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1999 Technology for a Sustainable Environment

NSF/EPA Partnership for Environmental Research

Interagency Announcement of Opportunity

OPENING DATE: APRIL 26, 1999

CLOSING DATE: JULY 26, 1999

NATIONAL SCIENCE FOUNDATION
Directorate for Engineering
Directorate for Mathematical and Physical Sciences

ENVIRONMENTAL PROTECTION AGENCY
National Center for Environmental Research and Quality Assurance

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SUMMARY OF PROGRAM REQUIREMENTS

GENERAL INFORMATION

Program Name: Technology for a Sustainable Environment:
NSF/EPA Partnership for Environmental Research

Short Description/Synopsis of Program:

This competition is designed to address pollution avoidance / prevention processes, methodologies, and technology research. Research proposals are invited that advance the development and use of innovative technologies and approaches directed at avoiding or minimizing the generation of pollutants at the source. Research projects are possible in the general areas of: chemistry for pollution avoidance or prevention; engineering for pollution avoidance and prevention; chemical processes and reaction engineering; simulations, modeling, sensors, and feedback techniques for pollution avoidance and prevention; and industrial ecology.

This competition is not intended to address issues related to waste monitoring, treatment, remediation, recycling, or containment other than those aspects that pertain to in-process recycling of waste. Research in the areas of remediation and treatment of hazardous materials, while very important, is supported by other program activities in both agencies.

NSF and EPA are providing funds for fundamental and applied research in the physical sciences and engineering that will lead to the discovery, development, and evaluation of advanced and novel environmentally benign methods for industrial processing and manufacturing. The competition addresses technological environmental issues of design, synthesis, processing, and the production, use, and ultimate disposition of products in continuous and discrete manufacturing industries. Projects must employ fundamental new approaches, and address, or be relevant to, current national concerns for pollution avoidance / prevention (at the source). Projects that are "on the cutting edge" or are "high-risk/high-payoff" are encouraged. Projects also will be considered that show the potential to change research infrastructure, by developing teams, using systems approaches, introducing new ways of conducting research.

Cognizant Program Officer(s): At EPA**,** Barbara Karn, EPA Environmental Research Division, telephone (202) 564-6824, e-mail: Karn.Barbara@epamail.epa.gov; at NSF, Robert Wellek, Deputy Division Director, Room 525, Division of Chemical and Transport Systems, fax (703) 306-0319, e-mail: rwellek@ nsf.gov.

Applicable Catalog of Federal Domestic Assistance (CFDA): 47.041 Engineering; 47.049 Mathematics and Physical Sciences; 66.500 EPA Grants.

ELIGIBILITY

- Limitation on the categories of organizations that are eligible to submit proposals: Proposals may be submitted by universities and not-for-profit institutions in support of individual investigators or small groups.
- PI eligibility limitations: None
- Limitation on the number of proposals that may be submitted by an organization: Only one proposal may be submitted by a Principal Investigator and he/she may only collaborate in one other proposal as a co-Investigator.

AWARD INFORMATION

- Type of awards anticipated: Standard and Continuing Grants
- Number of awards anticipated in FY 2000: 20
- Amount of funds available: Approximately $5.0 million will be available for this initiative in FY 2000
- Anticipated date of award: January 2000

PROPOSAL PREPARATION & SUBMISSION INSTRUCTIONS

- **Proposal Preparation Instructions**

  - Letter of Intent requirements: None
  - Preproposal requirements: None
  - Proposal preparation instructions: Standard NSF Grant Proposal Guide instructions
  - Supplemental proposal preparation instructions: None
  - Deviations from standard (GPG) proposal preparation instructions: None

- **Budgetary Information**

  - Cost sharing/matching requirements: Cost sharing with NSF at a level of 30% of total eligible project costs is required for all equipment expenses submitted in response to this announcement above $10,000. The proposed cost sharing must be shown on line M on the proposal budget (NSF Form 1030.) EPA grants will not require cost-sharing.
  - Indirect cost (F&A) limitations: None
  - Other budgetary limitations: None

- **FastLane Requirements**

  - FastLane proposal preparation requirements: FastLane use optional
  - FastLane points of contact:

    Florence I. Rabanal
    NSF Directorate for Mathematical and Physical Sciences
    FastLane Project Coordinator
    frabanal@nsf.gov
    voice (703) 306-1998

    Cheryl Albus
    NSF Directorate for Engineering
    FastLane Coordinator
    calbus@nsf.gov
    voice (703) 306-1302

- **Deadline/Target Dates**

  Full Proposal Deadline: 5:00 p.m., EDT, July 26, 1999 (paper)
  5:00 p.m., local time, July 26, 1999 (FastLane)

PROPOSAL REVIEW INFORMATION

Merit Review Criteria: Standard National Science Board approved criteria and other special criteria

AWARD ADMINISTRATION INFORMATION

Grant Award Conditions: NSF, GC-1 or FDP-III. EPA grants awarded as a result of this announcement will be administered in accordance with 40 CFR Part 30 and 40 or the most recent FDP-III, "*Federal Demonstration Partnership General Terms and Conditions*," terms and conditions, depending upon the grantee institution.

- Special grant conditions anticipated: None anticipated
- Special reporting requirements anticipated: None

1.0 INTRODUCTION

The National Science Foundation (NSF) and Environmental Protection Agency (EPA) announce their intent to continue to support an extramural grants competition in fundamental environmental research to be held in Fiscal Year (FY) 1999-2000. This NSF/EPA research activity has been developed based on a Memorandum of Understanding between the agencies which establishes a partnership emphasizing the support and merit review of fundamental environmental research. This is the fifth year of the joint awards competition. Information on awards made in the FY 1995 through FY 1998 competitions may be found on the Internet through: (http://www.epa.gov/ncerqa) or (http://www.nsf.gov/home/crssprgm/epa/start.htm).

The four research areas targeted this year are:

- Technology for a Sustainable Environment
- Water and Watersheds
- Decision-making and Valuation for Environmental Policy
- Environmental Statistics

This announcement solicits applications for Technology for a Sustainable Environment (TSE). Awards made through this competition are dependent upon responsiveness of the proposals to the announcement, the quality, potential impact, and uniqueness of the proposed research, and the availability of funds. NSF and EPA anticipate awarding approximately $5 million (combined from the two agencies) for TSE, with a projected award range from $50,000 to $150,000 per award per year, and an approximate duration of 2 to 3 years. Subject to the availability of funds and agency programming decisions, NSF and EPA plan to issue additional solicitations in the TSE program through FY 2001.

Proposals in response to this TSE announcement must be received by July 26, 1999. It is anticipated that awards will be made by early FY 2000. Awards resulting from this TSE competition may be made by either NSF or EPA, or by joint agency funding through split awards, at the option of the agencies, not the grantee.

Further information, if needed, may be obtained from the NSF and EPA officials indicated below. E-mail inquiries are preferred.

General Information on the NSF/EPA Partnership for Environmental Research:

Dr. Robert E. Menzer
EPA National Center for Environmental Research and Quality Assurance
menzer.robert@epamail.epa.gov
voice (202) 564-6849

Dr. Robert M. Wellek
NSF Directorate for Engineering
rwellek@nsf.gov (preferred)
fax (703) 306-0319

Dr. Elbert Marsh
NSF Directorate for Engineering
emarsh@nsf.gov
voice (703) 306-1301

Dr. Henry N. Blount, III
NSF Directorate for Mathematical and Physical Sciences
hblount@nsf.gov
voice (703) 306-1946

Information on Technology for a Sustainable Environment (TSE):

Dr. Barbara Karn
EPA Environmental Engineering Research Division
karn.barbara@epamail.epa.gov
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Mr. Stephen A. Lingle
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Dr. Robert Wellek
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Dr. Margaret Cavanaugh
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mcavanau@nsf.gov
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NSF FastLane Help Desk
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Florence I. Rabanal
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Cheryl Albus
NSF Directorate for Engineering FastLane Coordinator
calbus@nsf.gov
voice (703) 306-1302

2.0 TECHNOLOGY FOR A SUSTAINABLE ENVIRONMENT

2.1 Introduction

As a nation, we seek long-term economic growth that creates jobs while improving and sustaining the environment. It is increasingly clear that "end-of-pipe" pollution controls are not a sufficient means of reaching these goals. A new generation of cleaner industrial manufacturing and processing technologies is needed that supports pollution avoidance / prevention (at the source), efficient resource use, and industrial ecology. Such a strategy can help companies become more competitive by lowering resource and energy needs, reducing waste and emissions control costs, and fostering sustainable development.

This competition is designed to address pollution avoidance / prevention processes, methodologies, and technology research. Research proposals are invited that advance the development and use of innovative technologies and approaches directed at avoiding or minimizing the generation of pollutants at the source. This competition is not intended to address issues related to waste monitoring, treatment, remediation, recycling, or containment other than those aspects that pertain to in-process recycling of waste. Research in the areas of remediation and treatment of hazardous materials, while very important, is supported by other program activities in both agencies.

NSF and EPA are providing funds for fundamental and applied research in the physical sciences and engineering that will lead to the discovery, development, and evaluation of advanced and novel environmentally benign methods for industrial processing and manufacturing. The competition addresses technological environmental issues of design, synthesis, processing, and the production, use, and ultimate disposition of products in continuous and discrete manufacturing industries. Projects must employ fundamental new approaches, and address, or be relevant to, current national concerns for pollution avoidance / prevention (at the source). Projects that are "on the cutting edge" or are "high-risk/high-payoff" are encouraged. Projects also will be considered that show the potential to change research infrastructure, by developing teams, using systems approaches, introducing new ways of conducting research.

Answering research questions related to environmental sustainability issues often requires the analysis and evaluation of scientific information and complex phenomena over large spatial and time domains. The use of modern information technology (IT) and high end computing resources to do this research presents exciting opportunities to the research community, and proposals utilizing these approaches may fit in with other NSF and EPA programs. Molecular modeling and simulation of physical, biological, and chemical phenomena is another example of a general research approach that is expected to have a major impact on methods of approaching environmental sustainability.

The areas of this announcement cover: Chemistry for Pollution Avoidance or Prevention; Engineering for Pollution Avoidance or Prevention; Simulations, Modeling, Sensors, and Feedback Techniques for Pollution Avoidance or Prevention; and Industrial Ecology.

2.1.1 New Grants for Current TSE Projects

Proposal applications that request new grants for currently on-going TSE projects related to chemistry and engineering activities described below SHOULD include some form of academic-industrial collaboration, partnership or involvement. Examples of some possible collaborative mechanisms are more fully described in NSF's *Grant Opportunities for Academic Liaison with Industry* Solicitation (GOALI, NSF 98-142), a program dedicated to industry-university collaborative efforts. More information may be obtained at (http://www.nsf.gov/goali).

2.2 Description of Possible Research Projects

2.2.1 Chemistry for Pollution Avoidance or Prevention

The long-range goal of this activity is to develop substances and processes that are safer, reduce health risks, and are environmentally friendly. For the chemical industry, preventing pollution at the source, or "green chemistry," involves the design of chemicals and alternative chemical processes that do not utilize toxic feedstocks, reagents, or solvents or reduce or do not produce toxic byproducts or co-products.

Appropriate areas of investigation span the broad range of chemistry and include chemical synthesis and catalysis; analysis and detection; separation processes; computational modeling; sensor innovation; reaction mechanisms; and environmentally benign materials. Some specific examples are:

- Development of innovative synthetic methods using catalysis or biocatalysis, including combinatorial or self-assembly approaches; photochemical, electrochemical, or biomimetic activation; or starting materials that are innocuous or renewable.

- Development of alternative new reaction conditions, such as using solvents that are environmentally benign, developing separation methods that reform feedstocks for improved efficiency, developing advanced laser control of reactivity, or increasing reaction selectivity to reduce wastes and emissions.

- Discovery or redesign of useful chemicals and materials such that they are less toxic to health and the environment or safer with regard to accident potential.

- Development of advanced sensors that have potential application in reducing resource use or improving production selectivity.

2.2.2 Engineering for Pollution Avoidance and Prevention

The focus of this program activity is to develop novel engineering approaches for preventing or reducing pollution from industrial manufacturing and processing activities, both for continuous and discrete processes. The scope includes: technology and equipment modifications, reformulation or redesign of products, substitution of alternative materials, and in-process

changes. Although these methods are often thought of in relation to the chemical, biochemical, and materials process industries, they can be utilized in many other industries, such as semiconductor manufacturing systems.

Potential areas of research include:

- *Biological Applications*: Development of innovative environmental technologies using bioengineering techniques such as bioprocessing to prevent pollution at the source in bio-manufacturing processes. Examples include: research to convert waste biomass into useful products, genetic engineering to produce more specific biocatalysts, bioprocessing to increase energy efficiency, decrease use of hazardous reactants or byproducts, or develop more cost effective methods of producing environmentally benign products. Remediation is not addressed here.

- *Fluid and Thermal Systems:* Improved thermal processes that employ novel thermal or fluid and/or multiphase/particulate systems resulting in significantly lower hazardous effluent production. Examples include: novel refrigeration cycles using safe and environmentally-benign working fluids to replace halogenated hydrocarbons hazardous to upper atmosphere ozone levels; improved automobile combustion process design for reduced pollutant production.

- *Interfacial Transport and Separations:* Materials substitutions and process alternatives which prevent or reduce environmental harm, such as change of raw material or the use of less hazardous solvents, organic coatings, and metal plating systems where the primary focus is on non-reactive diffusional and interfacial phenomena. Examples include: use of special surfactant systems for surface cleaning and reactions; novel, cost-effective methods for the highly efficient in-process separation of useful materials from the components of the process waste stream, for example, field enhanced and hybrid separation processes; novel processes for molecularly controlled chemical and materials synthesis of thin films and membranes.

- *Design, Manufacturing, and Industrial Innovations*: (a) New or improved manufacturing processes that reduce production of hazardous effluents at the source. Examples include: machining without the use of cutting fluids that currently require disposal after they are contaminated; eliminating toxic electroplating solutions by replacing them with ion or plasma-based dry plating techniques; new bulk materials and coatings with durability, long life, and other desirable engineering properties that can be manufactured with reduced environmental impact. (b) Optimization of existing discrete parts manufacturing operations to prevent, reduce, or eliminate waste. Concepts include: increased in-process or in-plant recycling and improved and intelligent process control and sensing capabilities; in-process techniques that minimize generation of pollutants in industrial waste incineration processes, design tool development

- *Chemical Processes and Reaction Engineering:* Improved reactor, catalyst, or chemical process design in order to increase product yield, improve selectivity, or reduce unwanted by-products. Approaches include: novel reactors such as reactor-separator combinations that provide for product separation during the reaction, alternative energy sources for reaction

initiation, and integrated chemical process design and operation, including control. Other approaches are: new multifunctional catalysts that reduce the number of process stages; novel heterogeneous catalysts that replace state-of-the-art homogeneous ones; new photo- or electro catalysts that operate at low temperatures with high selectivity; novel catalysts for currently uncatalyzed reactions; processes that use renewable resources in place of synthetic intermediates as feedstocks; novel processes for molecularly controlled materials synthesis and modification.

2.2.3 Simulations, Modeling, Sensors, and Feedback Techniques for Pollution Avoidance and Prevention

This competition also encourages research in physical sciences and engineering that will lead to the development of novel measurement and assessment techniques for pollution avoidance / prevention (at the source). Topics in this program activity include computational simulations and process design algorithms, as well as the development of appropriate measurement methods to use as input for such analyses. The methods developed should provide the basis for scientifically sound and quantitative comparisons of the environmental impact of various technologies. The following examples provide some areas of investigation:

- Innovative, quantitative methodologies for conducting plant process or manufacturing analysis which permit sound quantitative comparisons of impacts of different pollutants on different media.

- Algorithms incorporating pollution avoidance / prevention (at the source) into process design, intelligent control, and simulation methodologies for process and manufacturing design.

- Process simulator modules for new technologies such as novel membrane processes.

- Computational (molecular) models that predict reaction selectivity in terms of a few fundamental properties of substances and integration of those models into chemical reaction databases relevant to environmentally benign chemical processes.

- Improved and intelligent sensors and control algorithms for real time, in-process multivariate control of manufacturing equipment and systems to reduce waste material and hazardous emissions.

2.2.4 Industrial Ecology

This competition supports the development of new methodologies and approaches in the growing field of industrial ecology. Industrial ecology requires that an industrial system be viewed not in isolation from its surrounding systems, but in concert with them. It is a systems view in which one seeks to optimize the total materials cycle from virgin material, to finished material, to component, to product, to recycle or reuse, to obsolete product, to ultimate disposal. Factors to be optimized include resources, energy and capital.

Potential research topics include, but are not limited to, the following:

- Innovative methodologies for streamlined and targeted life-cycle-assessment and analysis, including product use interactions with the environment and impact prioritization models;

- Environmentally benign processes in a systems context including design for material and energy minimization while avoiding environmental harm;

- Environmentally benign product design methodologies, considering the entire life-cycle of the materials employed in the production, use and disposal of products; product design methodologies and systems that can provide scientifically sound comparisons with less comprehensive data inputs and computational analysis; design for disassembly, reuse and recycling.

2.3 Additional Considerations

2.3.1 Industrial-Academic Collaboration

A clearer understanding of problems and more creative solutions often result from collaboration between academic and the industrial investigators who represent the eventual customers for the products of the research. Therefore, applicants are strongly encouraged to seek meaningful project collaboration with industrial partners on research issues that link fundamental and applied aspects of pollution prevention / avoidance. In some cases, government agencies or professional organizations may be an appropriate substitute for an industrial partner. The NSF GOALI program announcement (NSF 98-142) outlines several mechanisms for these collaborations. Other mechanisms for collaboration will also be considered.

2.3.2 Multidisciplinary Proposals

Environmental problems often cross disciplinary boundaries. This solicitation welcomes interdisciplinary proposals that address the TSE topic areas. Proposals may be submitted by individuals or small groups of investigators who are working on projects that will advance the concepts and technologies of pollution avoidance / prevention (at the source).

2.3.3 Student involvement

Researchers from both academic and non-profit institutions may apply for support (see Section 3.0). Projects involving the training and education of junior scientists and engineers (such as graduate students) in academia through the research experience are very strongly encouraged.

3.0 ELIGIBILITY

Academic and not-for-profit institutions located in the U.S. are eligible. Profit-making firms and federal agencies are not eligible to apply to this program. However, personnel in profit-making firms may participate as non-funded co-investigators or through sub-contracts with the awardee institution.

Federal employees may cooperate or collaborate with eligible applicants within the limits imposed by applicable legislation and regulations. However, federal agencies, national laboratories funded by federal agencies (FFRDCs), and federal employees are not eligible to submit applications to this program and may not serve in a principal leadership role on a grant. Under exceptional circumstances the principal investigator's institution may subcontract to a federal agency or FFRDC to purchase unique supplies or services unavailable in the private sector. Examples are purchase of satellite data, census data tapes, chemical reference standards, unique analyses or instrumentation not available elsewhere, etc. A written justification for such federal involvement must be included in the application, along with an assurance from the federal agency that commits it to supply the specified service. Federal employees may not receive salaries or in other ways augment their agency's appropriations through grants made by this program. Potential applicants who are uncertain of their eligibility should contact Dr. Robert E. Menzer at EPA (Address listed in Section 1.0).

EPA and NSF welcome applications on behalf of all qualified scientists, engineers, and other professionals and strongly encourage women, members of underrepresented groups, and persons with disabilities to compete fully in any of the programs described in this announcement.

In accordance with Federal statutes and regulations and EPA and NSF policies, no person on grounds of race, color, age, sex, national origin, or disability shall be excluded from participation in, denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from EPA or NSF.

4.0 INSTRUCTIONS FOR APPLICATION SUBMISSION

4.1 Sorting Codes

In order to facilitate proper assignment and review of applications, each applicant MUST identify the topic area in which the application is to be considered. Failure to do so may result in delay. At various places within the application, applicants will be asked to identify this topic area by using the appropriate Sorting Code. The *Sorting Codes* correspond to the topic areas within the announcement and are shown below:

- Chemistry for Pollution Prevention TSE99-A

- Engineering for Pollution Prevention:
  - Biological Applications TSE99-B
  - Fluid and Thermal Systems TSE99-C
  - Interfacial, Transport, Separations TSE99-D
  - Design, Manufacturing, and Industrial Innovations TSE99-E
  - Chemical Processes and Reaction Engineering TSE99-F

- Simulations, Modeling, Sensors, and Feedback Techniques for Pollution Avoidance and Prevention TSE99-G

- Industrial Ecology TSE99-H

The Sorting Code must be placed at the end of the proposal title and enclosed in parentheses, e.g., "A New Algorithm to Incorporate Pollution Avoidance Into Process Design (TSE99-G)," and this title must also be placed on the top of the project summary (abstract) page. NSF and/or EPA may reassign proposals to other or multiple sorting categories to ensure optimal review of proposals.

4.2 The Application

Proposals submitted to the TSE competition MUST conform to NSF proposal submission requirements. The NSF Grant Proposal Guide (GPG, NSF 99-2) provides detailed proposal preparation guidance. All proposals should be prepared in accordance with the GPG (http://www.nsf.gov/cgi-bin/getpub?nsf992), except as modified in this announcement. (including the information in section 4.3 below.) All forms needed to apply are available in the GPG and in the Proposal Forms Kit (NSF 99-3). The GPG and Forms Kit are available electronically through the NSF Home Page at (http://www.nsf.gov). Paper copies can be obtained from the NSF Publications Clearinghouse, P.O. Box 218, Jessup, MD 20794-0218; Phone: 301-947-2722 or by e-mail from pubs@nsf.gov.

Proposers are reminded to identify the program announcement number (NSF 99-108) in the program announcement/solicitation block on the NSF Form 1207, “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.

Applicants are strongly encouraged to prepare their proposals for full electronic submission using the FastLane system at (https://www.fastlane.nsf.gov). For proposals prepared for paper-copy submission, the cover sheet and project summary MUST be submitted through FastLane. For further information, see section 4.5 *How to Apply* and *Appendix A* below.

To fulfill the requirements of section 4.3 below, applicants submitting through FastLane should place these additional pages, clearly labeled, at the end of the Project Description section. Paper-copy submissions should place these pages, clearly labeled, in Section I, *Special Information and Supplementary Documentation*, as identified in the *GPG*. Other than these additional pages, the fifteen (15) page limit on the *Project Description* section is in effect.

It is important that the application contain all the information requested in the format described. If it does not, the application will be returned without review. Once an applicant is chosen for award (i.e., after external peer review and internal programmatic review), EPA or NSF program officers may request additional documentation and forms.

4.3 Additional Pages – Quality Assurance Narrative

All projects must provide a statement on how quality products will be assured. This statement should not exceed two pages. The Quality Assurance Narrative Statement should, for each item

listed below, either present the required information or provide a justification as to why the item does not apply to the proposed research.

- The activities to be performed or hypothesis to be tested (reference may be made to the specific page and paragraph number in the application where this information may be found); criteria for determining the acceptability of data quality in terms of precision, accuracy, representativeness, completeness, comparability;

- The study design including sample type and location requirements and any statistical analyses that were used to estimate the types and numbers of samples required for physical samples or similar information for studies using survey and interview techniques;

- The procedures for the handling and custody of samples, including sample identification, preservation, transportation, and storage;

- The methods that will be used to analyze samples collected, including a description of the sampling and/or analytical instruments required;

- The procedures that will be used in the calibration and performance evaluation of the sampling and analytical methods used during the project;

- The procedures for data reduction and reporting, including a description of statistical analyses to be used and of any computer models to be designed or utilized with associated verification and validation techniques;

- The intended use of the data as they relate to the study objectives or hypotheses;

- The quantitative and or qualitative procedures that will be used to evaluate the success of the project;

- Any plans for peer or other reviews of the study design or analytical methods prior to data collection.

More details on the Quality Assurance Narrative Statement may be found at (http://www.epa.gov/ncerqa/qanar.html).

These additional pages (mandated by EPA, should be submitted as supplementary documentation, as detailed in Section I of the GPG, in the submission to NSF, and) do not count against the fifteen (15) page limit NSF has established for the *Project Description* section of proposals.

4.4 Additional Budgetary Guidance

Subcontracts for research to be conducted under the grant which exceed 40% of the total direct cost of the grant for each year in which the subcontract is awarded must be especially well justified.

Researchers may be invited to participate in an annual All-Investigators Meeting with NSF and EPA scientists, engineers, and other grantees to report on research activities and to discuss areas of mutual interest. Budget requests should include travel funds to accommodate that eventuality.

4.5 How to Apply

A. Proposal Deadline

For paper submission of the proposals, ten copies of the proposal MUST be received by 5:00 p.m., Eastern Daylight Time (EDT), July 26, 1999.

For electronic submission of proposals by FastLane, the proposal MUST be submitted by 5:00 p.m., local time, July 26, 1999. Copies of the signed proposal cover sheet must be submitted in accordance with the instructions below.

B. Paper Proposal Submission

Submission of paper copies still requires the use of FastLane. See the additional instructions for Cover Page and Summary Submission in Appendix A.

To be considered, the original and ten (10) copies of the fully developed application must be received by NSF no later than 5:00 p.m. EDT on the closing date, July 26, 1999.

Completed applications should be sent via regular or express mail to:

National Science Foundation
Proposal Processing Unit P060, TSE
4201 Wilson Blvd.
Arlington, VA 22230
Phone: 703-306-1118

For paper submission of proposals, the delivery address **must clearly identify the NSF announcement or solicitation number** under which the proposal is being submitted.

C. Electronic Proposal Submission: FastLane

The NSF FastLane system is available for electronic preparation and submission of a proposal through the Web at the FastLane Web site at (https://www.fastlane.nsf.gov). The Sponsored Research Office (SRO or equivalent) must provide a FastLane Personal Identification Number (PIN) to each Principal Investigator (PI) to gain access to the FastLane Proposal Preparation application. PIs who have not submitted a proposal to NSF in the past must contact their SRO to be added to the NSF PI database. This should be done as soon as the decision to prepare a proposal is made.

In order to use NSF FastLane to prepare and submit a proposal, the following is required:

Browser (must support multiple buttons and file upload)
* Netscape 3.0 or greater * Microsoft Internet Explorer 4.01 or greater

PDF Reader (needed to view/print forms)
* Adobe Reader 3.0 or greater

PDF Generator (needed to create project description)
* Adobe Acrobat 3.01 or greater * Aladdin Ghostscript 5.10 or greater.

A list of registered institutions and the FastLane registration form are located on the FastLane Web page.

The cover page should identify the DIV OF CHEMICAL AND TRANSPORT SYSTEMS as the organizational unit to receive the proposal. This can be done by clicking the "Add Organizational Unit" button, which can be found on the Cover Sheet Screen within the FastLane Proposal Preparation Module, and selecting the item from the pull-down menu.

Proposals must be submitted to NSF by your institution's SRO before 5 p.m. local time on July 26, 1999. Proposals or changes in proposal content after that time will not be considered.

Submission of Signed Cover Sheets

For proposals submitted electronically via the NSF FastLane, the signed proposal Cover Sheet (NSF Form 1207) should be forwarded to the following address and received by NSF by August 2, 1999:

National Science Foundation
DIS-FastLane Cover Sheet (TSE Program)
4201 Wilson Blvd.
Arlington, VA 22230

Informal, incomplete, or unsigned proposals will not be considered. A proposal may not be processed until the complete proposal (including signed Cover Sheet) has been received by NSF. [If the proposal is delivered in person to NSF, a signed and dated receipt must be obtained from a member of NSF's Proposal Processing Unit as confirmation of receipt. It is also strongly recommended that a backup floppy disk (with the material sent by FastLane) be mailed to the NSF Directorate for Engineering FastLane Coordinator (Cheryl Albus, Room 505)].

5.0 REVIEW AND SELECTION

5.1 Review Procedures

A. Merit Review

All grant applications are initially screened by NSF and EPA to determine their compliance with legal and administrative requirements. 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 of each agency charged with the oversight of the review process. Care is taken to ensure that reviewers have no conflicts of interest with the proposer. Special efforts are made to recruit reviewers from non-academic institutions, minority serving institutions, adjacent disciplines to that principally addressed in the proposal, etc. This review is designed to evaluate each proposal according to its scientific and technical merit, potential impact on environmental quality, and uniqueness. Proposals submitted in response to this announcement will be reviewed by panel review only except in special cases where supplemental mail review may be used.

Proposals will be reviewed against the following general merit review criteria established by the National Science Board (NSB 97-72). Following each criterion are potential considerations that the reviewer may employ in the evaluation. The revised criteria are designed to be useful and relevant across NSF's many different programs; however, NSF and EPA will continue to employ special criteria required to highlight the specific objectives of certain programs and activities. The two revised merit review criteria are listed below. Following each criterion are potential considerations that reviewers may employ in the evaluation. These are suggestions and not all will apply to any given proposal. Reviewers will address only those points that are relevant to the proposals and for which they are qualified to make judgments.

In evaluating the responsiveness of proposals to the research needs set forth in this announcement, the review group will consider:

- 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 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?

Although budget information is not used by the reviewers as the basis for their evaluation of scientific merit, the reviewers are asked to provide their input on the appropriateness and/or adequacy of the proposed budget and its implications for the potential success of the proposed research. Input on requested equipment is of particular interest.

B. Integration of Research and Education

One of the principal strategies in support of this program'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 for individuals to concurrently assume responsibilities as researchers, educators, and students for all to engage in joint efforts that infuse education with the excitement of discovery and enrich research through the diversity of learner perspectives. PIs should address this issue in their proposal to provide reviewers with the information necessary to respond fully to both merit review criteria. Program staff of both agencies will give it careful consideration in making funding decisions.

C. Integrating Diversity into Program, 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 and EPA are committed to this principle of diversity and deem it central to the programs, projects, and activities they consider and support. PIs should address this issue in their proposal to provide reviewers with the information necessary to respond fully to both merit review criteria. Program staff of both agencies will give it careful consideration in making funding decisions.

D. Review Considerations (Industrially Relevant Issues; Impact)

It is worth emphasizing several points regarding focuses of this solicitation. Since TSE has been established to address problems related to pollution prevention and avoidance, specifically at the source, proposals will be evaluated on the potential impact of the research on important environmental topic areas as set forth in this solicitation. Some of the other significant process industry issues are highlighted in documents such as *Vision 2020* (http://www.chem.purdue.edu/v2020/). Industrial collaborators are another source of environmental issues to be addressed. If an industrial collaboration is described in the proposal, reviewers will assess the collaborative contribution to meeting the goals of this competition.

Reviewers will consider the potential impact of the research on pollution prevention at the source, uniqueness, and extent of high risk, in addition to scientific criteria, as described in NSF's standard review criteria in the NSF Grant Proposal Guide (NSF 99-2).

Following the review panel, a joint EPA/NSF selection panel of NSF and EPA staff will review the recommendations of the panel, and arrive at agency funding recommendations. Applications that receive high merit scores from the peer reviewers are subjected to a programmatic ("relevancy") review within EPA, the object of which is to assure a balanced research portfolio for EPA. Scientists from the Office of Research and Development (ORD) Laboratories and EPA Program and Regional Offices review these applications in relation to program priorities and their complementarity to the ORD intramural program and recommend selections to National Center for Environmental Research and Quality Assurance (NCERQA) (http://es.epa.gov/ncerqa/). Staff from each agency will contact the potential grantee regarding possible clarifications of the budgets, format, scope, and format. Copies of the evaluations by the

technical reviewers will be provided to each applicant. In the case of proposals that may be funded by EPA, a revised proposal will be necessary to conform to EPA format and policy requirements. This procedure has been followed for the past four years, as the primary administration of this joint agency research activity rotates between the two agencies. EPA grants will not require cost-sharing. Funding decisions are the sole responsibility of EPA and NSF. Grants are selected on the basis of technical merit, relevancy to the research priorities outlined, program balance, and budget. The anticipated date of awards is early FY 2000. The approximate total levels of funding of each agency are: EPA: $3,000,000; NSF: $2,000,000.

5.2 Proprietary Information

By submitting an application in response to this announcement, the applicant grants NSF and EPA permission to share the application with technical reviewers both within and outside the Agencies. Applications should not include proprietary or other types of confidential information that cannot be evaluated on this basis.

6.0 GRANT ADMINISTRATION

Upon conclusion of the review process, meritorious applications may be recommended for funding by either NSF or EPA, at the option of the agencies, not the applicant**. Notification of the award** is made *to the submitting organization* by a Grants Officer. 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. Subsequent grant administration procedures will be in accordance with the individual policies of the awarding agency.

6.1 EPA Grant Administration

The funding mechanisms for all EPA awards issued under this announcement will consist of grant agreements between EPA and the recipient. In accordance with Public Law 95-224, grants are used to accomplish a public purpose of support or stimulation authorized by Federal statute rather than acquisition for the direct benefit of the Agency. In using a grant agreement, EPA anticipates that there will be no substantial involvement during the course of the grant between the recipient and the Agency.

EPA grants awarded as a result of this announcement will be administered in accordance with 40 CFR Part 30 and 40 or the most recent FDP-III, "*Federal Demonstration Partnership General Terms and Conditions*," terms and conditions, depending upon the grantee institution.

EPA provides awards for research in the sciences and engineering related to environmental protection. The awardee is solely responsible for the conduct of such activities and preparation of results for publication. EPA, therefore, does not assume responsibility for such findings or their interpretation.

EPA annual and final reports and their summaries are to be submitted electronically. Summaries will be posted on the NCERQA home page on the Internet.

6.2 NSF Grant Administration

NSF grants awarded as a result of this announcement will be administered in accordance with the terms and conditions of the most recent NSF GC-1,"*Grant General Conditions*," or the FDP-III, depending on the grantee organization. More comprehensive information on the administration of NSF grants is contained in the *Grant Policy Manual* (GPM, NSF 95-26, July 1995), Chapter II, available electronically on the NSF Web site. The GPM is also for sale through the Superintendent of Documents, Government Printing Office (GPO), Washington, D.C. 20402. The telephone number at GPO is 202-512-1800 for subscription information; the GPM can also be ordered through the GPO Web site at (http://www.gpo.gov).

Organizations applying to NSF for the first time, or which have not received an NSF award within the preceding two years, should refer to the NSF Grant Policy Manual, Section 500, for instructions on specific information that may be requested by NSF. One copy of the Grant Policy Manual will be provided free of charge to new grantee organizations. The "Prospective New Awardee Guide" (NSF 97-100) includes information on: Administration and Management Information; Accounting System Requirements and Auditing Information; and Payments to Organizations with Awards. This information will assist an organization in preparing documents that NSF requires to conduct administrative and financial reviews of an organization. The guide also serves as a means of highlighting the accountability requirements associated with Federal awards. This document is available electronically on NSF's Web site at: <http://www.nsf.gov/cgi-bin/getpub?nsf97100>. First time NSF awardees will be required to submit organizational, management, and financial information, including a certification of civil rights compliance, before a grant can be made.

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 60 days before the end of each budget period. (Note: The PI should consult with the cognizant NSF program officer because individual program officers may have additional or more specific guidelines for these reports). Within 90 days after expiration of a grant, the PI must submit a final project report. Approximately 30 days before expiration, NSF will send a notice to remind the PI of the requirement. Failure to provide final technical reports delays NSF review and processing of pending NSF proposals for that PI and any co-PIs. PIs should examine or determine the formats of the required progress and final reports in advance, to assure that they are keeping adequate data and records. Effective October 1, 1998, PIs are required to use the new formats for these reports and effective October 1, 1999, are required to submit their reports electronically via FastLane.

NSF Final Report Requirements are described in GPG, NSF 99-2. Final project report formats are available on the web. Also, some programs may have additional recommendations of format, style, etc. and so it is best to remain in contact with the appropriate program director.

6.2.1 About the NATIONAL SCIENCE FOUNDATION

NSF funds research and education in most fields of science and engineering. Grantees 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 (unless otherwise specified in the eligibility requirements for a particular program).

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 program announcement or contact the program coordinator at (703) 306-1636.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation regarding NSF programs, employment, or general information. TDD may be accessed at (703) 306-0090 or through FIRS on 1-800-877-8339.

6.2.2 EPA Mission and Research and Development Strategy

The mission of EPA is to protect both environmental quality and human health through effective regulations and other policy initiatives. Achievement of this mission requires the application of sound science to assessment of environmental problems and to evaluation of possible solutions. A significant challenge is to support both long-term research that anticipates future environmental problems as well as research that fills gaps in knowledge relevant to meeting current Agency goals. Requests for Applications issued by the Science to Achieve Results (STAR) Program are an important mechanism for promoting a sound scientific foundation for environmental protection.

EPA's research programs focus on reduction of risks to human health and ecosystems and on the reduction of uncertainty associated with risk assessment. Through its laboratories and through grants to academic and other not-for-profit institutions, EPA also fosters the development and evaluation of new risk reduction technologies across a spectrum, from pollution prevention through end-of-pipe controls to remediation and monitoring. In all areas, EPA is interested in research that recognizes issues relating to environmental justice, the concept of achieving equal protection from environmental and health hazards for all people without regard to race, economic status, or culture.

EPA's extramural research grant program, the STAR Program, is administered by the Office of Research and Development's National Center for Environmental Research and Quality Assurance (NCERQA). Announcements of specific programmatic announcements will be found on the internet at http://www.epa.gov/ncerqa.

6.2.3 PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

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

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

6.2.4 YEAR 2000 REMINDER

In accordance with NSF Important Notice No. 120 dated June 27, 1997, Subject: Year 2000 Computer Problem, NSF and EPA awardees are reminded of their responsibility to take appropriate actions to ensure that the activity being supported is not adversely affected by the Year 2000 problem. Potentially affected items include: computer systems, databases, and equipment. NSF and EPA should be notified if an awardee concludes that the Year 2000 will have a significant impact on its ability to carry out an NSF or EPA funded activity. Information concerning Year 2000 activities can be found on the NSF web site at (http://www.nsf.gov/oirm/y2k/start.htm).

The National Science Foundation is committed to making all of the information we publish easy to understand. If you have a suggestion about how to improve the clarity of this document or other NSF-published materials, please contact us at plainlanguage@nsf.gov.

Activities described in this publication are in the following categories in the Catalog of Federal Domestic Assistance (CFDA): 47.041 Engineering; 47.049 Mathematics and Physical Sciences; 66.500 EPA Grants. OMB 3145-0058

APPENDIX A: Paper Copy Submission: FastLane Cover Sheet and Project Summary

If you are submitting your proposal using paper copies rather than electronically, you are required to submit the proposal cover sheet and the project summary to NSF using FastLane. To access FastLane, go to the NSF Web-site at (http://www.nsf.gov), then select "FastLane," or go directly to FastLane: (https://www.fastlane.nsf.gov).

A.1 Instructions for the Principal Investigator (PI):

Contact your institution's Sponsored Research Office (SRO) for a PIN number to gain access to the FastLane "*Proposal Preparation*" module. If you have not submitted a proposal to NSF in the past, you must contact your SRO to be added to the NSF PI database. Please do this as soon as you decide to prepare a TSE proposal, since this may require a few days.

As early as possible, enter your cover sheet and project-summary information using the FastLane "*Proposal Preparation*" module. In the field labeled "*Program Announcement*" on the cover sheet type in the program announcement number, (e.g., NSF 99-108) exactly as shown with no additional spaces or characters. The Sorting Code must be put at the end of the title and set off with parentheses as described in Section 4.1.

The cover page should identify the DIV OF CHEMICAL AND TRANSPORT SYSTEMS as the organizational unit to receive the proposal. This can be done by clicking the "Add Organizational Unit" button, which can be found on the Cover Sheet Screen within the FastLane Proposal Preparation Module, and selecting the item from the pull-down menu.

Click on the "*Allow SRO Access*" button. Allow time for your SRO to approve, copy and mail the proposal to meet the deadline.

A.2 Instructions for the Sponsored Research Office (SRO):

Print the second page of the cover sheet in time to obtain the required institutional signatures.

Before assembling the proposal for copying, submit the cover sheet to NSF via FastLane using the "*Submit Proposal*" function within the "*Institutional Management of FastLane*" module. This will generate a proposal number. Print a copy of the cover sheet from FastLane; it will have the proposal number on it. Substitute the first page of the cover sheet for the one produced by the PI. Make copies of the proposal and submit to NSF according to the usual procedures for a paper proposal.

For 1999, the paper copies of the proposal MUST be received at NSF by 5:00 p.m. Eastern Daylight Time on July 26,1999, in order to be eligible. PIs and SROs should allow sufficient time to be sure that all material will reach NSF in time. You may direct questions concerning FastLane or problems utilizing FastLane to the FastLane contacts listed in Section 1.0.

APPENDIX B: RELATION TO NSF, EPA, AND OTHER CURRENT AND PAST AGENCY ACTIVITIES

NSF and EPA have many different environmental research activities. This section describes a few past and current NSF and EPA activities related to environmental technology. The activities described below are for your background or future use only; they may not be necessarily related to this announcement, or they may not currently be accepting proposals separate from this announcement.

The NSF/EPA Technology for a Sustainable Environment activity is an integral part of EPA's *Science to Achieve Results (STAR)* research program and supports *EPA's Green Chemistry Challenge Program*, *Green Engineering*, and other pollution prevention activities in EPA. For NSF, this activity is an integral part of its *Environmentally Benign Chemical Synthesis and Processing (EBCS&P; NSF 92-13)* activity and its *Environmentally Conscious Manufacturing (ECM; NSF 95-91)* program activity as described below.

B.1 Environmental Protection Agency

Green Chemistry Program: This program is directed at preventing pollution by promoting design of less toxic chemical substances and alternative chemical pathways that involve less toxic feedstocks, reagents, or solvents and generate fewer toxic products, by-products, or co-products. As part of this program, EPA has initiated the Green Chemistry Challenge Program to recognize and promote fundamental and innovative chemical methodologies that accomplish pollution prevention through source reduction and that have a broad application in industry. Green chemistry encompasses all aspects and types of chemical processes — including synthesis, catalysis, analysis, monitoring, separations, and reaction conditions — that reduce negative impacts on human health and the environment relative to the current state of the art. Through awards and grants programs, the Green Chemistry Challenge Program recognizes and promotes fundamental and innovative technologies that incorporate the principles of green chemistry into chemical design, manufacture, and use. The Green Chemistry Challenge Awards Program recognizes those in industry, academia, and government who have met the Green Chemistry objectives in an exemplary way. The Green Chemistry Challenge Grants Program, through projects awarded under TSE, enhances support for cutting-edge research in this area.

Design For The Environment And The Green Engineering Programs: Through the Design for the Environment (DfE) Program, EPA provides businesses with information to make environmentally-informed choices and ultimately prevent pollution and reduce risks. DfE partners with industry, public interest groups, universities, research institutions, labor groups, and other governmental agencies to evaluate cleaner alternatives to existing products, processes, or technologies. Across a wide variety of projects, the DfE Program strives to promote the consideration of environmental factors along with the traditional business decision parameters of cost and performance. Currently, DfE supports cooperative industry projects in eight sectors. Other green engineering programs include educational partnerships for curriculum development and professional training in pollution prevention, and a project in environmental accounting.

B.2 National Science Foundation

Environmentally Benign Chemical Synthesis and Processing (EBCS&P): This program, described in NSF 92-13 (http://www.nsf.gov/pubs/stis1992/nsf9213/nsf9213.txt), is aimed at preventing pollution by providing financial support for fundamental research in the identification of environmentally benign chemical and material synthesis and related manufacturing processes. For the NSF Engineering Directorate's Chemical and Transport Systems Division, the *Technology for a Sustainable Environment (TSE)* activity subsumes the *EBCS&P* activity in Fiscal Years 1999-2000. For the NSF Directorate of Mathematics and Physical Science's Division of Chemistry, research proposals are also accepted for *EBCS&P* activities as part of its normal review process, as well as through this special NSF/EPA TSE activity. Proposals submitted directly to the Chemistry Division must be received between July 1, 1999 and January 15, 2000.

The *ECM* competition addresses specific aspects of the *Environmentally Conscious Manufacturing* Initiative Announcement, NSF 95-91. Therefore in Fiscal Year 1999, the *ECM* activity is largely subsumed in this announcement. However, only those areas described in this solicitation will be considered; proposals in all other *ECM* topic areas may be submitted under the normal procedures for unsolicited NSF proposals (Grant Proposal Guide, NSF 99-2) to the relevant divisions. Copies of the NSF 95-91 or 99-2 announcements are available upon request (703-306-1330) and can also be obtained via the World Wide Web at (http://www.nsf.gov/cgi-bin/pubsys/browser/odbrowse.pl).

B.3 Joint NSF and EPA Activities

Interagency Announcement of Opportunities in Metabolic Engineering: This Announcement is described in NSF 99-85 and provides an Interagency definition of Metabolic Engineering. The Announcement focuses on three topic areas of Metabolic Engineering that are of particular interest to the eight participating agencies, including EPA and NSF. Metabolic Engineering proposals will not be supported in TSE and should be directed to the NSF 99-85 announcement. All of the Research Directorates at NSF are participating in this Activity, which is designed to allow two or more of the participating Agencies to support projects of common interest. The topic areas of Metabolic Engineering mentioned in its Announcement have applications in bio-remediation, environmentally conscious manufacturing, and pollution prevention. Pre-Proposals are due May 17, 1999, and those Pre-Proposals that are considered responsive to the Announcement will be invited to submit Full Proposals.

B.4 Other Agencies

This research solicitation can be viewed as part of an evolving national network of Federal research support and industry collaboration that is becoming a “research stewardship network” in Green Chemistry and Engineering. Although still developing, a set of research plans or roadmaps is evolving through joint efforts of federal agencies, industry and academia that can form the basis for a coordinated research network. A series of research workshops to discuss research results and needs in each of several research components or areas of Green Chemistry and Engineering is emerging. For example, workshops have been held or are planned addressing

polymer chemistry, catalysis, dense phase fluids, electro-technologies, bioprocessing and bioseparations, solid/liquid separations, and synthesis and processing using alternate resources. These workshops, which are hosted or sponsored by different stakeholder organizations, link directly to the industry's *Vision 2020* strategy.

Information on *Vision 2020* roadmaps may be found at (http://www.ccrhq.org/v2020).

Another important part of the developing research network is the *National Green Chemistry and Engineering Conference* presented by the American Chemical Society with support from EPA, NSF and co-sponsorship by several other federal agencies and trade and professional organizations. This conference presents the latest research findings and provides a forum for an annual overview of research in these areas. The next scheduled conference will be held on June 29-July 2, 1999, at the National Academy of Sciences in Washington, D.C.

The federal research support programs in this area are complementary. For example, the research supported in this solicitation is on the more fundamental end of the research continuum, though oriented toward long-term improvement of environmental sustainability of the chemical and other industries. Collaboration with industry researchers is encouraged. Funding from other agencies such as the Departments of Energy and Commerce tends to support more applied stages of research and requires collaboration and co-funding by industry.

NATIONAL SCIENCE FOUNDATION
ARLINGTON, VA 22230

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