

Sensors and Sensor Networks (Sensors)

Program Solicitation

NSF 04-522

Replaces Document 03-512



National Science Foundation

Directorate for Engineering

Directorate for Biological Sciences

Directorate for Geosciences

Office of Polar Programs

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

February 26, 2004

REVISIONS AND UPDATES

Please note that this is a much narrower solicitation than its predecessor, [NSF 03-512](#). Proposals outside the scope of the topical areas described in this solicitation are subject to return without review.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Sensors and Sensor Networks (Sensors)

Synopsis of Program:

The National Science Foundation (NSF) announces a broad interdisciplinary program of research and education in the area of advanced sensor development. This solicitation seeks to advance fundamental knowledge in engineering of materials, concepts and designs for new sensors; networked sensor systems in a distributed environment; terrestrial, atmospheric, and aquatic environmental analysis; the integration of sensors into engineered systems; and the interpretation and use of sensor data in decision-making processes. The Directorate for Computer and Information Science and Engineering, the Directorate for Mathematical and Physical Sciences, the Directorate for Education and Human Resources, and the Directorate for Social, Behavioral, and Economic Sciences plan to participate in the reviews and identify proposals of mutual interest and may provide co-funding for programs of high quality that meet their programmatic requirements.

Please note that this is a much narrower solicitation than its predecessor, [NSF 03-512](#). Proposals outside

the scope of the topical areas described in this solicitation are subject to return without review.

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

- 47.074 --- Biological Sciences
- 47.041 --- Engineering
- 47.050 --- Geosciences
- 47.078 --- Office of Polar Programs

Eligibility Information

- **Organization Limit:**

Proposals may be submitted only by U.S academic institutions and nonprofit research institutions in support of individual investigators, small teams, and interdisciplinary research groups. The limitation is intended to apply also to subawards.

- **PI Eligibility Limit:**

An individual researcher may not be named as a participant on more than one proposal submitted to this solicitation. This limitation includes participation in any context for which financial remuneration is requested.

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

Award Information

- **Anticipated Type of Award:** Standard or Continuing Grant
- **Estimated Number of Awards:** 55 to 60 - including Individual-Investigator (up to \$125,000 per year for 3 years), Small-Team (up to \$250,000 per year for 3 years), and Interdisciplinary-Research-Group (up to \$500,000 per year for up to 5 years) awards.
- **Anticipated Funding Amount:** \$31,000,000 from the Directorate for Engineering and up to \$5,000,000 additionally from other NSF Directorates/Offices, subject to availability of funds and the quality of proposals received.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Full Proposal Preparation Instructions:** This solicitation contains information that supplements the standard Grant Proposal Guide (GPG) proposal preparation guidelines. Please see the full text of this solicitation for further information.

B. Budgetary Information

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

C. Due Dates

- **Full Proposal Deadline Date(s)** (due by 5 p.m. proposer's local time):
February 26, 2004

Proposal Review Information

- **Merit Review Criteria:** National Science Board approved criteria apply.

Award Administration Information

- **Award Conditions:** Standard NSF award conditions apply.
- **Reporting Requirements:** Standard NSF reporting requirements apply.

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I. INTRODUCTION

In recent years, sensor research has been undergoing a quiet revolution, promising to have significant impact on a broad range of applications relating to national security, health care, the environment, energy, food safety, and manufacturing. The convergence of the Internet, communications, and information technologies with techniques for miniaturization has placed sensor technology at the threshold of a period of major growth. Emerging technologies can decrease the size, weight and cost of sensors and sensor arrays by orders of magnitude, and increase their spatial and temporal resolution and accuracy. Large numbers of sensors may be integrated into systems to improve performance and lifetime, and decrease life-cycle costs. Communications networks provide rapid access to information and computing, eliminating the barriers of distance and time for telemedicine, transportation, detecting toxic agents, recording spatial and temporal variations in environmental parameters, and monitoring the security of civil and engineering infrastructures. New geophysical/geochemical sensor networks will permit more effective monitoring of volcanic or seismic activity, severe wind patterns, and the health of the atmosphere and earth's subsurface. The coming years will likely see a growing reliance on and need for more powerful sensor systems, with increased performance and functionality.

Some needs for new sensors and sensor systems include (1) the ability to respond to new toxic chemicals, explosives and biological agents, (2) enhanced sensitivity, selectivity, speed, robustness, and fewer false alarms, and (3) the ability to function unattended and autonomously in unusual/extreme/complex environments. These needs can be addressed by the design and synthesis of functionalized receptors and materials resulting in next-generation devices. The materials may be of varying porosity enabling them to detect single toxic compounds in complex mixtures, or physical configurations that have surfaces with microchannels for microfluidic discrimination. Genomic tools may be incorporated to aid in characterizing ecological changes in aquatic and terrestrial environments. The full battery of advanced biological, chemical and materials research can be brought to bear on this challenge, including the design of functional nano- and meso-scale complex structures. Robustness under anticipated manufacturing schemes is required. Sensor arrays are of interest in this regard. Quantification of sensor data including limits of detection, calibration, interferences, sampling and verification of accuracy also needs to be considered.

Miniaturization, manufacture, cost and power consumption are also issues. Integration of sensors, processors, energy sources, and the communications network interface on a chip would facilitate the exchange of sensor data and critical information with the outside world. Information extraction may involve detection of events or objects of interest, estimation of key parameters, and human-in-the-loop or closed-loop adaptive feedback. Arrays of ultra low-power wireless nodes may be incorporated in high-bandwidth reconfigurable networks with high-speed connectivity to processing centers for decision and responsive action.

Sensing principles include but are not limited to mechanical, chemical, thermal, electrical, chromatographic, magnetic, biological, fluidic, optical, acoustic, ultrasonic, and mass sensing. Sensors may be exposed to hostile environments. They may be incorporated in mobile robotic systems, stationary platforms, or into manufacturing systems. Their environment may include high temperatures, high pressure, high vibration, high noise, or corrosive chemicals. In biological systems, the sensors themselves must not adversely affect the system or organism. The technology for sensing and control now has the potential for significant advances, with profound benefits for society.

To meet future societal needs, it will be necessary for sensor systems to leverage and incorporate projected advances in adjacent technologies, such as nanofabrication, biosystems, massively distributed networks, ubiquitous computing, broadband wireless communications, and information and decision systems.

Successful invention of low-cost, robust, miniaturized sensors and detection equipment such as mass spectrometers and

chromatographs will be of benefit to the scientific education community. Education projects about sensors have the potential to attract students to a fruitful interdisciplinary area with clear societal benefits. The area has the potential to help build a diverse scientific workforce.

Recent NSF workshop reports at <http://www.chemistry.gatech.edu/sensingforum-02> and <http://www.ce.berkeley.edu/Programs/Geoengineering/sensors> discuss projected sensor needs.

II. PROGRAM DESCRIPTION

This multidisciplinary research activity seeks to advance fundamental knowledge in new technologies for sensors and sensor networks, including sensors for toxic chemicals, explosives and biological agents; sensor systems in a distributed environment; terrestrial, atmospheric, and aquatic environmental analysis, the integration of sensors into engineered systems, and the interpretation and use of sensor data in decision-making processes. It is envisioned that research will be carried out by individual investigators, as well as by small teams and larger interdisciplinary groups that generate new concepts and approaches stimulated by the synergistic interaction of diverse disciplines. Proposals providing new sensing principles and/or materials, built-in sensor intelligence, and significantly improved performance and security are particularly encouraged. It is important that the research programs on advanced sensing concepts identify and address target applications, and projects should show a clear relationship to the requirements of the application. The community is encouraged to be innovative in educational aspects of sensor research. Projects should include underrepresented groups through the research and outreach.

TOPICAL AREAS

This solicitation will provide research support under the following topical areas. It is intended that these areas be broadly defined. Examples are provided to explore the breadth of each topic and are not intended to be all-inclusive.

Engineering of Materials, Concepts and Designs for New Sensors and Sensing Systems

Emphasis is on materials and devices suitable for engineering, biological or environmental applications, as opposed to analytical laboratory uses. The resulting sensors should be robust, sensitive, selective, and stable with rapid response time. Research ideas may encompass thin films, microreactors, microfluidics, tailored surfaces and selective separation agents. Other examples include: biomimetic sensors including hybrids consisting of proteins, enzyme fragments/components, bio-organometallics or other biocatalysts and other macromolecules with affinity domains that can be linked to surfaces; sensors to analyze signature bioactivities from cell to environment; bioMEMS; sensors for operation in harsh environments; sensors to monitor material flow in manufacturing processes; wireless sensors; chip-based systems incorporating multiple sensors, computation, actuation, and wireless interfaces; sensor systems capable of remote activation and interrogation; lightweight sensor power sources; novel optical and acoustical imaging concepts; new modeling and simulation tools; new techniques for on-sensor self-calibration and self-test; enhanced specificity to maximize accuracy and minimize false alarms; and new methods for sensor fabrication, manufacture and encapsulation.

Interpretation, Decision and Action Based on Networked Sensors

This area addresses system-level application areas. Research issues include: decision and control theory for sensed information; new statistical algorithms for sensor networks; sampling, pattern recognition, state estimation, false-alarm, and feedback theory for sensed data; tailored supervisory control systems; optimal sensor locations for effective process or system control; mathematical and hybrid system tools for monitoring distributed networks of large arrays of sensors and actuators; integrated hand-held sensors and kits for assembling them. System-level sensor applications include: biomedical health monitoring, diagnosis, and therapy; image-guided surgery; health monitoring systems for civil/mechanical/aero structures; sensors embedded in manufacturing processes and engineered systems; crisis management sensor systems; detection and response to severe environmental events; surveillance technology; robotics; mobile sensor networks; tracking/monitoring of mobile units (endangered species, inventory control, transportation); monitoring of variability in

terrestrial, atmospheric, and aquatic environments; and sensor assessment (reliability, verification, validation).

INTEGRATION OF SENSOR RESEARCH AND EDUCATION

This Program Solicitation will emphasize the integration of research and education, including curriculum development, innovative sensor test beds with remote access to demonstrate research concepts, educate students, and illustrate future technological directions. Widely available, low-cost, demonstration modules should benefit graduate, undergraduate, and K-12 education. The goal is to attract students to a fruitful interdisciplinary area with clear societal benefits, build a diverse scientific and engineering workforce, and help realize the potential educational impact of sensor-enabled science and technology.

TYPES OF SUPPORT

While important research advances by individual investigators are anticipated, a major goal of this solicitation is to stimulate highly innovative, interdisciplinary research at the interfaces of sensor technology and rapidly developing areas in science and engineering. It is likely that competitive proposals will involve research in more than one of the topical areas listed above. Sensor and Sensor Network research issues must be the central focus of the proposed work. Proposals that deal only tangentially with sensors are outside the scope of this solicitation and may be returned without review. This would include, for example, proposals addressing system-level applications, which do not also promise creative and enabling sensor research. Similarly, proposals with a primary emphasis on geosciences, biological sciences or polar research will not be considered eligible for funding unless they build meaningful partnerships between sensor and network engineers and the discipline scientists, and propose fundamental advances in sensors and sensor networks by engineering/scientific researchers to strengthen the linkage between engineering and science applications. Finally, while enabling, interdisciplinary sensor research may incorporate research in information technology, proposals that address general information technology for sensors and sensor nets should be directed in 2004 to the Information Technology Research program or appropriate disciplinary programs. This would include research in networking; communications; distributed and embedded systems; and sensor-based data acquisition, signal processing, and information systems. Proposers should consult with the directorate contact to determine whether the proposed research is suitable and encouraged for the Sensors and Sensor Networks competition in that directorate.

Projects funded under this solicitation will support collaborative research and education activities of the following types: 1) Sensor Individual Investigator (SII), 2) Sensor Small Teams (SST), and 3) Sensor Interdisciplinary Research Groups (SIRG). Each proposal should have an integrating research and education focus with components aimed at the development of a skilled workforce.

1) SII proposals by single investigators, or several investigators within the same discipline, should involve innovative and high-risk sensor research. Awards up to \$125,000 per year for three years will be considered. All such proposals should contain "Sensors:" at the beginning of the title, and must be directed to the most appropriate disciplinary program within the directorate that will be responsible for proposal evaluation.

2) Sensor Small Team (SST) proposals must involve fundamental contributions in research and education by investigators in multiple disciplines. They should generate new concepts and approaches that are enabled by the synergistic interaction of diverse technical fields. The proposals should contain two or three investigators, all listed on the cover page of the proposal, and having the diverse skills necessary to pursue the research objectives. Awards up to \$250,000 per year for three years will be considered. All such proposals should contain "SST:" at the beginning of the title. They must be directed to "ECS – Sensor Small Teams" for administrative purposes, and will be evaluated in a centralized review process.

3) Sensor Interdisciplinary Research Group (SIRG) proposals are intended to address research challenges on problems of breadth and complexity, where a synergistic blend of expertise is needed to make significant contributions. SIRG proposals must involve fundamental research contributions by investigators in diverse disciplines, involving one or a combination of the topical areas described above. Sensor proposals with the promise for significant advances by multiple collaborating investigators are especially encouraged. The proposals should contain three or more investigators, all listed on the cover page of the proposal, with time committed in the budget, and having the diverse skills necessary to pursue the research objectives. They should have a focus on integrating research and education with components aimed at the development of a

skilled workforce. Awards up to \$500,000 per year for up to 5 years will be considered. All such proposals should contain “SIRG:” at the beginning of the title. They must be directed to “ECS – Sensor Interdisciplinary Research Groups” for administrative purposes, and will be evaluated in a centralized review process.

A grantees' conference at NSF (Arlington, Virginia) at the end of the second year will enable the principal investigators of SSTs and SIRGs to review progress, exchange information, and promote collaborations. At least one investigator from each funded research team will be required to participate. Funds should be included in the proposals for attendance at this conference.

III. ELIGIBILITY INFORMATION

Proposals may only be submitted by U.S academic institutions and nonprofit research institutions in support of individual investigators, small teams, and larger interdisciplinary research groups. This limitation is also applies to subawards. An individual researcher may not be named as a participant on more than one proposal submitted to this solicitation. This limitation includes participation in any context for which financial remuneration is requested. For other information, the [Grant Proposal Guide](#) should be consulted.

IV. AWARD INFORMATION

- **Anticipated Type of Award:** Standard or Continuing Grant
- **Estimated Number of Awards:** 55 to 60
- **Anticipated Funding Amount:** \$31,000,000 from the Directorate for Engineering and up to \$5,000,000 additionally from other NSF Directorates/Offices, for awards of the following types:
 - Individual-Investigator Awards (up to \$125,000 per year for 3 years),
 - Small-Team Awards (up to \$250,000 per year for 3 years), and
 - Interdisciplinary-Research-Group Awards (up to \$500,000 per year for up to 5 years).

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

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal Instructions:

Proposals submitted in response to this program announcement/solicitation should be prepared and submitted in accordance with the general guidelines contained in the NSF *Grant Proposal Guide* (GPG). The complete text of the GPG is available electronically on the NSF Website at: <http://www.nsf.gov/cgi-bin/getpub?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.

The program solicitation contains supplements to the Grant Proposal Guide (GPG) proposal preparation guidelines. Please

see full program solicitation for further information.

Cover Sheet: See GPG Section II.C.

- Project Title. The project title for individual-investigator proposals must begin with "Sensors:" and follow with an informative title. Project titles for small-team and interdisciplinary-research-group proposals must begin with "SST" and "SIRG," respectively, followed by an informative title.
- Program selection. In order to facilitate proper assignment and review of proposals, **individual-investigator proposals must identify the NSF division and disciplinary program** closest to the subject matter of the proposed activities. **For all small-team and interdisciplinary group proposals, applicants must select "ECS - Sensor Small Teams" and "ECS - Sensor Interdisciplinary Research Group," respectively, as the division-program of interest.** Failure to do so may cause delays in processing.

Project Description: See GPG Section II.C.

- Note: the project description may not exceed 15 pages for any proposal submitted in response to this solicitation.

Proposers are reminded to identify the program announcement/solicitation number (04-522) in the program announcement/solicitation block on the proposal Cover Sheet. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

B. Budgetary Information

Cost Sharing:

Cost sharing is not required in proposals submitted under this Program Solicitation.

C. Due Dates

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

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

February 26, 2004

D. FastLane Requirements

Proposers are required to prepare and submit all proposals for this announcement/solicitation through the FastLane system. Detailed instructions for proposal preparation and submission via FastLane are available at: <http://www.fastlane.nsf.gov/a1/newstan.htm>. For FastLane user support, call 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 announcement/solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this announcement/solicitation.

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. Proposers are no longer required to provide a paper copy of the signed Proposal Cover Sheet to NSF. Further instructions regarding this process are available on the FastLane Website at: <http://www.fastlane.nsf.gov>

VI. PROPOSAL REVIEW INFORMATION

A. NSF Proposal Review Process

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

The National Science Board approved revised criteria for evaluating proposals at its meeting on March 28, 1997 ([NSB 97-72](#)). All NSF proposals are evaluated through use of the two merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

On July 8, 2002, the NSF Director issued [Important Notice 127](#), Implementation of new Grant Proposal Guide Requirements Related to the Broader Impacts Criterion. This Important Notice reinforces the importance of addressing both criteria in the preparation and review of all proposals submitted to NSF. NSF continues to strengthen its internal processes to ensure that both of the merit review criteria are addressed when making funding decisions.

In an effort to increase compliance with these requirements, the January 2002 issuance of the GPG incorporated revised proposal preparation guidelines relating to the development of the Project Summary and Project Description. Chapter II of the GPG specifies that Principal Investigators (PIs) must address both merit review criteria in separate statements within the one-page Project Summary. This chapter also reiterates that broader impacts resulting from the proposed project must be addressed in the Project Description and described as an integral part of the narrative.

Effective October 1, 2002, NSF will return without review proposals that do not separately address both merit review criteria within the Project Summary. It is believed that these changes to NSF proposal preparation and processing guidelines will more clearly articulate the importance of broader impacts to NSF-funded projects.

The two National Science Board approved merit review criteria are listed below (see the [Grant Proposal Guide](#) Chapter III.A for further information). 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 he/she is qualified to make judgments.

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.

B. Review Protocol and Associated Customer Service Standard

All proposals are carefully reviewed by at least three other persons outside NSF who are experts in the particular field represented by the proposal. Proposals submitted in response to this announcement/solicitation will be reviewed by Ad Hoc and/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.

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

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.

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 Division

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

B. Award Conditions

An NSF award consists of: (1) the award letter, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award letter; (4) the applicable award conditions, such as Grant General Conditions (NSF-GC-1); * or Federal Demonstration Partnership (FDP) Terms and Conditions * and (5) any announcement or other NSF issuance that may be incorporated by reference in the award letter. Cooperative agreement awards also are administered in accordance with NSF Cooperative Agreement Terms and Conditions (CA-1). Electronic mail notification is the preferred way to transmit NSF awards to organizations that have electronic mail capabilities and have requested such notification from the Division of Grants and Agreements.

*These documents may be accessed electronically on NSF's Website at http://www.nsf.gov/home/grants/grants_gac.htm. 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 is contained in the NSF *Grant Policy Manual* (GPM) Chapter II, available electronically on the NSF Website at <http://www.nsf.gov/cgi-bin/getpub?gpm>. The GPM is also for sale through the Superintendent of Documents, Government Printing Office (GPO), Washington, DC 20402. The telephone number at GPO for subscription information is (202) 512-1800. The GPM may be ordered through the GPO Website at <http://www.gpo.gov>.

C. Reporting Requirements

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

Within 90 days after the expiration of an award, the PI also is required to submit a final project report. Failure to provide final technical reports delays NSF review and processing of pending proposals for the PI and all Co-PIs. 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. This system permits electronic submission and updating of project reports, including information on project participants (individual and organizational), activities and findings, publications, and other specific products and contributions. PIs will not be required to re-enter information previously provided, either with a proposal or in earlier updates using the electronic system.

VIII. CONTACTS FOR ADDITIONAL INFORMATION

General inquiries regarding this program should be made to:

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- George A. Hazelrigg, Group Leader, Directorate for Engineering, Division of Design, Manufacture, & Industrial Innovation, 550 S, telephone: (703) 292-7068, fax: (703) 292-9056, email: ghazelri@nsf.gov
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For questions related to the use of FastLane, contact:

- FastLane Help Desk, National Science Foundation, telephone: 800-673-6188, email: fastlane@nsf.gov

IX. OTHER PROGRAMS OF INTEREST

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

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Related Programs:

- Sensors and Sensor Networks ([NSF 04-522](#))

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