

**Program Announcement
To DOE National Laboratories
LAB 10-316**

***Scientific Discovery through Advanced Computing: Advanced
Simulation of Fusion Plasmas***

SUMMARY:

The Fusion Energy Sciences (FES) Program of the Office of Science (SC), U.S. Department of Energy (DOE), hereby announces its interest in receiving proposals from interdisciplinary teams for the development and application of high performance scientific simulation codes under the SC Scientific Discovery through Advanced Computing (SciDAC) program. The FES SciDAC portfolio focuses on the creation of high physics fidelity simulation codes that can advance scientific discovery in fusion plasma science and contribute to the FES goal of developing a validated predictive capability for magnetically confined plasmas by fully exploiting the emerging capabilities of petascale and beyond computing resources and associated progress in software and algorithm development.

The specific areas of interest under this Program Announcement are:

1. Electromagnetic waves in plasmas
2. Magnetohydrodynamics
3. Plasma turbulence and transport, and
4. Energetic particles in plasmas

More specific information on each area of interest is outlined in the general and program specific supplementary information below.

All teams planning to submit proposals for new or renewal funding in Fiscal Year 2011 should submit in response to this announcement. Partnerships among Academic Institutions, National Laboratories, and Private Industry are strongly encouraged.

PREPROPOSALS DUE DATE: April 23, 2010, 11:59 PM Eastern Time

Preproposals are **REQUIRED** and must be submitted by April 23, 2010, 11:59 PM Eastern Time. **Failure to submit a preproposal by an applicant will preclude the full proposal from due consideration.** The preproposal should be submitted electronically by E-mail to John.Mandrekas@science.doe.gov and John.Sauter@science.doe.gov. **Please include "Preproposal for LAB 10-316" in the subject line.**

Preproposals should include cover page information, a brief description of the proposed work (1 - 2 pages, including text with minimum font size 11 point, figures, and references), and a one-page curriculum vitae from each Principal Investigator (PI), co- Principal Investigator (co-PI), and senior collaborator or consultant. The cover page should include: (a) A statement that the

document is a preproposal in response to Program Announcement LAB 10-316; (b) PI information: name, institutional affiliation, telephone number, fax number, and e-mail address; and, (c) names and institutions of all co-PIs, and senior collaborators or consultants (excluding postdoctoral associates). Since among the purposes of the preproposal is to facilitate FES in planning the merit review and the selection of peer-reviewers without conflicts of interest, it is important that applicants ensure their list of supported or unsupported participants is as comprehensive as possible.

Preproposals will be reviewed by FES program officials for responsiveness to this Program Announcement and the SciDAC program, eligibility of the applicant organization, and qualification of the applicant's personnel for carrying out a large-scale computational research activity. Only those applicants who receive notification from DOE encouraging a full proposal may submit a formal proposal. **No other formal proposals will be considered.**

DATES: Proposals submitted in response to this Program Announcement must be received no later than May 20, 2010, 11:59 PM Eastern Time to be accepted for merit review and to permit timely consideration for an award.

Please see the "Addresses" section below for further instructions on the method of submission for the proposal.

ADDRESSES: Have your LAB administrator submit the entire LAB proposal and FWP via Searchable FWP (<https://www.osti.gov/fwp>). If you have questions about who your LAB administrator is or how to use Searchable FWP, please contact the Searchable FWP Support Center. Please submit, via Federal Express, a single PDF file of the entire LAB proposal and FWP on a CD along with two hard copies to the address below. This will assist in expediting the review process.

Please send the CD and 2 hard copies via Federal Express to:

Mr. John Sauter
U.S. Department of Energy
Office of Fusion Energy Sciences, SC-24.2/GTN
19901 Germantown Road
Germantown, MD 20874-1290
ATTN: Program Announcement LAB 10-316

To identify that the FWP is responding to this Program Announcement, when sending your CD please identify the Program Announcement Title and Program Announcement number on the Federal Express package.

In addition, please submit via E-mail, a single PDF file of the entire LAB proposal and FWP. This will assist in expediting the review process. Please send the email to: john.sauter@science.doe.gov and john.mandrekas@science.doe.gov. Please include "Proposal for LAB 10-316" in the subject line of the email.

DOE National Laboratories should submit as instructed above. Researchers from other Federal agencies and Non-DOE Federally Funded Research and Development Centers (FFRDCs) should follow the format at http://www.science.doe.gov/grants/fed_prop.html and also submit via email as stated above.

FOR FURTHER INFORMATION CONTACT:

Program Manager: Dr. John Mandrekas

Office of Fusion Energy Sciences

Office of Science

U.S. Department of Energy

Phone: (301) 903-0552

FAX: (301) 903-4716

E-mail: john.mandrekas@science.doe.gov

Communications related to the formal proposal should use "Program Announcement LAB 10-316" in the subject line.

SUPPLEMENTARY INFORMATION:

Scientific Discovery through Advanced Computing

The SC SciDAC program goes beyond the scientific computing and computational science research embedded in the core programs of the SC Program Offices and invests in a portfolio of coordinated research efforts directed at exploiting the emerging capabilities of high performance "ultrascale" computing. The research projects in this portfolio respond to the extraordinary difficulties of realizing sustained peak performance for those scientific applications that require ultrascale computing capabilities to accomplish their research goals. They respond also to the need for developing collaborative software environments where distributed resources and expertise are combined to address complex questions that no single institution or investigator can manage alone. Research funded under the SciDAC portfolio is enabling teams of University, Laboratory, and Private Industry researchers to solve some of the most challenging scientific problems in the SC core programs at a level of accuracy and detail never before achieved. A complete description of the SciDAC program can be found at: <http://www.scidac.gov/>

Description of topical areas

1. Electromagnetic waves in plasmas

Proposals are solicited for the development and application of large-scale scalable simulation codes for the study of the propagation, absorption, interaction, and control of radiofrequency (RF) waves in various frequency ranges and regimes in burning plasmas. Topics of interest include RF coupling and loading of antennas to reactor-grade edge plasmas including 3D effects, wave-particle interactions including interactions with energetic particle populations, RF sheath formation and interaction with plasma facing components and other structures, and RF-generated flows. Increased integration of RF codes with Fokker-Plank, energetic particle, extended MHD, and plasma turbulence codes is also desirable.

2. Magnetohydrodynamics

Proposals are solicited for the development and application of scalable, non-linear, time dependent, extended magnetohydrodynamic (MHD) codes to model the macroscopic dynamics of reactor-grade tokamak plasmas. Application areas include, but are not limited to, Edge Localized Modes (ELMs) and their control using Resonant Magnetic Perturbations (RMPs) or other techniques, disruption mitigation, nonlinear evolution and control of Resistive Wall Modes (RWMs), and sawteeth oscillations. Increased integration with energetic particle and plasma turbulence codes allowing the study of the effect of MHD modes on energetic particle confinement is also desirable.

3. Plasma Turbulence and Transport

Proposals are solicited for the development and application of high-performance nonlinear gyrokinetic simulation codes for the study of plasma turbulence and transport in magnetically confined plasmas. The proposed work should focus on understanding, predicting, and controlling the transport of ion and electron thermal energy, momentum, and particles (including impurity species) from the core and edge of magnetically confined plasmas in toroidal configurations, with emphasis on burning plasmas and ITER. The codes should include all relevant physics-such as electromagnetic effects, non-adiabatic species, and realistic collision operators-and should be able to simulate plasmas in experimentally relevant geometries. Codes based both on the Particle-In-Cell (PIC) and the continuum or Eulerian methodologies are of interest. Close collaboration with theorists should be established to ensure the underlying gyrokinetic formulation is appropriate for the proposed tasks. Increased integration allowing evolution of profiles and other relevant parameters on the transport time scale is also desirable.

4. Energetic particles in plasmas

Proposals are solicited for the development and application of large-scale scalable simulation codes for the study of energetic particle effects in strongly self-heated burning plasmas. The proposed work should focus on developing a predictive understanding of the nonlinear coupling and interaction between energetic particle driven Alfvén modes and the background thermal plasma, including interaction with core stability and core plasma turbulence, in the small normalized fast ion gyro-radius regime anticipated in ITER and reactor-grade plasmas and the effects of this interaction on the energetic particle and background plasma confinement. Further integration of energetic particle effects on the longer time scales characterizing core stability and transport is also desirable for a self-consistent assessment of their impact on plasma performance.

Additional Considerations

Applied Math, Computer and Computational Science Application Components

In addition to descriptions of the physical models in the various simulation codes, proposals should include information on the proposed mathematical algorithms, computer science methods, and data management and visualization techniques. Applicants should include information on the readiness of their codes to run on today's leadership computing facilities supported by the Office of Science-including results from realistic scaling studies, if available. In particular, applicants

should address the question of how access to increasingly powerful computational resources will make a difference in achieving their targeted research goals and how it will enhance the overall physics fidelity of their simulation models. To facilitate the review process, the applied mathematics and computer / computational science components of each proposal should be included in a separate section.

Verification and Validation

A strong verification and validation (V&V) component is essential for this effort and therefore applicants should discuss their V&V plans in sufficient detail. In addition, since cross-benchmarking of different codes is an indispensable and often-used verification tool for large-scale simulation codes, successful applicants are expected to share data and other supporting information in a timely fashion with other researchers. Applicants are expected to follow the FES data sharing guidelines for large-scale computational projects which can be found at: http://www.ofes.fusion.doe.gov/FusionDocuments/OFES_DataSharingGuidelines.pdf.

Coordination with the Fusion Simulation Program

The Fusion Simulation Program (FSP) is an FES-led computational initiative aimed at the development of an experimentally validated integrated simulation capability for magnetically confined fusion plasmas in the regimes relevant for practical fusion energy. Currently undergoing a detailed design study, the full program is expected to be launched in the latter part of FY 2011. The success of the FSP will depend critically on synergistic collaborations with the FES SciDAC Centers whose computational modules will be among the building blocks of the larger integrating effort. Accordingly, successful applicants are expected to establish close coordination with the FSP and with the other FES SciDAC Centers and adjust annual Center goals to be consistent with FSP research needs.

Management Plan

The scope and complexity of these projects will require close collaboration among researchers from the computational and theoretical plasma physics, computer and computational science, and applied mathematics disciplines. Applicants should outline their plans for the implementation of an appropriate management plan for fostering coordination and collaboration among the key researchers and across the relevant disciplines.

References for additional discussion and insight

1. *Magnetic Fusion Energy Sciences Research Needs Workshop (ReNeW) report, June 2009*, <http://www.science.doe.gov/ofes/ReNeW%20report%20press.pdf>
2. *Scientific Grand Challenges in Fusion Energy Sciences and the Role of Computing at the Extreme Scale workshop, March 2009*, <http://extremecomputing.labworks.org/fusion/index.stm>
3. *Fusion Simulation Project (FSP) Workshop report, May 2007*, <http://www.science.doe.gov/ofes/ProgramDocuments/reports/FSPWorkshopReport.pdf>

The project description must be **25 pages** or less, exclusive of attachments and appendices and must contain an abstract or summary of the proposed research. All collaborators should be listed with the abstract or summary. Attachments include literature cited, biographical sketches, description of facilities and resources, letters of endorsement from unfunded collaborators, and a listing of all current and pending federal support. Please do not submit general letters of support as these are not used in making funding decisions. Biographical sketches should be limited to no more than two pages per individual.

The instructions and format described below should be followed. You must reference Program Announcement LAB 10-316 on all submissions and inquiries about this program.

PROGRAM FUNDING

It is anticipated that up to a total of \$4,100,000 will be available for multiple awards in Fiscal Year 2011, contingent upon the availability of appropriated funds for this program. The above funding amount refers to the total available funding for both the LAB 10-316 Announcement and the associated Funding Opportunity DE-FOA-0000316. At this funding level, 4-5 awards are anticipated. Depending on the quality of the proposals, this supports one award for each of the four major topical areas and a possible second award in one area where complementary approaches are deemed essential for reducing risk. Funding will be available annually for up to five years, with outyear support contingent on the availability of funds, progress of the research, and programmatic needs. Funding for the final two years is contingent upon satisfactory completion of a progress review during the third year of each project. At this time, a redirection of focus and task reprioritization within the original scope of work of the projects may become necessary to respond to the FSP needs.

DOE is under no obligation to pay for any costs associated with the preparation or submission of a proposal. DOE reserves the right to fund, in whole or in part, any, all, or none of the proposals submitted in response to this Announcement.

The instructions and format described should be followed. You must reference Program Announcement LAB 10-316 on all submissions and inquiries about this program.

OFFICE OF SCIENCE GUIDE FOR PREPARATION OF SCIENTIFIC/TECHNICAL PROPOSALS TO BE SUBMITTED BY NATIONAL LABORATORIES

Proposals from National Laboratories submitted to the Office of Science (SC) as a result of this Program Announcement will follow the Department of Energy Field Work Proposal process with additional information requested to allow for scientific/technical merit review. The following guidelines for content and format are intended to facilitate an understanding of the requirements necessary for SC to conduct a merit review of a proposal. Please follow the guidelines carefully, as deviations could be cause for declination of a proposal without merit review.

1. Evaluation Criteria

After an initial screening for eligibility and responsiveness to the solicitation, proposals will be subjected to scientific merit review (peer review). The proposals will be evaluated against the following criteria, which are listed in descending order of importance:

1. Scientific and/or technical merit of the project

- a. Does the project address an important and relevant problem in the indicated science application area where breakthrough advances can be enabled by the use of high performance computing?
- b. What is the potential of the project to advance the state-of-the-art within the indicated scientific application area? Outside the indicated scientific application area?
- c. What are the scientific and/or technical merit, originality, and likelihood of this project to make fundamental advances in the field?
- d. Does the project demonstrate a functional partnership among the indicated science application scientists, applied mathematicians, and computational scientists?

2. Appropriateness of the proposed methods or approach

- a. Is the conceptual and mathematical framework of the science application being addressed adequately developed and appropriate?
- b. Does the proposed research make use of appropriate and best available mathematical algorithms and computer science methods?
- c. Has the project demonstrated that their software codes can effectively use the Office of Science's high performance computing resources?
- d. Are there significant potential problems in the proposed method or approach? If so, are the applicants' plans to address these problems- including the consideration of alternative strategies-adequate?

3. Competency of the applicant's personnel and adequacy of the proposed resources

- a. How well qualified are the key personnel to carry out the research?
- b. Is there an appropriate management plan for fostering coordination and collaboration among the key researchers and across the relevant disciplines and is this being implemented successfully?
- c. Is the balance between computational scientists and application scientists appropriate to make advances in the indicated application area?
- d. Has the project interacted or plans to interact with the SciDAC Centers and Institutes and/or SciDAC Outreach Center and has this interaction had an impact on the project?

4. Reasonableness and appropriateness of the project budget and work plan

- a. Are the staffing levels and budget appropriate for carrying out the proposed research?
- b. Are the proposed work plans and milestones appropriate?

For renewal proposals, the reviewers will also be asked to answer the following question:

5. Performance under existing award

- a. Assess the progress made thus far towards the project's research goals.
- b. Has the project team disseminated the results of their research through publications in peer-reviewed journals, meetings, conferences presentations and/or other appropriate means?
- c. How well integrated have the applied mathematics and computer science efforts been in the overall project?
- d. Has the project effectively utilized the Office of Science's high performance computing resources?

The reviewers are also asked to comment on **Other Appropriate Factors**:

- How well does this project advance the SciDAC goals?
- What are the overall strengths and weaknesses of the application?
- If applicable, please comment on the educational benefits of the proposed activity.

FES will also consider, as part of the evaluation, other available advice or information as well as program policy factors, such as ensuring an appropriate balance within the program and quality of previous performance. The selected projects will be required to acknowledge support by DOE in all public communication of the research results.

External peer reviewers are selected with regard to both their scientific expertise and the absence of conflict-of-interest issues. Both Federal and non-Federal reviewers may be used, and submission of a proposal constitutes agreement that this is acceptable to the investigator(s) and the submitting institution.

2. Summary of Proposal Contents

- Field Work Proposal (FWP) Format (Reference DOE Order 412.1A) (DOE ONLY)
- Proposal Cover Page
- Table of Contents
- Budget (DOE Form 4620.1) and Budget Explanation
- Abstract (no more than two pages)
- Narrative (main technical portion of the proposal, including background/introduction, recent accomplishments, proposed research and methods, timetable of activities, and responsibilities of key project personnel)
- Literature Cited
- Biographical Sketch(es)
- Description of Facilities and Resources
- Other Support of Investigator(s)
- Appendix (optional)

3. Detailed Contents of the Proposal

Adherence to type size and line spacing requirements is necessary for several reasons. No researcher should have the advantage, by using small type, of providing more text in their proposals. Small type may also make it difficult for reviewers to read the proposal. Proposals must have 1-inch margins at the top, bottom, and on each side. Type sizes must be at least 11 point. Line spacing is at the discretion of the researcher, but there must be no more than 6 lines per vertical inch of text. Pages should be standard 8 1/2" x 11" (or metric A4, i.e., 210 mm x 297 mm).

3.1 Field Work Proposal Format (Reference DOE Order 412.1A) (DOE ONLY)

The Field Work Proposal (FWP) is to be prepared and submitted consistent with policies of the investigator's laboratory and the local DOE Operations Office. Additional information is also requested to allow for scientific/technical merit review.

Laboratories may submit proposals directly to the SC Program office listed above. A copy should also be provided to the appropriate DOE operations office.

3.2 Proposal Cover Page

The following proposal cover page information may be placed on plain paper. No form is required.

Title of proposed project
SC Program announcement title
Name of laboratory
Name of principal investigator (PI)
Position title of PI
Mailing address of PI
Telephone of PI
Fax number of PI
Electronic mail address of PI
Name of official signing for laboratory*
Title of official
Fax number of official
Telephone of official
Electronic mail address of official
Requested funding for each year; total request
Use of human subjects in proposed project:
 If activities involving human subjects are not planned at any time during the proposed project period, state "No"; otherwise state "Yes", provide the IRB Approval date and Assurance of Compliance Number and include all necessary information with the proposal should human subjects be involved.
Use of vertebrate animals in proposed project:
 If activities involving vertebrate animals are not planned at any time during this project, state "No"; otherwise state "Yes" and provide the IACUC Approval date

and Animal Welfare Assurance number from NIH and include all necessary information with the proposal.

Signature of PI, date of signature

Signature of official, date of signature*

*The signature certifies that personnel and facilities are available as stated in the proposal, if the project is funded.

3.3 Table of Contents

Provide the initial page number for each of the sections of the proposal. Number pages consecutively at the bottom of each page throughout the proposal. Start each major section at the top of a new page. Do not use unnumbered pages and do not use suffices, such as 5a, 5b.

3.4 Budget and Budget Explanation

A detailed budget is required for the entire project period and for each fiscal year. It is preferred that DOE's budget page, Form 4620.1 be used for providing budget information*. Modifications of categories are permissible to comply with institutional practices, for example with regard to overhead costs.

A written justification of each budget item is to follow the budget pages. For personnel this should take the form of a one-sentence statement of the role of the person in the project. Provide a detailed justification of the need for each item of permanent equipment. Explain each of the other direct costs in sufficient detail for reviewers to be able to judge the appropriateness of the amount requested.

Further instructions regarding the budget are given in section 4 of this guide.

* Form 4620.1 is available at web site: <http://www.science.doe.gov/grants/budgetform.pdf>

3.5 Abstract

Summarize the proposal in no more than two pages. Give the project objectives (in broad scientific terms), the approach to be used, and what the research is intended to accomplish. State the hypotheses to be tested (if any). At the top of the abstract give the project title, names of all the investigators and their institutions, and contact information for the principal investigator, including e-mail address.

3.6 Narrative (main technical portion of the proposal, including background/introduction, proposed research and methods, timetable of activities, and responsibilities of key project personnel).

The narrative comprises the research plan for the project and is **limited to 25 pages** (maximum), including text and figures, when printed using standard 8.5" by 11" paper with 1 inch margins (top, bottom, left, and right) and font not smaller than 11 point. It should contain enough

background material in the Introduction, including review of the relevant literature, to demonstrate sufficient knowledge of the state of the science. The major part of the narrative should be devoted to a description and justification of the proposed project, including details of the methods to be used. It should also include a timeline for the major activities of the proposed project, and should indicate which project personnel will be responsible for which activities.

It is important that the 25-page technical information section provide a complete description of the proposed work, because reviewers are not obliged to read the Appendices. Proposals exceeding these page limits may be rejected without review.

If any portion of the project is to be done in **collaboration** with another institution (or institutions), provide information on the institution(s) and what part(s) of the project it will carry out. Further information on any such arrangements is to be given in the sections "Budget and Budget Explanation," "Biographical Sketches," and "Description of Facilities and Resources.

The project narrative should include the following sections:

Executive Summary

Summarize the proposal in no more than two pages

Background and Recent Accomplishments

- Background - explanation of the importance and relevance of the proposed work
- Recent Accomplishments - this subsection is mandatory for renewal proposals and should summarize the proposed work and the actual progress made during the previous funding period.

Proposed Research and Tasks

In addition to the technical description of the proposed work and tasks, include a discussion of the following:

- Verification and Validation (V&V) plans
- Applied mathematics, computer and computational science components
- Estimate of required high performance computing resources and readiness of application codes to fully utilize high performance computing resources

Management plan

Describe the management plan of the Center, including work breakdown structure showing the level of effort for each task.

Project Timetable:

This section should outline as a function of time, year by year, all the important activities or phases of the project, including any activities planned beyond the

project period. It should also include tables of quarterly milestones for each year of the proposed work. Successful applicants must use this project timetable to report progress.

3.7 Literature Cited

Give full bibliographic entries for each publication cited in the narrative. Each reference must include the names of all authors (in the same sequence in which they appear in the publication), the article and journal title, book title, volume number, page numbers, and year of publication. Include only bibliographic citations. Principal investigators should be especially careful to follow scholarly practices in providing citations for source materials relied upon when preparing any section of the proposal.

3.8 Biographical Sketches

This information is required for senior personnel at the institution submitting the proposal and at all subcontracting institutions (if any). The biographical sketch is limited to a maximum of two pages for each investigator and must include:

Education and Training. Undergraduate, graduate and postdoctoral training, provide institution, major/area, degree and year.

Research and Professional Experience. Beginning with the current position list, in chronological order, professional/academic positions with a brief description.

Publications. Provide a list of up to 10 publications most closely related to the proposed project. For each publication, identify the names of all authors (in the same sequence in which they appear in the publication), the article title, book or journal title, volume number, page numbers, year of publication, and website address if available electronically. Patents, copyrights and software systems developed may be provided in addition to or substituted for publications.

Synergistic Activities. List no more than 5 professional and scholarly activities related to the effort proposed.

To assist in the identification of potential conflicts of interest or bias in the selection of reviewers, the following information must also be provided in each biographical sketch.

Collaborators and Co-editors: A list of all persons in alphabetical order (including their current organizational affiliations) who are currently, or who have been, collaborators or co-authors with the investigator on a research project, book or book article, report, abstract, or paper during the 48 months preceding the submission of the proposal. Also, include those individuals who are currently or have been co-editors of a special issue of a journal, compendium, or conference proceedings during the 24 months preceding the submission of the proposal. If there are no collaborators or co-editors to report, this should be so indicated.

Graduate and Postdoctoral Advisors and Advisees: A list of the names of the individual's own graduate advisor(s) and principal postdoctoral sponsor(s), and their current organizational affiliations. A list of the names of the individual's graduate students and postdoctoral associates during the past five years, and their current organizational affiliations.

3.9 Description of Facilities and Resources

Facilities to be used for the conduct of the proposed research should be briefly described. Indicate the pertinent capabilities of the institution, including support facilities (such as machine shops), that will be used during the project. List the most important equipment items already available for the project and their pertinent capabilities. Include this information for each subcontracting institution (if any).

3.10 Other Support of Investigators

Other support is defined as all financial resources, whether Federal, non-Federal, commercial, or institutional, available in direct support of an individual's research endeavors. Information on active and pending other support is required for all senior personnel, including investigators at collaborating institutions to be funded by a subcontract. For each item of other support, give the organization or agency, inclusive dates of the project or proposed project, annual funding, and level of effort (months per year or percentage of the year) devoted to the project.

3.11 Appendix

Information not easily accessible to a reviewer may be included in an appendix, but do not use the appendix to circumvent the page limitations of the proposal. Reviewers are not required to consider information in an appendix, and reviewers may not have time to read extensive appendix materials with the same care they would use with the proposal proper.

The appendix may contain the following items: up to five publications, manuscripts accepted for publication, abstracts, patents, or other printed materials directly relevant to this project, but not generally available to the scientific community; and letters from investigators at other institutions stating their agreement to participate in the project (do not include general letters of endorsement of the project).

4. Detailed Instructions for the Budget

(DOE Form 4620.1 "Budget Page" may be used).

4.1 Salaries and Wages

List the names of the principal investigator and other key personnel and the estimated number of person-months for which DOE funding is requested. Proposers should list the number of postdoctoral associates and other professional positions included in the proposal and indicate the number of full-time-equivalent (FTE) person-months and rate of pay (hourly, monthly or annually). For graduate and undergraduate students and all other personnel categories such as

secretarial, clerical, technical, etc., show the total number of people needed in each job title and total salaries needed. Salaries requested must be consistent with the institution's regular practices. The budget explanation should define concisely the role of each position in the overall project.

4.2 Equipment

DOE defines equipment as "an item of tangible personal property that has a useful life of more than two years and an acquisition cost of \$50,000 or more." Special purpose equipment means equipment which is used only for research, scientific or other technical activities. Items of needed equipment should be individually listed by description and estimated cost, including tax, and adequately justified. Allowable items ordinarily will be limited to scientific equipment that is not already available for the conduct of the work. General purpose office equipment normally will not be considered eligible for support.

4.3 Domestic Travel

The type and extent of travel and its relation to the research should be specified. Funds may be requested for attendance at meetings and conferences, other travel associated with the work and subsistence. In order to qualify for support, attendance at meetings or conferences must enhance the investigator's capability to perform the research, plan extensions of it, or disseminate its results. Consultant's travel costs also may be requested.

4.4 Foreign Travel

Foreign travel is any travel outside Canada and the United States and its territories and possessions. Foreign travel may be approved only if it is directly related to project objectives.

4.5 Other Direct Costs

The budget should itemize other anticipated direct costs not included under the headings above, including materials and supplies, publication costs, computer services, and consultant services (which are discussed below). Other examples are: aircraft rental, space rental at research establishments away from the institution, minor building alterations, service charges, and fabrication of equipment or systems not available off-the-shelf. Reference books and periodicals may be charged to the project only if they are specifically related to the research.

a. Materials and Supplies

The budget should indicate in general terms the type of required expendable materials and supplies with their estimated costs. The breakdown should be more detailed when the cost is substantial.

b. Publication Costs/Page Charges

The budget may request funds for the costs of preparing and publishing the results of research, including costs of reports, reprints page charges, or other journal costs (except costs for prior or early publication), and necessary illustrations.

c. Consultant Services

Anticipated consultant services should be justified and information furnished on each individual's expertise, primary organizational affiliation, daily compensation rate and number of days expected service. Consultant's travel costs should be listed separately under travel in the budget.

d. Computer Services

The cost of computer services, including computer-based retrieval of scientific and technical information, may be requested. A justification based on the established computer service rates should be included.

e. Subcontracts

Subcontracts should be listed so that they can be properly evaluated. There should be an anticipated cost and an explanation of that cost for each subcontract. The total amount of each subcontract should also appear as a budget item.

4.6 Indirect Costs

Explain the basis for each overhead and indirect cost. Include the current rates.