

# Artificial Intelligence & Cognitive Science (AICS)

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## Program Solicitation

**NSF 03-600**

*Replaces Document NSF 01-156*



### National Science Foundation

Directorate for Computer and Information Science and Engineering

Division of Information and Intelligent Systems

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

December 19, 2003

December 19, yearly

## REVISIONS AND UPDATES

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The Dear Colleague Letter, "Proposal Submission Deadlines for the Division of Information and Intelligent Systems [IIS]," (NSF 01-156 dated September 6, 2001) established two annual proposal submission deadlines, March 1 and November 16. The Dear Colleague Letter is being replaced by individual IIS program solicitations, each with one annual proposal submission deadline. Please see the IIS Web site (<http://www.cise.nsf.gov/iis>) for additional information.

Effective on the day this program solicitation is posted by NSF, the annual deadline for Artificial Intelligence and Cognitive Science proposals is December 19. Proposals submitted in anticipation of a November 16, 2003 deadline will be accepted and reviewed with those submitted for the December 19, 2003 deadline.

## SUMMARY OF PROGRAM REQUIREMENTS

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### General Information

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#### Program Title:

Artificial Intelligence & Cognitive Science (AICS)

#### Synopsis of Program:

The Artificial Intelligence and Cognitive Science (AICS) program focuses on advancing the state of the art in Artificial Intelligence and Cognitive Science. The program supports research and related education activities fundamental to the development of computer systems capable of performing a broad variety of intelligent tasks, and to the development of computational models of intelligent behavior across the spectrum of human intelligence.

Examples of performance-oriented topics include intelligent agents, planning, automated reasoning, machine learning, case-based reasoning, knowledge representation methodologies, and architectures for combining intelligent tasks such as perception, reasoning, planning, learning, and action. Examples of cognitive-oriented topics include analogical reasoning, concept formation and evolution, argumentation, integration of knowledge from diverse sources and experience, knowledge acquisition by human learners, manipulation and development of taxonomies and classification systems, collaborative behavior, and adaptation and learning.

Many topics, such as the support of human decision making and diagnosis in complex task domains, require a combination of the two orientations.

#### **Cognizant Program Officer(s):**

- Edwina Rissland, Program Director, Directorate for Computer & Information Science & Engineering, Division of Information and Intelligent Systems, 1115 N, telephone: (703) 292-8930, fax: (703) 292-9073, email: [erisslan@nsf.gov](mailto:erisslan@nsf.gov)

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

- 47.070 --- Computer and Information Science and Engineering

#### **Eligibility Information**

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- **Organization Limit:** None Specified.
- **PI Eligibility Limit:** None Specified.
- **Limit on Number of Proposals:** None Specified.

#### **Award Information**

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- **Anticipated Type of Award:** Standard or Continuing Grant
- **Estimated Number of Awards:** 15
- **Anticipated Funding Amount:** \$5,500,000

#### **Proposal Preparation and Submission Instructions**

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##### **A. Proposal Preparation Instructions**

- **Full Proposal Preparation Instructions:** Standard GPG Guidelines apply.

##### **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):  
December 19, 2003

## Proposal Review Information

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

## Award Administration Information

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

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## I. INTRODUCTION

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The mission of the AICS program is twofold: to create systems that perform intelligently, and to develop a computational understanding of intelligence. The program seeks to encourage innovative approaches to core concerns of Artificial Intelligence and Cognitive Science such as the acquisition and evolution of concepts for use by humans and/or intelligent

programs in contexts that are characteristically more changing than not.

## II. PROGRAM DESCRIPTION

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The program seeks to encourage research and related education activities that advance the twofold mission of AICS. Thus, for instance, a project that is primarily concerned with cognitive processes should also address how it contributes to the development of intelligent systems that perform without necessarily being concerned with human cognition, and vice versa, a project whose goal is performance-oriented should address how it furthers our understanding of cognition or how it might be used to augment human performance. Projects should include a discussion of how the results will be evaluated, such as theoretical or empirical analyses.

Research topics in Artificial Intelligence and Cognitive Science include (but are not limited to):

- Integrated architectures for cognition
- Ontologies and representation of common sense, scientific, engineering or other specialized knowledge including web semantics
- Automated reasoning: deductive, probabilistic, diagnostic, causal and analogical inference
- Intelligent agents
- Case-based reasoning
- Machine Learning
- Knowledge discovery and acquisition
- Planning and scheduling
- Problem solving
- Constraint satisfaction
- Neural Networks
- Evolutionary Computing
- Cognitive modeling
- Modeling of human learning and knowledge acquisition in complex domains
- Hypothesis generation and confirmation in common sense or cutting edge scientific problems
- Computational approaches to design, and design theory and methodology
- Hybrid AI architectures that combine several alternative strategies.

The proposers are requested to carefully follow the [Grant Proposal Guide](#). In particular, clearly describe the Intellectual Merit and Broader Impacts of the proposed research, provide an evaluation plan (success metrics) for the proposed research, a mile-stone-based plan for each year of the project, and outline expected results, their potential applications and dissemination plans.

Projects that involve **human subjects** (e.g., to evaluate the relevance of retrieved images, validity of discovered knowledge, usefulness of an interface, etc.) or potentially sensitive personal data (e.g., Web logs, medical images, etc.) will require the IRB Approval or Exemption, and HUMAN SUBJECTS need to be indicated on the Proposal Cover Sheet. For details, see [Grant Proposal Guide, Proposals Involving Human Subjects](#). Failure to address Human Subjects issues in the proposal may result in critical reviews, and/or delay/terminate award processing, as NSF must comply with the Federal government's "Common Rule" for the protection of human subjects.

## III. ELIGIBILITY INFORMATION

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The categories of proposers identified in the [Grant Proposal Guide](#) are eligible to submit proposals under this program announcement/solicitation.

#### IV. AWARD INFORMATION

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In Fiscal Year 2004, the anticipated funding amount is \$5,500,000. The estimated number of awards in the program will be 15. The estimated duration of these awards is up to three years.

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

#### V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

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##### A. Proposal Preparation Instructions

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###### 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](mailto:pubs@nsf.gov).

Proposers are reminded to identify the program announcement/solicitation number (03-600) in the program announcement/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.

##### B. Budgetary Information

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###### Cost Sharing:

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

##### C. Due Dates

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

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

December 19, 2003

December 19, yearly

##### D. FastLane Requirements

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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](mailto: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

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### A. NSF Proposal Review Process

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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**

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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

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### A. Notification of the Award

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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

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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](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](mailto: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

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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

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General inquiries regarding this program should be made to:



- Edwina Rissland, Program Director, Directorate for Computer & Information Science & Engineering, Division of Information and Intelligent Systems, 1115 N, telephone: (703) 292-8930, fax: (703) 292-9073, email: [erisslan@nsf.gov](mailto:erisslan@nsf.gov)

For questions related to the use of FastLane, contact:

- Michele R. Johnson, Program and Technology Specialist, Directorate for Computer & Information Science & Engineering, Division of Information and Intelligent Systems, 1115 N, telephone: (703) 292-8930, fax: (703) 292-9073, email: [mrjohnso@nsf.gov](mailto:mrjohnso@nsf.gov)

## IX. OTHER PROGRAMS OF INTEREST

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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 *Custom News Service* (<http://www.nsf.gov/home/cns/start.htm>) to be notified of new funding opportunities that become available.

### Related Programs:

- Computer Vision ([NSF 03-602](#))
- Robotics ([NSF 03-601](#))

Research on related topics is supported through other programs in IIS: Robotics, Computer Vision, Human Language and Communication, Information and Data Management, and Digital Society and Technologies. Projects on education are supported through the [Directorate of Education and Human Resources](#) and those related to psychology in the [Directorate for Social, Behavioral and Economic Sciences](#).

## ABOUT THE NATIONAL SCIENCE FOUNDATION

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

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

financial assistance from NSF, although some programs may have special requirements that limit eligibility.

*Facilitation Awards for Scientists and Engineers with Disabilities (FASED)* provide funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on NSF-supported projects. See the GPG Chapter II, Section D.2 for instructions regarding preparation of these types of proposals.

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 or (800) 281-8749
  
- **To Order Publications or Forms:**  
  
Send an e-mail to: [pubs@nsf.gov](mailto:pubs@nsf.gov)  
  
or telephone: (703) 292-7827
  
- **To Locate NSF Employees:** (703) 292-5111

## **PRIVACY ACT AND PUBLIC BURDEN STATEMENTS**

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The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to applicant institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies needing information as part of the review process or in order to coordinate programs; and to another Federal agency, court or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records," 63 Federal Register 268 (January 5, 1998). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to an information collection unless it displays a valid OMB control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding this burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to: Suzanne Plimpton, Reports Clearance Officer, Division of Administrative Services, National Science Foundation, Arlington, VA 22230.

OMB control number: 3145-0058.

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