NSF/DOE PARTNERSHIP ON ADVANCED COMBUSTION ENGINES 2012-2015

PROGRAM SOLICITATION
NSF 12-559

National Science Foundation

Directorate for Engineering
Division of Chemical, Bioengineering, Environmental, and Transport Systems

U.S. Department of Energy, Vehicle Technologies Program

Letter of Intent Due Date(s) ***(required)*** (due by 5 p.m. proposer's local time)*:*

June 18, 2012

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

August 08, 2012

IMPORTANT INFORMATION AND REVISION NOTES

A revised version of the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), NSF 11-1, was issued on October 1, 2010 and is effective for proposals submitted, or due, on or after January 18, 2011. Please be advised that the guidelines contained in NSF 11-1 apply to proposals submitted in response to this funding opportunity.

Cost Sharing: The PAPPG has been revised to implement the National Science Board's recommendations regarding cost sharing. Inclusion of voluntary committed cost sharing is prohibited. In order to assess the scope of the project, all organizational resources necessary for the project must be described in the Facilities, Equipment and Other Resources section of the proposal. The description should be narrative in nature and must not include any quantifiable financial information. Mandatory cost sharing will only be required when explicitly authorized by the NSF Director. See the PAPP Guide Part I: *Grant Proposal Guide (GPG)* Chapter II.C.2.g (xi) for further information about the implementation of these recommendations.

Data Management Plan: The PAPPG contains a clarification of NSF's long standing data policy. All proposals must describe plans for data management and sharing of the products of research, or assert the absence of the need for such plans. FastLane will not permit submission of a proposal that is missing a Data Management Plan. The Data Management Plan will be reviewed as part of the intellectual merit or broader impacts of the proposal, or both, as appropriate. Links to data management requirements and plans relevant to specific Directorates, Offices, Divisions, Programs, or other NSF units are available on the NSF website at: http://www.nsf.gov/bfa/dias/policy/dmp.jsp. See Chapter II.C.2.j of the GPG for further information about the implementation of this requirement.

Postdoctoral Researcher Mentoring Plan: As a reminder, each proposal that requests funding to support postdoctoral researchers must include, as a supplementary document, a description of the mentoring activities that will be provided for such individuals. Please be advised that if required, FastLane will not permit submission of a proposal that is missing a Postdoctoral Researcher Mentoring Plan. See Chapter II.C.2.j of the GPG for further information about the implementation of this requirement.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

NSF/DOE PARTNERSHIP ON ADVANCED COMBUSTION ENGINES 2012-2015

Synopsis of Program:

The Directorate for Engineering at the National Science Foundation (NSF) has established a partnership with the Vehicle Technologies Program (VTP) of the U.S. Department of Energy (DOE) in order to address critical fundamental and applied research challenges associated with advanced combustion engine technologies. The goal of the partnership is to leverage the complementary missions of deployment and commercialization (DOE) and fundamental research and education (NSF) to address issues of national importance that impact the efficiency of the internal combustion engine (ICE). The Directorate for Engineering seeks proposals with transformative ideas that meet the detailed requirements delineated in this solicitation.

Cognizant Program Officer(s):

Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.

- Sumanta Acharya, Thermal Transport Processes Program, NSF/ENG/CBET, telephone: (703) 292-7494, email: sacharya@nsf.gov
- George Antos, Program Director, Catalysis and BioCatalysis Program, NSF/ENG/CBET, telephone: (703) 292-4997, email: gantos@nsf.gov
- Arvind Atreya, Program Director, Combustion, Fire, Plasma Systems Program, NSF/ENG/CBET, telephone: (703) 292-8695, email: aatreya@nsf.gov
- Gurpreet Singh, Group Leader, Vehicle Technologies Program, DOE, telephone: (202) 586-2333, email: gurpreet.singh@ee.doe.gov

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

- 47.041 --- Engineering
- 81.049 --- Office of Science Financial Assistance Program

Award Information

Anticipated Type of Award: Continuing Grant

Estimated Number of Awards: 5 to 20 each of up to 3-years duration

Anticipated Funding Amount: $200,000 to $800,000

Total Funds Available: $12,000,000, equally distributed in FY 2012, 2013, and 2014, pending availability of funds.

Eligibility Information

Organization Limit:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the Grant Proposal Guide, Chapter I, Section E.

PI Limit:

Principal Investigators (PIs) must be at the faculty level as determined by the submitting organization. While participation from non-engineering disciplines is encouraged and may be essential for some proposals, projects should fundamentally contribute to engineering research.

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI:

The principal investigator and co-principal investigators may participate in only one proposal submitted to this solicitation. It is the responsibility of the submitting institution to insure that the PI and all co-PIs are participating in only one proposal submitted to this solicitation. If more than one proposal is submitted by the PI or co-PI, NSF reserves the right to return without review the last proposal received or all proposals received from the PI or co-PI.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- Letters of Intent: Submission of Letters of Intent is required. Please see the full text of this solicitation for further information.
- Preliminary Proposal Submission: Not Applicable
- Full Proposals:
  - Full Proposals submitted via FastLane: NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) Guidelines apply. The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg.
  - Full Proposals submitted via Grants.gov: NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov Guidelines apply (Note: The NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide)

B. Budgetary Information

- Cost Sharing Requirements: Inclusion of voluntary committed cost sharing is prohibited.
- Indirect Cost (F&A) Limitations: Not Applicable
- Other Budgetary Limitations: Not Applicable

C. Due Dates

- Letter of Intent Due Date(s) ***(required)*** (due by 5 p.m. proposer's local time)*:*

  June 18, 2012

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

  August 08, 2012

Proposal Review Information Criteria

Merit Review Criteria: National Science Board approved criteria. Additional merit review considerations apply. Please see the full text of this solicitation for further information.

Award Administration Information

Award Conditions: Standard NSF award conditions apply.

Reporting Requirements: Additional reporting requirements apply. Please see the full text of this solicitation for further information.

TABLE OF CONTENTS

I. INTRODUCTION

Liquid fuels have dominated transportation systems for over a century and will continue to do so for decades to come. Within the U.S. alone, almost 12 million barrels of oil are consumed per day in ground transportation vehicles that are powered by the internal combustion engine (ICE). By 2035, this number is expected to grow to more than 17 million barrels per day. At the present time, sustainable energy technologies (e.g., wind, solar, electric) are not yet at the stage where they can significantly impact petroleum use. While such sustainable concepts are being developed, R&D investments that seek to improve the efficiency of the ICE stand to have a near-term impact on reducing oil consumption and the emissions they generate. The potential is significant. For example, the fuel economy of light-duty vehicles could potentially be improved by 75 percent and heavy-duty vehicles by 30 percent with concepts that are just beginning to be better understood.

Because the NSF and DOE have long invested in research and development in elements related to advanced combustion engines, these two agencies have developed a jointly funded partnership to address a problem of national importance that impacts our reliance on foreign sources of oil, while also addressing the environmental impact of performance. Specifically, proposals are solicited that are directly relevant to ICE technologies as outlined in this solicitation. The awards associated with this Solicitation will potentially enable efficiency gains in the ICE by improving the sub-processes that are addressed. Such an effort comes at a critical time in the Nation's history as our energy security and economic well-being demands that oil consumption be reduced. This DOE and NSF partnership is directed to that end. It seeks to exploit the complementary missions of (i) research and development for NSF, and (ii) deployment and commercialization for DOE to develop the critical understanding technologies associated with ICE

performance.

The sub-programs within NSF and DOE that will manage this partnership are the Advanced Combustion Engines R&D Sub-Program within the VTP, and the Combustion, Fire and Plasma Systems Program, the Thermal Transport Processes Program, and the Catalysis and Biocatalysis Programs within the Chemical, Bioengineering, Environmental and Transport Systems (CBET) Division of the Directorate for Engineering at NSF. Each of these programs already includes strong components of the elements of advanced combustion engine technologies within the portfolio of projects they support.

The VTP supports the mission of the DOE which is to strengthen America's energy security, environmental quality, and economic vitality. These goals are achieved through activities that enhance energy efficiency and productivity, and which commercialize clean, reliable, and affordable technologies. CBET supports the NSF mission of research and education with activities that involve the transformation and/or transport of matter and energy by chemical, thermal, or mechanical means. CBET research and education contributes significantly to the development of the workforce for major components of the U.S. economy.

II. PROGRAM DESCRIPTION

The rising prices of oil and gasoline are placing increasing pressures on our national security, economic competiveness, and our energy independence against global instabilities. Two-thirds of petroleum-based fuels are used by ground transportation systems so that our energy security is intimately tied to the transportation sector. In addition, the impacts of transportation on global climate change are evidenced by the fact that almost a quarter of CO_2 emissions come from ground vehicles.

The prime mover in ground transportation systems is the ICE. Improvements in ICE fuel efficiency will have a near-term impact on petroleum consumption and climate change. This NSF/DOE Partnership in Advanced Combustion Engines is formed with this goal in mind. Transformative ideas are solicited in several targeted areas listed below with the potential to enable an increase in the efficiency of internal combustion engines while minimizing the energy penalty of meeting emissions regulations. This goal will be accomplished by directed research and development in advanced engine combustion regimes and emission control strategies, coupled with advanced fuel formulations including both non-petroleum-based and petroleum-based fuels.

The high-level performance goals supported by this Partnership are a 25-40% improvement in fuel economy in a light-duty vehicle and the attainment of 55% brake thermal efficiency in heavy-duty engine systems. Achieving breakthrough efficiencies in an engine and/or powertrain system for either light- or heavy-duty vehicles is a very challenging objective but one that must be achieved to reduce the nation's petroleum consumption to levels that are economically and environmentally sustainable.

Proposals are encouraged that advance transformative ideas to develop the enabling understanding for improving the efficiency of the ICE and the emissions they generate. This goal will be facilitated by fundamental research to establish the basis for new concepts, design elements and tools performed through university/industry/national laboratory partnerships. The over arching theme is the reduction of the design cycle for testing, manufacturing and implementation of new ideas, which is currently expensive and time-consuming.

Areas of Interest

This solicitation promotes the science and technology of advanced combustion engines; and of the advanced emission control strategies that are required. Specific topical areas are listed below though other aspects that hold promise to improve ICE efficiency may also be considered. The research should focus on the fundamental thermal/fluid/chemical processes of the problem to be investigated rather than on a development and testing effort. It is also expected that a connection will be made between the understanding of the problem to be studied and the associated ICE efficiency gains.

The ICE is a complex system whose operation is controlled by a wide range of processes. These include sprays that deliver the fuel to the combustion chamber and which set the initial conditions for combustion, stochastic in-cylinder dynamics for conversion of chemical energy to work that include random turbulent mixing, fuel evaporation and combustion, multi-phase fuel-air mixing, wall impingement, combustion chemistry, heat transfer and fluid interactions, and exhaust treatment (e.g., catalytic) technologies to reduce toxic gas and particulate emissions. All of these aspects require an improved understanding to realize significant efficiency gains of the ICE.

Advanced combustion regimes for the ICE have the potential to make a near-term impact on oil consumption. Development of low temperature combustion (LTC), learn-burn gasoline combustion and development of alternative (e.g., bio-derived) fuels have the potential to dramatically increase fuel economy. LTC is based on developing dilute mixtures that result in peak combustion temperatures below about 1900K in order to reduce emissions of oxides of nitrogen. With lower temperatures heat losses are reduced which enable the extraction of more energy in the expansion stroke and thereby a higher net work out and higher fuel efficiency. Additional benefits of reduced combustion temperatures include lower particulate and toxic gas emissions which are important considerations in global climate change. Optimizing evaporation, mixing, kinetics, and heat transfer to achieve high efficiencies and low emissions is the desired goal. LTC is incorporated in such processes as homogeneous charge compression ignition (HCCI), premixed charge compression ignition (PCCI) or a number of other variants that employ lean premixed and partially premixed combustion.

Key areas that must be better understood to enable LTC regimes to realize their full potential include, but are not limited to, the following:

- stochastic and deterministic in-cylinder processes that influence the stability of LTC
- methodologies to increase power density in LTC or lean-burn operation
- validated, predictive models of combustion control, pollutant formation and ignition chemistry at engine-relevant pressures and temperatures
- ignition characteristics of lean mixtures of various fuels
- liquid fuel properties and their combustion characteristics, including bio (renewable) fuels and surrogates
- near wall heat transfer and unsteady reciprocating effects on boundary layer behavior
- droplet impingement and surface heat transfer mechanisms
- spray/droplet evaporation and combustion of bio (renewable) and surrogate fuels
- turbulence-radiation Interactions
- atomizer design and spray type, effects of swirl, and combustion chamber geometry
- high temperature, low heat-loss materials for engine application

Given efficiency gains from in-cylinder processes, emission control devices must be designed to preserve these gains, and may also have the potential to improve performance by reducing emissions to near-zero levels. Catalysts, in particular, have been effective for

their impact on reducing oxides of nitrogen, particulate matter, non-methane organic gases or hydrocarbons, and carbon monoxide. Included are three-way catalysts, oxidation catalysts, and selective catalytic reduction (SCR) processes, lean NO_x trap or NO_x adsorber catalysts, and particulate filters. Relevant topics include, but are not limited to, the following:

- new catalysts and their performance; particularly those catalyst designs that will lower the light-off temperatures (i.e., the temperature at which 90% effectiveness is achieved) to less than 150ºC
- new concepts for SCR, lean NO_x trap or NO_x adsorber catalysts, particulate filters and regeneration technologies
- understanding and mitigating the negative effects of sulfur and other contaminants on catalyst durability, especially at low temperatures
- determination of pre-catalytic converter emissions as a function of engine combustion modes and operating parameters, and evaluation of anticipated reference catalyst performance with these input emission
- understanding aging mechanisms in lean NOx traps and new models to predict catalyst performance
- enabling cost-effective and fuel-efficient thermal management of catalyst systems including active control

Required Elements:

Successful proposals will involve collaborations between a lead academic PI and with industry, and/or other academic and/or national laboratory collaborators that provide complementary experimental/modeling/facility capabilities. PI teams will not be at a disadvantage in the proposal competition if they do not have access to IC engine facilities to demonstrate the efficacy of their approach. However, it is expected that proposed concepts will establish a clear connection to improving ICE efficiency. This connection may be accomplished by system-level modeling, by employing modifications yielding self-evident efficiency improvements by bench-scale experiments, or by testing in an actual ICE. The narrative should detail what each collaborator contributes to the project, and how the collaboration will be effectively coordinated and managed.

Budgets must include travel for at least one PI to attend DOE's Annual Merit Review in Washington, DC, and up to two additional DOE meetings (the DOE Advanced Combustion Engines Working Group Meeting (Livermore, CA) or the DOE Emission Control Working Group Meeting) as appropriate, or the NSF CBET Division Annual Grantee's Meeting in Washington, D.C.

In preparing proposals in response to this solicitation, the text should not devote considerable space to background and motivation related to the importance of improving the efficiency of the ICE in the context of the National and Global energy picture (which was discussed in the solicitation). Rather, the narrative should, within the page limit established by these guidelines, discuss in sufficient detail the research plans to enable evaluation of the approach and methods that would be brought to bear to meet project objectives. The intellectual merit and the innovation of the research proposed in the context of the existing state of the art should be clearly emphasized.

III. AWARD INFORMATION

Anticipated Type of Award: Continuing Grant

Estimated Number of Awards: 5 - 20 awards, each of up to 3-years duration

Anticipated Funding Level: Each project team may receive support up to between $200,000 and $800,000 per year for up to three years on a continuing basis, pending availability of funds and research progress made. It is not expected that all awards will receive the amounts stipulated above; the size of awards will depend on the type of research program that is proposed, and the PIs are encouraged to provide adequate budget justification related to the tasks proposed.

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

IV. ELIGIBILITY INFORMATION

Organization Limit:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the Grant Proposal Guide, Chapter I, Section E.

PI Limit:

Principal Investigators (PIs) must be at the faculty level as determined by the submitting organization. While participation from non-engineering disciplines is encouraged and may be essential for some proposals, projects should fundamentally contribute to engineering research.

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI:

The principal investigator and co-principal investigators may participate in only one proposal submitted to this solicitation. It is the responsibility of the submitting institution to insure that the PI and all co-PIs are participating in only one proposal submitted to this solicitation. If more than one proposal is submitted by the PI or co-PI, NSF reserves the right to return without review the last proposal received or all proposals received from the PI or co-PI.

Additional Eligibility Info:

Proposals may be submitted by a single organization or a group of organizations consisting of a lead organization in partnership with one or more partner organizations. Only U.S. academic institutions which perform research and with degree-granting education programs in disciplines normally supported by NSF are eligible to be the lead organization. Academic institutions are defined as universities and two- and four-year colleges (including

community colleges) accredited in, and having a campus located in the United States, acting on behalf of their faculty members. Principal investigators are encouraged to form synergistic collaborations with industrial researchers, government laboratories, and engineers and scientists at foreign organizations where appropriate. For interaction with industry, when appropriate for the proposed research, the GOALI mechanism (Grant Opportunities for Academic Liaison with Industry NSF 12-513) may be used. Alternatively, subcontracts may be included in the award to the lead institution.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Letters of Intent ***(required)***:

A one-page Letter of Intent (LOI) is required. Letters of Intent are not reviewed but are used to anticipate the overall response and requirements for reviewers. The letter should be submitted via FastLane no later than the date specified in this solicitation. The subject heading of the letter should include a brief title of the proposal and the name of the lead institution. Each letter must include the following:

1. THE TITLE - Title of the proposal preceded by the words "NSF/DOE Advanced Combustion Engines:"

2. THE TEAM - Names, affiliations, and expertise of the Principal Investigator and all additional participants.

3. SYNOPSIS (GOALS) - Brief description of the specific goals of the proposal (maximum of 250 words).

The LOIs are not used as pre-approval mechanisms for the submission of proposals, and no feedback is provided to the submitters.

Letter of Intent Preparation Instructions:

When submitting a Letter of Intent through FastLane in response to this Program Solicitation please note the conditions outlined below:

- Sponsored Projects Office (SPO) Submission is not required when submitting Letters of Intent
- A Minimum of 0 and Maximum of 4 Other Senior Project Personnel are allowed
- A Minimum of 0 and Maximum of 10 Other Participating Organizations are allowed
- Submission of multiple Letters of Intent is not allowed

Full Proposal Preparation Instructions: Proposers may opt to submit proposals in response to this Program Solicitation via Grants.gov or via the NSF FastLane system.

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the NSF Grant Proposal Guide (GPG). The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov. Proposers are reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov. The complete text of the NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: (http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via the NSF FastLane system. Chapter II, Section D.4 of the Grant Proposal Guide provides additional information on collaborative proposals.

Full Proposal Instructions:

If there is more than one institution involved in a proposal, it may be submitted as a single full proposal (with subawards), or as separately submitted collaborative proposals. In either case, the roles, responsibilities and qualification of all team members must be clearly identified.

The following exceptions and additions to the GPG apply to proposals submitted to this Program:

Cover Sheet: Select the CBET program solicitation number from the pull down list. Entries on the Cover Sheet are limited to the principal investigator and co-principal investigators. Additional project leaders or senior personnel should be listed on the Project Summary page and entered as senior personnel in FastLane or Grants.gov.

Title of Proposed Project: The title of the proposed project must begin with "*NSF/DOE Partnership on Advanced Combustion Engines:".* The title must state clearly and succinctly the major focus of the project.

Project Summary: (one-page limit) Provide the following information: (1) the title of the project, the name of the PI and the lead institution or organization, and a list of co-PIs and senior personnel along with their institutions and organization or both; (2) a succinct summary of the intellectual merit of the proposed project that states the transformative nature of the proposed research

as well as the significant interdisciplinary approach to the proposed research; and (3) a succinct statement of the broader impacts of the proposed work including teaching and education plans as well as the potential impact of the research on ICE efficiency. Proposals that do not address both intellectual merit and broader impacts in separate and clearly-marked statements within the project summary will be returned without review. Elaboration of the intellectual merit and broader impacts merit review criteria are included in VI.A NSF Merit Review Criteria. In addition, the strength of the collaborations, and the potential demonstrable impact on efficiency and emissions must be identified.

Project Description: (maximum 15 pages) must include the following subsections:

1. Results from Prior Research: Describe prior research of PI and co-PIs funded by NSF or DOE that is directly relevant to the proposed project; and

2. Proposed Research: Describe specific goals of the proposed research, its relevance to the current literature, the research plan including approaches and methodologies to attain the goals, tasks, roles and responsibilities, and the expected synergy outcomes. The Project Description should end with a subsection labeled Impact that describes the fundamental research contributions as well as the technological impact of the proposed effort. The research plan should be sufficiently detailed and well thought out, with supporting data and references, in order to project a credible outcome for success.

References Cited: Indicate with an asterisk any cited publications that resulted from prior research funded by NSF or DOE for the PI or co-PIs.

Biographical Sketches: Required for key personnel (PI, co-PIs, and each of the senior personnel listed on the Project Summary page). Use the standard format described in the GPG.

Current and Pending Support: Information must be provided for the PI and each of the co-PIs and Senior Personnel listed on the Project Summary page. For grants that are related, a short description must be provided to allow evaluation.

Facilities and Equipment: Provide a description of available facilities and priorities for their use, as applicable. For projects requiring additional equipment, justify the need for these resources in the context of the research proposed.

In the Supplementary Docs section, include the following:

1. List the key personnel involved. Describe the qualifications of each person and how they uniquely contribute to the project. Describe how personnel are integrated to produce positive synergies. (maximum of two pages total).

2. Provide a detailed management plan including means of communication and coordination, and data tracking or management within the group, management of intellectual property resulting from the project, and timeline of activities. (maximum three pages)

3. Proposals involving metrology components must include a description of how the uncertainty in, and repeatability of measured data will be determined and reported. Similar elements of validation, verification and uncertainty quantification must be provided for proposals that include numerical simulations. (maximum two pages)

4. For proposals that include support for post-doctoral researchers, a Post-Doc Mentoring Plan must be included as a supplementary document. Proposals that include post-doctoral researchers but do not include the mentoring plan as a supplementary document will be returned without review. (maximum one page)

5. Include a Data Management Plan section, that describes a means of sharing the outcome of the research with the scientific and engineering communities including but not limited to publications, web sites, and significant data bases, etc. The description should be specific and describe what, how, and when the community will have access to the results. (maximum two pages).

6. An alphabetized list of the full names and institutional affiliations of all people with conflicts of interest for all senior personnel (PI and co-PI's) and any named personnel whose salary is requested in the project budget. Conflicts to be identified are: (1) Ph.D. thesis advisors and advisees, (2) collaborators and co-authors, including post-doctoral researchers, during the preceding 48 months, and (3) any other individuals with whom, or institutions with which the investigator has financial ties (please specify type of ties).

7. Academic and industry partners must agree in advance as to how intellectual property rights will be handled. An industry-university agreement on intellectual property including publication and patent rights must be submitted prior to an award. Documentation outlining the IP agreement should be submitted with the proposal, and the signed agreement must be submitted by the date of award.

Supplementary materials may not be used to circumvent the 15-page limit on the Project Description. Information in the supplementary materials will be evaluated as part of the review process, as needed.

Pre-submission Check List:

- No principal investigator or co-principal investigator is listed as a principal investigator or co-principal investigator on any other NSF/DOE Advanced Combustion Engine Partnership Proposal.
- The Lead PI must be at the faculty level, as determined by the submitting institution.
- The Intellectual Merit and Broad Impact are clearly identified in the Project Summary.
- A Post Doc Mentoring (if applicable) and Data Management Plan are included as supplementary documents.
- Each annual budget must not exceed $800,000 and the duration of the research must not exceed three years.
- The proposal and the LOI must be submitted by the deadline specified (5:00p.m local time at the proposer's institution)

Note: Proposals not meeting the above requirements will be returned without review.

B. Budgetary Information

Cost Sharing: Inclusion of voluntary committed cost sharing is prohibited

Budget Preparation Instructions: Budgets must include travel for at least one PI to attend DOE's Annual Merit Review in Washington, DC, and up to two additional DOE meetings (the DOE Advanced Combustion Engines Working Group Meeting (Livermore, CA) or the DOE Emission Control Working Group Meeting) as appropriate, or the NSF CBET Division Annual Grantee's Meeting in Washington, D.C.

C. Due Dates

- Letter of Intent Due Date(s) ***(required)*** (due by 5 p.m. proposer's local time)***:***

  June 18, 2012

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

  August 08, 2012

D. FastLane / Grants.gov Requirements

- For Proposals Submitted Via FastLane:

  Detailed technical instructions regarding the technical aspects of preparation and submission via FastLane are available at: https://www.fastlane.nsf.gov/a1/newstan.htm. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or e-mail fastlane@nsf.gov. The FastLane Help Desk answers general technical questions related to the use of the FastLane system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

  Submission of Electronically Signed Cover Sheets. The Authorized Organizational Representative (AOR) must electronically sign the proposal Cover Sheet to submit the required proposal certifications (see Chapter II, Section C of the Grant Proposal Guide for a listing of the certifications). The AOR must provide the required electronic certifications within five working days following the electronic submission of the proposal. Further instructions regarding this process are available on the FastLane Website at: https://www.fastlane.nsf.gov/fastlane.jsp.

- For Proposals Submitted Via Grants.gov:

  Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: http://www07.grants.gov/applicants/app_help_reso.jsp. In addition, the NSF Grants.gov Application Guide provides additional technical guidance regarding preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

  Submitting the Proposal: Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to the NSF FastLane system for further processing.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program where they will be reviewed if they meet NSF proposal preparation requirements. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with the oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal.

A. NSF Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board (NSB)-approved merit review criteria: intellectual merit and the broader impacts of the proposed effort. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two NSB-approved merit review criteria are listed below. The criteria include considerations that help define them. These considerations are suggestions and not all will apply to any given proposal. While proposers must address both merit review criteria, reviewers will be asked to address only those considerations that are relevant to the proposal being considered and for which the reviewer is qualified to make 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, original, or potentially transformative 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?

Examples illustrating activities likely to demonstrate broader impacts are available electronically on the NSF website at: http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf.

Mentoring activities provided to postdoctoral researchers supported on the project, as described in a one-page supplementary document, will be evaluated under the Broader Impacts criterion.

Additional Solicitation Specific Review Criteria

Please see the full text of this solicitation for further information.

NSF staff also will give careful consideration to the following in making funding decisions:

Integration of Research and Education
One of the principal strategies in support of NSF's goals is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the diversity of learning perspectives.

Integrating Diversity into NSF Programs, Projects, and Activities
Broadening opportunities and enabling the participation of all citizens -- women and men, underrepresented minorities, and persons with disabilities -- is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review 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.

NSF will manage and conduct the review process of proposals submitted in accordance with NSF standards and procedures. Relevant information about proposals and reviews of proposals will be shared with DOE/VTP.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF is striving to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director accepts the Program Officer's recommendation.

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

In all cases, after programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications and the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process.)

B. Award Conditions

An NSF award consists of: (1) the award letter, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award letter; (4) the applicable award conditions, such as Grant General Conditions (GC-1); * or Research Terms and Conditions * and (5) any announcement or other NSF issuance that may be incorporated by reference in the award letter. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

*These documents may be accessed electronically on NSF's Website at http://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

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

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer at least 90 days before the end of the current budget period. (Some programs or awards require more frequent project reports). Within 90 days after expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report will delay NSF review and processing of any future funding increments as well as any pending proposals for that PI. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through FastLane, for preparation and submission of annual and final project reports. Such reports provide information on activities and findings, project participants (individual and organizational), publications, and other specific products and contributions. PIs will not be required to re-enter information previously provided, either with a proposal or in earlier updates using the electronic system. Submission of the report via FastLane constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

The PIs should note that all reports will be reviewed by NSF and DOE program officers or their designees. This evaluation of the report is an important component of the annual evaluation and the continuation of funding for the next year. In addition, as noted earlier, the PIs or their designee are expected to attend the DOE and/or NSF review meetings as part of the annual evaluation process.

VIII. AGENCY CONTACTS

Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.

General inquiries regarding this program should be made to:

- Sumanta Acharya, Thermal Transport Processes Program, NSF/ENG/CBET, telephone: (703) 292-7494, email: sacharya@nsf.gov
- George Antos, Program Director, Catalysis and BioCatalysis Program, NSF/ENG/CBET, telephone: (703) 292-4997, email: gantos@nsf.gov
- Arvind Atreya, Program Director, Combustion, Fire, Plasma Systems Program, NSF/ENG/CBET, telephone: (703) 292-8695, email: aatreya@nsf.gov
- Gurpreet Singh, Group Leader, Vehicle Technologies Program, DOE, telephone: (202) 586-2333, email: gurpreet.singh@ee.doe.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: fastlane@nsf.gov.

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: support@grants.gov.

Point of Contact at U.S. Department of Energy is Gurpreet Singh: 202-586-2333 or gurpreet.Singh@ee.doe.gov

IX. OTHER INFORMATION

The NSF Website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this Website by potential proposers is strongly encouraged. In addition, National Science Foundation Update is a free e-mail subscription service designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF Regional Grants Conferences. Subscribers are informed through e-mail when new publications are issued that match their identified interests. Users can subscribe to this service by clicking the "Get NSF Updates by Email" link on the NSF web site.

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this new mechanism. Further information on Grants.gov may be obtained at http://www.grants.gov.

ABOUT THE NATIONAL SCIENCE FOUNDATION

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

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

NSF receives approximately 55,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Arctic and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

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

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

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

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

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

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

  Send an e-mail to: nsfpubs@nsf.gov

  or telephone: (703) 292-7827
- To Locate NSF Employees: (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004), and NSF-51, "Reviewer/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton
Reports Clearance Officer
Division of Administrative Services

National Science Foundation
Arlington, VA 22230