

Active Nanostructures and Nanosystems (ANN)

Program Solicitation

NSF 06-595

Replaces Document(s):

NSF 05-610



National Science Foundation

Directorate for Engineering
Directorate for Social Behavioral & Economic Sciences

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

November 15, 2006

REVISION NOTES

In furtherance of the President's Management Agenda, in Fiscal Year 2006, NSF has identified programs that will offer proposers the option to utilize Grants.gov to prepare and submit proposals, or will require that proposers utilize Grants.gov to prepare and submit proposals. Grants.gov provides a single Government-wide portal for finding and applying for Federal grants online.

In response to this program solicitation, proposers may opt to submit proposals via Grants.gov or via the NSF FastLane system.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Active Nanostructures and Nanosystems (ANN) FY 2006

Synopsis of Program:

The National Science Foundation (NSF) announces a program on collaborative research and education in the area of active nanostructures, nanosystems, and on the long-term societal change associated with these innovations. Active nanostructures change or evolve their structure, property, or function during their operation. The goal of this program is to support fundamental research and catalyze synergistic science and engineering research and education in several emerging areas of nanoscale science and engineering, including:

- Active nanostructures;

- Nanosystems with improved functionality and new architectures;
- Hierarchical nanomanufacturing; and
- Long-term societal and educational implications of scientific and technological advances on the nanoscale.

This solicitation provides support for Nanoscale Interdisciplinary Research Teams (NIRT) and Nanoscale Exploratory Research (NER).

Other research and education projects in nanoscale science and engineering will continue to be supported in the relevant programs and divisions.

Cognizant Program Officer(s):

- Kevin Lyons, Program Director, Directorate for Engineering, Division of Design and Manufacturing Innovation, National Science Foundation, 510N, telephone: (703) 292-5365, fax: 703-292-9056, email: klyons@nsf.gov
- Matthew Realf, Program Director, Directorate for Engineering, Division of Design and Manufacturing Innovation, National Science Foundation, 510N, telephone: (703) 292-7081, fax: 703-292-9056, email: mrealff@nsf.gov
- Rajinder Khosla, Program Director, Directorate for Engineering, Division of Electrical and Communications Systems, National Science Foundation, 675S, telephone: (703) 292-8339, fax: 301-292-9147, email: rkhosla@nsf.gov
- Lawrence Goldberg, Program Director, Directorate for Engineering, Division of Electrical and Communications Systems, National Science Foundation, 675S, telephone: 703-292-8339, fax: 703-292-9147, email: lgoldber@nsf.gov
- Bruce Kramer, Program Director, Directorate for Engineering, Division of Engineering Education & Centers, National Science Foundation, 585N, telephone: (703) 292-5348, fax: 703-292-9051, email: bkramer@nsf.gov
- Ken Chong, Program Director, Directorate for Engineering, Division of Civil & Mechanical Systems, National Science Foundation, 545S, telephone: (703) 292-8360, fax: 703-292-9053, email: kchong@nsf.gov
- Judy Raper, Program Director, Directorate for Engineering, Division of Chemical & Transport Systems, National Science Foundation, 525N, telephone: (703) 292-8371, fax: 703-292-9054, email: jraper@nsf.gov
- Leon Esterowitz, Program Director, Directorate for Engineering, Division of Bioengineering & Environmental Systems, National Science Foundation, 565S, telephone: (703) 292-7942, fax: 703-292-9098, email: lesterow@nsf.gov
- Mark Weiss, Science Advisor, Directorate for Social, Behavioral and Economic Sciences, National Science Foundation, 905N, telephone: (703) 292-7272, fax: 703-292-9083, email: mweiss@nsf.gov
- Priscilla Regan, Program Director, Division of Social and Economic Sciences, National Science Foundation, 995N, telephone: (703) 292-7318, fax: 703-292-9068, email: pregan@nsf.gov

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

- 47.041 --- Engineering
- 47.075 --- Social, Behavioral and Economic Sciences

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 60

Anticipated Funding Amount: \$29,000,000 - of which \$24,500,000 for approximately 20 NIRT awards and \$4,500,000 for approximately 40 NER awards.

Organization Limit:

Proposals may only be submitted by the following:

- A. **Nanoscale Interdisciplinary Research Teams (NIRT):** NIRT proposals may be submitted by a single organization or a group of organizations consisting of a lead organization in partnership with one or more partner organizations. Only U.S. academic institutions with significant research and degree-granting education programs in disciplines normally supported by NSF are eligible to be the lead organization. Principal investigators are encouraged to form synergistic collaborations among researchers. However no funds will be provided to private and public sector organizations, government laboratories, or scientists and engineers at foreign organizations. At least three PIs and co-PIs, all with funded time committed in the budget, must be listed on the cover page or on the budget page of the proposal. The maximum number of PIs and co-PIs is five; other participants may be listed in the project summary and on the budget pages.

Collaborations between university and industry researchers using the approach of the Grant Opportunities for Academic Liaison with Industry (GOALI) program are encouraged. *Please see section IX. Other Information about GOALI.* Primary support for foreign participants or activities, or both must be secured through their own national sources. For foreign participants, the U.S. organization may provide funds under participant support costs for travel and per diem for visits to the U.S. organization as consistent with applicable international agreements. No NSF funds may go directly to foreign organizations. For this solicitation, funds for salaries and research expenses of staff of national laboratories, state agencies, and non-NSF Federally Funded Research and Development Centers (FFRDC) may not be requested. However, it is appropriate for students supported by the award to work at an FFRDC or comparable site or for the award to support research expenses incurred when scientists from such entities work at university sites. Federal employees may not receive salaries or in other ways augment their agency's appropriation through grants made by this solicitation, and no funds for equipment at FFRDCs are allowed.

- B. **Nanoscale Exploratory Research (NER):** Proposals may be submitted by U.S. academic institutions with undergraduate and Ph.D. programs or both in disciplines usually supported by NSF. Research may be proposed by individual investigators or by small groups from academic institutions. Synergistic collaborations among researchers, and collaborations or partnerships with private or public sector organizations or government laboratories are encouraged when appropriate. Prospective proposers are encouraged to contact one of the program officers listed in this solicitation for additional guidance on the suitability of their NER submission if there are questions.

PI Limit:

Principal Investigators must be at the faculty level or equivalent.

Limit on Number of Proposals per Organization:

4

- A. **Nanoscale Interdisciplinary Research Teams (NIRT):** An organization – a university, or a campus in a multi-campus university -- may submit no more than two (2) proposals on which it is the lead organization in response to this solicitation. The same organization may be a collaborative partner in any number of other multi-organization group proposals in which it is not the lead. An authorized organizational representative of the lead organization will make the selection of the proposals that are submitted. Proposals submitted to other NSF programs are not eligible for consideration by this competition. NIRT proposals involving more than one organization must be submitted as a single administrative package with the managing principal investigator from the lead organization.
- B. **Nanoscale Exploratory Research (NER):** An organization – a university or a campus in a multi-campus university -- may submit no more than two (2) proposals on which it is the lead organization in response to this NER solicitation. An exception is made for an additional NER proposal that may be submitted in "Societal and Educational Issues Associated with Long-term Research Science and Engineering Advances" (see Research and Education Themes in Section II). At least one NER

proposal submitted by an organization must have a PI or co-PI at the level of assistant professor or equivalent. An authorized organizational representative of the lead organization will make the selection of the proposals that are submitted. Proposals submitted to other NSF programs are not eligible for consideration by this competition. NER proposals involving more than one organization must be submitted as a single administrative package with the managing principal investigator from the lead organization.

Limit on Number of Proposals per PI:

None Specified

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not Applicable
- **Full Proposals:**
 - Full Proposals submitted via FastLane: 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/bfa/dias/policy/docs/grantsgovguide.pdf>)

B. Budgetary Information

- **Cost Sharing Requirements:** Cost Sharing is not required by NSF.
- **Indirect Cost (F&A) Limitations:** Not Applicable
- **Other Budgetary Limitations:** Not Applicable

C. Due Dates

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

November 15, 2006

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: Standard NSF award conditions apply

Reporting Requirements: Standard NSF reporting requirements apply

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I. INTRODUCTION

One nanometer (one billionth of a meter) is a magical point on the dimensional scale. Nanostructures are at the confluence of the smallest of human-made devices and the largest molecules of living systems. Nanoscale science and engineering here refer to the fundamental understanding and resulting technological advances arising from the exploitation of new physical, chemical, and biological properties of systems that are intermediate in size, between isolated atoms and molecules and bulk materials, where the transitional properties between the two limits can be controlled. Nanotechnology is the creation and use of functional materials, devices, and systems with novel properties and functions that are achieved through the control of matter, atom-by-atom, molecule by molecule or at the macromolecular level. During the last years, novel structures, phenomena, and processes have been observed at the nanoscale (from a fraction of nanometer to about 100 nm) and new experimental, theoretical, and simulation tools have been developed for investigating them. These advances provide fresh opportunities for scientific and technological developments in active nanostructures and nanosystems with new architectures and improved functionality. Similarly, continuing advances in nanoscale science and engineering require continuing attention to accompanying societal issues.

The current pace of revolutionary discoveries in nanoscience and technology is expected to accelerate greatly in the next decade. However, formidable challenges remain in the areas of fundamental understanding, device design, system design and architecture, manufacturing, converging technologies, system integration and deployment, and consideration of associated societal and ethical phenomena, before the full potential of nanotechnology becomes a reality. To date, relatively small attention has been paid to the organizational and social structures and processes capable of identifying, monitoring, and assessing these changes and the associated ethical, social, psychological and economic implications. Key research opportunities have been identified for advancing nanotechnology in the areas of active nanostructures and nanosystems, as well as societal dimensions of nanotechnology (see the **National Nanotechnology Initiative Strategic Planning II**, December 2004, http://www.nsf.gov/crssprgm/nano/reports/sp_report_nset_final.pdf).

The rudimentary capabilities of nanotechnology today for control and manufacture at the nanoscale are expected to evolve significantly by 2020. The focus of this solicitation is on active nanostructures, nanosystems, their manufacturing, and on long-term societal issues associated with nanoscale science and engineering continuing advances.

An active nanostructure changes or evolves its state during its operation. For instance, a mechanical actuator may change its dimensions, and a nanoparticle for drug delivery may change its morphology and chemical composition. The new state may be subject to other successive changes. Such changes are more complex as the structures and systems are larger and involve multiple phenomena. Active nanoscale structures and devices may encompass mechanical, electronic, magnetic, photonic, biological, and other effects. Examples of active nanostructures are nanoelectromechanical systems (NEMS), nanomachines, self-healing materials, nanobiodevices, transistors, amplifiers, targeted drugs and chemicals, actuators, molecular machines, light-driven molecular motors, plasmonics, nanoscale fluidics, laser-emitting devices, adaptive nanostructures, energy storage devices, and sensors changing their state during operation. Nanoelectronics would include the area of “silicon nanoelectronics and beyond”, with structures leading to complementary metal-oxide semiconductor (CMOS) scaled to its ultimate limits and possibly beyond CMOS, integrating nanocomponents and nanodevices (e.g., carbon nanotube, single-electron and molecular transistors) and new devices or both based on state variables other than electric charge (e.g., electron spin, nuclear spin or photonic states). Nanomedicine would include targeted cancer therapies, sensors for in vivo monitoring, localized drug delivery, neural stimulation, and cardiac therapies.

Nanosystems have nanostructures and nanodevices as components. The number of components may range from several (such as a sensor and actuator) to large numbers (such as tens of thousands of molecules in a synthetic biology system). Nanosystems may be created by various syntheses and assembling techniques such as a combination of molecular assembling and top-down miniaturization techniques, bio-assembling, networking at the nanoscale and multiscale and hierarchical architectures, robotics on surfaces, modular nanosystems, chemo-mechanical processing of molecular assemblies, and quantum interactions. Nanoelectronics would include possible new system architectures. Nanomedicine would include artificial tissues built from the nanoscale and systems for cell conditioning. Other examples are robotic systems with emerging behavior, evolutionary systems, regenerative medicine, modified viruses and bacteria, and brain prostheses.

The convergence of nanotechnology with information technology, modern biology and social sciences will reinvigorate discoveries and innovation in many relevant areas. The application of active nanostructures and nanosystems may bring significant changes in industry, medicine, quality of life, and environment. Not much attention has been paid to the organizational and social structures and processes capable of identification, monitoring, and assessment of these changes and the associated ethical, social, psychological, and economic implications.

The National Nanotechnology Initiative (NNI – <http://www.nano.gov/> and at NSF – <http://www.nsf.gov/nano>) 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 discoveries. This ANN solicitation represents one of the NSF’s contributions to the NNI. Collaborative research among engineers, physicists, chemists, biologists, materials scientists, geoscientists, mathematicians, computer scientists, social and behavioral scientists, economists, and educators is an integral part of both NNI and ANN.

II. PROGRAM DESCRIPTION

This solicitation focuses on four high-risk/high-reward research and education themes, three focusing on active nanostructures and nanosystems and the fourth on societal and educational issues associated with continuing advances in nanoscale science, engineering, and technology.

- **Active Nanostructures.** Research in this area supports discovery and development of active nanostructures and their engineered nanosystems. Typical active nanostructures include components in nanoelectromechanical systems (NEMS), nanobiodevices, energy storage devices, actuators, and sensors which change their state during measurement, targeted drugs and chemicals, actuators, molecular machines, light-driven molecular motors, nanoscale fluidics, laser-emitting devices, and adaptive structures. An *active* nanostructure changes its state during operation: for example, an actuator changes its dimensions, and a drug delivery particle changes its morphology and chemical composition. The new state may also be subject to successive changes in the mechanical, electronic, magnetic, photonic and biological properties, as well as other effects. One may identify two subcategories: (a) bio-active nanostructures with potential effects on human health and ecosystems; and (b) physico-chemical active nanostructures. Examples of areas of relevance are the study of biological and biologically inspired systems in which nanostructures play an important role, nanostructured catalysts, novel separation systems with molecular resolution, nanoshells for environmental remediation, advanced drugs, quantum computing, DNA computing, production of two- and three-dimensional nanostructures by design, nanoscale fluidics, biophotonics, control of surface processes and lubrication.
- **Nanoscale Devices and System Architecture.** New concepts, tools and design methodologies are needed to create new nanoscale devices, synthesize nanosystems and integrate them into architectures for various operational environments. These require a profound understanding of the physical, chemical, and biological interactions among nanoscale components, including self-assembling and self-organization of molecular and supramolecular systems. In order to systemize the design of complex nanosystems, multiple layers of abstractions and various mathematical

models to represent component behavior in different layers are also required. Research is encouraged in design principles and construction methods of nanoscale processing systems, as well as their energy supply and operation control systems. Research in this area includes development of new tools for sensing, assembling, processing, manipulating, manufacturing and integration along scales, controlling and testing nanostructures, devices, design and architecture of concepts, software specialized for nanosystems, including nanoelectronics, and design automation tools for assembling systems of large numbers of heterogeneous nanocomponents. A special focus is on new architectures and improved functionality of large and complex nanosystems, and their integration with larger scale systems. This includes deterministic, emerging and evolutionary nanosystems, and their integration with large scale systems. One can envision systems that sense and gather information and analyze and respond to that information, the development of high capacity computer memory chips, and more powerful computing systems and architectures.

- **Hierarchical Nanomanufacturing.** Research in this area will focus on creating nanostructures and assembling them into nanosystems and then into larger complex structures of at least two length scales where the principles of manufacturing or operation are different. This research should address understanding nanoscale processes, developing novel tools for measurement and manufacturing at the nanoscale, developing novel concepts for high-rate synthesis and processing of nanostructures and nanosystems, scale integration, scale up of nanoscale synthesis and processing methods, and constructing nanoscale systems. Examples are synthesis of nanostructures for various functions, fabrication methods for devices and nanosystems, design concepts for manufacturing, simulation of the manufacturing methods at the nanoscale, and evaluation of the economic and environmental implications of manufacturing at the nanoscale. Possible benefits include improving understanding of manufacturing processes in the pre-competitive environment, generating a new group of nanoscale manufacturing methods for nanoelectronics, and nanomedicine, increasing the performance and scale up of promising techniques, and establishing the physical and human infrastructure for measurements and manufacturing capabilities.
- **Societal and Educational Issues Associated with Long-Term Nanoscale Science and Engineering Advances.** Research proposals submitted in this thematic area are expected to increase understanding, assessment and management of long-term societal change associated with nanoscale science, engineering, and technology. Subjects for examination can include a) the educational, economic, social, organizational and ethical changes associated with support for, design of, and results from inventions and innovations involving active nanostructures and nanosystems; and b) the development and assessment of potentials for applications in health care and human and artificial cognition. These proposals can focus on any social or behavioral phenomena, alone or in combination, and should relate to research emphases and findings in the areas of active nanostructures and nanosystems. Thus, they should include experts in the relevant social, behavioral, or economic sciences and nanoscale science and engineering. Proposals that include the potential for enhancements to social or behavioral science infrastructure, instrumentation or tools are especially welcome. For instance, research teams developing deliberative workshops or interview and survey projects might design or amend and test in several iterations a module focusing on public perception of converging developments in bioscience, cognitive science, information science, and nanoscale science and engineering. In conjunction with designing new instruments with the potential for cognitive assessment, teams could examine the potential benefits to and consequences for privacy, human identity, or social understanding. This theme aims at a long-term vision for addressing societal and ethical implications of nanotechnology with special reference to active nanodevices and nanosystems.

Proposals with focus on active nanostructures and nanosystems that incorporate elements of more than one scientific theme are welcome. Given NSF's strong focus on developing the infrastructure for nanoscale science and engineering, all proposals should address integration of research and education, including course development, appropriate to the nature of the project.

In FY 2007, consistent with NNI emphases and the four themes described above, NSF encourages proposals involving novel instrumentation, manufacturing processes, nanoelectronics and challenges faced by conventional CMOS technology, energy conversion and storage, and devices for chemical, biological, radiological, or explosive agents detection that involve nanoscale processes.

NSF does not normally support technical assistance, pilot plant efforts, research requiring security classification, or the development of products for commercial marketing or market research for a particular project or invention. Research in bioengineering, with diagnosis or treatment related goals, however, that apply engineering principles to problems in biology and medicine while advancing engineering knowledge is eligible for support. Bioengineering research to aid persons with disabilities is also eligible. However, research with disease-related goals, including work on the etiology, diagnosis or treatment of physical or mental disease, abnormality or malfunction in human beings or animals, is normally not supported. Animal models of such conditions or the development or testing of drugs or other procedures for their treatment also are not eligible for support.

Other research and education projects in nanoscale science and engineering will continue to be supported in the relevant programs divisions and directorates.

III. AWARD INFORMATION

Anticipated Type of Award: Continuing Grant or Standard Grant.

Estimated Number of Awards: 60.

Estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

Nanoscale Interdisciplinary Research Teams (NIRT): A NIRT award will be in the range of \$250,000-\$350,000 per year for four years depending on the scope of the work proposed. Grants may be awarded in a variety of sizes and durations. The total request for NSF funding for each project, for all investigators and all organizations, may not exceed \$1,400,000. NSF expects to fund approximately 20 NIRT awards in FY 2007, depending on the quality of submissions and the availability of funds. Anticipated date of awards: May 2007.

Nanoscale Exploratory Research (NER): NER awards will be made as one-year grants. NER awards may not exceed \$130,000 and cannot be renewed. NSF plans to fund about 40 new NER awards in fiscal year 2007, subject to the quality of submissions and availability of funds. Anticipated date of awards: May 2007.

IV. ELIGIBILITY INFORMATION

Organization Limit:

Proposals may only be submitted by the following:

- A. **Nanoscale Interdisciplinary Research Teams (NIRT):** NIRT proposals may be submitted by a single organization or a group of organizations consisting of a lead organization in partnership with one or more partner organizations. Only U.S. academic institutions with significant research and degree-granting education programs in disciplines normally supported by NSF are eligible to be the lead organization. Principal investigators are encouraged to form synergistic collaborations among researchers. However no funds will be provided to private and public sector organizations, government laboratories, or scientists and engineers at foreign organizations. At least three PIs and co-PIs, all with funded time committed in the budget, must be listed on the cover page or on the budget page of the proposal. The maximum number of PIs and co-PIs is five; other participants may be listed in the project summary and on the budget pages.

Collaborations between university and industry researchers using the approach of the Grant Opportunities for Academic Liaison with Industry (GOALI) program are encouraged. *Please see section IX. Other Information about GOALI.* Primary support for foreign participants or activities, or both must be secured through their own national sources. For foreign participants, the U.S. organization may provide funds under participant support costs for travel and per diem for visits to the U.S. organization as consistent with applicable international agreements. No NSF funds may go directly to foreign organizations. For this solicitation, funds for salaries and research expenses of staff of national laboratories, state agencies, and non-NSF Federally Funded Research and Development Centers (FFRDC) may not be requested. However, it is appropriate for students supported by the award to work at an FFRDC or comparable site or for the award to support research expenses incurred when scientists from such entities work at university sites. Federal employees may not receive salaries or in other ways augment their agency's appropriation through grants made by this solicitation, and no funds for equipment at FFRDCs are allowed.

- B. **Nanoscale Exploratory Research (NER):** Proposals may be submitted by U.S. academic institutions with undergraduate and Ph.D. programs or both in disciplines usually supported by NSF. Research may be proposed by individual investigators or by small groups from academic institutions. Synergistic collaborations among researchers, and collaborations or partnerships with private or public sector organizations or government laboratories are encouraged when appropriate. Prospective proposers are encouraged to contact one of the program officers listed in this solicitation for additional guidance on the suitability of their NER submission if there are questions.

PI Limit:

Principal Investigators must be at the faculty level or equivalent.

Limit on Number of Proposals per Organization:

4

- A. Nanoscale Interdisciplinary Research Teams (NIRT): An organization – a university, or a campus in a multi-campus university -- may submit no more than two (2) proposals on which it is the lead organization in response to this solicitation. The same organization may be a collaborative partner in any number of other multi-organization group proposals in which it is not the lead. An authorized organizational representative of the lead organization will make the selection of the proposals that are submitted. Proposals submitted to other NSF programs are not eligible for consideration by this competition. NIRT proposals involving more than one organization must be submitted as a single administrative package with the managing principal investigator from the lead organization.
- B. Nanoscale Exploratory Research (NER): An organization – a university or a campus in a multi-campus university -- may submit no more than two (2) proposals on which it is the lead organization in response to this NER solicitation. An exception is made for an additional NER proposal that may be submitted in "Societal and Educational Issues Associated with Long-term Research Science and Engineering Advances" (see Research and Education Themes in Section II). At least one NER proposal submitted by an organization must have a PI or co-PI at the level of assistant professor or equivalent. An authorized organizational representative of the lead organization will make the selection of the proposals that are submitted. Proposals submitted to other NSF programs are not eligible for consideration by this competition. NER proposals involving more than one organization must be submitted as a single administrative package with the managing principal investigator from the lead organization.

Limit on Number of Proposals per PI:

None Specified

Additional Eligibility Info:

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal 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 pubs@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/bfa/dias/policy/docs/grantsgovguide.pdf>). 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 pubs@nsf.gov.

A. NANOSCALE INTERDISCIPLINARY RESEARCH TEAMS (NIRT)

NIRT - Proposal Preparation and Submission Instructions

FastLane Users: Proposers must identify this program solicitation number in the program announcement/solicitation block on the Cover Sheet and select "**Nanoscale: Interdiscipl Rsrch T**" from the FastLane org. unit pull-down list. The project title must begin with "**NIRT:**".

Grants.gov Users: The program solicitation number will be pre-populated by Grants.gov on the NSF Grant Application Cover Page. In Field 2, Unit of Consideration, enter 07020000 for the Division Code and 1674 for the Program Code. The project title must begin with "**NIRT:**".

Proposers must indicate in order of priority one (or more) of the four research and education themes described in Section II which the proposal addresses. This must be stated in the last line of the project summary, and it will be used to assist in assignment of the proposal to the most appropriate panel.

NOTE: The Project Summary and Project Description sections must indicate, in separate statements, the intellectual merit of the proposed work and its broader impacts. (See Section VI.), or the proposal will be returned without review.

NIRT proposals must conform to the requirements of the *Grant Proposal Guide (GPG)* or the *NSF Grants.gov Application Guide*, with three modifications:

Collaborative research activities should be described and submitted in a single proposal in which a single award is requested, with subawards administered by the lead organization to any other participating organizations. (See GPG section II.D.3.a.) This solicitation encourages team approaches in the belief that a synergistic blend of expertise is needed to make major headway in research, education, and development of the infrastructure. Budgets for any subawards to different organizations must be included.

The project description is limited to 15 pages plus 1 additional page per each co-principal investigator. For example, a proposal with 1 principal investigator and 4 co-principal investigators listed on the cover page and budget request would be limited to 19 pages of project description. The maximum number of PIs and Co-PIs is 5, so the maximum number of pages in the project description would be 19 pages.

The project description should include a discussion of the management, education and outreach aspects of the project. The proposal should describe the roles to be played by the participating organizations, the responsibilities of the managing PI the activities of associated partners, arrangements for networking, exchange, dissemination of data and results. The managing PI must be from the lead organization. Details on the education, training, and outreach activities planned as part of the project should be included. Opportunities for students to obtain novel research or educational experiences should be detailed, as well as any specific training activities or workshops.

Proposals that exceed the page limitations described above will be returned without review.

Proposal Deadline Date: Full proposals for NIRT are due by **5 p.m. proposer's local time on November 15, 2006**. Proposals must be submitted electronically through FastLane or Grants.gov by the **lead organization**.

Inquiries regarding NIRT proposals should be directed to the Directorate for Engineering (ATTN: Judy Raper, Program Director, jraper@nsf.gov).

B. NANOSCALE EXPLORATORY RESEARCH (NER)

NER - Proposal Preparation and Submission Instructions

FastLane Users: Proposers must identify this program solicitation number in the program announcement/solicitation block on the Cover Sheet and to select "**Nanoscale: Exploratory Rsrch**" from the FastLane org. unit pull-down list. The project title

must begin with "NER: ".

Grants.gov Users: The program solicitation number will be pre-populated by Grants.gov on the NSF Grant Application Cover Page. In Field 2, Unit of Consideration, enter 07020000 for the Division Code and 1676 for the Program Code. The project title must begin with "NER:".

Proposers must indicate in order of priority one (or more) of the four research and education themes listed in Section II which the proposal addresses. This must be stated in the last line of the project summary, and it will be used to assist in assignment of the proposal to the most appropriate panel.

NOTE : The Project Summary and Project Description sections must indicate, in separate statements, the intellectual merit of the proposed work and its broader impacts. (See Section VI.), or the proposal will be returned without review.

Proposal Deadline Date: Full proposals for NER are due by **5 p.m. proposer's local time on November 15, 2006**. Proposals must be submitted electronically through FastLane or Grants.gov by the **lead organization**.

Investigators are strongly encouraged to contact the NSF staff members in the program covering the proposal topic before submitting an NER proposal if there are questions.

Inquiries regarding NER proposals should be directed to the Directorate for Engineering (ATTN: Leon Esterowitz, Program Director, lesterow@nsf.gov).

B. Budgetary Information

Cost Sharing: Cost sharing is not required by NSF in proposals submitted to the National Science Foundation.

C. Due Dates

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

November 15, 2006

For Nanoscale Interdisciplinary Research Teams (NIRT)

For Nanoscale Exploratory Research (NER)

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.

The Grants.gov's Grant Community User Guide is a comprehensive reference document that provides technical information about Grants.gov. Proposers can download the User Guide as a Microsoft Word document or as a PDF document. The Grants.gov User Guide is available at: <http://www.grants.gov/CustomerSupport>. 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 and, if they meet NSF proposal preparation requirements, for review. 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 with the proposer.

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 and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

What are the broader impacts of the proposed activity?

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

NSF staff 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.

Additional Review Criteria:

A. Nanoscale Interdisciplinary Research Teams (NIRT)

In addition, the following criteria will be used:

- Potential for significant contributions to the advancement of nanoscale science and engineering in one or more of the four research and education themes: active nanostructures, nanosystems, hierarchical nanomanufacturing, and societal and educational issues;
- Strength of the collaborations planned and degree of interdisciplinarity;
- Value to nanotechnology education;
- Appropriateness and likely effectiveness of collaborations with public or private sector organizations, national laboratories, and comparable research groups in foreign countries, when applicable. Proposals will be evaluated not by the number of collaborators, but by the quality of the collaborations; and
- Likely effectiveness of the management plan.

B. Nanoscale Exploratory Research (NER)

In addition, the following criteria will be used:

- The likelihood of a significant advance over existing knowledge, level of innovation, or breakthrough as compared to previous work in one or more of the four research and education themes: active nanostructures, nanosystems, hierarchical nanomanufacturing, and societal and educational issues;
- Scarcity of data, tools, information or analysis in new, relevant fields of research and education; and
- The research plan for the demonstration of feasibility.

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by Adhoc Review or Panel Review.

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 date of receipt. 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 Federal Demonstration Partnership (FDP) Terms and Conditions * and (5) any announcement or other NSF issuance that may be incorporated by reference in the award letter. Cooperative 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/general_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from pubs@nsf.gov.

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

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.

Failure to provide the required annual or final project reports 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.

VIII. AGENCY CONTACTS

General inquiries regarding this program should be made to:

- Kevin Lyons, Program Director, Directorate for Engineering, Division of Design and Manufacturing Innovation, National Science Foundation, 510N, telephone: (703) 292-5365, fax: 703-292-9056, email: klyons@nsf.gov
- Matthew Realf, Program Director, Directorate for Engineering, Division of Design and Manufacturing Innovation, National Science Foundation, 510N, telephone: (703) 292-7081, fax: 703-292-9056, email: mrealff@nsf.gov
- Rajinder Khosla, Program Director, Directorate for Engineering, Division of Electrical and Communications Systems, National Science Foundation, 675S, telephone: (703) 292-8339, fax: 301-292-9147, email: rkhosla@nsf.gov
- Lawrence Goldberg, Program Director, Directorate for Engineering, Division of Electrical and Communications Systems, National Science Foundation, 675S, telephone: 703-292-8339, fax: 703-292-9147, email: lgoldber@nsf.gov
- Bruce Kramer, Program Director, Directorate for Engineering, Division of Engineering Education & Centers, National Science Foundation, 585N, telephone: (703) 292-5348, fax: 703-292-9051, email: bkramer@nsf.gov
- Ken Chong, Program Director, Directorate for Engineering, Division of Civil & Mechanical Systems, National Science Foundation, 545S, telephone: (703) 292-8360, fax: 703-292-9053, email: kchong@nsf.gov
- Judy Raper, Program Director, Directorate for Engineering, Division of Chemical & Transport Systems, National Science Foundation, 525N, telephone: (703) 292-8371, fax: 703-292-9054, email: jraper@nsf.gov
- Leon Esterowitz, Program Director, Directorate for Engineering, Division of Bioengineering & Environmental Systems, National Science Foundation, 565S, telephone: (703) 292-7942, fax: 703-292-9098, email: lesterow@nsf.gov
- Mark Weiss, Science Advisor, Directorate for Social, Behavioral and Economic Sciences, National Science Foundation, 905N, telephone: (703) 292-7272, fax: 703-292-9083, email: mweiss@nsf.gov
- Priscilla Regan, Program Director, Division of Social and Economic Sciences, National Science Foundation, 995N, telephone: (703) 292-7318, fax: 703-292-9068, email: pregan@nsf.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: fastlane@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 questions related to the use of FastLane, contact:

- telephone: 1-800-673-6188, email: fastlane@nsf.gov

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, MyNSF (formerly the Custom News Service) is an information-delivery system 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 or the user's Web browser each time new publications are issued that match their identified interests. MyNSF also is available on NSF's Website at <http://www.nsf.gov/mynsf/>.

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>.

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

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

Grant Opportunities for Academic Liaison with Industry (GOALI), NSF 98-142) <http://www.nsf.gov/pubs/1998/nsf98142/nsf98142.htm>. Grant Opportunities for Academic Liaison with Industry (GOALI) aims to synergize university-industry partnerships by making funds available to support an eclectic mix of industry-university linkages. Special interest is focused on affording the opportunity for:

- interdisciplinary university-industry teams to conduct long-term research projects;
- Faculty, postdoctoral fellows, and students to conduct research and gain experience with production processes in an industrial setting; and
- Industrial scientists and engineers to bring industry's perspective and integrative skills to academe.

This solicitation, previous program solicitations, and additional information concerning related activities such as workshops and publications, including "**The National Nanotechnology Initiative – Supplement to the President's FY 2007 Budget**" (2005) prepared by the National Science and Technology Council, are available on-line at <http://www.nsf.gov/nano> and <http://nano.gov/>. NSF has also prepared the reports, "**Societal Implications of Nanoscience and Nanotechnology**" (2001), "**Societal Implications of Nanotechnology: Increasing Benefits to Humanity**" (2005), and "**Converging Technologies for Improving Human Performance**" (2003).

ABOUT THE NATIONAL SCIENCE FOUNDATION

The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

NSF receives approximately 40,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

Facilitation Awards for Scientists and Engineers with Disabilities provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See Grant Proposal Guide Chapter II, Section D.2 for instructions regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.

To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at <http://www.nsf.gov>

- **Location:** 4201 Wilson Blvd. Arlington, VA 22230
- **For General Information** (NSF Information Center): (703) 292-5111
- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**

Send an e-mail to: pubs@nsf.gov
or telephone: (703) 292-7827
- **To Locate NSF Employees:** (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; 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

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Division of Administrative Services
National Science Foundation
Arlington, VA 22230

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The National Science Foundation, 4201 Wilson Boulevard, Arlington, Virginia 22230, USA
Tel: (703) 292-5111, FIRS: (800) 877-8339 | TDD: (800) 281-8749

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