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Engineering Sciences for Modeling and Simulation-Based Life-Cycle Engineering

Program Solicitation
NSF 00-31
(replaces NSF 99-56)

DIRECTORATE FOR ENGINEERING
Division of Chemical and Transport Systems
Division of Civil and Mechanical Systems
Division of Design, Manufacture and Industrial Innovation

DEADLINE DATES:

ABSTRACT – March 31, 2000
FULL PROPOSALS – May 19, 2000

NATIONAL SCIENCE FOUNDATION

SANDIA NATIONAL LABORATORIES
Engineering Sciences Center

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SUMMARY OF PROGRAM REQUIREMENTS

GENERAL INFORMATION

Program Name: Engineering Sciences for Modeling and Simulation-Based Life-Cycle Engineering

Short Description/Synopsis of Program: This is a continuation of a collaborative research program between the National Science Foundation and Sandia National Laboratories that was initiated in 1997. The objective of this collaborative program is fund research projects that are focused on advancing the fundamental knowledge base needed to support advanced computer simulations. Advances are needed in the following broad classes of technical development: the fidelity of the simulation models, experimental discovery necessary for the determination of the models and their validations, uncertainty quantification of the resulting computations, and computational techniques for the solution of the simulation models on high performance computing platforms.

Cognizant Program Officers:
Dr. Stefan T. Thynell, CTS Division, NSF, (703) 306-1371, sthynell@nsf.gov or Dr. Thomas C. Bickel, Sandia National Laboratories, (505) 845-9301, tbickel@sandia.gov .

Thermal Transport: Dr. Stefan T. Thynell, CTS Division, NSF, (703) 306-1371, sthynell@nsf.gov or Dr. Thomas C. Bickel, Sandia National Laboratories, (505) 845-9301, tbickel@sandia.gov .

Solid Mechanics: Dr. Ken P. Chong, CMS Division, NSF, (703) 306-1361, kchong@nsf.gov, Dr. Clifford Astill (geotechnical problems), CMS Division, NSF, (703) 306-1362, castill@nsf.gov or Dr. E. P. Chen, Sandia National Laboratories, (925) 294-2334, epchen@sandia.gov .

Design and Operation of Engineering Systems: Dr. George A. Hazelrigg, DMII Division, NSF, (703) 306-1330, ext. 5299, ghazelri@nsf.gov or Dr. David R. Martinez, Sandia National Laboratories, (505) 844-1457, drmarti@sandia.gov .

Applicable Catalog of Federal Domestic Assistance (CFDA) No.: 47.041 – Engineering

ELIGIBILITY INFORMATION

- Limitation on the categories of organizations that are eligible to submit proposals: **Proposals may be submitted by individual investigators or small groups from colleges, universities and non-profit organizations in the United States.**
- Limitation on number of proposals that may be submitted by a PI: **None**
- Limitation on eligible topics: **The proposed effort should address only one of the focus areas and be related to either validation of models intrinsic to high performance computing or to the development of modeling protocols and computational procedures which materially accelerate and improve such computations relative to their specific focus area.**
- Limitation on the number of proposals that may be submitted by an organization: **None**

AWARD INFORMATION

- Type of award anticipated: **Standard or Continuing Grants**
- Number of awards anticipated in FY 2001: **6-12 awards are anticipated**
- Amount of funds available: **$2 million will be available for this competition in FY 2001, subject to availability of funds.**

- Anticipated date of awards: **October 2000**

PROPOSAL PREPARATION & SUBMISSION INSTRUCTIONS

- **Proposal Preparation Instructions**

  - Letter of Intent requirements: **None**
  - Pre-proposal requirements: **Abstract required by March 31, 2000**
  - Proposal Preparation instructions: **Standard NSF Grant Proposal Guide instructions.**
  - Supplemental proposal preparation instructions: **None**
  - Deviations from standard (GPG) proposal preparation instructions: **None**

- **Budgetary Information**

  - Cost sharing/matching requirements: **The Divisions of Chemical and Transport Systems, Civil and Mechanical Systems, and Design, Manufacture, and Industrial Innovation of NSF require 1/3 cost-sharing of equipment expenses. The proposed cost sharing must be shown on line M on the proposal budget (NSF Form 1030). Sandia National Laboratories has the same cost sharing requirement.**
  - Indirect cost (F&A) limitations: **None**
  - Other budgetary limitations: **Projects can be up to 3 years in duration. The typical annual budget is about $80,000, but budgets up to $300,000 each year could be possible if well justified.**

- **FastLane Requirements**

  - FastLane proposal preparation requirements: **FastLane proposal submission is required.**
  - FastLane point of contact: **Nichelle Coward, 703-306-1371, ncoward@nsf.gov . Also please visit http://www.fastlane.nsf.gov .**

- **Deadline/Target Dates**

  - Abstract Deadline: **5:00 PM local time, March 31, 2000 (by e-mail only)**
  - Research Proposal Deadline: **5:00 PM local time, May 19, 2000 (FastLane)**

PROPOSAL REVIEW INFORMATION

- Merit Review Criteria: **Standard National Science Board approved criteria plus additional evaluation criteria for the Design Theory proposals.**

AWARD ADMINISTRATION INFORMATION

- Grant Award Conditions: **NSF awards GC-1 or FDP III; Sandia award conditions.**
- Special grant conditions anticipated: **None anticipated**
- Special reporting requirements anticipated: **All successful PIs are required to attend the annual awardees meeting at a date and place to be specified by NSF and Sandia, during the tenure of the award.**

II. INTRODUCTION

This is a solicitation for the continuation of a collaborative research program between the National Science Foundation (NSF) and Sandia National Laboratories (Sandia). Sandia has the responsibility for engineering systems that have profound impact on national security and defense, and helps to assure operability of other national systems, particularly under conditions of stress. This responsibility spans the "life cycle" of a variety of engineered systems, where "life cycle" for the system includes defining its requirements, establishing the concepts to meet the requirements, proposing designs, verifying that the design satisfies the requirements, manufacturing the system, operating and maintaining the system, and finally dismantling and disposing of the system. With the advent of teraflop, massively parallel computers, Sandia is moving toward an engineering process in which decisions will increasingly be based on computational simulations with decreasing experimental validation. These simulations are of a magnitude unprecedented in computational size, scope of technical issues, spatial and temporal resolution, complexity in terms of coupled multiphysics phenomena, and comprehensiveness in terms of parameter-space that is being explored.

The NSF mission is to advance the fundamental science and engineering base of the United States, including a commitment to the further development of engineering processes using computer modeling and simulation. The two organizations have entered into a collaborative program to fund research projects that are focused on advancing the fundamental knowledge base needed to support advanced computer simulations.

In order to establish the engineering process identified above using advanced simulations on teraflop computers, it appears that our knowledge base is insufficient. To expand this knowledge base, significant advances are required in the fundamental sciences and engineering that form the foundation of all computational analyses. Advances are needed in the following broad classes of technical development: the fidelity of the simulation models, experimental discovery necessary for the determination of the models and their validations, uncertainty quantification of the resulting computations, and computational techniques for the solution of the simulation models on high performance computing platforms. Sandia and NSF are seeking proposals that address these modeling and simulation advances in several focus areas. The focus areas are Thermal Transport, Solid Mechanics, and Engineering Design (which includes the sub-areas of Design Theory and Modeling and Simulation Uncertainty). Detailed information of the scope of each of the focus areas is given below.

III. FOCUS AREAS

A. Thermal Transport.

Thermal transport plays a central role in many engineering applications such as thermal control of engineering systems, manufacturing and materials processing, power conversion and storage, biological, and micro/quantum scale thermal/fluid processes. Because the analysis of the related thermal processes often requires excessive computing times, the thermal analysis and design of systems involving these processes are difficult. With the advent of teraflop computers, it is now possible to exploit high performance computing methodologies to address these issues, assuming that the models are accurate and correctly implemented. When analyzing existing systems, the models can be modified by comparison with data and the errors minimized, leading to an improved understanding of the process. However, when designing systems, if the conditions under which the model was validated differ from those associated with the design, errors can result.

This focus area is particularly interested in proposals which emphasize the development of analytical and computational methods that represent critical thermal transport phenomena and processes with appropriate resolution, dimensionality, coupling with other physical processes, and diversity of length and time scales. Topics suitable for consideration include, but are not limited to, convective heat transfer coupled with moving boundaries and possibly with participating media radiative heat transfer, interfacial heat transfer, phase change systems, interaction of heat transfer and material processing (such as crystallization, levitation, machining). The development and application of advanced experimental methods to better characterize critical thermal transport phenomena are also appropriate.

B. Solid Mechanics.

This focus area seeks to improve and expand fundamental computational and material mechanics knowledge in the areas of nonlinear, large deformation, deterioration of materials, quasistatics and transient dynamics. The shift from a test-based to a simulation-based design environment requires accurate, robust and efficient computer codes which model large ranges of loadings, deformation amplitudes and rates, length- (including nano-, micro-, meso- and macro-scales) and time-scale mechanics, and damping of mechanical interfaces and joints. It seeks to develop a basic engineering understanding of numerical solution methods including finite elements, boundary elements, and gridless Lagrangian methods for challenging simulation problems such as in impact and penetration, thermomechanical aspects of material processing and manufacturing, crack initiation, propagation and arrest, design optimization and uncertainty analysis, including accurate constitutive description of materials. The solution algorithms must be robust, reliable, efficient, and scalable on parallel computing platforms. Carefully designed experimental investigations to validate and otherwise support the above technology areas are also needed.

C. Engineering Design.

There are new and emerging challenges that engineering designers face. Increasing and global competition demand that designs push limits of materials and processes, leaving less room for conservatism, and customers always want more for less. A fast-moving marketplace rapidly diminishes the value of new technologies, so that shortening the time from concept to market is increasingly important. On top of these demands, society also demands that new systems offer higher levels of safety and reliability, and lower environmental impact. These challenges have pushed conventional design approaches to their limits.

On the other hand computational capabilities are emerging that truly were inconceivable only a few years ago. Coupled with emerging models, such as finite element techniques, that represent engineered systems, these capabilities offer significant advantages. Computational design support tools enable the examination and comparison of wide ranges of design alternatives rapidly and inexpensively. The hope is that these tools will enable increased competitiveness in all the aspects noted above.

Still, despite the enormous power of computational models, they are far from perfect. All models are only abstractions of the realities that they are intended to represent. As such, the model-predicted performance of a system and the actual system performance will deviate at some level. When we use models to facilitate the understanding of nature, such deviations can be controlled and minimized. But in the case of design-support models, such control is not possible. The significant difference is that scientific models of nature are developed to fit extant data, whereas engineering design models are intended to predict future performance of systems. Studies of the inaccuracies in our ability to predict the behavior of engineered systems produce alarming results. Errors are considerable, and they cannot be controlled or minimized beyond modest limits. Thus, it is important to model the errors inherent in engineering design models and to develop a framework that will accommodate and use probabilistic results.

Recently, a framework has emerged that provides the capability to make use of probabilistic information in the context of engineering design. It is a decision theoretic framework. Under this framework, the role of decision making in engineering design is explicitly recognized. As such, three subactivities of the design process are recognized: (1) the generation of a set of design alternatives from which the preferred design will be chosen, (2) the estimation of expectations, that is, the performance expected from each design choice, and (3) the determination of human values relevant to the design and the use of these values to effect the selection of a preferred design. Much of an axiomatic base for decision-based design has been laid in the fields of mathematics and economics. For example, the von Neumann-Morgenstern axioms define a mathematics of value valid under conditions of risk and uncertainty that appear to apply to engineering design. And probability theory appears to provide a framework for analysis of uncertainty and risk.

Research in Engineering Design will be supported in two topical areas:

C.1 Design Theory.

Proposals in this focus area of Design Theory will be judged in terms of their ability/potential to provide sweeping theories that will cover and regularize wide ranges of engineering design.

Under this activity, research will be supported to create and/or implement an axiomatic basis for engineering design. One acceptable approach would be to build upon the concept of decision-based design and the axioms that define von Neumann-Morgenstern utility. However, other rigorous approaches will also be entertained. There is a need for a theory of value applicable to design decision-making under conditions of uncertainty and risk. There is a need for a theory for the estimation of system performance given imperfect ability to perform system modeling, imperfect estimation of model data, and imperfect knowledge of the future environment within which engineered systems must operate. And there is a need for a theory of option creation or creativity. The first such theory may already exist primarily within the fields of economics and decision theory. The second will likely find a basis in the mathematics of probability theory and forecasting. The third is more speculative, and progress in this area is likely to be difficult.

C.2 Modeling and Simulation Uncertainty.

Proposals in this focus area of Modeling and Simulation Uncertainty will be judged in terms of their ability/potential to provide general approaches to, and new theories for, uncertainty estimation in modeling and simulation-based design. The goal of the uncertainty estimation methodology is to understand the impact of uncertainties on modeling and numerical simulation activities and thereby increase the confidence in decision-based design methods.

Present design methodology for engineered systems is based on incremental changes and improvements of previously successful designs. In addition, present design practice relies heavily on extensive testing of components, subsystems and prototype systems. With rapidly increasing computational capability, modeling and simulation based design is taking on increased responsibility for the success of new engineering systems. This is a fundamental paradigm shift; one whose risks and uncertainties must be assessed during the design process. This research activity will address fundamental issues relating to the inclusion of quantitative estimation of uncertainty in mathematical modeling and computational simulation and the ascription of uncertainty to model and data elements. It will complement the above mentioned research in design theory. All sources of uncertainty and error may be considered. Furthermore, techniques are sought that incorporate uncertainty quantification in the development of constitutive models for stochastic or uncertain subsystems. A variety of methods are sought to estimate the global impact of uncertainty/error sources on confidence in a design.

IV. ELIGIBILITY INFORMATION

Proposals will be accepted from colleges, universities, and other not-for-profit institutions in the United States. Both single principal investigator (PI) and multi-disciplinary team proposals will be considered. The proposed work should address only one of the above focus areas and the overall aim of the research should be to either validate models intrinsic to high performance computing or to develop modeling protocols and computational procedures that materially accelerate and improve such computations relative to the specific focus area. Due to the limited availability of funds, prospective applicants are strongly urged to contact one of the program officers listed at the end of this document for guidance.

V. AWARD INFORMATION

Approximately $2 million will be provided to support projects, subject to the availability of appropriations. It is expected that between six to twelve projects will be funded.

In the 1st year of the program, 93 proposals were submitted and 8 awards were made. In the 2nd year of the program, 180 abstracts were submitted and 57 accepted; 51 proposals were received and 8 awards were made. Awards may be funded by Sandia or NSF. The NSF awards will be made as standard or continuing grants, funded at a typical annual range of $70,000/year to $100,000/year for individual investigator awards and $300,000/year to $400,000/year for group awards. The NSF awards will typically have a duration of 3 years. The Sandia awards will be contracts for up to 3 years. NSF and Sandia will determine which organization will fund individual proposals.

VI. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. General Information.

NSF and Sandia will use a two-step process for proposal submission and evaluation under this solicitation. As the first step, proposers must submit an abstract. If the abstract is judged to address the overall aims of this solicitation, the PI will be encouraged to submit a full proposal (second step).

B. Abstract Preparation Instructions.

A short abstract must be submitted by the PI in response to this solicitation. ***PIs are encouraged to discuss their ideas with one of the program directors before considering submission of an abstract.*** **It is requested that such submission be done at the earliest possible convenience.** The abstract should be submitted to both the contact person for general information at NSF (sthynell@nsf.gov) and at Sandia (tbickel@sandia.gov) no later than March 31, 2000. The abstract should contain the following:

- a title with a maximum of 12 words;
- names of all investigators and their institutions;
- a concise statement of research goals; and
- a concise description of relevance.

The descriptions of Goals and Relevance are limited to a total of 100 words. No fax or mail copies of the abstracts will be accepted. Abstracts that do not specifically address the overall aims of this solicitation will be judged to be nonresponsive.

Abstracts that address the overall aims of this solicitation, such as directing the effort to only one of the focus areas and proposing research related to either validation of models intrinsic to high performance computing or to the development of modeling protocols and computational procedures which materially accelerate and improve such computations relative to their specific focus area, will be accepted. PIs of such abstracts will be notified by email no later than April 7, 2000, and will be invited to submit a full proposal.

C. Proposal Preparation Instructions.

Only invited proposals, selected on the basis of review of abstracts, will be considered by NSF and Sandia in this competition.

Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *Grant Proposal Guide* (GPG), NSF 00-2. The complete text of the GPG (including electronic forms) is available electronically on the NSF Web site at: http://www.nsf.gov/. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone 301.947.2722 or by e-mail from pubs@nsf.gov.

Proposers are reminded to identify the program solicitation number (NSF 00-31) in the program announcement/solicitation block on the NSF Form 1207, "*Cover Sheet for Proposal to the National Science Foundation*." Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

Principal Investigators who wish proposals to be considered under this solicitation must submit a properly signed AUTHORIZATION TO DISCLOSE PROPOSAL AND REVIEW MATERIAL TO SANDIA NATIONAL LABORATORIES (found at the back of this Solicitation along with the signed NSF cover sheet) in order to be considered for funding.

D. Budgetary Information.

Cost Sharing Requirements.

Requested equipment expenses require 1/3 cost sharing for all proposals submitted in response to this solicitation. The proposed cost sharing must be shown on line M on the proposal budget (NSF Form 1030).

The amount of cost sharing must be shown in the proposal in enough detail to allow NSF to determine its impact on the proposed project. Documentation of availability of cost sharing must be included in the proposal.

Only items which would be allowable under the applicable cost principles, if charged to the project, may be included as the grantee's contribution to cost sharing. Contributions may be made from any non-Federal source, including non-Federal grants or contracts, and may be cash or in-kind (see OMB Circular A-110, Section 23). It should be noted that contributions counted as cost-sharing toward projects of another Federal agency may not be counted towards meeting the specific cost-sharing requirements of the NSF grant.

All cost-sharing amounts are subject to audit. Failure to provide the level of cost-sharing reflected in the approved grant budget may result in termination of the NSF grant, disallowance of grant costs and/or refund of grant funds to NSF.

E. Proposal Due Dates.

Submission of abstracts must be completed no later than 5:00 PM (local time) on March 31, 2000. **It is strongly encouraged that PIs submit their abstract as early as possible in order to obtain sufficient time for proposal preparation.** Principal Investigators of abstracts will be emailed by April 7, 2000, and either invited to submit a full proposal in response to this Program Solicitation or not encouraged to submit a full proposal.

The invited proposal **MUST** be submitted via FastLane by 5:00 PM, local time, May 19, 2000.

A proposal may not be processed until the complete proposal (including the signed Cover Sheet and the signed Authorization to Disclose Proposal and Review Material to Sandia National Laboratories) has been received by NSF. A proposal is considered complete when the proposal, including the Project Description, has been submitted to NSF. The receipt date will be the date the sponsored projects office transmits the proposal to NSF.

Submission of Signed Cover Sheets. The signed copy of the proposal Cover Sheet (NSF Form 1207) must be postmarked (or contain a legible proof of mailing date assigned by the carrier) within five working days following proposal submission and be forwarded to the following address:

NSF 00-31
National Science Foundation
DIS-FastLane Cover Sheet
4201 Wilson Blvd.
Arlington, VA 22230

F. FastLane Requirements.

Proposers are required to prepare and submit all proposals for this Program Solicitation through the FastLane system. Detailed instructions for proposal preparation and submission via FastLane are available at: https://www.fastlane.nsf.gov/al/newstan.htm.

Submission of Signed Cover Sheets. The signed copy of the proposal Cover Sheet (NSF Form 1207) must be postmarked (or contain a legible proof of mailing date assigned by the carrier) within five days following proposal submission in accordance with the FastLane proposal preparation and submission instructions referenced above.

VII. PROPOSAL REVIEW INFORMATION

A. NSF Proposal Review Process.

Reviews of proposals submitted to NSF are solicited from peers with expertise in the substantive area of the proposed research or education project. These reviewers are selected by Program officers charged with the oversight of the review process. NSF invites the proposer to suggest, at the time of submission, the names of appropriate or inappropriate reviewers. Care is taken to ensure that reviewers have no conflicts with the proposer. Special efforts are made to recruit reviewers from non-academic institutions, minority serving institutions or adjacent disciplines to that principally addressed in the proposal.

Proposals will be reviewed against the following general merit review criteria established by the National Science Board. Following each criterion are potential considerations that the reviewer may employ in the evaluation. These are suggestions and not all will apply to any given proposal. Each reviewer will be asked to address only those that are relevant to the proposal and for which he/she is qualified to make judgments.

What is the intellectual merit of the proposed activity?

How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

What are the broader impacts of the proposed activity?

How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

PIs should address the following elements in their proposal to provide reviewers with the information necessary to respond fully to both NSF merit review criteria. NSF and Sandia Program Officers will give these factors careful consideration 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 learner 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 Evaluation Criteria

In addition to the above criteria, *proposals in the focus area of Design Theory* *will be judged in terms of their ability/potential to provide sweeping theories that will cover and regularize wide ranges of engineering design.* ***Proposals in the focus area of Modeling and Simulation Uncertainty*** *will be judged in terms of their ability/potential to provide general approaches to, and new theories for, uncertainty estimation in modeling and simulation-based design.*

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

B. Review Protocol and Associated Customer Service Standard.

All proposals are carefully reviewed by at least three other persons outside NSF who are experts in the particular field represented by the proposal. Proposals submitted in response to this solicitation will involve a panel review, but additional ad-hoc mail reviews may also be used. The review will be coordinated by a joint working group of NSF and Sandia program officers.

Reviewers will be asked to formulate a recommendation to either support or decline each proposal. A program officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation. NSF will be able to tell applicants whether their proposals have been declined or recommended for funding within six months for 95 percent of proposals. The time interval begins on the proposal deadline or target date or from the date of receipt, if deadlines or target dates are not used by the program. The interval ends when the division director accepts the program officer's recommendation.

In all cases, after programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications and the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants 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 an 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 Officer does so at its own risk.

VIII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award.

The final award recommendations will be a joint decision of a working group comprised of program officers from NSF and Sandia. Grants from NSF or contracts from Sandia will be funded individually by either agency. Notification of Program Officers' recommendation will be made to the Principal Investigator by August 30, 2000.

Notification of an award from NSF is made ***to the submitting organization*** by a Grants Officer in the Division of Grants and Agreements (DGA). Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program Division administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided to the Principal Investigator. Sandia contracts will be administered in accordance with their policies and procedures, and information is available at http://www.sandia.gov/Working.htm .

B. Grant Award Conditions.

An NSF grant consists of: (1) the award letter, which includes any special provisions applicable to the grant 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 grant conditions, such as Grant General Conditions (NSF GC-1)* or Federal Demonstration Partnership Phase III (FDP) Terms and Conditions* and (5) any NSF brochure, program guide, announcement or other NSF issuance that may be incorporated by reference in the award letter. Electronic mail notification is the preferred way to transmit NSF grants to organizations that have electronic mail capabilities and have requested such notification from the Division of Grants and Agreements.

***** These documents may be accessed electronically on NSF's Web site at: http://www.nsf.gov/. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone 301.947.2722 or by e-mail from pubs@nsf.gov.

More comprehensive information on NSF Award Conditions is contained in the NSF *Grant Policy Manual* (GPM) Chapter II, (NSF 95-26) available electronically on the NSF Web site. The GPM also is available in paper copy by subscription from the Superintendent of Documents, Government Printing Office (GPO), Washington, DC 20402. The GPM may be ordered through the GPO Web site at: http://www.gpo.gov. The telephone number at GPO for subscription information is 202.512.1800.

C. Reporting Requirements.

For all multi-year grants (including both standard and continuing grants), the PI must submit an annual project report to the cognizant Program Officer at least 90 days before the end of the current budget period.

Within 90 days after expiration of a grant, the PI also is required to submit a final project report. Approximately 30 days before expiration, NSF will send a notice to remind the PI of the requirement to file the final project report. Failure to provide final technical reports delays NSF review and processing of pending proposals for that PI. PIs should examine the formats of the required reports in advance to assure availability of required data.

NSF has implemented an electronic project reporting system, available through FastLane. This system permits electronic submission and updating of project reports, including information on: project participants (individual and organizational); activities and findings; publications; and other specific products and contributions. PIs will not be required to re-enter information previously provided, either with a proposal or in earlier updates using the electronic system.

In addition to standard NSF reporting requirements, principal investigators funded under this program will be required to attend an annual progress review meeting each year while funding for the project is in force. Travel expenses for this meeting will come from the award.

IX. CONTACTS FOR ADDITIONAL INFORMATION

Contacts for general information: Dr. Stefan T. Thynell, CTS Division, NSF, (703) 306-1371, sthynell@nsf.gov or Dr. Thomas C. Bickel, Sandia National Laboratories, (505) 845-9301, tbickel@sandia.gov .

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Solid Mechanics: Dr. Ken P. Chong, CMS Division, NSF, (703) 306-1361, kchong@nsf.gov, Dr. Clifford Astill (geotechnical problems), CMS Division, NSF, (703) 306-1362, castill@nsf.gov or Dr. E. P. Chen, Sandia National Laboratories, (925) 294-2334, epchen@sandia.gov .

Design and Operation of Engineering Systems: Dr. George A. Hazelrigg, DMII Division, NSF, (703) 306-1330, ext. 5299, ghazelri@nsf.gov or Dr. David R. Martinez, Sandia National Laboratories, (505) 844-1457, drmarti@sandia.gov .

For questions related to the use of FastLane, contact **Nichelle Coward, 703-306-1371, ncoward@nsf.gov**.

X. OTHER PROGRAMS OF INTEREST

The NSF Guide to Programs is a compilation of funding for research and education in science, mathematics, and engineering. General descriptions of NSF programs, research areas, and eligibility information for proposal submission are provided in each chapter. Many NSF programs offer announcements concerning specific proposal requirements. To obtain additional information about these requirements, contact the appropriate NSF program offices listed in Appendix A of the GPG. Any changes in NSF's fiscal year programs occurring after press time for the Guide to Programs will be announced in the NSF Bulletin, available monthly (except July and August), and in individual program announcements. The Bulletin is available electronically via the NSF Web Site at **http://www.nsf.gov**. The direct URL for recent issues of the Bulletin is **http://www.nsf.gov/od/lpa/news/publicat/bulletin/bulletin.htm** Subscribers can also sign up for NSF's Custom News Service to find out what funding opportunities are available.

ABOUT THE NATIONAL SCIENCE FOUNDATION

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

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

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

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Pursuant to 5 CFR 1320.5(b), an agency may not conduct or sponsor, and a person is not required to respond to an information collection unless it displays a valid OMB control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding this burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to: Suzanne Plimpton, Reports Clearance Officer, Information Dissemination Branch, Division of Administrative Services, National Science Foundation, Arlington, VA 22230, or to Office of Information and Regulatory Affairs of OMB, Attention: Desk Officer for National Science Foundation (3145-0058), 725 – 17th Street, N.W. Room 10235, Washington, D.C. 20503.

YEAR 2000 REMINDER

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

CFDA No. 47.041, Engineering
OMB #3145-0058
NSF 00-31 (Replaces NSF 99-56)

AUTHORIZATION TO DISCLOSE PROPOSAL
AND REVIEW MATERIALS TO
SANDIA NATIONAL LABORATORIES

I acknowledge by signing below that I understand the program solicitation for Engineering Sciences for Modeling and Simulation-Based Life-Cycle Engineering is a joint initiative of the National Science Foundation (NSF) and the Sandia National Laboratories (Sandia), and that submitted proposals and review materials will be shared with Sandia for purposes of proposal evaluation. I authorize the NSF to disclose my proposal and all associated materials and review documents concerning my proposal to Sandia and its representatives for the purpose of evaluation and selection of proposals.

_____
PI Signature Date

_____
Co-PI Signature Date

_____
Co-PI Signature Date

EFFECT OF NOT AUTHORIZING DISCLOSURE: Submission of your proposal and consent to disclose to Sandia are voluntary. However, failure to authorize disclosure will preclude review of your proposal under this joint initiative and will result in your ineligibility for an award under this joint program solicitation.