Engineering Research Centers (ERC)

Partnerships in Transformational Research, Education and Technology - A Focused Call for Nanosystems ERCs (NERCs)

PROGRAM SOLICITATION
NSF 11-537

REPLACES DOCUMENT(S):
NSF 09-545

National Science Foundation

Directorate for Engineering
Engineering Education and Centers

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

July 15, 2011

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

September 16, 2011

IMPORTANT INFORMATION AND REVISION NOTES

A revised version of the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), NSF 11-1, was issued on October 1, 2010 and is effective for proposals submitted, or due, on or after January 18, 2011. Please be advised that the guidelines contained in NSF 11-1 apply to proposals submitted in response to this funding opportunity.

1. **Data Management Plan:** The NSF Proposal & Award Policies & Procedures Guide (PAPPG) (NSF 11-1) contains a clarification of NSF's long standing data policy. All proposals must describe plans for data management and sharing of the products of research, or assert the absence of the need for such plans. FastLane will not permit submission of a proposal that is missing a Data Management Plan. The Data Management Plan, submitted in the "supplementary documents" section of the proposal and limited to two pages, will be reviewed as part of the intellectual merit or broader impacts of the proposal, or both, as appropriate. Links to data management requirements and plans relevant to specific Directorates, Offices, Divisions, Programs, or other NSF units are available on the NSF website at: http://www.nsf.gov/bfa/dias/policy/dmp.jsp. See Part I, "Grant Proposal Guide" (GPG), Chapter II.C.2.j (pg. II-19) of the PAPPG for further information about the implementation of this requirement.

ERC Program proposers must follow the ENG Directorate specific data management guidelines available at http://nsf.gov/eng/general/ENG_DMP_Policy.pdf, and also refer to the ERC Program solicitation for additional details in Sec. 10, "Supplementary Documents, Data Management Plan." While there are no specific ERC Program Guidelines with respect to the Data Management Plan, proposers must follow the ENG Directorate specific data management guidelines.

Specifically, the basic level of digital data to be archived and made available includes (1) the analyzed data and (2) the metadata that define how these data were generated. These are data that are or that should be published in theses, dissertations, refereed journal articles, supplemental data attachments for manuscripts, books and book chapters, and other print or electronic publication formats.

- Analyzed data are (but are not restricted to) digital information that would be published, including digital images, published tables, and tables of the numbers used for making published graphs.
- Necessary metadata are (but are not restricted to) descriptions or suitable citations of experiments, apparatuses, raw materials, computational codes, and computer-calculation input conditions.

2. **Awards under this ERC Topical Solicitation:** Depending upon the quality of proposals and the available budget, up to three awards will be made in the Transformational Nanotechnology Engineered Systems topic area only. These ERCs will be called Nanosystems ERCs (NERCs). ERC proposals submitted to this solicitation must propose a vision consistent with the general guidance on this topic area that is provided in Section II.B.1.a in the solicitation. No other topics will be accepted under this solicitation.

It is anticipated that approximately $9,750,000 is expected to be available to support up to three new Gen-3 Nanosystems ERCs in late summer of 2012 with year one start-up budgets each of up to $3,250,000. Subsequently, there would be year two budgets of up to $3,500,000, year three budgets of up to $3,750,000 and years four and five budgets of up to $4,000,000 each, pending satisfactory annual performance and availability of funding. The actual number of NERCs funded will depend on the scale and scope of the proposed Centers, the availability of funds, and the quality of the proposals submitted.

Note, proposals that focus on the innovation process itself as an engineered system or on engineering education as an engineered system will be returned without review.

Note, proposals focused on topics on other transformational engineered systems will not be supported under this solicitation and will be returned without review. Later in 2011, when the awards for the ERC Class of 2011 under the previous ERC solicitation, NSF 09-545, are announced a new solicitation will be issued for engineered systems and proposing ERC teams will be able to chose their own topics.

3. **Full Proposals Only:** This solicitation requests full proposals only; there will be no preliminary proposal phase. Therefore, full proposal preparation must be done carefully according to the guidelines presented in this solicitation.

4. **Information Webinar:** Update: This Information Webinar has been canceled.

For the first time the ERC program is foregoing the Pre-Proposal stage of the competition. *We will be posting a summary of frequently-asked questions about the solicitation on or about August 1, 2011.*

5. **Gen-3 and Small Business:** For ERC intellectual property that member firms do not license, Gen-3 ERCs must include translational research partnerships between ERC faculty and small firms to accelerate product development.

6. **The Lead Principal Investigator:** The Center Director must be the Lead Principal Investigator (PI) of this proposal and must be a tenured faculty member in an engineering department/school of engineering at the lead university. The Director's doctoral degree must be in engineering or an associated field of science; if the latter, she/he must have substantial career experience in engineering as evidenced by an appointment in an engineering department/school of engineering at the lead university.

7. **Postdoctoral Researcher Mentoring Plan:** As a reminder, each proposal that requests funding to support postdoctoral researchers must include, as a supplementary document, a description of the mentoring activities that will be provided for such individuals. Please be advised that if required, FastLane will not permit submission of a proposal that is missing a Postdoctoral Researcher Mentoring Plan. See Chapter II.C.2.j of the GPG for further information about the implementation of this requirement. Note that for ERC proposals there is an expanded mentoring requirement. See Section II.B.8.e of this solicitation. Proposals that include support for postdoctoral researchers but do not include a mentoring statement will be returned without review.

8. **ITAR and EAR:** Proposers must show "Awareness and Compliance with International Traffic in Arms Regulations (ITAR)" and "Export Administration Regulations (EAR)" (if relevant to the technology proposed). Proposers should contact their research administration offices for additional guidance.

9. **Full Proposal Submission:** In response to this program solicitation, proposers may opt to submit full proposals via Grants.gov or via the NSF FastLane system. However, LOIs must be submitted via FastLane.

10. **NERC Partner Universities:** To qualify as a partner university there should be a team of at least three faculty participating in the NERC plus undergraduate and graduate students (number not specified).

11. **Cost-Sharing:** Cost sharing requirements have been modified to show that proposers must append to their cost sharing tables a justification/explanation of the cost shared items and submit the tables and justification in the single-copy documents section of the proposal. The budget justification section of the proposal will not include any cost shared items, only items that are not cost shared. Inclusion of cost sharing above the mandatory level as stated in the ERC cost sharing formula would be considered "voluntary cost sharing" which is specifically prohibited in NSF's revised cost sharing principles, as stated in the NSF Grant Proposal Guide (GPG). ERC proposals that include cost sharing amounts in excess of the specified formula run the risk of being returned without review or declined.

12. **List of Senior Project Personnel:** Proposers are required to submit a "List of Project Personnel," as a text-searchable single PDF document, submitted in FastLane in the single copy documents section of the full proposal. Refer to the single copy documents section of the solicitation for details.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Engineering Research Centers (ERC)
Partnerships in Transformational Research, Education and Technology - A Focused Call for Nanosystems ERCs

Synopsis of Program:

The National Nanotechnology Initiative (NNI), a federal interagency research and development venture, was launched in FY 2001. Over the last decade, there has been considerable investment in fundamental research - from nanostructured materials to devices and manufacturing processes - that has revealed new phenomena and resulted in a plethora of important advances. At NSF the funding vehicles included individual grants (unsolicited and Nanoscale Exploratory Research - NERs), small teams (Nanoscale Interdisciplinary Research Teams - NIRTs), user networks such as National Nanotechnology Infrastructure Network (NNIN) and the Network for Computational Nanotechnology (NCN), and centers (Nanoscale Science and Engineering Centers - NSECs). In addition, there were other NSF programs that supported research and education activities in nanotechnology. More information can be found at http://www.nsf.gov/nano/.

At this time, some discoveries are at the phase to explore their integration into nanosystems, thus leading to adoption in applications critical for their commercial use. To enable this integration, the Engineering Research Centers (ERC) program is launching this new competition targeting the Transformational Nanotechnology of Engineered Systems Centers or NanoSystems ERCs (NERCs). These new centers will adopt and follow all the features of Generation-3 (Gen-3) ERCs.

The goal of the Generation Three (Gen-3) Engineering Research Centers (ERC) Program is to create a culture in engineering research and education that links discovery to technological innovation through transformational fundamental and engineered systems research in order to advance technology and produce engineering graduates who will be creative U.S. innovators in a globally competitive economy. These ERCs will be at the forefront as the U.S. competes in the 21st century global economy where R&D resources and engineering talent are internationally distributed. Recognizing that optimizing efficiency and product quality are no longer sufficient for U.S. industry to remain competitive, these ERCs will optimize academic engineering research and education to stimulate increased U.S. innovation in a global context. They will develop this culture that joins discovery and innovation, i.e., an innovation ecosystem. An innovation ecosystem includes the people, institutions, policies, and resources that promote the translation of new ideas into products and processes and services. The innovation ecosystem of Gen-3 ERCs is achieved through a symbiotic relationship between the ERC's researchers, small businesses, larger

industrial and practitioner partners, and partner organizations devoted to stimulating entrepreneurship and innovation. In essence this solicitation requires that the efforts be devoted to creating, developing, and enhancing capacities in ERCs from transformational fundamental research to technology commercialization and creating a continuous pipeline in engineering education from middle school to graduate studies.

In order to achieve this, Gen-3 ERCs will:

1. Advance discovery and build bridges from science-based discovery to technological innovation to realize transformational engineered systems;
2. Develop a culture in academe that joins research, education, and innovation to create and sustain an innovation ecosystem to enable the ERC's vision;
3. Provide international opportunities for research and education collaboration that will prepare U.S. engineering graduates for leadership in innovation in a global economy;
4. Form teams of diverse and talented faculty who will prepare diverse and talented domestic and international graduates to function effectively in a global world where research, design and production efforts cross national borders;
5. Function with transformational engineering education programs that rest on partnerships with pre-college institutions to attract students to engineering and university departments to strategically impart in engineering graduates the capacity to create and exploit knowledge for technological innovation; and
6. Build and sustain a culture that links discovery to innovation, the ERC innovation ecosystem, which will include partnerships with members firms/practitioners to strengthen the ERC and streamline technology transfer; translational research partnerships with small firms to accelerate commercialization of high risk ERC advancements; and innovation partnerships with local level organizations to stimulate entrepreneurship and job creation and enable technological innovation.

Cognizant Program Officer(s):

Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.

- Lynn Preston, Leader of the Engineering Research Centers (ERC) Program and Deputy Division Director (Centers), Division of Engineering Education and Centers (EEC), 585N, telephone: (703) 292-5358, fax: (703) 292-9051, email: lpreston@nsf.gov
- Deborah J. Jackson, telephone: (703) 292-7499, email: djackson@nsf.gov
- Barbara H. Kenny, telephone: (703) 292-4667, email: bkenny@nsf.gov
- Daniel DeKee, Program Director, Engineering Research Centers, Division of Engineering Education and Centers (EEC), 585N, telephone: (703) 292-8769, fax: (703) 292-9051, email: ddekee@nsf.gov
- Carole Read, telephone: (703) 292-2418, email: cread@nsf.gov
- Marshall Horner, telephone: (703) 292-2308, email: mhorner@nsf.gov

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

- 47.041 --- Engineering

Award Information

Anticipated Type of Award: Cooperative Agreement

Estimated Number of Awards: 3 Depending upon availability of funds, up to three new Nanosystems ERC awards will be made.

Anticipated Funding Amount: $9,750,000 It is anticipated that approximately $9,750,000 is expected to be available to support up to three new Gen-3 Nanosystems ERCs (NERCs) in late summer of 2012, with year one start-up budgets each of up to $3,250,000. Subsequently, there would be year two budgets of up to $3,500,000, year three budgets of up to $3,750,000 and years four and five budgets of up to $4,000,000 each, pending satisfactory annual performance and availability of funding. The actual number of ERCs funded will depend on the scale and scope of the proposed Centers, the availability of funds, and the quality of the proposals submitted. NSF support will be augmented by academic cost sharing and financial and in-kind support provided by member firms, and for certain nano-related topic areas, these members would include state and local government agencies. Additional support from states and other sources is desired, but not required and cannot be counted as cost sharing.

Eligibility Information

Organization Limit:

Proposals may only be submitted by the following:

- Only U.S. universities with undergraduate, masters, and doctoral engineering programs with the breadth and depth appropriate to support the vision may submit proposals as the lead university. Proposals must be submitted by the lead university. Separately submitted collaborative proposals are not acceptable and will be returned without review.
    - The proposal is submitted by the lead university and an award is made to the lead university. If the Lead PI (Center Director) leaves or decides to transfer to another university during the review process or after an award is made, the NERC proposal/award remains with the lead university.
    - The lead university and the other academic and innovation partners of the NERC cannot change after submission of the full proposal. Industry partners may be added throughout the review process.

Other Organizational Requirements:

NERC Proposals must meet all of the following organizational requirements or they will be returned without review:

- Commitments for domestic lead and core partner university cost sharing and industrial/government agency financial support must be included in the proposal.
- The number of domestic partner universities is limited to the lead university plus one to four additional domestic partner universities. The lead or one of the domestic partner universities must be a university that serves large numbers of students predominantly underrepresented in engineering in the U.S. (i.e. women, African Americans, Pacific Islanders, Native Americans, Hispanic Americans, or persons with disabilities). However, the overall requirement of broadening participation through diversity will not be the sole responsibility of institutions that serve large numbers of women and underrepresented minorities as each partner university is responsible for meeting an ERC's diversity goals.
- At least one but no more than three foreign universities are required to be partners in research and education to fill gaps in expertise that is missing from the ERC domestic partners and provide cross-cultural research and educational experiences for U.S. students.
- The NERC must partner in pre-college education with middle and high schools nearby the lead and partner universities that agree to include engineering concepts and experiences in their classrooms. The NERC must partner with local level organizations devoted to stimulating entrepreneurship, innovation, and job creation based on university technology.

PI Limit:

The Lead PI (Center Director) must be a tenured faculty member in an engineering department/school of engineering at the lead university. The Director's doctoral degree must be in engineering or an associated field of science; if the latter, she/he must have substantial career experience in engineering as evidenced by an appointment in an engineering department/school of engineering at the lead university.

Limit on Number of Proposals per Organization:

There is no limit on the number of proposals to be submitted by a lead university and there is no limit on the number of ERC partnerships a partner university may join. A lead university can receive only one ERC award through this solicitation. The lead university and the other academic and innovation partners of the ERC cannot change after submission of the full proposal. Industry partners may be added throughout the review process.

Limit on Number of Proposals per PI:

A PI may be identified as Center Director on only one proposal.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Submission of Letters of Intent is required. Please see the full text of this solicitation for further information.
- **Preliminary Proposal Submission:** Not Applicable
- **Full Proposals:**
  - Full Proposals submitted via FastLane: NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) Guidelines apply. The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg.
  - Full Proposals submitted via Grants.gov: NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov Guidelines apply (Note: The NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide)

B. Budgetary Information

- **Cost Sharing Requirements:** Cost Sharing is required. Please see the full text of this solicitation for further information.
- **Indirect Cost (F&A) Limitations:** Not Applicable
- **Other Budgetary Limitations:** Other budgetary limitations apply. Please see the full text of this solicitation for further information.

C. Due Dates

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

  July 15, 2011

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

  September 16, 2011

Proposal Review Information Criteria

Merit Review Criteria: National Science Board approved criteria. Additional merit review considerations apply. Please see the full text of this solicitation for further information.

Award Administration Information

Award Conditions: Additional award conditions apply. Please see the full text of this solicitation for further information.

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

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I. INTRODUCTION

Gen-3 Engineering Research Centers (ERC) build on two generations of achievement of 40 successful ERCs funded between 1985 and 2006. At the request of the White House and the National Academy of Engineering, the ERC program was established in 1984 to develop a new interdisciplinary culture in engineering research and education in partnership with industry to strengthen the competitiveness of U.S. industry. The goal was to educate new generations of engineers who would be capable of integrating fundamental knowledge across disciplines to advance systems-level technology.

The first generation of 18 successful ERCs, established between 1985 and 1990, focused on next-generation technological systems and the expansion of design and manufacturing in the academic engineering experience. The second generation of 22 successful ERCs, established from 1994 to 2006, focused on transformational engineered systems with the potential to transform industrial processes and product lines, became more multi-university in configuration, included pre-college education, and focused on significantly increasing the diversity of their faculty and students. Both generations of these ERCs functioned with sustained partnerships with industry and practitioners to bring knowledge of industrial and professional practices and needs to academe and streamline the translation of their research into useful products, processes, and services. These partnerships have educated thousands of ERC engineering graduates who have proven to be more effective in advancing technology in industry.

The beginning of the 21st century finds the U.S. again faced by economic challenges and opportunities but in a different context - i.e., a more broadly based global economy, increased global competitiveness, and declining U.S. student interest in careers in science and engineering. There have been a series of major publications analyzing the position of the U.S. economy in the world economy and raising a significant call for action:

- Engineering Research and America's Future, Committee to Assess the Capacity of the U.S. Engineering Research Enterprise, National Academy of Engineering (NAE), Washington, DC, 2005;
- The Engineer of 2020, NAE, 2004 and Educating the Engineer of 2020, NAE, 2005;
- Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future, National Research Council/COSEPUP, Washington, DC. 2005;
- Innovate America: National Innovation Initiative Final Report, Council on Competitiveness, Washington, DC, 2005;
- The World is Flat: A Brief History of the Twenty-First Century, Thomas L. Friedman, Farrar, Straus, and Giroux, New York, 2005, 2006, and 2007;
- University-Private Sector Research Partnerships in the Innovation Ecosystem, President's Council of Advisor's on Science and Technology, November 2008;
- A Strategy for American Innovation: Driving Towards Sustainable Growth and Quality Jobs; National Economic Council, Office of Science and Technology Policy, September 2009;
- Rising Above the Gathering Storm, Revisited: Rapidly Approaching Category 5, National Research Council, Washington, DC, 2010;
- National Science Board report, "Globalization of Science and Engineering Research: A companion to Science and Engineering Indicators 2010

These and other publications, such as The America COMPETES Act of 2007 and its reauthorization in 2010, point to the following

challenges and opportunities:

- Increase the capacity of U.S. society for creative innovation because optimizing efficiency and product quality is not enough to successfully compete in the 21st century;
- Support a culture of innovation through a symbiotic relationship between research, commercialization, and life-long skill development;
- Build bridges from science based discovery to technological innovation by creating entirely new fields at the interface of science and engineering research;
- Stimulate diverse domestic and international talent to pursue engineering careers in the U.S.;
- Transform engineering education to impart the capacity to create and exploit knowledge for technological innovation;
- Build partnerships in engineering education between pre-college institutions and universities; and
- Produce engineering graduates who can compete in a global world where design and production efforts cross national borders.

The beginning of the 21st century also saw the launch of the nanotechnology revolution. In the U.S., this revolution was formalized through the federal interagency National Nanotechnology Initiative (http://www.nano.gov). Over the past decade significant advances have been made from nanostructured materials to nanodevices, hybrid devices comprised of nanoelements or features integrated into macroscale devices or subsystems, nanomanufacturing processes, societal implications, environmental health and safety, and many other ways. Nanotechnology already has made an impact in areas such as energy, medicine, communications, security, computation, transportation, and civil infrastructure. However, the integration of devices and components derived from nanoscale science and engineering into systems level applications is needed.

Hence, the third generation of Engineering Research Centers - i.e., the Gen-3 ERC program - is designed to address these needs and to embrace advances in nanotechnology by building strong bridges between discovery, education, and innovation as a model for academe to contribute to U.S. economic competitiveness. The U.S. is continuously challenged by the rapidly increasing capabilities of global competitors. In response to these challenges, ERCs provide the framework for transformational fundamental research integrated with engineered systems implementation to advance technology and produce globally competitive engineering graduates.

The core key features of Gen-3 ERCs, as presented below, rest on the proven capacity of two prior generations of ERCs to contribute to U.S. competitiveness, augmented by new features that strengthen the role of ERCs and universities in innovation to address these challenges (see the full program description). The Gen-3 ERCs - through partnerships with member firms; other small R&D firms engaged in translational research; local level partners devoted to stimulating entrepreneurship, innovation, and job creation; and foreign university partners - will be positioned to produce engineering graduates who will thrive as innovators in a highly competitive, global economy.

The first class of Gen-3 ERCs to undertake this mission was awarded in 2008. These are:

NSF Engineering Research Center for Biorenewable Chemicals (CBiRC), Iowa State University (http://www.cbirc.iastate.edu/index.asp);

NSF Engineering Research Center for Revolutionizing Metallic Biomaterials, North Carolina Agricultural and Technology University (http://erc.ncat.edu/);

NSF Engineering Research Center for Future Renewable Electric Energy Delivery and Management (FREEDM) Systems, North Carolina State University (http://www.freedm.ncsu.edu/);

NSF Engineering Research Center for Smart Lighting, Rensselaer Polytechnic Institute (http://smartlighting.rpi.edu/); and

NSF Engineering Research Center for Integrated Access Networks (CIAN), University of Arizona (http://www.cian-erc.org/).

NSF will announce the FY 2011 Class of Gen-3 ERCs after awards are made under NSF 09-545, sometime later in 2011.

II. PROGRAM DESCRIPTION

A. Goal and Key Features of Generation Three (Gen-3) ERCs:

The goal of the Gen-3 Engineering Research Centers Program is to create a culture that links scientific discovery to technological innovation through transformational engineered systems research and education to advance technology and produce engineering graduates who will be creative innovators in a global economy. The Nanosystems ERCs (NERCs) awarded under the targeted topic area "Transformational Nanotechnology Engineered Systems" through this solicitation will function with the Gen-3 goal and key features.

To achieve this goal, Gen-3 ERCs will have the following key features:

- Guiding strategic vision for joining fundamental research and transformational engineered systems to innovation and developing an innovative, globally competitive engineering workforce;
- Strategic plans for research, education, innovation and diversity
- Cross-disciplinary research program designed to support systems motivated fundamental research and advance it to innovation and rapid commercialization;
- Cross-cultural global research and education experiences through partnerships with foreign universities;
- Education program strategically designed, in partnership with academic engineering departments, to produce creative, innovative engineers by engaging ERC students in all phases of the research and innovation process;
- Long-term partnerships with middle and high schools to bring engineering concepts and experiences to the classroom and increase enrollment in college-level engineering degree programs;
- An innovation ecosystem that includes partnerships with:
    - Member firms/practitioners to support and strengthen the ERC and streamline technology transfer;
    - Other small firms in translational research to accelerate commercialization of high risk ERC advances; and,
    - Local or national level organizations to stimulate entrepreneurship and job creation and accelerate technological innovation.

These ERCs require the following infrastructure to succeed:

- Multi-university configuration, with complementary expertise and skills that fill most or all gaps, comprised of an eligible

lead U.S. university and no more than four domestic partner universities enabled by a long-term cross-institutional commitment to support and sustain the ERC and facilitate and foster the cross-disciplinary team, its innovation, mentoring, and diversity goals (See Section II.B.8.e);
- At least one but no more than three foreign universities are required to be partners in research and education to fill gaps in expertise that is missing from the ERC domestic partners and provide cross-cultural research and educational experiences for U.S. students;
- Capable and diverse leadership, faculty, and student teams committed to the vision, with effective management systems;
- Leadership, financial, and management systems to develop, operate, and sustain the ERC during its NSF funding life and beyond;
- Effective cross-institution collaboration among faculty and students through shared resources (e.g., shared data, experimentation, simulations, and testbeds), and shared programs of education, enabled by the cyberinfrastructure;
- A partnership with industry/practitioners governed by a center-wide membership agreement and intellectual property policy to support and sustain the ERC and accelerate technology transfer and innovation;
- Effective academic policies that sustain and reward the ERC's cross-disciplinary, global culture of the ERC, its goals for technological innovation, and the role of its faculty and students in mentoring and pre-college outreach; and
- Financial and in-kind cost sharing support from the domestic lead and core partner universities and membership fees from industry/practitioner organizations to augment NSF support to demonstrate a partnership with NSF to enable the ERC to achieve its goals and to sustain the ERC after graduation from NSF support. Additional support from states and other sources is desired, but not required. See the cost sharing requirements information in Section V.B. "Budgetary Information" for further information.

B. Guidance Regarding Gen-3 Key Features:

Since the Gen-3 ERCs have not operated long enough to develop a set of best practices for the features that are unique to these Centers, NSF expects each proposing team to develop new modes to effectively realize the Gen-3 key features. Best practices for Gen-2 ERCs are a useful starting point regarding the core features shared by both Gen-2 and Gen-3 ERCs. They can be found in the "Best Practices Manual" at http://www.erc-assoc.org/manual/bp_index.htm. This manual was developed by faculty, staff, and students from ongoing ERCs funded between 1994 and 2003.

1. Systems Vision:

a. Vision Area: Approximately three anticipated awards will be funded in the **Transformational Nanotechnology Engineered Systems** topic area.

Note the following: 1) proposals that focus on the innovation process itself or engineering education as an engineered system are not appropriate and will be returned without review; 2) proposals focused on other transformational engineered systems topics are not appropriate under this solicitation and will be returned without review; and 3) sometime later in 2011, after the awards for the ERC Class of 2011 under the previous ERC Solicitation NSF 09-545 are announced, a new Gen-3 ERC solicitation will be issued for engineered systems with open topics to be chosen by the proposing teams.

The following general guidance is provided regarding **Transformational Nanotechnology Engineered Systems Centers - or Nanosystems ERCs (NERCs)**:

A Gen-3 Nanosystem Engineering Research Center (NERC) will focus on a transformational engineered system(s) that could not be achieved without a significant level of fundamental knowledge of nanoscale phenomena that feeds into devices and components needed to realize the targeted engineered system(s). NERCs will be supported in emerging areas of nanoscale science that are ready to feed into proof-of-concept engineered systems within the 10-year life span of support. These emerging areas might include nanobio systems for healthcare delivery, nanosystem architectures for communication and other industry sectors, nanoscale processes for sustainable development in areas such as energy and other infrastructure systems, nanoscale manufacturing process systems, among other potential areas to be proposed. As appropriate to the topic area, the NERC will include the societal and environmental implications of the nano-enabled scientific and technological breakthroughs and involvement of a wide range of relevant industry and practitioner groups. Like all Gen-3 ERCs, the NERCs are expected to create science and engineering platforms for the respective fields of nanoscale research, education, and innovation.

The NERCs will link with the resources of the Network for Computational Nanotechnology (NCN) as the main cyberplatform for dissemination of computational and simulation tools and educational materials. Information about the NCN can be found at http://www.ncn.purdue.edu. The equipment plan will include efforts to leverage the experimental resources of the National Nanotechnology Infrastructure Network (NNIN) and the computational resources of the NCN. Information about the NNIN can be found at http://www.nnin.org.

The NERCs will be a part of the National Nanotechnology Initiative (NNI: http://nano.gov and NNI at NSF http://www.nsf.gov/nano), which is a government-wide activity designed to ensure that investments in this area are made in a coordinated and timely manner and to accelerate the pace of revolutionary nanotechnology discoveries. A long-term view for nanotechnology research and education needs is documented in the 2010 NSF/WTEC report, "Nanotechnology Research Directions for Societal Needs in 2020," which is available on the NSF website at: http://www.nsf.gov/nano.

Informational Gen-3 Nanosystems ERC Webinar Update: The webinar has been canceled.

We will be posting a summary of frequently-asked questions about the solicitation on or about August 1, 2011.

b. Vision Guidance: Given the vision area guidance in 1.a, a prospective NERC team will develop a ten-year vision for advances in an emerging and potentially revolutionary or a transformational engineered system(s) with the potential to significantly change current practices, establish entirely new industries, or transform public sector services or the infrastructure. The systems vision will provide an opportunity for national economic competitiveness or contribute to the solution of a major societal problem that has a national, and perhaps an additional international, impact. The vision also will be positioned at the cusp of emerging discoveries in science and engineering and be expansive in scope to include innovation and commercialization goals. If relevant to the technology proposed, the proposal must indicate awareness and compliance with the International Traffic in Arms Regulations (ITAR) and Export Administration Regulations. Refer to Section V.A(4.b) "Vision and Rationale for the NERC" for more details.

What is an engineered system?

An engineered system is a combination of components that work in synergy to collectively perform a useful function. That system can be a service delivery system, a technology system, or an infrastructure system. Part of the complexity of engineered systems research derives from integrating factors that represent their use in products or services, factoring in their impacts on the environment, society or the human body, as appropriate to the system chosen. This complexity should be factored into the development of the vision and the strategic research plan.

What is Not a Suitable Vision Topic for a Nanosystems ERC (NERC)?

If the vision and research program of the proposed NERC does not require a significant body of nanoscale research and technology to realize the systems vision, the proposal is not appropriate for this solicitation and will be returned without review.

If this analysis reveals that a significant fraction of the ten-year time frame for the research would be spent on basic/fundamental research before enabling and systems technology research and development could be undertaken, the vision is not suitable for an ERC. Furthermore, if the vision focuses on incremental advances to current practices, the vision also is not suitable for an NERC under this solicitation.

While high quality research on one or more of the enabling technological components of the system will be required to realize the functionality of the system, a focus on the individual components without their integration into an engineered system is not appropriate for an ERC.

Additionally, proposers will avoid focusing on an engineered system that too closely overlaps those of ongoing or recently graduated Nanoscale Science and Engineering Centers (NSECs), ERCs or other centers supported by NSF, other Federal agencies, or state governments. A list of these centers can be found at http://www.nano.gov/html/centers/nnicenters.html. Specifically:

1. If the proposal is relevant to the research mission of another Federal Agency or another NSF centers program, the vision section of the proposal must include a justification of the value added by the proposed NERC over the project/centers already funded by that agency or called for in solicitations from those agencies already released at the time of submission of the full proposal.
2. If the proposing team is derived largely from the team involved in a graduated NSF or other agency funded center or one that would have graduated from NSF or other agency support by the time the NERC would be funded, the vision chosen must reflect a significantly different vision to warrant an additional NSF investment.
3. If the vision of the proposed NERC overlaps the visions of current or graduated NSECs, NERCs, ERCs or other centers supported by NSF or other Federal agencies or state governments, the vision chosen must reflect a significantly different vision to warrant an additional NSF investment. In those cases, the difference must be specifically addressed in the vision section of the proposal.

Descriptions of Ongoing ERCs: Access to the web sites for ongoing ERCs can be found at http://www.erc-assoc.org/centers.htm. Descriptions of other NSF-funded centers where engineering research plays a significant role, such as Industry/University Cooperative Research Centers (IUCRCs), Nanoscale Science and Engineering Centers (NSECs), Science and Technology Centers (STCs), Science of Learning Centers (SLCs), and Materials Research Science and Engineering Centers (MRSECs), can be found by searching the NSF website at http://www.nsf.gov. Nano-related centers supported by various federal agencies can be found at http://www.nano.gov/html/centers/nnicenters.html.

2. ERC Configuration:

a. Domestic Universities: The number of domestic partner universities is limited to the lead university plus one to four additional domestic partner universities as defined in the Eligibility, Organization Limit section above. This does not imply that to be competitive, the proposal must include five partners; however, a configuration of one lead and no partner universities is not acceptable. The lead or one of the domestic partners must be a university that serves large numbers of students predominantly underrepresented in engineering in the U.S. (i.e. women, African Americans, Pacific Islanders, Native Americans, Hispanic Americans, or persons with disabilities). Therefore, this approach expands the set of universities serving underrepresented groups beyond those officially classified by the Department of Education as predominantly serving populations underrepresented in engineering and science. Descriptions of the Department of Education's official classifications of universities predominantly serving underrepresented populations can be found at: http://www2.ed.gov/about/offices/list/ocr/edlite-minorityinst.html.

The lead and each of the core partner universities must be committed to an integrated configuration to fulfill the research, university and pre-college education, and innovation goals of the NERC. To qualify as a partner university there should be a team of at least three faculty participating in the NERC plus undergraduate and graduate students (number not specified).

The lead and core partner domestic universities will be committed to support and sustain the NERC through real and in-kind cost sharing. Evidence of this cost sharing is required for the full proposal. Furthermore, the involvement of the Dean of Engineering of the lead institution is required. This Dean must serve as the official to whom the NERC's Center Director reports and as the leader of the cross-university partner NERC Council of Deans.

The level of financial support and time commitment allocated by the NERC Center Director to the lead and core partner universities will depend upon their role in the strategic plans and their performance and likely will vary over time.

While not required, there may be one or two affiliated faculty each from a few other universities/colleges to fill expertise gaps. These faculty are not required to have a long-term commitment to the NERC, and these universities/colleges are not considered partners and are not required to cost share. These universities are termed "universities providing affiliated faculty." In addition, staff from federal laboratories may participate in a NERC, but NSF funds may not support their effort. The contributions of these affiliated faculty or federal laboratory personnel may be in research, education, and/or innovation. This provision enables flexibility in faculty participation as the NERC evolves but should be kept to manageable numbers to reduce management complexity of the NERC while achieving overall objectives.

b. Foreign Universities: One of the goals of the ERC Program is to provide an opportunity for domestic students and faculty to collaborate in a globally connected university research and education environment to strengthen the ERC goals, to provide new opportunities for innovation, and to enable its graduates to work effectively in a globally connected economy. Thus, it is required that the NERC include at least one but no more than three foreign universities as partners in research and education, carrying out projects under the ERC's strategic plan that add value to the Center in research and education. It is critical that the goals, interests, and intellectual resources of the foreign partner(s) complement those of the U.S. investigators and contribute significant value in both research and education to the NERC.

The foreign university, its government, or other non-NSF sources will provide funds for this partnership. This funding will provide for the foreign faculty and students to work at their home university and as NERC partners, carrying out projects under the NERC's strategic plan. Funds from the foreign university partners, and/or other non-NSF sources, do not have to be in place at the proposal stage. Rather they will be provided during year one, if an award is made. Foreign students (non-U.S. citizens or non-permanent residents) who are matriculated in U.S. degree programs or on a post doctoral appointment, or foreign faculty serving on a visiting faculty appointment to the lead or one of the U.S. partner universities, may be supported by U.S. funds.

c. Other Organizations Carrying out the NERC's Mission: The NERC also will include pre-college educational institutions and local or national level organizations devoted to stimulating entrepreneurship and innovation. See Sections II.6. and II.7.b. for more information on these partnerships.

3. Strategic Research Plan: A NERC must have a strategic research plan motivated by the systems vision and positioned to advance the state-of-the-art technology and innovation. The objective of the strategic plan is to define: (1) the characteristics/

requirements of the system and how it is expected to function; (2) the barriers in the way of realizing the vision through analysis of the state of the art and practice; and (3) a critical path of fundamental and enabling and systems technology research and testbeds needed to explore and test the technology through proof-of-concept testbeds and translational research.

The strategic plan is dynamic over time and will evolve with the progress of the Center and the field. Since the focus will be on emerging, highly speculative technological opportunities, the ultimate implementation at the systems level may be uncertain at this time. Nevertheless, initial systems goals and requirements, specific knowledge gaps, technology goals and deliverables, and barriers to achieving these goals should be preliminarily identified, understanding that they will evolve in depth and sophistication over time.

If the analysis of the state-of-the-art and practice reveals that a significant fraction of the ten-year time frame for the research would be spent on basic/fundamental research before enabling and systems technology research could be undertaken, the topic is not suitable for an ERC. However, this statement should not be construed to mean that ERCs are focused on applied research only; rather they contain a portfolio of fundamental research and research focused on exploring and realizing enabling and systems technology and/or processes.

The systems requirements and barriers motivate and guide the selection of proposed research projects, testbeds, and the translational research to accelerate innovation. The testbeds enable proof-of-concept inquiries of enabling and systems-level technologies to test the new ideas/components and their relationships in an environment that simulates their intended application.

A plan to carry out translational research partnerships between NERC faculty and small firms must be included in the research program. These partnerships will be carried out at the appropriate time to strategically accelerate innovation when NERC-generated intellectual property is not licensed by member firms. This translational research will team NERC faculty and students with a start-up company or other small and innovative firms who license the technology. The quality of this plan and its execution through an integrated research program, as presented in the proposal, will be a key selection factor in the NERC competition.

The proposal must include a conceptual diagram using a customized version of the ERC Program's Three-Plane Strategic Planning Chart. The proposed strategic plan diagram (displayed on one full page such that is readable) must show how the systems goals/requirements of the NERC drive and integrate its major research goals and testbeds to address key barriers to realize the systems-level vision. This chart is available at http://www.erc-assoc.org under the button marked "ERC Solicitation Information."

In addition, the proposal must include a ten-year milestone chart (displayed in a font size that is readable) indicating the critical paths through key research projects and testbeds to achieve the major research goals and deliverables. There is no preferred model for this chart; however, it should be presented in a format that clearly indicates the points of integration. A linear Gant chart without points of interface is not effective. More clarity of milestones is expected for the first five years.

4. Research Program: The research program of an ERC merges the fundamental research culture of academe and the technology and 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 between faculty and students of different laboratories and disciplines. The projects are organized into thrusts focused on each of the major research goals.

Synergies within and across thrusts are necessary to achieve the goals of the ERC, and testbeds play a critical role in integrating the research and exploring the realities of enabling and systems-level technology. It should be understood that ERC testbeds are expected to go beyond the typical bench or laboratory scale, but are not expected to approach the product and process realization stages found in industry. Rather their role in an ERC is for proof-of-concept to explore the technology and streamline technology transfer. Often, these testbeds generate new research directions when barriers are more difficult to surmount than anticipated.

In the project-level descriptions in the research section of the proposal, provide a few examples of the fundamental barriers the research will address and the methods to be taken at the project level to address them in the context of known results and theory to demonstrate that the desired results constitute breakthroughs and are attainable in ten years. There must be sufficient depth in the proposal for reviewers to judge the quality of the effort proposed. Communicating this quality of effort can be achieved by a few in-depth explications of exemplar projects, but it cannot be achieved by superficial descriptions of all projects.

The research program will form collaborations of the best faculty and students working in fields that support the vision. It will integrate engineering disciplines with physical, materials, and natural science disciplines; and depending on the system(s) chosen, it will include computer science, medicine, social, economic, and decision sciences to achieve the vision of the NERC.

The research program will integrate discovery and innovation for all faculty and students to complement the discovery aspects of each person's research. The innovation ecosystem (See Section 7 of this solicitation) of the NERC will play a leading-edge role in bridging the gap between the discovery and successful product commercialization or service delivery in the private/public sector.

A key player in that process is the small, start-up business sector. There are times when ERC member companies are not interested in investing in promising technology to bring it to product, primarily because it is still nascent. Thus, at the appropriate stage of the research when intellectual property (IP) emerges and the member firms do not license it, there is opportunity to stimulate translational research projects that join faculty and students to team with start-up companies or other small firms, who license the IP. This type of partnership is anticipated to accelerate the research results of the ERC to innovation. It also will provide the opportunity for the ERC's students at all levels to work with members of these small firms to assure they learn about the innovation process as a part of their degree activities. If the topic proposed would lead to an innovation in service delivery or other professional practice, as opposed to a technology product, small firms or other organizations contributing to enhancing innovations in these services and expediting their use in practice should be engaged in the place of technologically-focused start-up firms.

In later stages, the research program also should budget to include support for technical staff to work with students and faculty to build the systems testbeds to transition the enabling and systems technology research to early-stage prototypes.

The NERC's research teams will be supported by appropriate research equipment and shared facilities, shared data, shared experimentation, and shared simulations or testbeds. A robust cyberinfrastructure should be in place to facilitate collaboration across space and time.

The research program will include graduate and undergraduate students from the domestic partner universities in core activities during the academic year in a ratio of at least 2 graduate students to 1 undergraduate student. Undergraduate participation will be augmented by a summer Research Experiences for Undergraduates (REU) program that supports a diverse group of students from universities/colleges outside the lead and partner universities. The NERC will budget for the REU program using its base budget (at least $42,000 per year not including indirect costs). Post-award, the NERC should submit a proposal to the NSF REU program solicitation for a full site award from that program to fully support the ERC's REU program or augment support from the base budget efforts. If the NERC does not receive an REU site award, it will continue to use its base budget to support this program.

5. University Education Program: The NERC will have a strategically designed university education plan with a driving hypothesis or design paradigm of how to nurture and develop undergraduate and graduate students who are adaptive and creative

innovators. The plan must build the capacity to advance fundamental knowledge and create and exploit that knowledge to accelerate innovation in a global economy.

Hence, the NERC will propose an education strategic plan that a) states the educational hypothesis and the desired characteristics of the NERC's graduates; b) describes activities that will be included in the education program to impart these characteristics in the students to test the NERC's educational hypothesis; and c) assesses progress and impact. The activities will be carried out in collaboration with the education programs of the domestic and foreign partnering universities. The education program must be structured to involve engineering students at the B.S., M.S. and Ph.D. levels. The education program also will develop course materials derived from the NERC's research and, if needed in the field, new degree programs, options, or certificates identified on transcripts. NSF has example programs, such as the Nanotechnology Undergraduate Education (NUE) in Engineering program, that can be used as a resource in developing the NERC education plan. Information on NUE can be found at http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13656&org=EEC&from=home, and other education and degree-related programs can be found on the NNI web site at http://www.nano.gov/html/edu/eduunder.html.

The education program will include a formative and summative assessment plan to monitor progress and impacts to improve the program through time and assess its long-term impacts. Given the projected ten-year life span of the Center, it is expected that longitudinal data will be collected and assessments of the impact of the education program will be carried out. Because of this type of process, Institutional Review Board (IRB) approval for research involving human subjects will have to be obtained.

The education team may need to be supported by faculty with backgrounds in research on engineering education, innovation, and educational assessment. The educational plan will be judged on the quality of the vision for the future graduates, the innovative nature of the educational plan, and the quality of the assessment plan.

6. Pre-college Education Program: The pre-college education program of the NERC will form long-term partnerships with a manageable number of pre-college institutions (middle through high school) located near the lead and partner universities, that are committed to including engineering concepts and experiences in the pre-college classroom. The goal is to stimulate student interest in engineering careers and increase the diversity of domestic students studying engineering at the college level. The partnerships will involve the pre-college and university administrators, faculty, and students. The lead and each of the partner universities will have pre-college partners. However, the total number should be limited as the purpose is to develop intensive and long-term relationships.

One goal is to involve pre-college teachers in the NERC's research to enable them to develop course modules to bring engineering concepts and experiences into the classroom. The teachers in turn can inform pre-college students about engineering and stimulate them to choose engineering degree programs in community colleges, colleges, and universities. Thus, the pre-college program will include a Research Experience for Teachers (RET) program using the NERC's base budget (at least $42,000 per year not including indirect costs) to support teachers from the ERC's pre-college partner schools. Post-award, the NERC should submit a proposal to the Directorate for Engineering RET solicitation for a site award from that program to fully support the NERC's RET program or augment support from the base budget efforts. If the NERC does not receive an RET site award, it will continue to use its base budget to support this program. More information about RETs can be found at http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5736&org=EEC&from=home.

In addition, pre-college students will be involved in the NERC's educational activities. For example, some promising high school students will be offered an ERC Young Scholars research opportunity within the ERC's research program to carry out projects in the Center's laboratories and to be mentored by the NERC's students. At completion of this program, these high school students will receive an ERC Young Scholars certificate of completion.

It is expected that the majority of the NERC's faculty and students will participate in the full scope of the pre-college education program and that their mentoring efforts will be recognized and rewarded by their home institutions.

The pre-college program will have an assessment component to determine whether its goals are being met. This assessment program will be formative and summative, and it is expected to adopt best practices in program implementation and assessment already developed by ongoing NSF-funded and other pre-college education programs.

Proposals will include letters from the partner administrators of the selected pre-college schools indicating their commitment to participate in the NERC. These letters should be uploaded in the supplementary documents section of the proposal.

7. ERC Innovation Ecosystem - Industrial/Practitioner Members and Innovation Program: One requirement of Gen-3 ERCs is the development of a culture that links discovery to innovation, the ERC's innovation ecosystem, to achieve the Center's vision. An innovation ecosystem includes the people, institutions, policies, and resources that promote the translation of new ideas into products, processes and services. The innovation ecosystem of Gen-3 ERCs is achieved through a symbiotic relationship between the ERC's researchers, small businesses, larger industrial and practitioner partners, and partner organizations devoted to stimulating entrepreneurship and innovation.

The proposal will include the Center's strategic plan for developing such an ecosystem and reducing the barriers to commercialization. The concept of the innovation ecosystem stresses that the flow of technology and information among people, enterprises, and institutions is key to a successful innovation process. It includes the interaction between the participants who are needed in order to turn an idea into a new process, product, or service for the market. In this context, the participants would include the NERCs industrial/practitioner members, the Center's innovation partners (i.e., partnerships with state and local governments, universities, or other organizations devoted to entrepreneurship and innovation), and small firms. A primary role of the small firms is to engage with the ERC on translational research and intellectual property (IP) that is not licensed by member firms in order to expedite it to commercialization.

Thus, the intent of the innovation ecosystem is to enable the translation of ERC-developed knowledge into innovations and accelerate their entry into the marketplace. If developed properly, the ecosystem should be a basis for continued innovation after the ERC graduates from NSF support in 10 years. For additional information on defining "innovation ecosystems" in general, refer to the following link: http://www.nsf.gov/eng/iip/innovation.pdf.

a. Members: The NERC's industrial/practitioner membership program will be strategically designed to optimize innovation and accelerate commercialization and use of NERC advances through member firms and, as appropriate to the vision of the NERC, practitioner organizations such as, for example, state and local government service delivery agencies or hospitals. Through this program, the NERC will take the lead role in bridging discovery to successful product and/or service commercialization and utilization.

The Gen-3 NERC will include as members a mix of sizes of firms. It will recognize the important role of domestic small member firms in transforming high-risk research into successful commercial products for the U.S. economy.

The membership program will be a shared pre-competitive partnership of industrial/practitioner collaboration that serves the NERC as a whole. The members will provide guidance on strategic planning, research opportunities, education, and the role of innovation

within the NERC, and they will help guide the translation of NERC research into innovation as discussed below. The industry/practitioners are expected to contribute to the NERC's research and education program by providing knowledge of manufacturing, product design, or the practices involved in service delivery. They are also expected to help in establishing the culture of innovation and a global experience required for its students and faculty.

Given the field, the NERC will strategically determine the right types of industrial/practitioner members needed to assume the essential risks involved in advancing discoveries to technological innovations that impact products and services. It is expected that there will be a mix of small, medium, and large firms (both domestic and foreign). The mix will depend upon the field. The inclusion of member practitioner organizations, such as hospitals or local government agencies, would depend upon the systems-level focus of the NERC.

The Gen-3 ERC's industrial/practitioner membership program will be governed by an ERC-wide membership agreement that defines the scope and function of the NERC's partnership with industry/practitioners and the NERC's Intellectual Property (IP) policies. Guidance on effective agreements and IP policies is available in the ERC Best Practices Manual in the chapter focused on industrial collaboration and technology transfer, which is found at http://www.erc-assoc.org/manual/bp_ch5.htm.

For Gen-3 ERCs, it is advised that the IP policies be developed to facilitate the Gen-3 innovation model and be flexible in recognizing IP jointly developed by faculty in different universities or that are developed by joint industry and university research. Proposals will provide a draft membership agreement and include a draft IP policy that have been reviewed by the lead and partner universities and discussed with representative potential industrial/practitioner members. It should be noted that intellectual property derived from NSF ERC program support and industry partner membership fees will first be offered to member firms for licensing before translational research partnerships can be supported. Industry sponsored research projects outside the membership fee structure can have different IP policies.

ERCs are required to have industry/practitioner members that pay membership fees to the center. Additional details on membership fees are as follows:

- The membership agreement will include a scaled fee structure for member firms/agencies/hospitals that will recognize the differing capacity of small, medium, and large firms and practitioner organizations to contribute to university research and education.
- The membership fees will be cash fees for industry but may be in-kind for local government agencies/public hospitals that join as members.
- All members may contribute augmented support through sponsored projects.
- There are no fixed requirements for the numbers of memberships or levels of support as judgments of sufficiency vary by field.
- Industry commitment will start with cash and may be augmented by in-kind contributions according to the agreement policy.
- Agency commitments may be cash or in-kind.
- There may be firms that provide support for sponsored projects but do not pay membership fees to join the center. These firms are not considered members, but their sponsored project support is counted in the total support for the ERC.
- Members and other firms may contribute in-kind support through equipment donations and other efforts.

Thus, the NERC's support from NSF and academe will be augmented by membership fees, sponsored project fees, in-kind support, and equipment donations from industry. Proposals must demonstrate financial commitment by industry/practitioner members. If an award is made, NSF expects the level of industrial support from firms committed to NERC membership to demonstrate strong industry interest in membership in the proposed NERC and commitment to financial support.

The NERC will function with an Industrial/Practitioner Advisory Board (IAB) involving all of its industry/practitioner members. The IAB will be the key mechanism for industrial/practitioner collaboration for the NERC. As a part of that role, the IAB will carry out an annual analysis of the NERC's strengths, weaknesses, opportunities, and threats to survival (a SWOT analysis). It will meet twice a year, and one of these meetings will include participation in the annual NSF review of the NERC's performance and plans through a private meeting with the site visit team to present and discuss the IAB's SWOT analysis.

b. State and Local Government and other Partners in Innovation: The NERC will include in its strategy for the innovation ecosystem formal partnerships with state and local government, universities and/or other organizations devoted to entrepreneurship and innovation. These partners would engage with the NERC in stimulating innovation, promoting entrepreneurship, and impacting local economic development and job creation. Furthermore, they would be involved with the NERC's education programs to bring awareness and knowledge of entrepreneurship and innovation to the NERC's students and faculty.

c. Translational Research Partnerships: As the research and technology of the NERC progresses, intellectual property will be developed and offered to the member firms for license. If such IP is not licensed, the NERC will join NERC faculty with a start-up or other small firm that has licensed the IP to carry out translational research.

8. Infrastructure:

a. Leadership and Team: Each NERC must have the following leaders and team members who are diverse in gender, race and ethnicity (from groups underrepresented in engineering) and includes persons with disabilities:

(1.) Center Director: in compliance with the PI eligibility criteria, a tenured engineering faculty member and the Lead NSF Principal Investigator (PI) who is responsible for leading the NERC 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.

(2.) Deputy Director: a faculty member who shares the leadership and management responsibilities of the NERC and is identified on the proposal as a CO-PI.

(3.) Thrust Leaders: faculty members responsible for leading and managing major research thrusts of the NERC.

(4.) Other Investigators and Staff: other faculty, postdocs, staff, undergraduate and graduate students, to carry out the research and education programs plus technical staff to build the testbeds for the NERC.

(5.) Education Program Director: faculty responsible for the development and execution of the NERC's strategic university education plan and supported by faculty, students, staff.

(6.) Pre-College Education Program Director: faculty or staff, experienced in pre-college education, responsible for the NERC pre-college education program, and supported by faculty, students, and staff.

(7.) Industrial Collaboration and Innovation Director: staff member, not faculty, at the lead university who is responsible for developing the NERC's innovation ecosystem, marketing the NERC to industry/practitioners, gaining their financial support, developing and coordinating industrial/practitioner involvement with faculty and students, managing the other partnerships for

innovation and the translational research program.

(8.) Managing Director: staff member at the lead university who is supported by staff and is responsible for operational management, financial management, data collection, publicity, and reporting, etc. for the NERC.

(9.) Student Leadership Council (SLC): comprised of undergraduate and graduate students responsible for coordinating student activities to strengthen the NERC and providing input to other leaders of the NERC and the NSF site visit team.

(10.) Scientific Advisory Board: outside experts who are selected by the NERC and meet collectively as a board at least once a year to advise the NERC leadership team. (Do not contact potential members or appoint this board during the proposal preparation and review process or list potential members in the participant table.)

(11.) Industrial/Practitioner Advisory Board: representatives of member companies/agencies/hospitals who meet collectively as a board twice a year to advise the NERC's leadership team and meet with the NSF site visit team.

(12.) Internal Academic Policy Board: administrators from the lead university who meet collectively as a board to coordinate NERC plans and policies with departmental and university leaders and committees.

(13.) Council of Deans: led by the Dean of Engineering from the lead university, this Council of Deans from the lead and partner academic institutions meets collectively as a board to provide administrative support of the NERC and to help facilitate the NERC's research, education, and innovation efforts across the lead and partner campuses.

The designation of individuals serving as the Managing Director, the Industrial Collaboration and Innovation Director, and the leaders of the SLC may occur after notification of award.

b. Diversity: NSF expects the leadership, faculty, and students involved in an ERC to be diverse in gender, race, and ethnicity and to include persons with disabilities at levels that exceed the academic engineering-wide national averages. This diversity is expected of the participants from the lead and each of the partner academic institutions, including at least one partner institution that serves large numbers of students predominantly underrepresented in engineering (women, African Americans, Native Americans, Pacific Islanders, Alaskan Natives, Hispanic Americans, or persons with disabilities).

Foreign partner universities are expected to respect the diversity of the NERC's faculty and students and provide inclusive research and education environments. The NERC also will be multicultural through the involvement of faculty and students from other countries by virtue of their role as faculty or students in the NERC's domestic institutions and through the involvement of faculty and students from the foreign partner universities. The NERC will include pre-college institutions with diverse student bodies as discussed above.

The NERC will prepare and execute diversity strategic plans in collaboration with the home departments and Deans of the NERC's faculty. These plans articulate the NERC's diversity goals and intended actions but not quantitative targets. Post-award annual reports will include the NERC's diversity strategic plan, information on the activities carried out, and the resulting quantitative impact on diversity. No single university shall bear the responsibility of the diversity plans; each NERC institution is responsible for implementing the plans at their respective location.

c. Organization and Management Systems: The NERC must report to the Dean of Engineering of the lead university. The NERC will function with management systems to assure effective integration of its components to meet its goals, sound financial management and reporting systems, and project selection and assessment systems that include input from its Scientific and Industrial/Practitioner Advisory Boards.

d. Facilities, Equipment, and Headquarters: In the proposal the lead university must commit to provide headquarters of sufficient space and resources to support the leadership, management, and collaboration functions of the NERC. The NERC will have appropriate facilities and equipment to achieve its goals. The NERC also will be supported by cyberinfrastructure with appropriate software and staff to enable effective cross-campus collaboration.

e. Institutional Commitment: The NERC will be a partnership with the lead university and the core domestic partner universities to support the NERCs research, education, and innovation culture and augment NSF's support during the award period and sustain the NERC once NSF's support ceases. To gauge the commitment to this culture, the ERC Program expects cost sharing. It also expects that there will be policies in place to reward faculty in the tenure and promotion process for cross-disciplinary research, research on education, research and other activity focused on advancing technology and innovation, and mentoring of university postdoctoral researchers (if supported), tenure-track faculty, graduate and undergraduate students, and pre-college students and teachers. In addition, the ERC Program expects that university students engaged in mentoring of other university students and in pre-college outreach will receive credit or official recognition for this activity.

The pre-college partners of the NERC will be committed to a long-term partnership that will involve teachers and students in the NERC, will adopt a Young Scholars program, and will include engineering information and activities in their curricula.

The lead university and the other academic and innovation partners of the NERC cannot change after submission of the full proposal. Industry partners may be added throughout the review process.

C. FINANCIAL SCOPE AND SCALE OF THE ERC.

1. NSF Award Size: Start-up base support will not exceed $3,250,000 for year one. Pending satisfactory annual performance, need, and availability of funds, the base support may increase to $3,500,000 (year 2), $3,750,000 (year 3), $4,000,000 (year 4), and $4,000,000 (year 5).

For foreign university partners, non-U.S. government support for each partner does not have to be in place at the proposal stage; rather the support will be provided during year one, if an award is made.

2. Total Support: Post-award, ERCs establish a center-level account into which is deposited the ERC program base support and any other support provided by other sources directly to the ERC to carry out the ERCs goals. In addition, the NERC may include support provided to a PI's department for projects that are to be carried out under the NERC's Strategic Plan. This support and the support provided by the foreign partner's universities or governments are considered associated project support.

III. AWARD INFORMATION

It is anticipated that approximately $9,750,000 is expected to be available to support up to three new Gen-3 Nanosystems ERCs (NERCs) in late summer of 2012, with year one start-up budgets each of up to $3,250,000. Subsequently, there would be year two budgets of up to $3,500,000, year three budgets of up to $3,750,000 and years four and five budgets of up to $4,000,000 each, pending satisfactory annual performance and availability of funding. The actual number of ERCs funded will depend on the scale and scope of the proposed Centers, the availability of funds, and the quality of the proposals submitted. NSF support will be augmented by academic cost sharing and financial and in-kind support provided by member firms, and for certain nano-related topic areas, these members would include state and local government agencies. Additional support from states and other sources is desired, but not required and cannot be counted as cost sharing.

IV. ELIGIBILITY INFORMATION

Organization Limit:

Proposals may only be submitted by the following:

- Only U.S. universities with undergraduate, masters, and doctoral engineering programs with the breadth and depth appropriate to support the vision may submit proposals as the lead university. Proposals must be submitted by the lead university. Separately submitted collaborative proposals are not acceptable and will be returned without review.
    - The proposal is submitted by the lead university and an award is made to the lead university. If the Lead PI (Center Director) leaves or decides to transfer to another university during the review process or after an award is made, the NERC proposal/award remains with the lead university.
    - The lead university and the other academic and innovation partners of the NERC cannot change after submission of the full proposal. Industry partners may be added throughout the review process.

Other Organizational Requirements:

NERC Proposals must meet all of the following organizational requirements or they will be returned without review:

- Commitments for domestic lead and core partner university cost sharing and industrial/government agency financial support must be included in the proposal.
- The number of domestic partner universities is limited to the lead university plus one to four additional domestic partner universities. The lead or one of the domestic partner universities must be a university that serves large numbers of students predominantly underrepresented in engineering in the U.S. (i.e. women, African Americans, Pacific Islanders, Native Americans, Hispanic Americans, or persons with disabilities). However, the overall requirement of broadening participation through diversity will not be the sole responsibility of institutions that serve large numbers of women and underrepresented minorities as each partner university is responsible for meeting an ERC's diversity goals.
- At least one but no more than three foreign universities are required to be partners in research and education to fill gaps in expertise that is missing from the ERC domestic partners and provide cross-cultural research and educational experiences for U.S. students.
- The NERC must partner in pre-college education with middle and high schools nearby the lead and partner universities that agree to include engineering concepts and experiences in their classrooms. The NERC must partner with local level organizations devoted to stimulating entrepreneurship, innovation, and job creation based on university technology.

PI Limit:

The Lead PI (Center Director) must be a tenured faculty member in an engineering department/school of engineering at the lead university. The Director's doctoral degree must be in engineering or an associated field of science; if the latter, she/he must have substantial career experience in engineering as evidenced by an appointment in an engineering department/school of engineering at the lead university.

Limit on Number of Proposals per Organization:

There is no limit on the number of proposals to be submitted by a lead university and there is no limit on the number of ERC partnerships a partner university may join. A lead university can receive only one ERC award through this solicitation. The lead university and the other academic and innovation partners of the ERC cannot change after submission of the full proposal. Industry partners may be added throughout the review process.

Limit on Number of Proposals per PI:

A PI may be identified as Center Director on only one proposal.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Letters of Intent*(required)*:

A Letter of Intent (LOI) is required to facilitate the NSF review process. The letter should be submitted via FastLane (not Grants.gov)

no later than the LOI deadline date specified in this solicitation. The LOI allows NSF to screen the proposals with respect to eligibility requirements, to categorize the proposals, and identify conflicts-of-interest so as to prepare for the proposal review processes. Follow these steps for the LOI preparation and submission:

Submit information for your LOI through FastLane under these categories and only under these categories (note the character limits, which include spaces, as stated below):

- **Project Title:** The project title should begin with "NSF Nanosystems Engineering Research Center for" and follow with a short title that reflects the system focus of the proposed Center.
- **Synopsis (max 2,500 characters in this section, including any spaces):** Provide brief statements of the vision and goals of the ERC, its research program including research thrust titles and goals, and its university and pre-college education, diversity, and industrial/practitioner collaboration and innovation programs, all at a sufficient level of detail to understand the proposed ERC.
- **Other Comments (max 2,500 characters including any blank spaces):** Continue Synopsis as needed in this section.
- **Organizational Attribute:** Select the appropriate organizational attribute for the lead university from the drop down list.
- **Key Academic Participants (max 255 characters including any blank spaces):** In this section identify the core ERC academic participants (people). Include the ERC titles/roles, and their departmental and institutional affiliations for the center director, the deputy director, the managing director, the thrust leaders, the education program director, and any other key academic faculty.
- **Key Academic Participants Continued (max 255 characters including any blank spaces):** Continue the list of "Key Academic Participants (people)" as needed.
- **Point of Contact for NSF Inquiries:** Center Director
- **Project PI Information:** Center Director's Contact Information
- **Submitter Information:** This section does not require input from LOI author. This information is automatically added to the final LOI submission by FastLane.
- **Senior Project Personnel (maximum of four official Co-PIs):** In this section identify your Lead PI (Center Director) and up to three additional Co-PIs. Include their names, universities, departments, and locations (city, state, country). Because the coversheet only allows a total of four PIs (the PI and up to three Co-PIs), any additional Co-PIs will be shown as "Senior Personnel" in any subsequent proposal and should be identified in the "Key ERC Academic Participants" section above.
- **Participating Organizations:** *This section should **only** include the domestic and foreign **"core academic partner universities"*** (not the universities that are contributing affiliated faculty). This would mean there would be up to 8 universities total. In this section for each core academic partner university include the name and location (city, state and country), then the appropriate heading for each: 1) the lead university (LU) 2), a domestic partner university(ies) (DPU) (one to four), and 3) a foreign partner university(ies) (FPU) (at least one but no more than three). Each university entry can have up to 76 characters (including any spaces) to show all of information you are asked to provide (university name, city, state, country and abbreviation for type of partner, (i.e. LU). You can abbreviate information, as needed. You can also do a search for the organization and if FastLane finds it you can then add the additional text information asked for above (i.e. LU), after you have selected the searched organization.

Letter of Intent Preparation Instructions:

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

- Sponsored Projects Office (SPO) Submission is required when submitting Letters of Intent
- A Minimum of 1 and Maximum of 4 Other Senior Project Personnel are allowed
- A Minimum of 3 and Maximum of 8 Other Participating Organizations are allowed
- Key Academic Participants: is required when submitting Letters of Intent
- Key Academic Participants (Continued): is required when submitting Letters of Intent
- Submission of multiple Letters of Intent is allowed

Full Proposal Preparation Instructions: Proposers may opt to submit proposals in response to this Program Solicitation via Grants.gov or via the NSF FastLane system.

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the NSF Grant Proposal Guide (GPG). The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov. Proposers are reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov. The complete text of the NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: (http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

The text of the project description must follow the spacing, font and formatting requirements of the NSF Grant Proposal Guide (GPG). Tables and lists in the project description may be in smaller type but be sure the type is readable when the page is printed out. Both will include the items listed below in the order indicated.

As a multi-university ERC, the proposal must be submitted as an integrated proposal by the lead university, with proposed sub awards to the other partner institutions. Separate proposals from each partner will not be accepted since separately submitted collaborative ERC proposals are not allowed.

Required Proposal Format:

(1.) Cover Sheet. Select the ERC Program solicitation number from the pull down list. If submitting via Grants.gov, the program solicitation number will be prepopulated by Grants.gov on the NSF Application Cover Page. Where asked to identify the NSF Unit of Consideration, select the Division of Engineering Education and Centers and then Engineering Research Centers Program. The proposal title should begin with "NSF Nanosystems Engineering Research Center for" and follow with a short title that reflects the

system focus of the proposed Center. For planning purposes, September 1, 2012 should be shown as the start date. The proposed Center Director must be shown as the Lead Principal Investigator.

Proposers are reminded to identify the current ERC program solicitation number in the program solicitation block on the NSF Cover Sheet. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

(2.) Project Summary (limited to one page). The summary should be written in the third person (i.e. the use of the pronoun "it" not "we" to represent the NERC) and should make a compelling case for the NERC. The summary should be informative to persons working in the same or related fields and, insofar as possible, understandable to a scientifically or technically literate lay reader.

At the top of the first page include the NERC's name, the Center Director's name, the lead university's name, and the names of the domestic and foreign universities. Write a clear description of the NERC, stating its vision and goals, the transformational nature of the systems technology, the fundamental barriers in the way, and its impact on innovation. Under the headings "Intellectual Merit" and "Broader Impact" as relevant, provide highlights of the proposed research, capacity to address the Gen-3 university and pre-college education goals, diversity strategy, industrial collaboration, technology transfer and innovation goals and strategies. Briefly indicate the unique opportunities that the Center will provide and its cross-disciplinary composition. **A proposal that does not include titled sections (Intellectual Merit and Broader Impacts) referencing the NSF review criteria and also provide specific reference to how the proposal will address these criteria will be returned without review.**

(3.) Table of Contents will be generated automatically by FastLane or Grants.gov.

(4.) Project Description.

The project description must contain sections 4.a to 4.f and is limited to 40 pages for full proposals, including all figures, tables, and charts. These page limits are extended only by the length of the Table of Academic and Other Participants, and Industrial and Practitioner Members (see section V.A.(4.a)). The project description should be prepared with reference to the review criteria and the guidance provided in this and the preceding sections of this solicitation. The intellectual merit and broader impacts of the NERC must be addressed and described as an integral part of the narrative.

The project description will ***not*** include the normally required separate section on prior NSF support, as this information will be integrated into the discussion of the state of the art in research and education.

If invited to carry out a site visit, the PI will have up to five days from the date of notification of the site visit invitation to provide updated information on firms and/or practitioner organizations committed to membership and to support the NERC if an award is made. By that deadline the PI will send an email to ercintent@nsf.gov with an updated Word NERC Participant Table saved as a PDF file, noting the additional committed firms/practitioner oganizations in red font. Entitle the subject heading "NERC updated firms/organizations" and include in the subject heading your full proposal number and your Center Director's name.

Start the project description with the Word Table of Academic and other Participants, and Industrial and Practitioner Members (see Section V.A.(4.a) below). NSF will extend the page limits above by the number of pages taken up by this table. For example, a three-page table extends the page limit for the narrative for a full proposal to 43 pages. These page limits include other charts, figures, and tables required as a part of the narrative and others the proposers wish to include. **If the Project Description section exceeds these extended page limits, the proposal will be returned without review.**

(4.a) Word Table of Academic and other Participants, and Industrial and Practitioner Members. The table should be inserted into the front of the Project Description using the Word table format available on the ERC Program's Website (http://www.erc-assoc.org) under the button "ERC Solicitation Information." Be sure to submit all of the required information and use the Word table format. The table will list: 1) the academic and other partners carrying out the research, education, innovation/technology transfer functions of the NERC, 2), the individuals who will receive support from the NERC, and 3) committed firms and agencies who will be industrial/practitioner members. NSF will use this table to determine whether potential reviewers have conflicts-of-interest and as a reference for the staffing and industrial participation in the proposed NERC. Insert the table at the beginning of the Project Description.

Also, the proposer must send the following two Power Point slides in PDF format, as detailed below. After receipt of the full proposal number from FastLane or Grants.gov, send an email to ercintent@nsf.gov with the PDF files. This must be done **no later than three days after the full proposal deadline**. Do not submit these slides separately through FastLane or Grants.gov. The subject heading of the email should note the proposal number, the Center Director's (PI's) name, and the lead university. Attach the following documents to the email:

Two Power Point Slides in PDF format: one slide stating the vision of the NERC and another showing the ERC's 3-plane strategic planning chart (each limited to one page). On each slide, as a header or footer, indicate the full proposal number, the Center Director's (Lead PI's) name, the title of the NERC, and the lead university's name. A sample can be found on the ERC Program's Website at http://www.erc-assoc.org, under the button marked "ERC Solicitation Information." These documents will be used during the review process. Remember to email these documents to ercintent@nsf.gov; do not submit the slides through FastLane or Grants.gov. Do not assume that all reviewers will see these two slides because they will be provided only to panelists during panel meetings.

The following additional sections (4.b through 4.f), of the Project Description should be prepared with reference to the guidance in Section II above and the review criteria. **They are also included in the Project Description's page limitations as described above for full proposals.**

(4.b) Vision and Rationale for the NERC. State the vision of the NERC, justify why it is transformational, position the proposed NERC in the state of the art, and provide a rationale for value added by the creation of the NERC in research, innovation, and education. Provide a statement of potential impact. Justify the value added of the vision over the state of the art and practice and over ongoing centers in the field**.**

Regarding the value added over ongoing or graduated federally or state supported centers, as appropriate, provide the following information: (1) If the proposal is relevant to the research mission of another Federal Agency, the vision section of the proposal must include a justification of the value added by the proposed NERC over the project/centers already funded by that agency or called for in solicitations from those agencies already released at the time of submission of the proposal. (2) If the proposing team is derived largely from the team involved in a graduated NSF or other agency funded center or one that would have graduated from NSF or other agency support by the time the NERC would be funded, the vision chosen should justify how the new vision reflects a significantly different vision to warrant an additional NSF investment. (3) If the vision is closely aligned to the visions of current or graduated ERCs or NSECs, the vision section should justify why the chosen vision is significantly different to warrant an additional

NSF investment.

Compliance with International Traffic in Arms Regulations (ITAR) and Export Administration Regulations (EAR), if applicable:

Please note that while the NERC Gen-3 solicitation requires international collaboration and offers the opportunity to establish a partnership with a foreign university and there are often several foreign students in an ERC, PIs need to be cognizant of appropriate Department of State regulations, specifically the International Traffic in Arms Regulations (ITAR) and Department of Commerce regulations, and Export Administration Regulations (EAR). If relevant to the technology proposed, the proposal should indicate awareness and compliance with the ITAR and EAR regulations in the section where the NERC's international collaboration is discussed. This is especially pertinent for proposals where the technology has an obvious dual use in both the military and civilian sectors and for technologies impacted by EAR regulations. A NERC awardee under this solicitation will be responsible for ensuring compliance with the appropriate regulations. Please direct your specific questions on how to comply with these regulations to your university research administration office.

(4.c) Strategic Research Plan and Research Program. Given the NERC's engineered system vision and strategy for innovation, present the NERC's strategic research plan, including its deliverables, the major fundamental and technological barriers in the way of achieving them, and the major research goals. Provide a graphical depiction of the strategic plan using the ERC Program's **3-Plane Strategic Planning Chart**. A sample chart can be found on the ERC Program's Website (http://www.erc-assoc.org), under the button marked "ERC Solicitation Information."

Describe how the NERC's research program will be structured into thrusts or groups of projects and the role of testbeds, translational research, and partnerships with entities designed to accelerate innovation in achieving the vision.

Milestone Chart or "Road Map": Within this section provide a milestone chart or "road map" depicting the timing of the key research topics and their interdependencies, the test beds, and deliverables of the NERC over a ten-year period, with greater detail for years one through five.

Discuss undergraduate involvement in the research program during the academic year and through a summer REU program as discussed in Section II.

In the research program section, for each thrust area, provide the following information as a minimum. At the start of each thrust's narrative, provide **a small table listing** the thrust leader and other faculty participants by name, their departments, and institutions. Discuss the goals and objectives of the thrust vis-à-vis the goals of the NERC. Benchmark the research proposed for the thrust with respect to the state-of-the-art (including the contributions of the proposed NERC faculty and others), and discuss its role in the NERC's three-plane strategic plan. Provide information on projected fundamental knowledge and technology deliverables, and the specific fundamental knowledge and other barriers the thrust will address in the context of the NERC's strategic plan. Provide specific examples of key research projects in sufficient detail for the reviewers to judge how the work will be done and methodologies to be used. Discuss the integration of projects within the thrust and the interdependencies among the thrusts. Discuss the cross-disciplinary mix needed to achieve the thrust's goals.

(4.d) University and Pre-college Education Programs. Provide the NERC's educational hypothesis of the desired characteristics of a creative and innovative engineer, capable of success in a global economy; the strategy to achieve these characteristics; and the implementation and assessment plans to determine progress and impact. The educational program should encompass all the partner academic institutions and should take advantage of available cyberinfrastructure for cross-institution educational impact.

Provide the NERC's pre-college education program goals, its strategy, its metrics for success and its assessment plan. Discuss the following: the role of the NERC's faculty and students and the pre-college institutions administrators, teachers, and students in the program.

This section and the university commitment letters should provide information on how the students and postdoctoral researchers will be mentored (discuss in separate statements). Also they should indicate how the university faculty and students will be rewarded for their educational/mentoring efforts by the university administrations involved. In addition, if a postdoctoral researcher(s) is to be supported on the NERC budget, a separate Postdoctoral Mentoring Statement must be included in the Supplementary Documents Section of the proposal or the proposal will be returned without review. Refer to the GPG for additional information.

(4.e) NERC Innovation Ecosystem - Industrial/Practitioner Members and Innovation Program. Provide the NERC's innovation ecosystem goals and strategies for industrial/practitioner memberships and involvement, state and local government and other partners in innovation, and translational research.

Proposals must include letter(s) from all partner organizations or programs, etc. devoted to entrepreneurship, nurturing start-up firms to accelerate innovation, such as state or local economic development organizations, venture capital firms, or hospitals that are committed to membership in the NERC's Industrial/Practitioner Partnership if an award is made. These letters are to be uploaded into the supplementary documents section of the proposal.

In addition, proposals will include letters from all firms/organizations committed to joining the NERC as members and providing support if an award is made. These letters should be uploaded into the supplementary documents section of the proposal. Do not include letters from those only interested in a partnership.

(4.f) Infrastructure.

Institutional Configuration

Justify the institutional configuration given the vision. Discuss the value added by each domestic and foreign university partner in research, education, and innovation. Discuss the role of the NERC in the strategic plans of the lead and partner institutions and how the NERC will be supported and sustained by the lead and partner universities. Discuss how the partnership with a foreign university(ies) will be administered. Also discuss when the foreign financial support is expected to be in place to support the foreign partner(s).

Team and Diversity

Briefly discuss the composition and roles of the leadership team, including the Director, Deputy Director, Research Thrust Leaders, University Education and Pre-college Education Program Directors, Industrial Collaboration and Innovation Director, Managing Director, and Student Leadership Council.

Provide summary information in the form of a pie chart indicating the disciplinary composition of the faculty team, based on their departmental affiliations or degrees, as appropriate for each person. For further detail, the proposal should refer the reader, as per section 9 below, to the **Facilities, Equipment and Other Resources** section. Note both sections should not include any

quantifiable financial information.

Provide the NERC's 10-year diversity strategic plan, including goals, non-quantitative milestones, and intended actions for success in building diverse leadership, faculty, graduate and undergraduate student teams and diverse cadres of NERC graduates. Plans may not include quantitative targets. However, upon award, annual reports will include quantitative information on impacts benchmarked against engineering-wide averages.

Proposals should include a table (sample below) showing the current diversity of the leadership team, faculty and thrust leaders (who are U.S. citizens and permanent residents), of the proposed NERC using the following sample format. Note, NSF is committed to providing equal opportunities for participation in its programs and promoting the full use of the Nation's research and engineering resources. To aid in meeting these objectives, NSF requests information on the gender, race, ethnicity and disability status of individuals named as PIs/co-PIs on proposals and awards. Submission of the information on this table is voluntary.

NERC Name	Total #*	Male	Female	African American	Native American, Pacific islander	Hispanic American	Persons with Disabilities
Leadership Team							
Thrust Leaders							
Faculty							
Totals							

* It is understood that the total will equal the total of males and females and the totals for racial and ethnic minorities and persons with disabilities will be larger than that total due to double counting. A person with a disability is someone who has one or more impairments that affects substantially one or more activities of daily living that is/are not completely correctable with assistive devices.

The data provided in this table will show the diversity of the leadership team, faculty, and thrust leaders who have been identified to participate in the NERC's research and curriculum development efforts during years one through five from the lead and the university-level domestic partner institutions. These data must include only the number of the leadership team, faculty and thrust leaders who are U.S. Citizens and U.S. Permanent Residents. In the chart identify the number of men and women; the number who are members of racial groups underrepresented in engineering (African American, Pacific Islander, Native American, Alaskan Native); the number who are members of ethnic groups underrepresented in engineering (Hispanic American); and the number who are persons with disabilities.

Since it is not clear at the proposal stage who the students are who will be involved in the NERC, please do not include students in the data. Also, do not include data for the following: non-tenure-track faculty, research staff, post-doctoral students, technicians, office staff, or pre-college teachers or students.

Discuss the commitment of the partner institutions to the goals of the proposed NERC and how they will assure their policies and practices support the center in achieving its goals. Include a discussion of tenure and mentoring policies per guidance in II.B.8.e.

Organizational Structure and Management System

Describe the proposed organizational structure including information on how the members from participating universities and pre-college institutions will be developed into an integrated team. Include an organization chart for the NERC. Discuss the roles of the Dean of Engineering in the NERC, the Council of Deans in coordinating the partner institutions, the lead university policy boards, the Student Leadership Council, the future Scientific Advisory Board (SAB), and the Industrial/Practitioner Advisory Board (IAB). While you should contact potential members of the IAB to determine their willingness to join as members and obtain their input on the proposal, do not contact potential members of the SAB or form it during the proposal preparation and review stages as this compromises the review process. Describe how projects will be selected and evaluated and who will be responsible for integration of projects to achieve the NERC's deliverables. Describe how the SAB and the IAB will be involved in the review of projects to be funded and their impacts.

Financial Support and Functional Allocation of Resources

(1) **Functional Budget Table:**

Insert into the Project Description section of the proposal a functional budget table, showing only the proportional distribution of effort across the functions of the NERC without showing the support levels from any sources. The table must not show the sources of support since the reviewers do not have access to the level of academic support. The table should be developed using a reasonable estimate of the allocation of total support from all sources for the first year of effort. A template of the table can be found at http://www.erc-assoc.org (under the button marked "ERC Solicitation Information.").

(2) **Year 1 Committed Industrial and Other Non-NSF, Non-Academic Support:**

The Project Description must also include a table showing the committed levels of support for the first year from committed member firms and any additional non-member commitment from state and/or local governments for cash and/or in-kind support. A template of the table can be found at http://www.erc-assoc.org (under the button marked "ERC Solicitation Information").

(3) **Pie Chart/Table of Planned Year 1 Distribution of NSF Funds:**

Provide a pie chart or a table showing the planned distribution of the requested NSF funds for year one among the lead, each domestic partner university, and each university contributing affiliated faculty.

Headquarters and Equipment Infrastructure

Briefly discuss the laboratories, shared facilities and equipment for the NERC, referring the reader to the required section on "Facilities, Equipment and Other Resources" in the FastLane proposal template for more detail. Discuss those that will be shared by members of the NERC team. Distinguish between equipment and facilities that are already available and any that will be acquired by the Center. Proposals must include a description of headquarters space, its size, and functionality. Note that the headquarters space must be located on the campus of the lead academic institution. Discuss how the facilities and equipment of the NERC and the Cyberinfrastructure will be used to form a collaborative team with shared resources and information.

(Note, this is the end of the requirements for (4) Project Description Section.)

(5) **References Cited**. Reference information is required. Each reference must include the names of all authors (in the same sequence in which they appear in the publication), the article and journal title, book title, volume number, page numbers, and year of publication. If the document is available electronically, the website address also should be identified. Proposers must be especially

careful to follow accepted scholarly practices in providing citations for source materials relied upon when preparing any section of the proposal. While there is no established page limitation for the references, this section must include bibliographic citations only and must not be used to provide parenthetical information outside of the Project Description's page limitation.

(6) **Biographical Sketches** (two-page limit per person). The basic GPG guidelines for preparation of biographical material apply. Biographical sketches are required of all the faculty and key staff participants (e.g., the Center Director, Deputy Director, the University Education Director the Pre-College Education Director (if known), Industrial Collaboration and Innovation Director (if known), the Research Thrust Leaders, the Managing Director (if known), and faculty expected to receive support in years one through five from the NERC. For faculty, publications listed should be highly relevant to the proposal.

(7) **Budgetary Information**. Proposals will include a budget for each of the five years proposed. FastLane or Grants.gov will automatically provide a cumulative budget. Provide a separate budget for subcontracts for the partner institutions at any level.

Travel Funds for ERC Leadership Team's Participation in Annual Meetings: Members of all ERCs' leadership teams are required to participate in the ERC Annual Meeting, held annually in the Washington, DC area, to share successes and failures, receive updates on the ERC Program, and provide input for future Program improvements. Therefore, include travel funds in each of the annual budgets to support participation in the three-day ERC Program Annual Meeting for all the members of the NERC's leadership team: the Center Director, the Deputy Director, the Thrust Leaders, other Co-PIs, the Education Program Director, the Pre-college Education Program Director, the Industrial Collaboration and Innovation Director, the Administrative Director, and up to four members of the Student Leadership Council.

Note, the budget justification section should only identify items that are not cost shared. A justification and explanation of cost shared items will be appended to the cost sharing tables that are submitted in the single-copy document section of the proposal. If additional space is required for the budget justification, put the information in the "Supplementary Documents" section of the proposal. Then, in the budget justification section, direct reviewers to the "Supplementary Documents" section of the proposal for the additional justification.

Cost sharing is mandatory and is specialized. Please see Section V.B. for additional information.

(8) **Current and Pending Support**. Include only for the Center Director, Deputy Director, and Research Thrust Leaders, and other faculty expected to receive support in the first five years from the NERC.

(9) **Facilities, Equipment and Other Resources.** This section of the proposal is used to assess the adequacy of the organizational resources available to perform the effort proposed. In this section of the proposal, proposers should describe only those resources (both physical and personnel) that are directly applicable. (See the NSF Grant Proposal Guide (GPG) Chapter II.C.2.i for additional information). Proposers should include an aggregated description of the resources that the organization will provide to the project, should it be funded. The description should be narrative in nature and must not include any quantifiable financial information. Reviewers will evaluate the information during the merit review process and the cognizant NSF Program Officer will review it for programmatic and technical sufficiency. Although these resources are not considered cost sharing as defined in 2 CFR § 215.23 (OMB Circular A-110), the Foundation does expect that the resources identified in the Facilities, Equipment, and Other Resources section will be provided, or made available, should the proposal be funded. The NSF Award Administration Guide (AAG) Chapter II.B.1 specifies procedures for use by the awardee when there are post-award changes to objective, scope or methodology.

(10) **Supplementary Documents. The following items are to be provided as supplemental documents.** For Grants.gov users, supplementary documents should be attached in Field 11 of the R&R Other Project Information Form.

Data Management Plan:

All proposals must describe plans for data management and sharing of the products of research, or assert the absence of the need for such plans. FastLane will not permit submission of a proposal that is missing a Data Management Plan. The Data Management Plan, submitted in the Supplementary Documents section and limited to two pages, will be reviewed as part of the intellectual merit or broader impacts of the proposal, or both, as appropriate. Links to data management requirements and plans relevant to proposals submitted to the Directorate for Engineering, including the ERC Program, must follow the specific Engineering Directorate data management guidelines at: http://nsf.gov/eng/general/ENG_DMP_Policy.pdf.

Specifically, the basic level of digital data to be archived and made available includes (1) the analyzed data and (2) the metadata that define how these data were generated. These are data that are or that should be published in theses, dissertations, refereed journal articles, supplemental data attachments for manuscripts, books and book chapters, and other print or electronic publication formats.

- Analyzed data are (but are not restricted to) digital information that would be published, including digital images, published tables, and tables of the numbers used for making published graphs.
- Necessary metadata are (but are not restricted to) descriptions or suitable citations of experiments, apparatuses, raw materials, computational codes, and computer-calculation input conditions.

See Chapter II.C.2.j of the GPG for further information about the implementation of this requirement. For additional reference there is also a compiled list of FAQs that might be useful at: http://www.nsf.gov/bfa/dias/policy/dmpfaqs.jsp.

Postdoctoral Mentoring Statement (if applicable)**:**

Each proposal that requests funding to support postdoctoral researchers must include, as a supplementary document limited to one page, a description of the mentoring activities that will be provided for such individuals (unless the postdoctoral researcher(s) is funded on the budget as "Senior Personnel). FastLane will not permit submission of a proposal that is missing a Postdoctoral Mentoring Plan if postdoctoral researchers are supported on the budget. See Chapter II.C.2.j of the GPG for further information about the implementation of this requirement. The postdoctoral mentoring plan will be evaluated during the merit review process, under the Broader Impacts and Education review criteria. NERC proposals that include support for postdoctoral researchers but do not include a mentoring statement will be returned without review. Note that for NERC proposals there is an expanded mentoring requirement for the Project Description. See Section II.B.8.e of this solicitation.

Letters of Commitment:

Submit the following letters of commitment:

(1) Letters from senior university administrators (Dean of Engineering and one other higher-level university official) for the domestic lead and core partner universities attesting to the institutional commitment to the goals of the NERC. The letters should not mention cost sharing, as that information cannot be revealed to reviewers, however it must discuss a commitment to headquarters space.

(2) Letters from partner state or local government agencies, university or other organizations ***committed*** to partnership with the

NERC to enhance its impact on entrepreneurship, innovation, job creation and local economic development.

(3) Letters from the administrator of each of the proposed pre-college partners committing to their roles in the NERC.

(4) Letters from all firms and agencies committed to membership.

(5) Letters from any participating federal laboratories indicating their financial support for their staff participating in the NERC.

(6) Letters of commitment from the foreign university administrator(s) regarding their participation and eventual financial support in year one.

Note, no letters are required from the universities providing affiliated faculty.

The letters as they appear in the proposal should be addressed to:

> Ms. Lynn Preston, Leader of the ERC Program, Division of Engineering Education and Centers, National Science Foundation, Suite 585, 4201 Wilson Boulevard, Arlington, VA 22230.

All letters must be placed in the Supplementary Documents section of the FastLane proposal or the Grants.gov proposal and submitted electronically, as part of the proposal. If submitting through Grants.gov, refer to the NSF Grants.gov Application Guide. Please instruct the authors of these letters not to mail, email, or fax copies to the NSF.

(11) Single Copy Documents-viewable only by NSF (also refer to the GPG Chapter II.C.1 on "Single-Copy Documents" for additional information):

Proposers must complete and submit a List of Senior Project Personnel. The list should identify the Center Director, the Deputy Director, other co-PIs, and any other senior project personnel to be supported by the NERC in years one through five. It should match the senior project personnel who are identified on the Table of Participants at the start of the Project Description section of the proposal. For the list provide the last name, first name, middle initial, affiliated department and institution/organization (use the internet domain name only for the institution/organization) for each individual. In the main body of the proposal, a corresponding biographical sketch should be provided for all individuals included on this list, as instructed in Section II.C.2.f of the Grant Proposal Guide.

Optional List of Suggested Reviewers or Reviewers Not to Include: Proposers may include in the single copy documents section a list of suggested reviewers who they believe are especially well qualified to review the proposal. Proposers also may designate persons they would prefer not review the NERC proposal, indicating why. These suggestions are optional. GPG Exhibit II-2 contains information on conflicts of interest that may be useful in preparation of this list. The cognizant Program Officer handling the proposal considers the suggestions and may contact the proposer for further information. However, the decision whether or not to use the suggestions remains with the Program Officer.

Cost Sharing Tables and Justification: Complete and submit the following tables: "Committed Cash and In-Kind Academic Support, Years 1-5" and, if applicable, a table showing the "Nature of In-Kind Support" identifying any in-kind commitments and the sources of the commitments. A template of those tables can be found at http://www.erc-assoc.org, under the button marked "ERC Solicitation Information." The tables should be uploaded into the single copy documents section of the full proposal. Appended to the cost sharing tables will be a justification/explanation of the source, nature, amount and availability of any proposed cost sharing. Proposers are directed not to include these tables and the cost sharing justification in any other part of the proposal as cost sharing commitments are not to be provided to reviewers. Refer to section B. Budgetary Information and Cost Sharing in this solicitation for information on cost sharing requirements and policies.

SUMMARY OF PROPOSAL REQUIREMENTS

(Note, this is not a total list of the NERC proposal requirements. Refer to the ERC Solicitation and the GPG for complete requirements)

Topic	Full proposal
Commitment of academic and industrial funds	Yes
Commitment for participation from foreign partner university(ies)	Yes
Identification of participating faculty members from the lead and university-level partner institutions	Years 1-5
Names of participating pre-college institutions	Yes
Names of pre-college teachers	No
Names of participating innovation partner(s), i.e. organizations devoted to entrepreneurship, stimulating innovation, etc.	Yes
Names of firms/practitioner organizations committed to membership in the NERC	Yes
PDF Files: Two PowerPoint slides - one on vision and one on strategic plan.	Yes, emailed to ercintent@nsf.gov within 3 days of the full proposal deadline
Letter of Intent (LOI) must be submitted through FastLane	----na---
Full Proposals can be submitted through FastLane or Grants.gov (see solicitation for instructions)	Submission through FastLane or Grants.gov
Information about PI/Co-PIs	Yes
NSF Cover Sheet. Be sure to identify the current NERC program solicitation number in the program solicitation block on the NSF Cover Sheet.	Yes
FastLane or Grants.gov submission of Cover Sheet	Either
Table of Contents	Automatic
Project Summary with titled sections (Intellectual Merit and Broader Impacts) referencing the NSF review criteria	Yes
Biographical Sketches for all the faculty and key staff participants (limited to 2 pages for each person)	Yes
References Cited	Yes
Table of Participants/Partners, at the start of the project description, in Word table format per example provided at http://www.erc-assoc.org (under the button marked "ERC Solicitation Information.").	Yes

Current and Pending Support (see solicitation for details)	Yes
Project Description	40 pages, including charts, etc., but extended by the size of the Table of Participants/Partners
Letters from lead and core domestic and foreign partner universities committing to the NERC (no letters are required from universities contributing affiliated faculty)	Yes (but no cost sharing identified in letters)
Letter from lead university committing to HQ space	Yes
Letters of commitment to membership from industry/practitioners	All
Letters of Commitment to partnership from pre-college partners	Yes
Letters of Commitment from any state or local government providing non-member financial support to the NERC	Yes
Letters of Commitment from participating innovation partner(s), i.e. organizations devoted to entrepreneurship, stimulating innovation, etc	Yes
Separate budgets for years 1-5	Yes, with subaward budgets
Cumulative budget for years 1-5	Generated by FastLane or Grants.gov
Pie Chart/Table of Year 1 Planned Distribution of NSF Funds	Yes, in the "Financial Support and Functional Allocation of Resources" section of the Project Description
Justification for Secretarial & Admin. Support	Yes
Functional Budget Table	Yes, included in Project Description
Year 1 Committed Industrial and Other Non-NSF, Non-Academic Support table	Yes, included in the Project Description
Table of "Committed Cash and In-Kind Academic Support, Years 1-5" and a table "Nature of In-Kind Support." Also, append to the tables a justification/explanation of any cost shared items.	Yes, submitted in the "Single-Copy Documents" section
Other Information:	
Postdoctoral Mentoring Statement	Yes, if applicable, upload in the "Supplementary Documents" Section
Data Management Plan (limited to two pages)	Yes, in the "Supplementary Documents" section
Compliance with International Traffic in Arms Regulations (ITAR) and Export Administration Regulations (EAR), if Applicable	If relevant to the technology proposed, the full proposal should indicate awareness and compliance with the ITAR and EAR regulations in the section where the NERC's international collaborations are discussed
Facilities, Equipment and Other Resources	Yes
List of Senior Project Personnel (a text-searchable, single PDF document)	Yes, submitted in the "Single-Copy Documents" section

B. Budgetary Information

Cost Sharing: Cost Sharing is required

Mandatory Cost Sharing Requirements and Policies:

Pursuant to the National Science Board's (NSB's) Recommendation 5 (as stated in NSB 09-20) mandatory cost sharing for the NSF Engineering Research Centers (ERC) Program has been reinstated since cost sharing is foundational to the strategic programmatic goals of the ERC Program. A set of Frequently Asked Questions (FAQs) on cost sharing is available on the NSF Policy Office website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=costsharefaqs.

Cost sharing is not a review criterion for ERCs but is an eligibility criterion for ERC proposals. Because cost sharing is not a review criterion, details on cost sharing will be not shared with reviewers.

Academic cost sharing is required to support and sustain the ERC. Upon issuance of the award, the lead university is responsible for securing, retaining, managing, and certifying and delivering to NSF the ERC's cost sharing (cash and in-kind), at the level stated in the cooperative agreement. The total level of cost sharing will be the responsibility of the lead university, but such cost sharing also can include contributions by any or all of the partner universities. The actual amount will be calculated based on the formula that is described below. The formula reflects both the type of institution and the level of funding proposed. Cost sharing is not required nor expected of institutions solely contributing affiliated faculty.

Cost sharing is required of the lead university and core domestic partner university(ies) and must be identified and commitments made in the proposal. Refer to the sections below for guidance on how to provide details on cost sharing for NSF and to ensure that cost sharing is not seen by the reviewers.

Inclusion of cost sharing above the mandatory level as stated in the ERC cost sharing formula would be considered "voluntary cost sharing" which is specifically prohibited in NSF's revised cost sharing principles, and as stated in the NSF Grant Proposal Guide (GPG). ERC proposals that include cost sharing amounts in excess of the specified formula run the risk of being returned without review or declined.

Instructions for Disclosure and Non-Disclosure of Cost Sharing within the Proposal:

- **Cost Sharing and Letters of Commitment:** Since cost sharing is not to be seen or considered by reviewers, any letters of commitment should not mention any cost sharing (cash or in-kind) since these letters will be seen by the reviewers and cost sharing is not a review criterion. Refer to the solicitation for details concerning the letters of commitment.
- **Cost Sharing in the Budget Submission:** The proposed cost sharing (including the estimated value of any in-kind cost sharing), according to the formula below, must be shown on Line M on the proposal budget. (Line M is masked from reviewers.) Do not include the justification/explanation for any cost-shared items in the budget justification section of the proposal. The justification/explanation for cost-shared items must be submitted in the single-copy documents section of the proposal, appended to the cost sharing tables. Only the non-cost shared items should be explained in the budget justification section, identifying the source, nature, amount and availability of non-cost shared items.
- **Cost Sharing Tables and Justification:** In order for NSF to determine that the proposed ERC meets the cost sharing

requirements, the cost sharing commitment of the ERC must be documented in the proposal and the details presented in the tables of committed support. The lead institution is instructed to provide a table of "Committed Cash and In-Kind Academic Support, Years 1-5" (including any partner university providing cash for years 1-5). Proposers must also complete the table "Nature of In-Kind Support" identifying in-kind commitments and the sources of the commitments. A template of those tables can be found at http://www.erc-assoc.org, under the button marked "ERC Solicitation Information." The tables should be uploaded into the single-copy documents section of the proposal. Append to the cost sharing tables a justification/explanation of the source, nature, amount and availability of any proposed cost sharing. Proposers are directed not to include these tables and the cost sharing justification in any other part of the proposal as cost sharing commitments are not to be provided to reviewers.

Cost Sharing Formula:

It is understood that the availability of financial resources may present significant challenges to commit to cost sharing in an ERC for some smaller universities and colleges and universities that do not have high research activity. Therefore, the ERC cost sharing requirements are graduated and vary by the basic classification categories of universities and colleges as defined in the "Carnegie Foundation's Classification of Institutions of Higher Education." The classification categories and ERC cost sharing requirements are as follows:

- RU/VH: Research Universities (very high research activity) - required cost sharing level is 20% of the allocation of the NSF budget to the lead or partner university;
- RU/H: Research Universities (high research activity) - required cost sharing level is 15% of the allocation of the NSF budget to the lead or partner university;
- DRU: Doctoral/Research Universities - cost sharing level is 10% of the allocation of the NSF budget to that partner university;
- Master's L: Master's Colleges and Universities (larger programs) - cost sharing level is 10% of the allocation of the NSF budget to that partner university/college;
- Bac/Diverse: Baccalaureate Colleges--Diverse Fields - cost sharing level is 5% of the allocation of the NSF budget to that partner college.

If the university is classified in more than one Carnegie category, it must cost share at the highest cost sharing category as described above. In addition, the Carnegie classification that is to be used is the classification in place at the LOI submission deadline and will remain throughout the duration of the competition and any subsequent award. The total ERC cost share will be 20% or less, depending upon the Carnegie classifications for each of the partners.

Source: http://www.carnegiefoundation.org/classifications/index.asp. (Use the "Institution Lookup" tab.)

The proposed cost sharing must be shown on Line M on the proposal budget. Only items which would be allowable under the applicable cost principles, if charged to the project, may be included as 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 (2 CFR § 215.23). 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 required by the NSF solicitation and 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.

Administrative requirements related to cost sharing may be found in 2 CFR § 215.23, "Cost Sharing or Matching." For additional information on cost principles consult: 2 CFR Part 220, Cost Principles for Educational Institutions (OMB Circular A-21); or 2 CFR Part 230, Cost Principles for Nonprofit Organizations (OMB Circular A-122), as applicable.

Other Budgetary Limitations:

Refer to the solicitation for additional information.

Budget Preparation Instructions: Refer to the solicitation for additional information.

C. Due Dates

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

  July 15, 2011

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

  September 16, 2011

LOIs and full proposals must be submitted by 5:00 p.m. proposer's local time on the relevant deadline or the proposal will be returned without review.

D. FastLane / Grants.gov Requirements

- **For Proposals Submitted Via FastLane:**

  Detailed technical instructions regarding the technical aspects of preparation and submission via FastLane are available at: https://www.fastlane.nsf.gov/a1/newstan.htm. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or e-mail fastlane@nsf.gov. The FastLane Help Desk answers general technical questions related to the use of the FastLane system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

  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 electronic certifications within five working days following the electronic submission of the proposal. Further instructions regarding this process are available on the FastLane Website at: https://www.fastlane.nsf.gov/fastlane.jsp.

For Proposals Submitted Via Grants.gov:

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: http://www07.grants.gov/applicants/app_help_reso.jsp. In addition, the NSF Grants.gov Application Guide provides additional technical guidance regarding preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

Submitting the Proposal: Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to the NSF FastLane system for further processing.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program where they will be reviewed if they meet NSF proposal preparation requirements. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with the oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal.

A. NSF Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board (NSB)-approved merit review criteria: intellectual merit and the broader impacts of the proposed effort. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two NSB-approved merit review criteria are listed below. The criteria include considerations that help define them. These considerations are suggestions and not all will apply to any given proposal. While proposers must address both merit review criteria, reviewers will be asked to address only those considerations that are relevant to the proposal being considered and for which the reviewer 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, original, or potentially transformative 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?

Examples illustrating activities likely to demonstrate broader impacts are available electronically on the NSF website at: http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf.

Mentoring activities provided to postdoctoral researchers supported on the project, as described in a one-page supplementary document, will be evaluated under the Broader Impacts criterion.

Additional Solicitation Specific Review Criteria

The additional review criteria for Nanosystems ERC proposals are as follows:

Vision and Research:

- Effectively defines a transformational nanosystems engineered system at the cusp of emerging discoveries in science and engineering and emerging opportunities for technological innovation;
- Effectively defines a culture of discovery and innovation (an innovation ecosystem) with a symbiotic relationship between research, education, and innovation;
- Research strategic plan:
    - Targets critical engineered systems goals and identifies significant technical, and as appropriate, societal, and environmental barriers to achieving those goals; and
    - Clearly motivates a high quality cross-disciplinary research program that addresses these barriers through a significant body of nanoscale fundamental research and supporting enabling and systems level research and proof-of-concept testbeds;
- Research thrusts propose significant goals, target significant fundamental and technical barriers, use high quality research methodologies that will advance the state of the art, integrate knowledge from other projects and thrusts, and involve a team with the skills and disciplines needed to achieve the goals; and
- Research program provides opportunities for significant involvement of undergraduate ERC students in research through the academic year and for other students through a Research Experiences for Undergraduates (REU) experience.

Education:

- University education strategy defines an education program that is based on a convincing hypothesis of how to develop graduates who are adaptive, creative innovators with the capacity to advance fundamental knowledge and exploit it to create innovations in a globally connected, innovation-driven world; Strategic plan specifies desired characteristics, proposes how the education program will impart these to students, and how it will measure and assess progress and impacts through longitudinal data;
- Effective plans proposed to integrate the NERC's cross-disciplinary and systems research into courseware and curricula;
- Effective programs and assessment tools for college and pre-college programs based on best practices;
- Effective plans for mentoring students, postdoctoral researchers and pre-college teachers; and
- Pre-college education program will develop an effective long-term partnership with a few pre-college institutions (middle and high schools) nearby each domestic partner university to:
    - Bring knowledge of engineering to the pre-college classroom through a Research Experiences for Teachers (RET) Program,
    - Engage a broadly diverse group of students in the NERC's programs to motivate them to study engineering; and,
    - Provide a Young Scholars research program for promising high schools students.

Innovation Ecosystem:

- Convincing strategy for developing innovation ecosystem including industrial/practitioner members; partnerships with state, local or other organizations devoted to entrepreneurship and innovation; and translational research partnerships with small firms;
- Convincing rationale for the selection of industrial/practitioner members and means to engage these partners in planning, research, education, and innovation; representative group of firms/organizations involving practitioners as appropriate to the vision;
- Active engagement of industry/practitioner organizations through an Industrial/Practitioner Advisory Board;
- Proposed draft terms of the industrial/practitioner membership agreement and intellectual property policy will structure a Center-wide program of industrial/practitioner collaboration to support overall ERC goals;
- A Center-wide intellectual property policy will facilitate collaboration with industry through shared rights for joint work and enable technology transfer;
- State and local government and other organizations devoted to entrepreneurship, innovations, job creation and local economic development are effectively partnered in the education and innovation programs; and
- For intellectual property that members do not license, clear strategy for NERC faculty to affiliate with small firms, that license the IP, to carry out translational research funded by the NERC to accelerate commercialization and provide students with an innovation experience.

Infrastructure:

- Institutional configuration is appropriate to the goals of the NERC and a convincing strategy for cross-institution collaboration in research, education, and innovation;
- Foreign university(ies) partner is committed to the goals of the NERC, will add value in research and education, and is committed to support its partnering faculty starting in year one;
- Diversity strategic plan evidences strong commitment to diversity at all levels from the lead and all partner institutions and will result in a very diverse team with a strong impact on the diversity of the engineering workforce through:
    - Including partner institutions serving large numbers of students underrepresented in engineering to enhance diversity,
    - Involving leadership, faculty and student teams that are diverse in gender, race, and ethnicity, and includes persons with disabilities;
- University administrators from the lead and partner institutions will join in partnership with the NERC to facilitate its cross-disciplinary configuration and industrial membership and IP policies that recognize shared rights for joint work, reward cross-disciplinary research and mentoring, and support its educational strategy, and deliver on its diversity goals;
- NERC has high quality expertise in all disciplines required to attain its goals, a capable leader and leadership team;
- Organizational structure and management plan effectively organize and integrate the resources of the NERC across the partner institutions to achieve its goals and include strong advisory and project selection/evaluation systems;
- Experimental, computational, and other required equipment, facilities, and laboratory space are in place or proposed to support the research of the Center;
- The cyberinfrastructure is effectively used to achieve collaboration and sharing of information;
- Appropriate policies are in place for universities receiving ERC funds to share findings, data and other research products;
- Headquarters space is located on the campus of the lead university, is sufficiently large to house the leaders and staff, and supports the management, communication, and cross-disciplinary collaboration functions of the NRC, and cross-institution communications equipment will effectively encourage and facilitate collaboration; and
- Level of committed industrial/practitioner financial support represents a commitment commensurate with typical levels of support for academic research in the fields involved in the NRC.

NSF staff also will give careful consideration to the following 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.

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review, Site Visit Review, or Reverse Site Review.

Proposals will be reviewed through a combination of ad hoc and panel reviews. A subset of the proposals will receive site visits. All

of the site visits will either be held on the campuses of the lead universities of the proposed NERCs, or as reverse site visits at or near NSF. The location of the site visits will be determined at a later date. At the conclusion of all the site visits, small teams from each of the site-visited proposed NERCs will brief a final review panel at NSF. Based on the information gained from these reviews and recommendations, NSF will select a subset of proposals for award.

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.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF is striving to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director accepts the Program Officer's recommendation.

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 Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

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 their 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 administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process.)

B. Award Conditions

An NSF award consists of: (1) the award 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 (GC-1); * or Research Terms and Conditions * and (5) any announcement or other NSF issuance that may be incorporated by reference in the award letter. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

*These documents may be accessed electronically on NSF's Website at http://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the NSF *Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

Special Award Conditions:

Should a NERC award be made, the awardee must adhere to the following Special Award Conditions as well as any other award conditions outlined in the cooperative agreement document.

Key Personnel:

Any contemplated changes in Key Personnel should be discussed with the NSF Program Officer. Written approval from the NSF Program Officer must be secured before any change is implemented. Any anticipated change in the person serving as the Center Director or the Deputy Director to be effective within the next performance year must be disclosed in the ERC's annual report, and a succession plan must be provided in the report.

Subawards:

Awardees should refer to the NSF Award and Administration Guide, Chapter II.B.3. for more information on subawards made to cooperative agreements.

NSF recognizes that, during the performance of this project, it may be necessary for the Awardee to establish subcontracts and subaward agreements with other organizations. Excluding contractual arrangements for commercially available supplies, materials, equipment, or support services, all subcontracts or other agreements under this award involving substantive effort are subject to the approval of the NSF Grants and Agreements Officer. For purposes of this agreement, a subcontract or subaward valued in excess of $100,000 shall be considered substantive effort.

If an approved subaward is over $100,000 and the amount allocated to the subawardee increases or decreases significantly (20

percent or more), a revised subaward budget and budget explanation must be submitted to the cognizant NSF program officer. This budget should be submitted via email to the program officer. If approved, the subaward change will be acknowledged by an amendment to the Cooperative Agreement. If approval is not granted, the Program Officer will notify the awardee via email.

Termination:

If either the lead university or any of the core academic partner universities (either domestic or foreign) of a NERC award is found to to be inadequately performing, the National Science Foundation reserves the right to recommend termination of, respectively, the NERC and/or any of the core academic partners.

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer at least 90 days before the end of the current budget period. (Some programs or awards require more frequent project reports). Within 90 days after expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report will delay NSF review and processing of any future funding increments as well as any pending proposals for that PI. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through FastLane, for preparation and submission of annual and final project reports. Such reports provide information on activities and findings, project participants (individual and organizational), 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. Submission of the report via FastLane constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

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

VIII. AGENCY CONTACTS

Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.

General inquiries regarding this program should be made to:

- Lynn Preston, Leader of the Engineering Research Centers (ERC) Program and Deputy Division Director (Centers), Division of Engineering Education and Centers (EEC), 585N, telephone: (703) 292-5358, fax: (703) 292-9051, email: lpreston@nsf.gov
- Deborah J. Jackson, telephone: (703) 292-7499, email: djackson@nsf.gov
- Barbara H. Kenny, telephone: (703) 292-4667, email: bkenny@nsf.gov
- Daniel DeKee, Program Director, Engineering Research Centers, Division of Engineering Education and Centers (EEC), 585N, telephone: (703) 292-8769, fax: (703) 292-9051, email: ddekee@nsf.gov
- Carole Read, telephone: (703) 292-2418, email: cread@nsf.gov
- Marshall Horner, telephone: (703) 292-2308, email: mhorner@nsf.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: fastlane@nsf.gov.
- Shalika N. Walton, FastLane Contact and ERC Program Specialist, 585N, telephone: (703) 292-7335, email: swalton@nsf.gov

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: support@grants.gov.

For information on all aspects of the ERC construct, strategic planning and the solicitation in general, contact Lynn Preston (lpreston@nsf.gov or 703-292-5358), Deborah Jackson (djackson@nsf.gov or 703-292-7499), Daniel De Kee (ddekee@nsf.gov or 703-292-8769), or Barbara Kenny (bkenny@nsf.gov or 703-292-4667).

For pre-college education, Research Experiences for Teachers (RETs), contact Mary Poats (mpoats@nsf.gov or 703-292-5357) and for Research Experiences for Undergraduates (REUs) contact Esther Bolding (ebolding@nsf.gov or 703-292-5342).

IX. OTHER INFORMATION

The NSF Website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this Website by potential proposers is strongly encouraged. In addition, National Science Foundation Update is a free e-mail subscription service designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF Regional Grants Conferences. Subscribers are informed through e-mail when new publications are issued that match their identified interests. Users can subscribe to this service by clicking the "Get NSF Updates by Email" link on the NSF web site.

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this new mechanism. Further information on Grants.gov may be obtained at http://www.grants.gov.

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- **To Locate NSF Employees:** (703) 292-5111

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The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems

of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004), and NSF-51, "Reviewer/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton
Reports Clearance Officer
Division of Administrative Services
National Science Foundation
Arlington, VA 22230