

Deep Underground Science and Engineering Laboratory (DUSEL S4)

Development of Technical Designs for Potential Candidates for the DUSEL Suite of Experiments

PROGRAM SOLICITATION

NSF 09-500



National Science Foundation

Directorate for Mathematical & Physical Sciences
Division of Physics

Directorate for Engineering
Civil, Mechanical and Manufacturing Innovation

Directorate for Geosciences
Division of Earth Sciences

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

January 09, 2009

REVISION NOTES

A revised version of the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), [NSF 09-1](#), was issued on October 1, 2008 and is effective for proposals submitted on or after January 5, 2009. Please be advised that the guidelines contained in [NSF 09-1](#) apply to proposals submitted in response to this funding opportunity. Proposers who opt to submit prior to January 5th, 2009, must also follow the guidelines contained in [NSF 09-1](#).

One of the most significant changes to the PAPPG is implementation of the mentoring provisions of the America COMPETES Act. Each proposal that requests funding to support postdoctoral researchers must include, as a separate section within the 15-page project description, a description of the mentoring activities that will be provided for such individuals. Proposals that do not include a separate section on mentoring activities within the Project Description will be returned without review (see the PAPP Guide Part I: *Grant Proposal Guide* Chapter II.C.2.d for further information).

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Deep Underground Science and Engineering Laboratory (DUSEL S4)
Development of Technical Designs for Potential Candidates for the DUSEL Suite of Experiments

Synopsis of Program:

The particle physics, cosmology/astrophysics and nuclear physics communities have identified the need for a deep underground laboratory infrastructure in order to address some of the most compelling, transformational questions at the frontier of their disciplines. Some of these questions include:

- What are the fundamental symmetries and absolute mass of the neutrino? Can these provide a window into the origin and pattern of particle masses that make up our universe?
- What are the fundamental properties and interactions of the three families of neutrinos, e.g., CP violation, mass hierarchy, CKM matrix and mixing angles? What can these and other neutrino studies tell us about the matter/antimatter asymmetry in the universe? Can it reveal new insights into the unification of the fundamental forces that govern physical laws as we now understand them?
- What is the proton lifetime, and does it decay? Is ordinary matter inherently (un)stable?
- What is dark matter?
- What is the spectrum of neutrinos from supernovae and the Big Bang, and what can this tell us about the history and evolution of our universe?

Physicists are on the threshold of advancing and deepening our understanding of nature's basic laws by probing these fundamental questions, which requires a deep underground environment and associated infrastructure. While such an underground infrastructure is envisioned to specifically address forefront physics research, it may

also provide cost effective opportunities for other communities to address important new research areas. (Section I of this solicitation - Introduction - contains references to community-based planning documents which have guided the development of such an underground research facility.)

The Deep Underground Science and Engineering Laboratory (DUSEL) is proposed to address the need for such an underground infrastructure, and is in the planning stages at the National Science Foundation for possible consideration for funding as a Major Research Equipment and Facilities Construction (MREFC) project, in accordance with the process described in the NSF Large Facilities Manual (LFM, NSF-07-38, <http://www.nsf.gov/pubs/2007/nsf0738/nsf0738.pdf>). If approved or funded as an MREFC project, DUSEL would include funds to support construction of both the facility and its infrastructure, the design of which is supported through the DUSEL Solicitation 3 award (S3, NSF-06-614, <http://www.nsf.gov/pubs/2006/nsf06614/nsf06614.pdf>), and the suite of DUSEL experiments that this infrastructure would host. This solicitation (DUSEL Solicitation 4, S4) invites proposals to develop project plans for specific candidate experiments that could be considered for the suite of DUSEL experiments.

The funds awarded for the proposals selected in S4 will allow the proposing team to complete the design phase(s) through Preliminary Design or beyond, as defined in the LFM, within the three year solicitation funding period. The project design phases are defined in detail in the LFM. The S4 selection will be based on the peer review of those proposals that put forward experiments that address the most cogent and transformational science questions that require the unique capabilities of an underground facility. Awards will be made for those experiments addressing the most compelling science, and will support design and development for those experiments. The suite of experiments will define the scope of the DUSEL infrastructure.

Proposals targeting research in physics will be the primary target for this Solicitation. Proposals targeting research in engineering and geosciences may also be submitted to this Program Solicitation, and if positively reviewed will be considered for funding by those Directorates, such funding would be separate from the Anticipated Funding Amount identified in this Solicitation. To the extent that engineering or geosciences proposals may represent significant cost drivers for the DUSEL infrastructure, for the needed instrumentation, or for operations, such proposals should be discussed with the relevant Program Directors in the Geosciences or Engineering Directorates for expressions of interest in co-funding, and/or to identify appropriate other agency funding partners, including other U.S. federal agencies, states, private sector organizations, and/or countries.

Reviews will be conducted within the NSF Directorate that normally oversees the proposed research; multi- and inter-disciplinary proposals will be reviewed collaboratively by the relevant Directorates. In some cases, developmental work or simulations may be needed to clarify specific technical features or approaches of the design being proposed. Accordingly, in such special cases, a limited amount of S4 funding will be considered to support targeted R&D and related activities that would complement the design work put forward. S4 provides support for development of project plans for potential candidates for the suite of DUSEL experiments. Should DUSEL be approved and funded as an MREFC project, selection for an S4 award does not constitute a commitment for inclusion in the suite of DUSEL experiments, nor do declinations for S4 funding imply exclusion. A subsequent solicitation (or solicitations), and corresponding review (or reviews), will be used to ultimately identify the suite of experiments that will be included as part of any DUSEL MREFC proposal.

In addition to the National Science Board-approved merit review criteria of intellectual merit and broader impacts (see Section VI.A), the DUSEL-specific guiding principles governing the review process for the proposals in response to this solicitation is to select for award those proposals that (1) show the greatest potential for world-class, transformational scientific and engineering results at the best cost/risk value to the government, and (2) collectively lead to a DUSEL infrastructure that is scientifically justified and fits within funding constraints. More details on the review criteria may be found in Section VI. The scope of the science and engineering activities appropriate for DUSEL are to be defined by the relevant communities, as referenced in Section I below.

Cognizant Program Officer(s):

- Jonathan Kotcher, telephone: (703) 292-8235, email: jkotcher@nsf.gov
- Richard Fragaszy, telephone: (703) 292-7011, email: rfragasz@nsf.gov
- David Lambert, telephone: (703) 292-8558, email: dlambert@nsf.gov

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

- 47.041 --- Engineering
- 47.049 --- Mathematical and Physical Sciences
- 47.050 --- Geosciences

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant or Cooperative Agreement

Estimated Number of Awards: 10 to 15 Approximately 10 to 15 awards total, inclusive of all disciplines.

Anticipated Funding Amount: \$15,000,000 maximum in total over the three year award period, subject to availability of funds. Up to \$5,000,000 per year for up to three years. Funding levels for each of the awards will vary, according to the scope and cost of the necessary work to develop the technical plan for the proposed activity.

Eligibility Information

Organization Limit:

Proposals may only be submitted by the following:

- Universities and Colleges: Universities and two- and four-year colleges (including community colleges) located and accredited in the US, acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI: 1

An individual may be the Principal Investigator (PI) or Co-Principal Investigator (Co-PI) for only one proposal.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not Applicable
- **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/pubs/policydocs/grantsgovguide607.pdf>)

B. Budgetary Information

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

C. Due Dates

- **Full Proposal Deadline(s)** (due by 5 p.m. proposer's local time):
January 09, 2009

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.

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I. INTRODUCTION

Significant advances in the science and engineering disciplines often require access to exotic environments, either to investigate processes that occur only under conditions not available in a conventional laboratory, or to search for rare processes that are easily masked under most realizable circumstances. Scientists and engineers then must create those environments artificially; in some instances, they can exploit naturally existing environments with the needed characteristics, provided there exist appropriate access and infrastructure. The Deep Underground Science and Engineering Laboratory (DUSEL) represents such a case.

In the past several years, research communities in particle, nuclear, and astrophysics have developed compelling scientific and technical arguments and a collective vision that establishes the need for access to facilities deep underground. Researchers in geosciences and engineering, have also clarified their needs regarding forefront research that can be supported utilizing this same unique environment. The planning activities that have guided this development have also examined the worldwide context for deep underground laboratory space, and concluded that development of new infrastructure capable of providing great volume or depth is necessary to address the highest priority research questions.

The science that the needed DUSEL infrastructure will support is expected to advance science and engineering by producing transformational discoveries, educational benefits, and public interest. A series of reports, some of which are listed below, lays out a fabric of compelling questions that can be answered only by providing a deep underground infrastructure for their studies:

- Bahcall Report (2001), NSF-DOE sponsored *ad hoc* scientific study on underground science.
- Nuclear Science Advisory Committee Long-Range Plan (2002).
- International Workshop on Neutrinos and Subterranean Science (NESS 2002).
- Connecting Quarks to the Cosmos (2003), National Research Council report.
- High Energy Physics Advisory Panel Long-Range Plan (2003).
- Neutrinos and Beyond (2003), National Research Council report.
- EarthLab (2003), NSF-sponsored report of underground opportunities in GeoSciences and GeoEngineering.
- Physics of the Universe (2004), National Science and Technology Council report.
- Quantum Universe (2004), NSF-DOE High Energy Physics Advisory Panel Sub-Panel report.
- Revealing the Hidden Nature of Space and Time (EPP2010 - 2006), National Research Council report.
- Deep Science (2006), report prepared in response to NSF DUSEL solicitation #1.
- The Frontiers of Nuclear Science: A Long Range Plan (2007), Nuclear Science Advisory Committee (NSAC).
- Particle Physics Project Prioritization Panel (P5): A Strategic Plan for the Next Ten Years (2008)

The NSF Directorate for Mathematical and Physical Sciences, Division of Physics, in conjunction with the Directorate for Engineering, Division of Civil, Mechanical and Manufacturing Innovation, and the Directorate for Geosciences, Division of Earth Sciences, has been working with the relevant communities to implement a sequence of steps that could lead to the creation of such a laboratory. A set of three solicitations was designed to request proposals that develop: (1) a report documenting the scientific and engineering opportunities of a DUSEL and the physical requirements for meeting the research goals; (2) conceptual designs that meet the goals identified in Solicitation 1, based on specific proposed sites; and (3) a technical design for a DUSEL, including a Preliminary Design, as defined in the NSF Large Facilities Manual (LFM, NSF-07-038, <http://www.nsf.gov/pubs/2007/nsf0738/nsf0738.pdf>) and Section II of the third solicitation, for a single DUSEL site. Awardees for all three solicitations were selected by means of a peer-reviewed competition.

Solicitation 1 (S1, NSF-04-595) resulted in a report, *Deep Science (2006)*, available at <http://www.DUSEL.org/>, that provides a description of the technical scope and physical requirements for a DUSEL.

Solicitation 2 (S2, NSF-05-503) resulted in proposals to develop conceptual designs for eight sites. An expert panel selected two sites that were judged to be the most promising candidates for a DUSEL, and awards were made to develop Conceptual Designs.

Solicitation 3 (S3, NSF-06-614) called for proposals to continue design activities for a DUSEL at a specific site. The purpose of S3 was to select a single site and to support continuing design and development of the infrastructure leading to a baseline design of sufficient detail and accuracy to allow it to be considered for implementation as a possible MREFC project by the NSF. The S3 review committee, consisting of recognized experts in the relevant subjects, such as deep mining, safety, environmental impacts, rock mechanics, mine operations, physics, biology, geology, engineering, and education and outreach, reached the unanimous conclusion that the proposal to develop an underground laboratory at the Homestake Mine in South Dakota offered the greatest potential for the realization of a world-leading DUSEL at the best cost/risk value to the government, and would best enable the science and engineering activities defined by the relevant user communities, as referenced in the reports above.

The present solicitation, S4, calls for proposals to develop technical designs for potential candidates for the suite of experiments whose requirements would define the DUSEL infrastructure. Previous solicitations required the proposing teams to discuss a suite of DUSEL experiments, both to manifest the scientific significance of DUSEL, and to begin the formulation of the research program, and its scope, within or by the various user communities. S4 calls for specific proposals to develop designs through the Preliminary Design phase or beyond as defined in the LFM for experiments that could be carried out in DUSEL once beneficial occupancy to the facility under development is made available. In some cases, developmental work or simulations may be needed to clarify specific technical features or approaches of the design being proposed. In such special cases, a limited amount of S4 funding will be considered to support focused and targeted R&D and related activities that would be necessary for the design work put forward.

NSF intends to combine the selected DUSEL experiments and the supporting DUSEL infrastructure into a single, integrated project for the purposes of seeking agency approval in the MREFC process. This helps to ensure that the technical, scientific and educational benefits of the investment in DUSEL are maximized, allowing the scientific program and the facility to be developed in close concert in order to enable the realization of a world-leading and appropriately scoped underground research program in a timely, efficient, and cost-effective manner.

Experiments performed in DUSEL are of interest to multiple agencies. In particular, two recent community reports detailing ten-year

roadmaps for nuclear physics and particle physics state the following:

"The panel endorses the importance of a deep underground laboratory to particle physics and urges NSF to make this facility a reality as rapidly as possible. Furthermore the panel recommends that DOE and NSF work together to realize the experimental particle physics program at DUSEL." [Particle Physics Project Prioritization Panel (P5): A Strategic Plan for the Next Ten Years (2008)]

"We recommend a targeted program of experiments to investigate neutrino properties and fundamental symmetries. These experiments aim to discover the nature of the neutrino, yet-unseen violations of time-reversal symmetry, and other key ingredients of the New Standard Model of fundamental interactions. Construction of a Deep Underground Science and Engineering Laboratory is vital to U.S. leadership in core aspects of this initiative." [The Frontiers of Nuclear Science: A Long Range Plan (2007), Nuclear Science Advisory Committee (NSAC)]

In response to these recommendations, NSF and the Department of Energy (DOE) have begun discussions about nuclear and particle physics experiments at DUSEL. The DOE Offices of Nuclear Physics and High Energy Physics will develop their own R&D programs, in parallel with this solicitation, for world-leading physics experiments that could be mounted at DUSEL. This R&D program will be coordinated with the appropriate programs in the NSF Directorate of Mathematical and Physical Sciences in order to realize the scientific opportunities provided by such a facility. Investigators interested in applying for DOE grants in this particular research area should refer to the general Office of Science solicitation at <http://www.science.doe.gov/grants/>.

Partnerships and/or collaborative research opportunities with other countries also exist; NSF welcomes expressions of interest for the development of cooperative international activities. It is expected that DUSEL will operate in an open, collaborative, and cooperative mode with the underground science and engineering laboratories world-wide, and with a corresponding open public access policy with respect to the resulting data.

S4 funds provide support for potential candidates for the suite of DUSEL experiments. Selection for an S4 award constitutes a commitment only to development of the design of specific experiments, and not for inclusion in the suite of DUSEL experiments, should DUSEL be approved and funded as an MREFC project; similarly, proposals declined in S4 are not excluded from the suite of DUSEL experiments. A subsequent solicitation (or solicitations), and corresponding review (or reviews), will be used to ultimately identify the suite of experiments that will be included in any DUSEL MREFC proposal.

II. PROGRAM DESCRIPTION

This solicitation invites proposals for development of technical designs for specific experiments to be located in the Deep Underground Science and Engineering Laboratory (DUSEL), currently under consideration by NSF for development at the Homestake Mine in South Dakota. The funds awarded for the proposals selected in S4 will allow the proposing team to complete the design phase(s) through Preliminary Design or beyond, as defined in the NSF Large Facilities Manual (LFM, NSF-07-038, <http://www.nsf.gov/pubs/2007/nsf0738/nsf0738.pdf>), within the three year award period. Competitive peer review of the proposals received will be used to select those experiments showing the most promise for inclusion in the suite of experiments for DUSEL, mindful that the experiments will ultimately define the DUSEL infrastructure, and also mindful of funding constraints; the subset of chosen experiments of the potential DUSEL program will thereby be afforded the opportunity to advance their designs to the point where the scientific and technical aspects of the proposed experiments may be judged in detail. The scope of the work to be funded under the awards resulting from this solicitation includes completion of the detailed design phase of each experiment, thus ensuring that the plans for construction, commissioning, and operations of each experiment are thoroughly analyzed and reviewed before deciding upon its inclusion in any DUSEL MREFC proposal. In the manners described above, the S4 solicitation contributes to the overall consideration of DUSEL by NSF.

The justification for a deep underground laboratory is that it provides the infrastructure required to perform the transformational science and engineering research experiments at a depth that provides necessary shielding from cosmic rays or direct access to study the physical/chemical/biological/geological processes that occur in the deep underground environment. The technical scope of the multidisciplinary program enabled by DUSEL and the resulting site-independent infrastructure requirements have been documented in *Deep Science (2006)*, available at <http://www.dusel.org/>, a report prepared in response to the first DUSEL solicitation in this series entitled "Deep Underground Science and Engineering Program and Technical Requirements" (NSF-04-595). The present solicitation is designed to result in the development of a comprehensive project plan for the design, construction, commissioning, and operations for the experiments described in each of the proposals receiving awards. The suite of highest priority experiments that will ultimately be selected for DUSEL is expected to provide a vigorous transformational research program that will be enabled by a deep underground laboratory infrastructure.

Proposals to develop project plans at DUSEL submitted in response to this solicitation should include plans to develop designs for all phases of the proposed experiments. Specifically, in addition to addressing the two National Science Board-approved review criteria of intellectual merit of the scientific and/or engineering basis for the experiment and the quality of the broader impacts proposed [see Section VI.A], proposals should address the plans for the development of the design of the experiment through the level of the Preliminary Design or beyond, as defined in the LFM. The anticipated lifetime of the proposed experiment should be included, as well as a timeline of the proposed design work. Any existing preliminary information on project cost, risk analysis and its mitigation, environmental, health and safety considerations, or other topics relevant to the mounting of the experiment should be included as well. Potential for possible future upgrades of the experiment and expansion of its scientific goals, e.g., increasing sensitivity to certain phenomena, may also be included as part of the intellectual justification for the experiment. Proposed experiments are expected to be at the leading edge of research in their field of inquiry.

The plans to be developed through awards from this solicitation should adhere to advanced project management standards - e.g., Work Breakdown Structure (WBS), resource loaded schedule, risk-based contingency analysis, etc. - and must include (a) time estimates for each work component of the project, (b) cost and staffing estimates for each component of the project, including identification of key personnel where appropriate, and (c) a management plan for the project that describes how the various functions - intellectual leadership, technical approach, experiment operations and maintenance, etc. - will be created, overseen and maintained, including both internal interactions within the experiment and external interactions with DUSEL laboratory management, with the scientific community, with the funding agencies, and with advisory bodies, project advisory committees, international collaborations, etc. Some specific topics that are to be covered in the Preliminary Design are listed below; a more complete description may be found in the LFM.

- A resource-loaded schedule in WBS format and Project Execution Plan for the full anticipated life cycle of the project - additional design, construction, commissioning and operations - at the appropriate level of detail for a Preliminary Design, as described in the LFM;
- Experiment-specific operations and maintenance requirements and costs;
- Experimental requirements for DUSEL infrastructure, including the necessity to perform the proposed research in DUSEL,

specific requirements that need to be met by the design of the DUSEL infrastructure, with clear delineation of which components/services lie within the scope of the proposed experiment and which are to be provided by the DUSEL laboratory;

- Qualifications of team for design completion, construction, commissioning and operations of the proposed experiment, including any expertise in multiple disciplines that might be required;
- Environmental, health and safety plans to assure the safety of users, staff, and visitors to DUSEL, and compliance with relevant governmental standards and regulations. Discussion of innovative ideas to elevate the life-safety level above that in the mining and underground construction industries to one appropriate for researchers, students, and the public should be included;
- A transition plan from construction to operations, including costs and staffing assessments for commissioning and operation of the experimental project after construction/acquisition;
- Special access or other requirements that may be needed during DUSEL construction for purposes of sampling and study of the *in situ* rock, hydrologic conditions, or other processes for the purposes of scientific and engineering research;
- Management and organization plan that indicates how the project will be managed and overseen, staffing levels for various labor classes (scientists, engineers, technicians, etc.), required provisions for obtaining scientific/technical/management advice, managerial and other communication interfaces between the experiment and the DUSEL laboratory, etc. during all phases of the project;
- Risk and risk-based contingency analyses and associated risk mitigation plan for the project;
- Plan for education, outreach, diversity, broadening participation and regional interaction plans;
- Specification of world-wide context for the proposed work;
- Plans for joint funding with other US agencies;
- Plans for international cooperation/collaboration; including co-funding;
- Plans for data management to address data acquisition, storage and retrieval, special infrastructure needs (hardware and software), cyber security, etc.
- Projections about potential follow-on experiment phases to extend the reach of the proposed project;
- Any other elements or considerations, identified by the proposing teams and not listed above, that are necessary to execute the proposed project throughout its life cycle.

In connection with possible funding partners (see above), it is emphasized that other U.S. agency and international participation in the research program at DUSEL is strongly encouraged. Co-funding with other U.S. agencies and other countries should be sought if cost estimates for (1) special infrastructure, (2) exceptionally large or complex instrumentation, and/or (3) activities which place exceptional demands on operational costs are estimated to represent a significant fraction of the proposed NSF DUSEL scope. Again, such proposals should be discussed for appropriateness in advance with the NSF Program Directors in the relevant Directorates.

Proposals submitted in response to this solicitation will be peer-reviewed by means of *ad hoc* mail reviews and/or panel reviews, and site visits and/or reverse site visits, as appropriate. It is expected that the experimental plans supported by this solicitation will be closely coordinated with the team developing the DUSEL infrastructure in order to ensure consistency with laboratory plans and goals, space and safety requirements, and other technical issues. As described in more detail in Section VI.A, the successful proposals will be those that show the greatest potential for major scientific and/or engineering advances, consistent with development of a world-leading deep underground laboratory, at the best cost/risk value to the government.

Awards will be made for design and development activities which are expected to result in designs at the level of a Preliminary Design or beyond, as defined in the LFM, for specific DUSEL experiments. The process for development of an executable scientific and engineering program for DUSEL will be conducted in accordance with the LFM.

S4 funds provide support for potential candidates in the DUSEL suite of experiments. Selection for an S4 award constitutes a commitment only to development of the design of specific experiment, and not to inclusion in the suite of DUSEL experiments, should DUSEL be approved and funded as an MREFC project; similarly, proposals declined in S4 are not excluded from the suite of DUSEL experiments. A subsequent solicitation (or series of solicitations), and corresponding review (or reviews), will be used to ultimately identify the suite of experiments that will be included in any DUSEL MREFC proposal.

III. AWARD INFORMATION

Anticipated Type of Award: Continuing Grant or Cooperative Agreement or Standard Grant

Estimated Number of Awards: Approximately 10 to 15 awards total, inclusive of all disciplines.

Anticipated Funding Amount: Up to \$5,000,000 per year for up to three years, for a maximum total of up to \$15,000,000 over the three year award period, subject to availability of funds. Funding levels for each of the awards will vary, according to the scope and cost of the necessary work to develop the technical plan for the proposed activity.

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

IV. ELIGIBILITY INFORMATION

Organization Limit:

Proposals may only be submitted by the following:

- Universities and Colleges: Universities and two- and four-year colleges (including community colleges) located and accredited in the US, acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI: 1

An individual may be the Principal Investigator (PI) or Co-Principal Investigator (Co-PI) for only one proposal.

Additional Eligibility Info:

In proposals involving multiple organizations, a single organization must submit the proposal as the lead organization, and accept overall management responsibility. Although their organizations may not serve as the lead organization, collaborators or subawardees may be affiliated with state governments or national laboratories, receiving funds for DUSEL activities via sub contracts. Support for scientific staff from non-academic institutions is to be provided by their home institutions.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

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 pubs@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/bfa/dias/policy/docs/grantsgovguide.pdf>). 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 pubs@nsf.gov.

This program solicitation contains deviations from the standard Grant Proposal Guide (GPG) or NSF Grants.gov Application Guide proposal preparation guidelines. The only deviations are in the specific information requested in the project description and in the additional review criteria, as indicated below.

Proposal Cover Sheet. Indicate the total amount of NSF support requested for the award period in the box entitled "requested amount."

Biographical Sketches. List the senior investigators (faculty level or equivalent), key engineering and technical personnel, higher level project management staff, and consultants, providing their full names, institutional (and departmental, where relevant) affiliations, and roles and/or titles within the project. Include a biographical sketch for each of these participants, listing up to ten publications and other professional accomplishments most pertinent to this proposal.

Project Description. The purpose of awards made under this solicitation is to develop technical plans that would meet all the requirements for a Preliminary Design (or beyond) for the total project as defined in the LFM. The project description in proposals submitted in response to this solicitation is limited to 20 pages. The proposal should provide information necessary to evaluate the scientific and/or engineering merit of the proposed activity and its broader impacts, to adequately address the DUSEL-specific items described below, where relevant, and allow evaluation of the merits for developing a Preliminary Design, as specified in the LFM.

Some specific topics to be addressed in the proposal include the following:

1. Intellectual merit, defined by the NSB criterion 1, to include the way in which the proposed experiment would advance significant intellectual frontier(s) of the scientific/engineering field addressed;
2. Broader impacts, defined by the NSB criterion 2, which might take the forms of impacts on other disciplines, other sectors (industry, health, defense), broadening the high tech workforce, strengthening education, etc;
3. Scope of planning work to be performed under the requested award in order to satisfy the requirements of the Preliminary Design specified in the LFM, including, where possible, the definition of the major elements of the Work Breakdown Structure (WBS) to be developed;
4. Qualifications of team for design and successful implementation of the proposed experiment, including expertise in the multiple disciplines and professions required to develop a Preliminary Design;
5. The anticipated lifetime of the proposed experiment;
6. A timeline and budget for the proposed design work. Estimates of cost, schedule, personnel profiles/needs (including scientific and technical personnel, any necessary consultants or contractors), required project software or other tools, or other relevant material should be included;
7. Any available preliminary information on project cost; risk analysis and its mitigation; environmental, health and safety considerations; project management and oversight; education, outreach, diversity, and regional interaction plans; or other topics relevant to the mounting of the experiment;
8. A description of any limited and targeted R&D, simulations or related activities that are needed to complement the design work put forward, as described in Sections I & II of this solicitation;
9. Potential for possible future upgrades of the experiment and expansion of the scientific goals or reach of the experiment, e.g., increasing sensitivity to certain phenomena;

10. A description of a data management plan to address eventual sharing of experimental data, access to all interested parties, including public access, and the development any needed MOU's on data policy with potential partners.
11. Specification of worldwide context for the proposed work; and
12. Co-funding plans with other US agencies (federal or state), private sector organizations, or other countries for construction of the instrumentation or exceptional needed infrastructure or for operations and maintenance.

Backup material may be submitted, which may or may not be used during the review process. This material is limited to 15 pages, and should be included in the submission in the Proposal Section under the heading Special Information and Supplementary Documentation.

Note that the review process may vary from discipline to discipline; e.g., a site visit may not be necessary for any, or every, discipline.

B. Budgetary Information

Cost Sharing: Cost sharing is not required under this solicitation.

C. Due Dates

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

January 09, 2009

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. The Grants.gov's Grant Community User Guide is a comprehensive reference document that provides technical information about Grants.gov. Proposers can download the User Guide as a Microsoft Word document or as a PDF document. The Grants.gov User Guide is available at:

<http://www.grants.gov/CustomerSupport>. 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 judgements.

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>.

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.

Additional Review Criteria:

In addition to the National Science Board-approved merit review criteria of Intellectual Merit and Broader Impacts, proposals will also be reviewed against the following additional review criteria:

1. Compatibility of the proposed experiment with the DUSEL scientific and engineering goals, as referenced in the community reports cited in Section I of this solicitation. This includes intellectual considerations regarding the scientific and/or engineering goals of the proposed experiment, as well as the experimental need for the unique conditions provided by DUSEL, e.g., the appropriate depth for the proposed experiment, and related issues.
2. Appropriateness and suitability of the proposed experiment for potential inclusion in the DUSEL suite of experiments, which collectively define the scope of the DUSEL infrastructure. Considerations include the impact of depth and volume requirements on overall project cost; reasonableness of schedules for experiment development and operations; health, safety, security, and environmental concerns; physical access requirements, etc.
3. Potential for developing a comprehensive, reliable Preliminary Design for a unique, transformational, world-leading research project matched to the mission and capabilities of the DUSEL. This includes the feasibility that the proposing team can develop a sound, well-documented technical design/plan in the allotted time, while minimizing unresolved issues and risk.
4. Thoroughness of the proposed approach for project definition (e.g., identification of functional performance goals, requirements definition, alternatives analysis, etc.) leading to an optimized design. The scientific merit relative to life-cycle costs will be one of the determinants in selecting projects for the DUSEL suite of experiments.
5. Soundness of the plan for the proposed design work with regard to the realism of the design plan (e.g., cost, schedule, and technical staffing requirements, etc.), strength of collaboration, commitment by performing institutions, commitment by foreign partners, and any co-funding plans involving other sponsors, including federal and state agencies, private sector organizations, and/or international partners.
6. Competitiveness of the proposed activity in the international context.
7. Commitment to, and breadth and quality of the plans for, leveraging an investment in the proposed DUSEL activity for education, diversity, and public outreach benefits.

The guiding principle governing the review process for the proposals submitted in response to this solicitation is to select those proposals that show the greatest potential for developing a reliable plan for a world-leading DUSEL research project at the best cost/risk and scientific/engineering value to the government, and that would best enable selected science and engineering activities defined by the relevant communities, as referenced in the community reports discussed in Section I of this solicitation.

The above criteria will also be among those applied to the selection of the DUSEL suite of experiments, appropriately modified where necessary to reflect the maturity of the projects being considered at that point in time.

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review, Site Visit Review, or Reverse Site Review.

Reviews will be conducted within the NSF Directorate that normally oversees the proposed research; multi- and inter-disciplinary proposals will be reviewed collaboratively by the relevant Directorates.

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.

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 pubs@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.

Failure to provide the required annual or final project reports 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.

In addition to the reporting requirements above, quarterly status reports, describing progress on the design and other material relevant to development of the proposed experiment, will be required. The Principal Investigator of the proposal will be responsible for composing and transmitting these reports to the NSF DUSL Program Directors.

VIII. AGENCY CONTACTS

General inquiries regarding this program should be made to:

- Jonathan Kotcher, telephone: (703) 292-8235, email: jkotcher@nsf.gov
- Richard Fragaszy, telephone: (703) 292-7011, email: rfragaszy@nsf.gov

- David Lambert, telephone: (703) 292-8558, email: dlambert@nsf.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: fastlane@nsf.gov.
- Ramona Winkelbauer, telephone: (703) 292-7390, email: rwinkelb@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.

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, MyNSF (formerly the Custom News Service) is an information-delivery system 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 or the user's Web browser each time new publications are issued that match their identified interests. MyNSF also is available on NSF's Website at <http://www.nsf.gov/mynsf/>.

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 40,000 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 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: pubs@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

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