanation of the decision to award or decline funding.

B. Review Protocol and Associated Customer Service Standard

All proposals are carefully reviewed by at least three other persons outside NSF who are experts in the particular field represented by the proposal. Pre-proposals and invited full proposals submitted in response to this solicitation will receive a peer review by experts outside of NSF.

Reviewers will be asked to formulate a recommendation to either support or decline each proposal. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

NSF is striving to be able to tell applicants whether their proposals have been declined or recommended for funding within six months for 70 percent of proposals. The time interval begins on the date of receipt. The interval ends when the Division Director accepts the Program Officer's recommendation.

In all cases, 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 and 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 its own risk.

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 Division 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.A. for additional information on the review process.)

B. Award Conditions

An NSF award consists of: (1) the award letter, 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 letter; (4) the applicable award conditions, such as Grant General Conditions (NSF-GC-1)* or Federal Demonstration Partnership (FDP) Terms and Conditions;* and (5) any announcement or other NSF issuance that may be incorporated by reference in the award letter. Cooperative agreement awards also are administered in accordance with NSF Cooperative Agreement Terms and Conditions (CA-1). Electronic mail notification is the preferred way to transmit NSF awards to organizations that have electronic mail capabilities and have requested such notification from the Division of Grants and Agreements.

*These documents may be accessed electronically on NSF's Web site at http://www.nsf.gov/home/grants/grants_gac.htm. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (301) 947-2722 or by e-mail from pubs@nsf.gov.

More comprehensive information on NSF Award Conditions is contained in the NSF *Grant Policy Manual* (GPM) Chapter II, available electronically on the NSF Web site at http://www.nsf.gov/cgi-bin/getpub?gpm. The GPM is also for sale through the Superintendent of Documents, Government Printing Office (GPO), Washington, DC 20402. The telephone number at GPO for subscription information is (202) 512-1800. The GPM may be ordered through the GPO Web site at http://www.gpo.gov.

Special Award Conditions
Grant General Conditions (GC-1), Cooperative Agreement General Conditions (CA-1), and any special conditions referenced in the cooperative agreement will apply.

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the PI must submit an annual project report to the cognizant Program Officer at least 90 days before the end of the current budget period.

In addition to the annual and final report, a data base of indicators of progress and impact is required. See IV. Award Information.

Within 90 days after the expiration of an award, the PI also is required to submit a final project report. Approximately 30 days before expiration, NSF will send a notice to remind the PI of the requirement to file the final project report. Failure to provide final technical reports delays NSF review and processing of pending proposals for that PI. PIs should examine the formats of the required reports in advance to assure availability of required data.

NSF has implemented an electronic project reporting system, available through FastLane. This system permits electronic submission and updating of project reports, including information on project participants (individual and organizational), activities and findings, publications, and other specific products and contributions. PIs will not be required to re-enter information previously provided, either with a proposal or in earlier updates using the electronic system.

VIII. CONTACTS FOR ADDITIONAL INFORMATION

General inquiries regarding Engineering Research Centers should be made to:

- Lynn Preston, Leader of the ERC Program and Deputy Division Director, Division of Engineering

Education and Centers, Suite 585, telephone: 703-292-8381, e-mail: lpreston@nsf.gov.

- Bruce Kramer, Director, Division of Engineering Education and Centers, Suite 585, telephone: 703-292-8380, e-mail: bkramer@nsf.gov.
- Mita Desai, ERC Program Director, Division of Engineering Education and Centers, Suite 585, telephone: 703-292-5346, e-mail: mdesai@nsf.gov.
- Tapan Mukherjee, ERC Program Director, Division of Engineering Education and Centers, Suite 585, telephone: 703-292-8381, e-mail: tmukherj@nsf.gov.
- Mary Poats, ERC REUs, pre-college outreach, education, Program Manager, Engineering Education and Centers, Suite 585, telephone: 703-292-8380, e-mail: mpoats@nsf.gov.
- Sohi Rastegar, Program Director, Engineering Education and Centers, Suite 585, telephone: 703-292-8381, e-mail: srastega@nsf.gov.

For questions related to the use of FastLane, contact:

- Esther Bolding, Administrative Manager, Division of Engineering Education and Centers, Suite 585, telephone: 703-292-5342, e-mail: ebolding@nsf.gov.

Other Program Directors from other Divisions of NSF may be consulted regarding the development of pre-proposals.

IX. OTHER PROGRAMS OF INTEREST

The NSF *Guide to Programs* is a compilation of funding for research and education in science, mathematics, and engineering. The NSF *Guide to Programs* is available electronically at http://www.nsf.gov/cgi-bin/getpub?gp. General descriptions of NSF programs, research areas, and eligibility information for proposal submission are provided in each chapter.

Many NSF programs offer announcements or solicitations concerning specific proposal requirements. To obtain additional information about these requirements, contact the appropriate NSF program offices. Any changes in NSF's fiscal year programs occurring after press time for the *Guide to Programs* will be announced in the NSF E-Bulletin, which is updated daily on the NSF web site at http://www.nsf.gov/home/ebulletin, and in individual program announcements/solicitations. Subscribers can also sign up for NSF's Custom News Service (http://www.nsf.gov/home/cns/start.htm) to be notified of new funding opportunities that become available.

Other center programs of special interest may be the the Industry/University Cooperative Research Centers, Science and Technology Centers, and the Materials Research Science and Engineering Centers. The Combined Research and Curriculum Development Program may also be of interest.

ABOUT THE NATIONAL SCIENCE FOUNDATION

The National Science Foundation (NSF) funds research and education in most fields of science and engineering. Awardees are wholly responsible for conducting their project activities and preparing the results for publication. Thus, the Foundation does not assume responsibility for such findings or their interpretation.

NSF welcomes proposals from all qualified scientists, engineers and educators. The Foundation strongly encourages women, minorities and persons with disabilities to compete fully in its programs. In accordance with Federal statutes, regulations and NSF policies, no person on grounds of race, color, age, sex, national origin or disability shall be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from NSF (unless otherwise

specified in the eligibility requirements for a particular program).

Facilitation Awards for Scientists and Engineers with Disabilities (FASED) provide funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on NSF-supported projects. See the program announcement/solicitation for further information.

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, FIRS at 1-800-877-8339.

The National Science Foundation is committed to making all of the information we publish easy to understand. If you have a suggestion about how to improve the clarity of this document or other NSF-published materials, please contact us at plainlanguage@nsf.gov.

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; 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 applicant 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 needing information as part of the review process or in order to coordinate programs; 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," 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records," 63 Federal Register 268 (January 5, 1998). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

Pursuant to 5 CFR 1320.5(b), an agency may not conduct or sponsor, and a person is not required to respond to an information collection unless it displays a valid 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 this burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to: Suzanne Plimpton, Reports Clearance Officer, Information Dissemination Branch, Division of Administrative Services, National Science Foundation, Arlington, VA 22230, or to Office of Information and Regulatory Affairs of OMB, Attention: Desk Officer for National Science Foundation (3145-0058), 725 17th Street, N.W. Room 10235, Washington, D.C. 20503.

OMB control number: 3145-0058.