Program Announcement
To DOE National Laboratories
LAB 02-15

Low Dose Radiation Research Program - Basic Research

The Office of Biological and Environmental Research (OBER) of the Office of Science (SC), U.S. Department of Energy (DOE) and the Office of Biological and Physical Research (OBPR), National Aeronautics and Space Administration (NASA), hereby announce their interest in receiving research proposals for well justified research that supports the DOE/OBER Low Dose Radiation Research Program, and that may include complementary research of direct interest to the NASA/OBPR Space Radiation Health Program that is of sufficient scientific merit to qualify for partial NASA support. These Programs use modern molecular tools to develop a better scientific basis for understanding exposures and risks to humans from low dose and low fluence radiation.

Research areas of particular programmatic interest include:

- Endogenous oxidative damage versus low dose radiation-induced damage
- Radio-adaptive responses
- Bystander effects
- Individual genetic susceptibility to low dose radiation exposure

Please review the Supplementary Information section below for further discussion of programmatic needs.

SUPPLEMENTARY INFORMATION: The DOE/OBER Low Dose Radiation Research Program is faced with the challenge of conducting research that can be used to inform the development of future national radiation risk policy for the public and the workplace. For the present solicitation, DOE/OBER is chiefly concerned with very low doses of low Linear Energy Transfer (LET) radiation (electrons, x- and gamma-rays). The focus of research should be on doses of low linear energy transfer radiation that are at or near current workplace exposure limits. In general, research in this program should focus on total radiation doses that are less than or equal to 10 rads. Some experiments will likely involve selected exposures to higher doses of radiation for comparisons with previous experiments or for determining the validity of extrapolation methods previously used to estimate the effects of low doses of radiation from observations made at high doses. Research projects utilizing the "systems biology" or "discovery science" approach, including the tools of comparative

genomics and proteomics, are especially sought. Research projects that use experimental protocols or cell microenvironments that will lead to an understanding of radiobiological responses in intact human tissue are also strongly encouraged. This research program will be a success if the science it generates is useful to policy makers, standard setters, and the public. Successful proposals will be expected to effectively communicate research results whenever possible through education and outreach, so that current thinking and the public debate reflect sound science.

The NASA/OBPR Space Radiation Health Program is charged with providing input for the determination of health risks to humans visiting the space radiation environment. NASA is especially interested in human exposure to low fluences of high-energy particulate ionizing radiation (protons and heavy ions). Where possible, projects that address the interests of both DOE/OBER and NASA/OBPR are particularly encouraged. Proposals whose principal focus is on low LET radiation are encouraged to include complementary research with high-energy particulate ionizing radiation that leverages progress, resources, and technology used for the low LET radiation research (see Specifics for NASA below). Investigators with currently funded low dose projects may also apply for supplementary funding to address closely related research of interest to NASA.

Not all research on the biological effects of low doses of radiation will be equally useful for the development of radiation risk policy, though the path from basic radiation biology research to radiation risk policy is admittedly not clear at this time. In the present context, the research considered to be most useful will focus on biological responses that:

- Are known to be induced at low doses of radiation,
- Have the potential to directly impact (i.e., increase or decrease) subsequent development of cancer or other harmful health impacts,
- Are potentially quantifiable,
- Could potentially be linked to the development of a biologically based model for radiation risk, and
- Could potentially lead to the development of biological predictors (biomarkers) of individual risk.

Alternatively, a biological response of interest could meet all of the above criteria only at high doses but may actually be absent (as opposed to simply undetectable) at low doses of radiation. Since the mechanisms of action may be different after high versus low doses of radiation, such studies would help define these mechanisms, and delimiting the unique doses where these mechanisms shift is important.

Endogenous oxidative damage in relation to low dose radiation induced damage - A key goal of this research program will remain the elucidation of similarities and differences between endogenous oxidative damage and damage induced by low levels of ionizing radiation, as well as understanding the health risks from both. This information will underpin our interpretation of the biological effects of exposure to low doses of ionizing radiation. Although qualitative descriptions of differences and/or similarities between the types of damage induced under both conditions will be useful in the design and interpretation of experiments in other parts of the program, there is a need for quantification of the levels of damage induced by normal oxidative processes and incremental increases due to low dose irradiation.

Living organisms are subject to a daily plethora of environmental insults. Carcinogenesis in an individual occurs as a function of all the forces and phenomena that go into the production of that individual's phenotype. These include (but are not limited to) individual genotype, as well as current and historical aspects of diet, physical exercise, and exposures to chemicals and radiation. To understand all factors responsible for individual responses to radiation, we are also soliciting research on key factors that influence the extent of metabolic, endogenously produced oxidative damage and, concomitantly, affect susceptibility to low doses of radiation.

Radio-Adaptive Response - The ability of a low dose of radiation to induce cellular changes that alter the level of subsequent radiation-induced or spontaneous damage. If low doses of radiation regularly and predictably induce a protective response in cells exposed to subsequent low doses of radiation or to spontaneous damage, this could have a substantial impact on estimates of adverse health risk from low dose radiation. The generality and the extent of the process of the induction itself need to be quantified, and the responsible genes and proteins discovered. By "generality" is meant quantification as a function of cell tissue type and species type; by "extent" is meant quantification as a function of priming dose, dose rate, and time constant of action.

Bystander effects - Biological responses observed in cells that are not directly traversed by radiation but are neighbors of an irradiated cell. Bystanders in cell monolayers have been shown to respond with gene induction and/or production of clastogenic changes. It is important for the DOE/OBER Low Dose program to determine if bystander effects can be induced by exposure to low LET radiation delivered at low total doses. A detrimental bystander effect, in essence, "amplifies" the biological effects (and the effective radiation dose) of a low dose exposure by effectively increasing the number of cells that experience adverse effects to a number greater than the number of cells directly exposed to radiation. Conversely, bystander cells may in some cases exert a protective effect on the irradiated cell or cells, although very few studies of this type of effect have been tried. More importantly,

entirely different types or levels of bystander effects may be occurring in three-dimensional tissues and intact organisms. Hence, there is considerable interest in extending studies to tissues, or at least toward more complex tissue-like models, and priority consideration will be given to these projects. Research is sought to characterize and determine mechanisms of low LET radiation induced bystander effect, and to quantify its induction and extent as a function of dose. New research projects studying bystander effects in isolated cells or cell monolayers will be considered only in exceptionally well-justified or novel approach cases.

Individual genetic susceptibility to low dose radiation - The Low Dose Radiation Research Program is interested in determining if genetic differences exist that result in sensitive individuals or sub-populations that are at increased risk for radiation-induced cancer. For example, research could focus on genes involved in the recognition, repair, and processing of damage induced by ionizing radiation, or on genes involved in maintaining the normal degree of irreversibility of cell differentiation for a particular tissue. Of critical interest would be the identification of these genes, determining frequencies of their polymorphisms in the population, and determining the biological significance of these polymorphisms with respect to cancer and radiation sensitivity. Ingenious, high throughput approaches, that evaluate many endpoints or individuals experimentally using pooling schemes, are of particular interest. We are also interested in mouse models that speed the discovery or characterization of putative human susceptibility genes. New studies focused only on a single or a few genes will not be funded unless substantial evidence is provided that those genes play a significant role in individual susceptibility to radiation. A long-term goal is to identify any genetic polymorphisms that significantly impact individual and population-level sensitivity to radiation, and characterize their mechanism of action.

Background information on the Low Dose Radiation Research Program can be found in the research program plan at: http://www.lowdose.org/index.html. A list of currently funded projects can be found at: http://lowdose.org/research.html. The program is currently funding a number of projects to develop micro-irradiation devices capable of delivering low doses of low LET radiation to individual cells or to specific parts of individual cells. For links to currently funded "microbeam" projects see: http://lowdose.org/99meeting/abstracts/tool.html – projects 26, 28, 29 and also: http://lowdose.org/99meeting/abstracts/response.html – project 3. Investigators are encouraged to use these or similar irradiators, as appropriate, in the design and conduct of their research. Funds are available to assist in the collaborative use of these or comparable tools.

Other resource considerations - Research in the areas discussed above will strongly complement ongoing initiatives at the National Institutes of Health (NIH).

DOE/OBER staff is working with staff at the NIH to ensure that research in the Low Dose Radiation Research Program is not duplicative of research funded by NIH programs.

A collaborative effort of five major centers, termed the International SNP Map Working Group, along with over 50 other contributing laboratories, are creating the largest publicly available catalog of single base-pair differences between two copies of the same gene (single nucleotide polymorphisms, or SNPs). The current catalog contains 1.4 million SNPs, each with their exact location mapped within the human genome. SNPs are the most common polymorphisms in the human genome, and some contribute to the traits that make us unique individuals. The catalog (http://www.ncbi.nlm.nih.gov/SNP/index.html) will be a boon for mapping complex traits such as cancer susceptibility and susceptibility to low dose radiation.

Inbred mouse strains and other model organisms with well-characterized differences in susceptibility to radiation-induced cancer are also important tools for identifying significant polymorphisms. Direct assessment of the biological significance of candidate "susceptibility genes" can also be undertaken using animal models such as knockout and knock-in mice, mice with specific genes removed or added.

Specifics for the Space Radiation Health Program - NASA

The primary area of emphasis of the NASA/OBPR Space Radiation Health Program is the development of mechanistic insights into biological effects of space radiation that account for radiation risks. Proposals are required to be hypothesis-driven and are expected to obtain their data in ground-based experimental radiobiology studies with protons and high-energy heavy ion beams in the energy range corresponding to space radiation. This is mainly a ground-based program using accelerator facilities to simulate space radiation. In addition to the research topics already described above this includes research on non-phenomenological predictors of late cell and tissue effects and the control and modification of radiation effect mechanisms

A short description of the current Space Radiation Health Strategic Program may be found at: http://spaceresearch.nasa.gov/common/docs/1998_radiation_strat_plan.pdf. Activities of OBPR, including research opportunities, descriptions of previous tasks, and other relevant information can be found at: http://SpaceResearch.nasa.gov/. A description of the ground-based facilities and experimental program at Brookhaven National Laboratory can be found at: http://www.bnl.gov/medical/NASA/NASA-home%20frame.htm. The proton therapy facilities at Loma Linda University Medical Center are described at: http://www.llu.edu/proton/. Finally, a description of the NASA Specialized Center of Research and Training at the Lawrence Berkeley National Laboratory may be found at: http://www.lbl.gov/lifesciences/NSCORT.

Scientists working in rapidly developing areas of biological sciences not necessarily associated with the study of radiation are particularly encouraged to consider the contributions that their field of study can make to Radiation Health. Proposals are required to provide evidence for expertise in radiation, either by reference to the Principal Investigator's work or by inclusion of active collaborators expert in radiation research. Hypotheses should be substantiated by presentation of preliminary data wherever feasible, or by adequate references to the published literature. Experimental proposals should include a clear discussion of the relevant aspects of the required radiation dosimetry and an estimate of the statistical power of the expected results.

Research proposals to which NASA will assign high priority:

a. Studies that increase the confidence in the accuracy of extrapolating the probability of radiation-induced genetic alterations or carcinogenesis from rodents to humans.
b. Determination of carcinogenic risks following irradiation by protons and HZE particles.
c. Determination if exposure to heavy ions at the level that would occur in deep space poses a risk to the integrity and function of the central nervous system.
d. Studies likely to result in the development of biological countermeasures in humans that could lead to prevention or intervention (including genetic or pharmacological agents) against effects of radiation damage in space.

Research that can lead to future space flight investigations will be welcome, and should take into account the impact of gender, age, nutrition, stress, genetic predisposition, or sensitivity to other factors of importance in managing space radiation risks.

NASA envisions that the selected proposals will be structured and operated in a manner that supports the country's educational initiatives and goals (including historically black colleges and universities and other minority universities), and in particular the need to promote scientific and technical education at all levels. NASA envisions that the selected proposals will support the goals for public awareness and outreach to the general public. The selected investigators are invited to participate in NASA-funded educational programs.

The proposals represent an opportunity to enhance and broaden the public's understanding and appreciation of radiation effects, as specified in the DOE Low Dose Program emphasis on communication of research results and the OBPR Policy for Education and Public Outreach. Therefore, all investigators are strongly encouraged to promote general scientific literacy and public understanding of radiation induced health risk research through formal and/or informal education opportunities. If appropriate, proposals should include a clear and concise description

of the education and outreach activities proposed. Examples include such items as involvement of students in the research activities, technology transfer plans, public information programs that will inform the general public of the benefits being gained from the research, and/or plans for incorporation of scientific results obtained into educational curricula consistent with educational standards.

Where appropriate, the supported institution will be required to produce, in collaboration with NASA, a plan for communicating to the public the value and importance of their work.

The particles of interest to the Space Radiation Health Program are protons with energies between 20 and 1000 MeV, and nuclei of He, C, N, O, Ne, Si, Ar, Ca, Mn, and Fe, with energies between 50 and 3000 MeV/nucleon. Fluencies of interest are of the order of 1-2 particles per cell; studies with higher fluencies will need to be justified by compelling arguments, including an explanation of how the results can be applied in the low fluency regime. NASA has developed facilities for use of protons at Loma Linda University Medical School and high- energy heavy ion beams at the Brookhaven National Laboratory Alternating Gradient Synchrotron (AGS). A dedicated irradiation facility, using the Booster Synchrotron at Brookhaven, is under construction and is expected to be operational in 2003. Proposals should not budget for the use of beams at these facilities, which is paid by NASA. NASA will cooperate with DOE to expand the range of technical resources available for experimentation and analysis of experimental results at Brookhaven.

DATES: Preproposals (letters of intent) are strongly encouraged, but not mandatory. A response to preproposals discussing the potential program relevance of a formal proposal will be communicated within one week.

The deadline for receipt of formal proposals is 4:30 P.M., E.D.T, April 16, 2002, in order to be accepted for merit review and to permit timely consideration for award in Fiscal Year 2002 and Fiscal Year 2003.

ADDRESSES: One-page preproposals referencing Program Announcement LAB 02-15, should be sent by E-mail to joanne.corcoran@science.doe.gov, or by facsimile transmission to (301) 903-8521. Preproposals will also be accepted if mailed to the following address: Ms. Joanne Corcoran, Office of Biological and Environmental Research, SC-72, U.S. Department of Energy, 19901 Germantown Road, Germantown, MD 20874-1290.

Formal proposals, referencing Program Announcement LAB 02-15, should be sent to: U.S. Department of Energy, Office of Science, Office of Biological and Environmental Research, SC- 72, 19901 Germantown Road, Germantown, MD

20874-1290, ATTN: Program Announcement LAB 02-15. This address must be used when submitting proposals by U.S. Postal Service Express, commercial mail delivery service, or when hand carried by the proposer.

FOR FURTHER INFORMATION CONTACT: Dr. Noelle Metting for general scientific or technical questions, telephone: (301) 903-8309, E-mail: noelle.metting@science.doe.gov, Office of Biological and Environmental Research, SC-72, U.S. Department of Energy, 19901 Germantown Road, Germantown, MD 20874-1290. For specific information on NASA/OBPR interests, contact Dr. Walter Schimmerling, telephone: (202) 358-2205, E-mail: wschimmerling@hq.nasa.gov, NASA Headquarters, Mail Code UB, Washington, DC 20546- 0001.

Program Funding

It is anticipated that up to $2.5 million will be available from DOE/OBER for new awards during Fiscal Year 2002, contingent upon the availability of funds. Multiple year funding of awards is expected, and is also contingent upon the availability of appropriated funds, progress of the research, and continuing program need. Proposals whose principal focus is on low LET radiation can include complementary research on high-energy particulate ionizing radiation that leverages progress, resources and technology used for the low LET radiation research. Up to $0.5M will be available from NASA in the first year, with higher amounts projected for successive years, also contingent upon the availability of funds. Funds will be available from DOE to assist in the collaborative use of certain microbeam irradiators. NASA provides beam time at the Brookhaven AGS and the Loma Linda proton accelerator; investigators will not be required to pay for the beam time. It is expected that most awards will be from 1 to 3 years and will range from $200,000 to $500,000 per year (total costs).

Collaboration

Researchers are encouraged to collaborate with researchers in other institutions, such as universities, industry, non-profit organizations, federal laboratories and Federally Funded Research and Development Centers (FFRDCs), including the DOE National Laboratories, where appropriate, and to incorporate cost sharing and/or consortia wherever feasible.

The Proposal

(PLEASE NOTE CRITICAL NEW INFORMATION BELOW ON PAGE LIMITS)

DOE is under no obligation to pay for any costs associated with the preparation or submission of proposals if an award is not made.

Adherence to type size and line spacing requirements is necessary for several reasons. No researchers should have the advantage of providing more text in their proposals by using small type. 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 10 point or larger. Line spacing is at the discretion of the proposer 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). Proposals must be written in English, with all budgets in U.S. dollars.

Proposers are expected to use the following ordered format, in addition to following instructions in the Office of Science Guide for Preparation of Scientific/Technical Proposals to be Submitted by National Laboratories (attached).

Field Work Proposal (FWP) Format (Reference DOE Order 5700.7C)(DOE ONLY)
Proposal Cover Page

- **Project Abstract Page** - Single page only, should contain:
  - Title
  - PI name
  - Abstract text should concisely describe the overall project goal in one sentence, and limit background/significance of project to one sentence. Short descriptions of each individual aim should focus on what will actually be done
- **Relevance Statement** - Single page only, should identify DOE or NASA requirements that each specific aim is intended to address
- **Budgets** - for each year and a summary budget page for the entire project period (using DOE F 4620.1)
- **Budget Explanation** - Budgets and Budget explanation for each collaborative subproject, if any (again, see information at: http://www.science.doe.gov/production/grants/Colab.html)
- **Project Description** - (The Project Description must be 20 pages or less, exclusive of attachments. **Proposals with Project Descriptions longer than 20 pages will be returned to proposers and will not be reviewed for scientific merit.**) The Project Description should contain the following five parts:
  - Goals
  - Background (concisely-stated, relevant)
  - Experimental Approach
  - Preliminary Studies (and Progress, if applicable)
  - Statistical Design and Methodologies
- **Literature Cited**
- **Collaborative Arrangements** (if applicable)

- **Biographical Sketches** (limit 2 pages per senior investigator, consistent with NIH guidelines)
- **Facilities and Resources** description
- **Current and Pending Support** for each senior investigator
- **Letters of Intent** from collaborators (if applicable)

Any recipient of an award from the Office of Science, performing research involving recombinant DNA molecules and/or organisms and viruses containing recombinant DNA molecules shall comply with the National Institutes of Health "Guidelines for Research Involving Recombinant DNA Molecules," which is available via the World Wide Web at: http://www.niehs.nih.gov/odhsb/biosafe/nih/rdna-apr98.pdf, (59 FR 34496, July 5, 1994), or such later revision of those guidelines as may be published in the Federal Register.

DOE requirements for reporting, protection of human and animal subjects and related special matters can be found on the World Wide Web at: http://www.science.doe.gov/production/grants/Welfare.html.

The instructions and format described below should be followed. Reference Program Announcement LAB 02-15 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

Proposals will be subjected to formal merit review (peer review) and will be evaluated against the following criteria which are listed in descending order of importance:

Scientific and/or technical merit of the project

Appropriateness of the proposed method or approach

Competency of the personnel and adequacy of the proposed resources

Reasonableness and appropriateness of the proposed budget

The evaluation will include program policy factors such as the relevance of the proposed research to the terms of the announcement and the Department's programmatic needs. External peer reviewers are selected with regard to both their scientific expertise and the absence of conflict-of-interest issues. Non-federal reviewers may be used, and submission of an proposal constitutes agreement that this is acceptable to the investigator(s) and the submitting institution. Proposals found to be scientifically meritorious and programmatically relevant will be selected in consultation with DOE and NASA selecting officials depending upon availability of funds in each agency's budget. In the course of the selection process, projects will be identified as addressing DOE requirements, NASA requirements, or both. The selected projects will be required to acknowledge support by one or both agencies, as appropriate, in all public communications of the research results.

2. Summary of Proposal Contents

Field Work Proposal (FWP) Format (Reference DOE Order 5700.7C) (DOE ONLY)
Proposal Cover Page
Table of Contents
Abstract
Narrative
Budget and Budget Explanation
Literature Cited
Other support of investigators
Biographical Sketches
Description of facilities and resources
Appendix

2.1 Number of Copies to Submit

An original and seven copies of the formal proposal/FWP must be submitted.

3. Detailed Contents of the Proposal

Proposals must be readily legible, when photocopied, and must conform to the following three requirements: the height of the letters must be no smaller than 10 point with at least 2 points of spacing between lines (leading); the type density must average no more than 17 characters per inch; the margins must be at least one-half

inch on all sides. Figures, charts, tables, figure legends, etc., may include type smaller than these requirements so long as they are still fully legible.

3.1 Field Work Proposal Format (Reference DOE Order 5700.7C)
(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 Abstract

Provide an abstract of no more than 250 words. Give the broad, long-term objectives and what the specific research proposed is intended to accomplish. State the hypotheses to be tested. Indicate how the proposed research addresses the SC scientific/technical area specifically described in this announcement.

3.5 Narrative

The narrative comprises the research plan for the project and is limited to 25 pages. It should contain the following subsections:

Background and Significance: Briefly sketch the background leading to the present proposal, critically evaluate existing knowledge, and specifically identify the gaps which the project is intended to fill. State concisely the importance of the research described in the proposal. Explain the relevance of the project to the research needs identified by the Office of Science. Include references to relevant published literature, both to work of the investigators and to work done by other researchers.

Preliminary Studies: Use this section to provide an account of any preliminary studies that may be pertinent to the proposal. Include any other information that will help to establish the experience and competence of the investigators to pursue the proposed project. References to appropriate publications and manuscripts submitted or accepted for publication may be included.

Research Design and Methods: Describe the research design and the procedures to be used to accomplish the specific aims of the project. Describe new techniques and

methodologies and explain the advantages over existing techniques and methodologies. As part of this section, provide a tentative sequence or timetable for the project.

Subcontract or Consortium Arrangements: If any portion of the project described under "Research Design and Methods" is to be done in collaboration with another institution, provide information on the institution and why it is to do the specific component of the project. 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".

3.6 Budget and Budget Explanation

A detailed budget is required for the entire project period, which normally will be three years, 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.sc.doe.gov/production/grants/forms.html

3.7 Literature Cited

List all references cited in the narrative. Limit citations to current literature relevant to the proposed research. Information about each reference should be sufficient for it to be located by a reviewer of the proposal.

3.8 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 devoted to the project.

3.9 Biographical Sketches

This information is required for senior personnel at the laboratory submitting the proposal and at all subcontracting institutions. The biographical sketch is limited to a maximum of two pages for each investigator.

3.10 Description of Facilities and Resources

Describe briefly the facilities to be used for the conduct of the proposed research. Indicate the performance sites and describe pertinent capabilities, 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.

3.11 Appendix

Include collated sets of all appendix materials with each copy of the proposal. Do not use the appendix to circumvent the page limitations of the proposal. Information should be included that may not be easily accessible to a reviewer.

Reviewers are not required to consider information in the Appendix, only that in the body of the proposal. Reviewers may not have time to read extensive appendix materials with the same care as they will read 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 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 $25,000 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.