

# Enhancing the Mathematical Sciences Workforce in the 21st Century (EMSW21)

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## Program Solicitation

NSF 04-600

Replaces Document 03-575



## National Science Foundation

Directorate for Mathematical and Physical Sciences

Division of Mathematical Sciences

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

October 12, 2004

## SUMMARY OF PROGRAM REQUIREMENTS

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### General Information

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#### Program Title:

Enhancing the Mathematical Sciences Workforce in the 21st Century (EMSW21)

#### Synopsis of Program:

The long-range goal of the EMSW21 program is to increase the number of U.S. citizens, nationals, and permanent residents who are well-prepared in the mathematical sciences and who pursue careers in the mathematical sciences and in other NSF-supported disciplines. EMSW21 builds on the Vertical Integration of Research and Education (VIGRE) program and now includes a broadened VIGRE activity, an additional component for Research Training Groups (RTG) in the Mathematical Sciences and an additional component for Mentoring through Critical Transition Points (MCTP) in the Mathematical Sciences.

#### Cognizant Program Officer(s):

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

- 47.049 --- Mathematical and Physical Sciences

## Eligibility Information

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- **Organization Limit:** None Specified.
- **PI Eligibility Limit:**

For EMSW21 proposals, participating students and postdoctoral associates must be citizens, nationals or permanent residents of the United States and its territories and possessions. No such restriction is placed on the Principal Investigators.

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

## Award Information

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- **Anticipated Type of Award:** Other - RTG and MCTP: Standard or Continuing Grant, VIGRE: standard grant for 3-5 years or initial funding for three years, with a possible extension for another two years contingent upon the outcome of a third-year review by NSF. subject to availability of funds
- **Estimated Number of Awards:** 9 to 15 - Varies with type and size of award
- **Anticipated Funding Amount:** \$18,500,000 in FY 2005 and annually thereafter, subject to the availability of funds. See Section IV for detailed information.

## Proposal Preparation and Submission Instructions

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### 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:** Other budgetary limitations apply. Please see the full text of this solicitation for further information.

### C. Due Dates

- **Full Proposal Deadline Date(s)** (due by 5 p.m. proposer's local time):  
October 12, 2004

## Proposal Review Information

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- **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

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- **Award Conditions:** Additional award conditions apply. Please see the full text of this solicitation for further information.
- **Reporting Requirements:** Standard NSF reporting requirements apply.

**Summary of Program Requirements**

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**I. INTRODUCTION**

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Traditionally, the Division of Mathematical Sciences (DMS) has supported students and junior researchers through such long-standing mechanisms as individual investigator awards, Research Experiences for Undergraduates (REU), and postdoctoral fellowships. More recently, the DMS Grants for Vertical Integration of Research and Education (VIGRE) activity supported students at different stages of their careers through grants that were largely departmentally based. In many cases, however, students at a variety of levels can be also trained through the leadership of a smaller, more focused group of researchers, based in a sub-area of the mathematical sciences or linked by a multidisciplinary theme. Mentoring of students and junior researchers through critical transition points in the career pathway can also support and increase the number of well-prepared scientists in NSF-supported disciplines. For these reasons the VIGRE program will be expanded to include three distinct opportunities: a modified VIGRE activity, an additional component for Research Training Groups (RTG) in the Mathematical Sciences and an additional component for Mentoring through Critical Transition Points (MCTP) in the Mathematical Sciences. Those institutions applying for more than one category of this program must include a section on how the various projects will interact if more than one proposal is successful. Similarly those institutions already holding an EMSW21 grant must explain how the proposed projects will interact with the existing one.

Applicants must be explicit about goals for their proposal and supply data about past achievements and the improvements expected. This will be an integral part of the review process and is more fully discussed in the Proposal Preparation section below. It should be kept in mind that EMSW21 grants are for training and not the support of more general activities. Funding requested for non-training activities necessary for EMSW21 projects should be kept to a minimum and thoroughly justified in the Program Description.

Participants (undergraduates, graduate students, postdoctoral associates) supported with NSF funds in EMSW21 must be citizens, nationals or permanent residents of the United States and its territories and possessions. For purposes of this solicitation, a postdoctoral associate is defined as a mathematical scientist within two years of having received the Ph.D. degree, regardless of the title of the position held.

## II. PROGRAM DESCRIPTION

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The long-range goal of the EMSW-21 activity is to increase the number of well-prepared U.S. citizens, nationals, and permanent residents who pursue careers in the mathematical sciences and to broaden their background and perspective. The program is intended to help stimulate and implement permanent positive changes in education and training within the mathematical sciences in the U.S.

### GRANTS FOR VERTICAL INTEGRATION OF RESEARCH AND EDUCATION (VIGRE)

The focus of this component is enhancing the educational experience of all students and postdoctoral associates in a department (or departments). Broad faculty commitment and a team approach to enhancing learning are necessary. A principal element of VIGRE activity is increasing the interaction among undergraduates, graduate students, postdoctoral associates, and faculty members, whether pair-wise or collectively. Integrating research and education for graduate students and postdoctoral associates, involving undergraduates in substantial learning by discovery, and developing a team approach are keys to successful VIGRE projects. These goals can be accomplished in many ways and proposers should develop creative approaches that suit their circumstances.

The enhancement of educational experiences of all students should stem from an understanding of current patterns of student participation in the life of the department(s). All VIGRE proposals are required to include the outcome of a curriculum review and at least five years of data on past performance in attracting and retaining well-qualified U.S. citizens, nationals, and permanent residents as graduate students and postdoctoral associates in the mathematical sciences, including women and those from underrepresented groups. Those departments who have had previous VIGRE awards should present data through the period of the award. Departments can use this information to describe its capacity to host a VIGRE project that will create a significant improvement in the educational experiences of their students and postdoctoral associates. These data may also inform recruitment and retention plans and mechanisms for assessment of the project.

In conjunction with NSF's goal of a globally-oriented science and engineering workforce, possibilities for international interaction are now included among VIGRE options. VIGRE student and postdoctoral associates and their mentors may participate in international research and education collaborative activities, including activities in other countries that are integrated into and benefit the overall VIGRE program at the institution. When incorporating this option in the program, organizers will need to give careful attention to the practical aspects of sending U.S. students abroad, including logistical arrangements, language and cultural issues, and administrative requirements and how effective mentoring will take place in the foreign host institution.

**Graduate Traineeships.** Graduate trainees, at the center of the training continuum, form a pivotal component of the integration. Their participation in VIGRE should result in

1. Involvement with research activities that include undergraduates, other graduate students, postdoctoral associates, and faculty members;
2. Graduate education that is both broad and deep;
3. Significant teaching experience; and
4. Communication skills appropriate for both expert and non-expert audiences.

Mentoring is a critical strategy for enhanced learning, preparing the graduate trainees to become successful researchers,

communicators, and mentors. Opportunities such as internship experiences in industry, business, government laboratories, or other science and engineering departments can contribute to broadening the education program. Graduate trainees are expected to have a minimum of one year of supervised teaching, with at least one term in which the student has substantial responsibility for a class. Some element of traineeship activities should help students develop proficiency in the presentation of mathematical research in both written and oral formats and the ability to place their research in context.

The VIGRE activity is meant to allow significant time for research, course work and related activities, rather than to follow traditional patterns of graduate support through teaching assistantships that require substantial time on the part of the student. A graduate trainee can receive up to 33 months of non-teaching support from a VIGRE activity. The institution is expected to bear the cost of a graduate trainee's required teaching. Departments should demonstrate how the traineeships will improve the quality of the education their graduate students receive. The traineeships are not meant to promote expansion of graduate programs and should not replace existing institutional funding of research fellowships or scholarships.

**Undergraduate Experience.** In this program solicitation, the term "substantial learning by discovery" includes all activities that introduce undergraduates to the thrill of discovery and generate within them excitement for the mathematical sciences. Examples of research experiences include: faculty directed projects, whether involving one or many undergraduates, either during part of the academic year or the summer; internships in industry, business, or government laboratories; and participation in interdisciplinary research teams. Such experiences are intended to involve students in the creative aspects of mathematics in a non-classroom setting. They are also expected to enhance the development of students' communication skills, with particular emphasis on the presentation of mathematical concepts in both written and oral contexts. In all cases, it is expected that these undergraduates receive mentoring to stimulate their further interest in the mathematical sciences.

**Postdoctoral Associates.** Effective VIGRE activities better prepare postdoctoral associates for their future careers, whether in academia, industry, or government. It is expected that at the end of the postdoctoral experience, each associate will have a well-defined independent research program, well-developed communication skills, a broad perspective of his or her field, and the ability to mentor.

The postdoctoral program can provide opportunities not commonly found in mathematical sciences education and training, including interdisciplinary research experiences in connection with other departments and programs; participation in international research programs; internships in business, industry, or government laboratories; or participation in research institute programs suitably aligned with the associate's research interests. Postdoctoral associates are expected to teach (on average) one course per term while in residence at the sponsoring university. Over the duration of the postdoctoral appointment, this teaching should encompass a diverse set of instructional experiences. Likewise, it is expected that each VIGRE postdoctoral associate will submit a research proposal to a funding agency at some time during the course of the postdoctoral appointment. Mentoring to ensure that all postdoctoral associates become successful researchers, communicators and mentors is a critical element of a VIGRE postdoctoral program, as is interaction of postdoctoral associates with undergraduate and/or graduate students.

The typical VIGRE postdoctoral appointment is for three years, beginning within 18 months of completion of the Ph.D. Exceptions to the 18 month restriction require approval of the cognizant program officer.

**Organization and Management:** VIGRE provides funds to support postdoctoral associate positions in order to provide enhanced opportunities for research and advanced training; graduate research traineeships; and undergraduate research experiences. VIGRE expects extended participation in the VIGRE program from the entire departmental faculty, particularly in mentoring participating students and postdoctoral associates. Thus, the numbers of students and postdoctoral associates should reflect the capability of the department to provide them with appropriate resources for their education and training and participation in research. VIGRE will provide limited faculty salary for the purpose of organizing and managing the program

A successful **VIGRE** project will help attain the program goal of motivating more students to pursue advanced education in the mathematical sciences. It will:

- be based in a U.S. academic institution that grants the Ph.D. in the mathematical sciences
- integrate research with educational activities;
- increase interaction among undergraduates, graduate students, postdoctoral associates, and faculty members (either pair-wise or collectively);
- broaden the educational experiences of its students and postdoctoral associates to prepare them for a wide range of

- career opportunities;
- provide for developing professional and personal skills, such as communication, teamwork, teaching, mentoring, and leadership;
- include an administrative plan and organizational structure that ensures effective management of the project resources;
- have an institutional commitment to furthering the plans and goals of the VIGRE project and to create a supportive environment for integrative research and education;
- have a plan to increase the number and diversity of U.S. citizens, nationals, and permanent residents in the graduate and postdoctoral programs; and
- have a post-VIGRE plan. The VIGRE program is intended to help stimulate and implement permanent positive changes in education and training within the mathematical sciences in the U.S. Thus it is critical that a VIGRE site adequately plan how to continue the pursuit of VIGRE goals when funding terminates.

## **RESEARCH TRAINING GROUPS IN THE MATHEMATICAL SCIENCES (RTG)**

This component will provide groups of researchers with related research goals in the mathematical sciences with funds to foster research-based training and education. The groups may include researchers and students from different departments and institutions, but the research-based training and education activities must be based in the mathematical sciences. The RTGs are expected to vary in size, scope, proposed activities and in their plans for organization, participation, and operation, but will all have the following characteristics:

- based in a U.S. academic institution that grants the Ph.D. in the mathematical sciences (faculty and students from a predominately undergraduate institution may participate);
- focused on a major research theme in the mathematical sciences;
- have a convincing plan showing how the proposed activity would create new or enhanced research-based training and education experiences in the mathematical sciences for the students and post-doctoral investigators;
- have a significant collective mentoring component;
- be directed by a principal investigator, with at least two other faculty members, who will assist in management and participate fully in the educational and research plans of the RTG.

Proposals may include support requests for graduate and advanced undergraduate students, postdoctoral investigators, visitors and consultant services, travel, conferences, and workshops. Other budget items that are deemed to be essential to the success of the proposed activities may be proposed.

The group of a successful proposal will have collaborating faculty with a history of research accomplishments. This group should have a history of working with students and/or postdoctoral investigators, and they should have a good plan for recruiting students who are US citizens, nationals, or permanent residents into their program.

Increasing the number of US citizens, nationals, or permanent residents entering the scientific workplace is the goal of RTG, therefore a substantial plan for involving undergraduates in a research training program will increase the probability of obtaining funding. When used in reference to undergraduates, the word “research” should be given its broadest interpretation.

## **MENTORING THROUGH CRITICAL TRANSITION POINTS IN THE MATHEMATICAL SCIENCES (MCTP)**

This component will provide a system of mentoring devoted to points of transitions in a mathematical sciences career path that are critical for success from undergraduate studies to the early years in a tenure track position. The program may be a comprehensive department effort or a more focused endeavor involving a few faculty mentors and aimed towards a specific transition point or group of points. However, department-wide programs that include components for undergraduates, graduates, and postdocs, may be more appropriate for the VIGRE component.

The goal is to encourage the participation of research oriented mathematicians in the nurturing of students and those new to research as they change the intensity of their involvement in university mathematics. The range of activities can vary from preparing postdocs for an academic or industrial career to preparing talented high school students to begin the study of serious mathematics at a university. The MCTP component welcomes proposals for activities addressing diversity issues in the mathematical sciences workforce. Covering the full spectrum of these activities is not required but having a significant component directed at undergraduates is imperative.

Successful proposals will be those that provide ways to increase the number and the quality of training of U.S. citizens, nationals, or permanent residents entering the scientific workforce with strong mathematical training including the number of degrees awarded in the mathematical sciences. Examples of critical transition points and some associated activities are given below. The list is not meant to be exhaustive.

- *The transition from talented and dedicated high school student to the study of advanced mathematics at a university.*
- *The transition from undergraduate to graduate studies:* A program designed for strong undergraduate students who are motivated to pursue advanced mathematical studies or to engage students who might not otherwise be aware of opportunities for such studies. Such a program might navigate the student through an accelerated curriculum that would allow one to complete both the B.S. and M.S. degrees in four to five years or provide a bridge between predominantly undergraduate and minority serving institutions and research universities. Work with faculty mentors could lead to a wide exposure to various fields of mathematical interest and mathematical research experiences. Interdisciplinary programs are encouraged, e.g., one degree (B.S. or M.S.) might be in the mathematical sciences and the other in a related science or engineering field. Programs could be proposed for upper division undergraduate students or beginning graduate students that provide preparation for the first year of graduate school.
- *The transition from course work to original research:* Topics might include choosing a Ph.D. advisor; how to identify good research topics; reading research papers, etc.
- *The transition from graduate work to a postdoctoral position:* Points of concern could include good practices in writing research papers or research proposals or oral presentations, development of independent research activity.
- *The transition from postdoctoral studies to a tenure-track position in a research university:* Development of independent research activity.
- *The transition from Ph.D. work to a position in an undergraduate institution:* Programs to help new faculty at undergraduate institutions to remain active scholars.
- *The transition from Ph.D. work to work in industry:* Graduate student summer internships with industry could be included. Support may be requested for travel, conferences or workshops related to these activities.

The MCTPs will vary in size, scope, proposed activities, and plans for organization, participation, and operation, but will all have the following characteristics:

- A convincing plan describing the critical transition point(s) to be addressed and showing how the proposed activity would address the transition.
- Plans for recruitment and selection of participants, including members of under represented groups.
- A strong plan for mentoring of the participants..

### 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.

Eligible Participants: **Participating undergraduates, graduate students and postdoctoral associates supported with NSF funds in EMSW21 must be citizens, nationals or permanent residents of the United States and its territories and possessions.** For purposes of this solicitation, a postdoctoral associate is defined as a mathematical scientist within two years of having received the Ph.D. degree, regardless of the title of the position held.

### IV. AWARD INFORMATION

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Estimated program budget, number of awards and average award size/duration are as follows but are subject to the availability of funds:

#### VIGRE component

Budget: \$10,000,000

Number of Awards: 3 to 5

Award size: \$400,000 to \$1,000,000 per year

Duration: 3 to 5 years

Each proposal for the VIGRE component should describe a five-year program. Some awards might be made for 3 or 4 years only. Five-year awards will initially fund the first three years of the project. Funding for the remaining two years is not guaranteed, and is contingent upon a satisfactory outcome of a comprehensive third-year assessment by NSF. Funding after the first year is always subject to availability of funds. VIGRE funds will provide awards in amounts from \$400,000 to \$1,000,000 per year (including direct and indirect costs) to support the main activities for a duration not to exceed five years. A modest amount of additional funding may be available to support optional activities. (Funding for these activities may also be requested as a supplement at a later date.) In determining the number and size of awards, NSF considers the advice of reviewers, and availability of funds. It is projected that awards resulting from the competition will be announced in March each year.

### **RTG component**

Budget: \$4,000,000

Number of Awards: 3 to 5

Award size: up to \$500,000 per year

Duration: 1 to 5 years

### **MCTP component**

Budget: \$4,500,000

Number of Awards: 3 to 5

Award size: up to \$500,000 per year

Duration: 1 to 5 years

## **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).



1. **Cover Sheet.** So that your proposal is properly identified, select the number for the EMSW21 program announcement from the pull-down list. From the ensuing screen, select the Division of Mathematical Sciences and the Infrastructure program. In the title of the project, include the label "EMSW21-VIGRE", "EMSW21-RTG" or "EMSW21-MCTP" depending on which component the proposal addresses.
2. **Project Summary** (1-page limit). Provide a description of the activities that would result if the project is funded including comments on its objectives, people to be supported, and intended impact. The project summary should include the following information: name of the host institution/organization and of any other institutions/organizations involved; the group(s) of people to be affected; number of people involved; number of summer weeks or academic year activity. The EMSW21 component should be identified at the top of the summary page. The project summary must clearly address in separate statements (within the one-page summary): (1) the intellectual merit of the proposed activity; and (2) the broader impacts resulting from the proposed activity.
3. **Project Description.** All EMSW21 proposals must include an assessment plan and management plan as described below. The proposal's goals must be clearly stated. This is necessary so that the National Science Foundation can verify at the conclusion of the grant, or some other specified time, that the goals have been reached. This can be done if the goals are numerical, but other versions of goals are acceptable as long as verification is not to be based on anecdotal evidence. The proposal's reviewers should have a clear picture of where your program is presently and where you intend to be should an award be made. This will be an important part of the review process.

Recall the long-range goal of the EMSW21 program as stated at the beginning of this solicitation. Goals set for any proposal submitted to this program must be consistent with the overall program goal and help NSF achieve it.

For example, one goal might be to increase the number of U.S. citizens, nationals, and permanent residents earning undergraduate or graduate degrees by a specifically stated percentage. Other possibilities might be to keep the number of U.S. citizens, nationals, and permanent resident degree recipients constant, but to increase the percentage of these who go to the next stage of a mathematical career or improve the quality of the career paths they choose. Another possible goal might be to increase the number of U.S. citizens, nationals, and permanent residents who receive doctoral degrees and accept a postdoctoral fellowship at a Group I department. Any definition of success can be used here and becomes part of the proposal that will be reviewed.

The management plan submitted in the proposal must contain a description of the actions that will be taken to achieve the goals set in the assessment plan. One basis for judging proposals will be the goals set and the likelihood that the actions described in the management plan will achieve them.

**The project description for the VIGRE Component must include the following items.**

The proposed project should have a five-year duration. Particular attention must be paid to the following items in preparing the description:

- Introduction. Discuss the vision, scope, objectives, and anticipated impact of the program, at the local institution and beyond. (Not to exceed 2 pages)
- Outcome of curriculum review. Describe the nature of the curriculum review and any planned or implemented changes based on it. (Not to exceed 2 pages)
- Proposed VIGRE project. Provide a discussion of the programs envisioned for graduate trainees, undergraduate research experiences, and postdoctoral associates. Proposals should describe the proposed mechanisms for interaction among undergraduates, graduate trainees, postdoctoral associates, and faculty, and how these mechanisms will achieve the VIGRE goals. Proposals should also describe how education will be integrated with research and ways in which the project will broaden the experience of the students and postdoctoral associates involved and enhance their career opportunities. In addition to research activities and the broadening of course work, describe activities such as industrial internships or arrangements with government laboratories, businesses, or other academic departments and how these activities contribute to meeting the VIGRE goals. Describe teaching requirements for the graduate trainees and the postdoctoral associates. Include a

discussion of adequate mentoring for each of these activities. Discuss the proposed means of improving communication skills at all levels. Finally, include a discussion of how the VIGRE activities might affect students and postdoctoral associates not supported on VIGRE funds. (Not to exceed 15 pages)

- Recruitment and Retention. Describe plans for the recruitment and retention of students and postdoctoral associates as. Plans to motivate more students to pursue an education in the mathematical sciences should also be discussed. Specific provisions for the recruitment of U.S. citizens, nationals, and permanent residents as well as women and members of other groups under represented in the mathematical sciences must be included. (Not to exceed 2 pages.)
- Organization and Management Plan. Describe the plans, procedures, and personnel for the development and monitoring of all aspects of the project. In particular, discuss plans to ensure appropriate mentoring of students and postdoctoral associates, as well as the roles of the faculty involved. Provide evidence of the faculty commitment necessary for the implementation of the proposed program. If the project involves international collaborations, industrial internships or arrangements with government laboratories, businesses, or other departments, then the proposal should discuss existing arrangements, any plans for expanding these arrangements, and the personnel involved in managing these linkages. If the proposal describes a joint project between two or more departments at the same institution, describe organization and management plans for the necessary interactions between the departments. (Not to exceed 3 pages.)
- Performance Assessment Plan. Each proposal should describe a plan to assess the progress towards the achievement of the VIGRE goals. This plan should describe the quantitative and qualitative information that will be used to monitor the VIGRE activities and determine necessary mid-course corrections. The performance assessment can also help prepare VIGRE sites for the comprehensive third year review that will be conducted by NSF. (Not to exceed 5 pages.)
- Dissemination. The VIGRE program is intended to have a positive impact at the national level on the mathematical sciences community. Broad dissemination of VIGRE site activities, experiences, and insights is critical to achieve this. Each proposal must include a plan for this dissemination. It is important to disseminate both successful activities as well as information on less successful activities and mid-course corrections. (Not to exceed 2 pages)
- Results from Prior Support. Existing VIGRE departments should include a summary of what has been accomplished with a previous VIGRE award. This should include information on career paths of VIGRE-supported graduate students and postdocs. (Not to exceed 5 pages)
- Post-VIGRE plan. The VIGRE program is intended to help stimulate and implement permanent positive changes in education and training within the mathematical sciences in the U.S. Thus, it is critical that a VIGRE site adequately plan how to continue the pursuit of VIGRE goals when funding terminates. (Not to exceed 2 pages)

**The Project Description for the RTG Component (not to exceed a total of 15 pages) must include:**

- a description of the group's research program;
- a description of a significant group effort to train students and postdoctoral associates in the context of a vigorous research program;
- a description of any new activities (courses, seminars, workshops, special programs, etc.) that will result from this support;
- a list of the faculty members involved with the group, together with a description as to how each individual will contribute to the training efforts of the group;
- an assessment plan with clearly stated goals and information on past achievements and future ambitions as discussed at the start of this section on the Project Description;
- recruitment and selection plans for the undergraduate and graduate students and postdoctoral associates who will be members of the group. In particular, describe plans for the recruitment and selection of students and postdoctoral associates who are members of under represented groups;
- plans for how the group will function to provide collective mentoring of the students, and how the resources will be allocated;
- evidence of past success in training graduate students or postdocs, including names and degree dates.

**The Project Description for the MCTP component (not to exceed a total of 15 pages) must include:**

- a description of the transition point(s) to be addressed;
- a description of any activities (courses, seminars, workshops, special programs, etc.) that will result from this support;
- a list of the faculty members involved with the project, together with a description as to how each individual will contribute to the project activities;
- an assessment plan with clearly stated goals and information on past achievements and future ambitions as discussed at the start of this section on the Project Description;
- recruitment and selection plans for the participants. In particular, plans for the recruitment and selection of participants who are members of under-represented groups should be included.
- plans for how the project will function to enhance the transition of the participants, and how the resources will be allocated.

4. **References Cited.** A listing of references to pertinent literature is desirable.
5. **Current and Pending Support.** This form should be provided for all persons listed as Senior Personnel (limited to 12 people).
6. **Biographical Sketches.** The basic GPG guidelines for biographical material apply; however, senior personnel are encouraged to include other activities or accomplishments relevant to the proposed activities. Senior personnel include the principal investigator; the co-principal investigators, if any have been designated; and other faculty/ professionals who are anticipated to serve in the project. The number of biographical sketches is limited to 12.
7. **Project Budget .** The proposal should include a detailed project budget and budget justification, as described in the GPG. The budget justification (not to exceed 3 pages) should explain and justify major cost items and any unusual situations/inclusions and address the cost-effectiveness of the project. You must include a breakdown of numbers by types of participants and stipend levels for undergraduates, graduate trainees and postdoctoral associates. Project costs may also include such items as participant stipends, housing, meals, travel, tuition, or laboratory use and modest amounts for faculty salaries who manage and organize the activities. Since expenditures cannot be funded beyond the fifth year of the project, the budget justification should also address how the project will enable the continued progress of individuals supported in Year 5 of the project.

Graduate Trainees: EMSW21 funds will provide \$25,000 per student for eleven months each year, with an allowance for tuition and fees of up to \$10,500 per year per student. Stipends may be supplemented during non-teaching periods with support from other sources. The institution must bear the cost of the one-year teaching requirement for EMSW21 graduate trainees.

Undergraduate Students: The stipends for summer projects are expected to be at least \$1,000 per month for full-time research, with academic year stipends comparable on a pro rata basis.

Postdoctoral Associates: The typical EMSW21 postdoctoral associate will have a 3-year appointment, but this appointment should not go beyond the expiration date of the EMSW21 award. An EMSW21 postdoctoral appointment must not exceed 3 years. The full-time rate for the university appointment should be at least \$45,000 for the academic year. Funds can be requested in the proposal to pay for half this academic year stipend up to a maximum of \$25,000 for a full-time EMSW21 postdoctoral associate. Postdoctoral associates who receive any support from EMSW21 funds must be full-time postdoctoral associates when in residence and supported by EMSW21 funds for at least half the academic year. Each EMSW21 postdoctoral associate is expected to teach, on average, one course per term. In addition, the grant will provide summer support for two summers at the rate of \$10,000 per summer. The grant can be charged for the fringe benefits on that portion of the stipend paid by the grant. The associate is expected to apply to an appropriate external funding agency for support for the third summer. Funding for the postdoctoral appointments should include a total of \$9,000 for the three years to cover travel, equipment, and supplies.

Note that this support of students and postdoctoral associates is in the form of stipends and, therefore, is not subject to indirect costs. The cost of students, postdoctoral associates, and any fringe benefits should be

entered as Participant Costs in Section F of the budget page.

Faculty and staff salary may be requested only for the purpose of organization and management of the program. EMSW21 is a program for student training; as such faculty and staff salary must be limited to a small fraction of the entire budget, with the vast majority of funds directed at student and postdoctoral support.

## 8. Supplementary Documentation.

For the VIGRE component proposals must provide the following supplemental information:

**(1)** Data indicating: (a) the number of baccalaureate degrees in the mathematical sciences awarded by the relevant department(s) in each of the past five years; (b) the number of full-time Ph.D. students for each of the past five years; (c) a list of Ph.D. recipients during the past five years, along with each individual's citizenship status, baccalaureate institution, time-to-degree, post-Ph.D. placement, and thesis advisor; (d) the names of postdoctoral associates (e.g., holders of named instructorships, 2- or 3-year terminal assistant professors) during the past five years, their Ph.D. institutions, postdoctoral mentors, and post-appointment placements; (e) the dollar amount of non-teaching (i.e., research assistantship) support of graduate students supplied by the university for each of the past five years and the anticipated changes in university support of this kind in the event of an award; (f) the dollar amount of funding by federal agencies for REUs, for graduate students and for postdoctoral associates in each of the past five years; (g) the anticipated size of the graduate program should this award be received. This data must be broken down by gender and ethnicity and the number of students who are U.S. citizens, nationals, and permanent residents. This information will provide baseline data to be used in subsequent performance assessments.

Existing VIGRE institutions should also include data for five years prior to the beginning of their existing award.

**(2)** Letters of commitment by the institution and other sources in support of the project. If industrial internships are planned, letters indicating the willingness of the industrial organization and of individual industrial mentors (if known) to participate should also be included. These documents should be scanned and uploaded into the FastLane supplementary documentation section.

For the RTG and the MCTP component you must include data spanning the preceding 5 years concerning classes of students to be affected should a grant be awarded. This data must be broken down by gender and ethnicity and the number of students who are U.S. citizens, nationals, and permanent residents. So, for example, an EMSW21 proposal that involves graduate students must include such data for the entire graduate student population of the department. Similar data on undergraduate majors is required should that be a group addressed by the proposal.

Since the activities in RTG and MCTP grants can vary widely, it is not possible to be specific regarding the types of data desired. Nevertheless the discussion of the data required for a VIGRE proposal can be seen as an indication of the depth and breadth of what is wanted. Inadequate data or data that is poorly presented will be negatively interpreted in the review process. All the data for RTG and MCTP proposals cannot exceed two pages.

For the RTG and the MCTP component you may include:

**Letters of Commitment.** Signed letters of commitment documenting collaborative arrangements of significance to the proposal should be scanned and placed in this section. Letters may be relevant where the awardee and performing organizations are different, where faculty or facilities of more than one institution are to be employed, or where international activities are arranged. Letters of endorsement are not permitted.

Proposers are reminded to identify the program announcement/solicitation number (04-600) 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

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### Cost Sharing:

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

### Other Budgetary Limitations:

Award sizes will be as follows:

VIGRE component- \$400,000 to \$1,000,000 per year

RTG component- up to \$500,000 per year

MCTP component- up to \$500,000 per year

## 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):

October 12, 2004

## 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: <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](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.

**Additional Review Criteria:**

EMSW21 proposals will be examined by external merit review. Reviewers will be asked to interpret the two basic NSF review criteria in the context of EMSW21. In addition, they will be asked to place emphasis on the following considerations:

- The appropriateness and value of the experience for the participants and the nature of participation in these activities;
- The quality of the environment in the department and the institution, including the record of the Principal Investigator and other senior personnel in the proposed activities, the facilities, and the professional development opportunities;
- The quality and appropriateness of the goals for the proposal and the assessment plan;
- Appropriateness of the recruitment and selection plan, including plans for involving participants from underrepresented groups;
- Quality of plans for participant preparation and follow-through designed to promote continuation of participant interest and involvement in the mathematical sciences; and
- The plans for managing the project and evaluating outcomes and the appropriateness of the budget.

**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.

In most cases, proposers will be contacted by the Program Officer after his or her recommendation to award or decline funding has been approved by the Division Director. This informal notification is not a guarantee of an eventual award.

NSF is striving to be able to tell proposers whether their proposals have been declined or recommended for funding within six months. The time interval begins on the closing date of an announcement/solicitation, or the date of proposal receipt, whichever is later. 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>.

#### **Special Award Conditions:**

While each VIGRE component proposal should describe a five-year program, some awards may be made for only three years. When an award is made for five years, initial funding will only cover the first three years of the project. Additional funding for the remaining two years will be contingent upon the satisfactory outcome of a comprehensive third-year assessment by NSF. Funding is always subject to availability of funds.

In addition the following special conditions will apply: the cognizant NSF program official must be notified prior to any reallocation of funds in excess of \$25,000, or any reallocation of funds granted as participant support costs.

### 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:

- John Conway, Program Director, Directorate for Mathematical & Physical Sciences, Division of Mathematical Sciences, 1025 N, telephone: (703) 292-4872, fax: (703) 292-9032, email: [jconway@nsf.gov](mailto:jconway@nsf.gov)
- Lloyd E. Douglas, Program Director, Directorate for Mathematical & Physical Sciences, Division of Mathematical Sciences, 1025 N, telephone: (703) 292-4862, fax: (703) 292-9032, email: [ldouglas@nsf.gov](mailto:ldouglas@nsf.gov)

For questions related to the use of FastLane, contact:

- Florence Rabanal, Electronic Business Coordinator, Directorate for Mathematical & Physical Sciences, 1005 N, telephone: (703) 292-8808, fax: (703) 292-9151, email: [frabanal@nsf.gov](mailto:frabanal@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.

[Research Experiences for Undergraduates \(http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf03577\)](http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf03577)

[Faculty Early Career Development \(CAREER\) Program \(http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf02111\)](http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf02111)

[Focused Research Groups in the Mathematical Sciences \(http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf02129\)](http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf02129)

[Interdisciplinary Grants in the Mathematical Sciences \(http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf04518\)](http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf04518)

[Mathematical Sciences Postdoctoral Research Fellowships \(http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf01126\)](http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf01126)

[Integrative Graduate Education and Research Training Program \(http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf04550\)](http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf04550)

## 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 (FASSED)* 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
  
- **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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