Program Announcement
To DOE National Laboratories

U.S. Department of Energy
Office of Science
Advanced Scientific Computing Research (ASCR)

Uncertainty Quantification Methodologies for
Enabling Extreme-Scale Science
LAB 13-895

Amendment: Page 8, first sentence - •   To upload a file into PAMS, click the "Attach File" button at the far right side of the screen. Click the "Browse" (or "Choose File" depending on your browser) button to search for your file. You may enter an optional description of the file you are attaching. Click the ~~"Attach"~~ "Upload" button to upload the file.

GENERAL INQUIRIES ABOUT THIS PROGRAM ANNOUNCEMENT TO DOE NATIONAL LABORATORIES SHOULD BE DIRECTED TO:

Technical/Scientific Program Contact:
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Office of Advanced Scientific Computing Research
Phone: 301-903-5710
Email: steven.lee@science.doe.gov

SUMMARY

The Advanced Scientific Computing Research (ASCR) program of the Office of Science (SC), U.S. Department of Energy (DOE), hereby invites proposals for basic mathematical, statistical and computational research that significantly advances uncertainty quantification methodologies for enabling extreme-scale science.

The mission of the DOE Office of Science is the delivery of scientific discoveries, capabilities and major scientific tools to transform the understanding of nature and to advance the energy, economic, and national security of the United States. The next level of scientific discovery will be enabled by research developments that can effectively harness significant or disruptive changes in computing technologies and also build up the requisite mathematical and statistical foundations for confidently using advanced computational approaches to pursue scientific investigations and breakthroughs. Short-range scientific computing agendas look ahead to carrying out DOE-mission research on multi- and many-core, high-performance computing systems. Future extreme-scale scientific computing targets a thousand-fold increase in today's capabilities with only a modest increase in power requirements. Long-range ASCR basic research seeks to anticipate the next paradigm shifts in developing the modeling, simulation, and analysis capabilities for achieving DOE-mission goals using extreme-scale scientific computing in conjunction with theory, experiments, observations, or other relevant resources.

The purpose of this Program Announcement is to invite proposals in ASCR Applied Mathematics basic research that significantly advance uncertainty quantification (UQ) methodologies as an enabling technology in extreme-scale scientific computing. UQ broadly refers to the end-to-end study of the accuracy, reliability, development and effective use of computational models in making scientific inferences. Mathematically rigorous UQ methodologies are essential to a wide range of DOE science and engineering applications in carrying out predictions, design optimization, decision making, or other high-level tasks. UQ relies on a broad range of applied mathematics and statistics research, along with algorithmic and computational developments, and subject matter expertise, to enable an appropriate level of confidence in the use of computational models for scientific investigations.

The computational science and engineering community understands the importance of uncertainty quantification, and key principles, best practices, and tools have been developed and are evolving for predictive science and engineering. At the same time, the nature of high-performance scientific computing research and practice is expected to be fundamentally different given the forecasts for disruptive changes in computing architectures and technologies in this decade. This Program Announcement calls for basic research in methodologies and tools that will deliver significantly improved or advanced UQ capabilities for DOE-mission science based on anticipating the characteristics and challenges, and fully realizing the potential advantages, of using extreme-scale computing systems.

More specific information is included under SUPPLEMENTARY INFORMATION below.

Proposals must be submitted through a DOE national laboratory. A companion funding opportunity announcement (DE-FOA-0000895) available on Grants.gov describes the Uncertainty Quantification Methodologies for Enabling Extreme-Scale Science funding opportunity for institutions that are not DOE national laboratories. Consult DE-FOA-0000895 for information on eligibility for that announcement.

PRE-PROPOSAL DUE DATE: April 24, 2013 at 5:00 PM Eastern Time

Pre-proposals are **REQUIRED** and must be submitted by April 24, 2013, 5:00 PM Eastern Time. Only the Lead Institution must submit the pre-proposal. Failure to submit a pre-proposal will preclude the full proposal from consideration.

DOE will send a response by email to each applicant encouraging or discouraging the submission of a formal proposal by April 30, 2013. Applicants who have not received a response regarding the status of their pre-proposals by this date are responsible for contacting the program to confirm this status. **Only those applicants that receive notification from DOE encouraging a formal proposal may submit full proposals.** No other formal proposals will be considered.

Those pre-proposals that are encouraged will be used to help the Office of Science begin planning for the formal proposal peer review process. The intent of the Office of Science in discouraging submission of certain full proposals is to save the time and effort of applicants in preparing a proposal that is unlikely to be selected for award negotiations. Such assessments do not necessarily reflect judgments on the merits of the proposed project.

Pre-proposals will be evaluated with respect to the scope and research directions as outlined in the SUMMARY and SUPPLEMENTARY INFORMATION sections. The pre-proposal may not exceed two pages, with a minimum text font size of 11 point and margins no smaller than one inch on all sides. Figures and references, if included, must fit within the two-page limit.
The pre-proposal should contain (1) a cover sheet, (2) a technical narrative, and (3) conflict of interest information. The cover sheet identifies the name, institutional affiliation, e-mail address and telephone number of the Lead Principal Investigator and Senior/Key personnel expected to be involved in the project, and an estimated amount of funding requested for each year and for each funded institution. No biographical data need be included.

The technical narrative must provide a clear, concise statement of specific research goals and objectives with respect to the development of UQ methodologies for enabling the confident and effective use of extreme-scale computation as a major scientific tool for the DOE mission.

To help the Office of Science avoid conflicts of interest (COI) in identifying potential reviewers, a list of collaborators, co-editors, and graduate/postdoctoral advisors and advisees must be submitted with the pre-proposal. **These lists should be the final set of pages in the pdf pre-proposal file and will not count against the two-page limit for the pre-proposal**. A COI list for the Lead Principal Investigator and each project collaborator (supported or unsupported) is required. Further guidance on how to prepare this COI list for each project member is included in the next two paragraphs.

Collaborators and Co-editors: List, in alphabetical order, all persons, including their current organizational affiliations, who are, or who have been, collaborators or co-authors with you on a research project, book or book article, report, abstract, or paper during the 48 months preceding May 2013. For publications or collaborations with more than 10 authors or participants, only list those individuals in the core group for which interactions occurred on a regular basis while the research was being done. Also, list any individuals who are currently or have been in the past co-

editors on a special issue with you on a journal, compendium, or conference proceedings during the 24 months preceding May 2013. If there are no collaborators or co-editors to report, state "None.".

Graduate and Postdoctoral Advisors and Advisees: List the names of your graduate advisor(s) and principal postdoctoral sponsor(s) and their current organizational affiliations. Also list the names of your graduate students and postdoctoral associates during the past five years.

It is important that the preproposal be a single file with extension .pdf, .docx, or .doc. The preproposal must be submitted electronically through the DOE Office of Science Portfolio Analysis and Management System (PAMS) website https://pamspublic.science.energy.gov/. The Principal Investigator and anyone submitting on behalf of the Principal Investigator must register for an account in PAMS before it will be possible to submit a preproposal. All PIs and those submitting preproposalss on behalf of PIs are encouraged to establish PAMS accounts as soon as possible to avoid submission delays.

To access PAMS, you may use Internet Explorer, Firefox, Google Chrome, or Safari browsers. Registering to PAMS is a two-step process; once you create an individual account, you must associate yourself with ("register to") your institution. Detailed steps are listed below.

Create PAMS Account: To register, click the "Create New PAMS Account" link on the website https://pamspublic.science.energy.gov/.
- Click the "No, I have never had an account" link and then the "Create Account" button.
- You will be prompted to enter your name and email address, create a username and password, and select a security question and answer. Once you have done this, click the "Save and Continue" button.
- On the next page, enter the required information (at least one phone number and your mailing address) and any optional information you wish to provide (e.g., FAX number, website, mailstop code, additional email addresses or phone numbers, Division/Department). Click the "Create Account" button.
- Read the user agreement and click the "Accept" button to indicate that you understand your responsibilities and agree to comply with the rules of behavior for PAMS.
- PAMS will take you the "Having Trouble Logging In?" page.

Register to Your Institution:
- Click the link labeled "Option 2: I know my institution and I am here to register to the institution." (Note: If you previously created a PAMS account but did not register to an institution at that time, you must click the Institutions tab and click the "Register to Institution" link.)
- PAMS will take you to the "Register to Institution" page.
- Type a word or phrase from your institution name in the field labeled, "Institution Name like," choose the radio button next to the item that best describes your role in the system, and

click the "Search" button. (Hint: If your institution has an acronym, such as ANL for Argonne National Laboratory or UCLA for the Regents of the University of California, Los Angeles, you may search for the acronym under "Institution Name like." Many institutions with acronyms are listed in PAMS with their acronyms in parentheses after their names.)

- Find your institution in the list that is returned by the search and click the "Actions" link in the Options column next to the institution name to obtain a dropdown list. Select "Add me to this institution" from the dropdown. PAMS will take you to the "Institutions – List" page.
- If you do not see your institution in the initial search results, you can search again by clicking the "Cancel" button, clicking the Option 2 link, and repeating the search.
- If, after searching, you think your institution is not currently in the database, click the "Cannot Find My Institution" button and enter the requested institution information into PAMS. Click the "Create Institution" button. PAMS will add the institution to the system, associate your profile with the new institution, and return you to the "Institutions – List" page when you are finished.

Submit Your Preproposal:
- Create your preproposal outside the system and save it as a file with extension .docx, .doc, or .pdf. Make a note of the location of the file on your computer so you can browse for it later from within PAMS.
- Log into PAMS and click the Proposals tab. Click the "View / Respond to DOE National Laboratory Announcements" link and find the current announcement in the list. Click the "Actions/Views" link in the Options column next to this announcement to obtain a dropdown menu. Select "Submit Preproposal" from the dropdown.
- On the Submit Preproposal page, select the institution from which you are submitting this preproposal from the Institution dropdown. If you are associated with only one institution in the system, there will only be one institution in the dropdown.
- Note that you must select one and only one Principal Investigator (PI) per preproposal; to do so, click the "Select PI" button on the far right side of the screen. Find the appropriate PI from the list of all registered users from your institution returned by PAMS. (Hint: You may have to sort, filter, or search through the list if it has multiple pages.) Click the "Actions" link in the Options column next to the appropriate PI to obtain a dropdown menu. From the dropdown, choose "Select PI."
- If the PI for whom you are submitting does not appear on the list, it means he or she has not yet registered in PAMS. For your convenience, you may have PAMS send an email invitation to the PI to register in PAMS. To do so, click the "Invite PI" link at the top left of the "Select PI" screen. You can enter an optional personal message to the PI in the "Comments" box, and it will be included in the email sent by PAMS to the PI. You must wait until the PI registers before you can submit the preproposal. Save the preproposal for later work by clicking the "Save" button at the bottom of the screen. It will be stored in "My Preproposals" for later editing.
- Enter a title for your preproposal.
- Select the appropriate technical contact from the Program Manager dropdown.
- To upload the preproposal file into PAMS, click the "Attach File" button at the far right side of the screen. Click the "Browse" (or "Choose File" depending on your browser) button to

search for your file. You may enter an optional description of the file you are attaching. Click the "Attach" button to upload the file.

- At the bottom of the screen, click the "Submit to DOE" button to save and submit the preproposal to DOE.
- Upon submission, the PI will receive an email from the PAMS system acknowledging receipt of the preproposal.

You are encouraged to register for an account in PAMS at least a week in advance of the preproposal submission deadline so that there will be no delays with your submission.

For help with PAMS, click the "External User Guide" link on the PAMS website, https://pamspublic.science.energy.gov/. You may also contact the PAMS Help Desk, which can be reached Monday through Friday, 9 AM – 5:30 PM Eastern Time. Telephone: (855) 818-1846 (toll free) or (301) 903-9610, Email: sc.pams-helpdesk@science.doe.gov. All submission and inquiries about this DOE National Laboratory Announcement should reference **LAB 13-895.**

Notifications sent from the PAMS system will come from the PAMS <PAMS.Autoreply@science.doe.gov> email address. Please make sure your email server/software allows delivery of emails from the PAMS email address to yours.

PROPOSAL DUE DATE: May 24, 2013 at 5:00 PM Eastern Time

Formal proposals submitted in response to this Program Announcement must be received by **May 24, 2013 at 5:00 PM Eastern Time**, to permit timely consideration of awards in Fiscal Year 2013. **You are encouraged to transmit your proposal well before the deadline. PROPOSALS RECEIVED AFTER THE DEADLINE WILL NOT BE REVIEWED OR CONSIDERED FOR AWARD.**

IMPORTANT SUBMISSION INFORMATION:

Full proposals must be submitted into the DOE Office of Science Portfolio Analysis and Management System (PAMS). For help with PAMS, click the "External User Guide" link on the PAMS website, https://pamspublic.science.energy.gov/. You may also contact the PAMS Help Desk, which can be reached Monday through Friday, 9:00 AM – 5:30 PM Eastern Time. Telephone: (855) 818-1846 (toll free number) or (301) 903-9610, Email: sc.pams-helpdesk@science.doe.gov. All submission and inquiries about this Program Announcement should reference **LAB 13-895.** Full proposals submitted in response to this Program Announcement must be submitted into PAMS no later than **May 24, 2013 at 5:00 PM Eastern Time**.

All PIs and those submitting on behalf of PIs are encouraged to establish PAMS accounts as soon as possible to ensure timely submissions**.** To register, click "Create New PAMS Account" on the website https://pamspublic.science.energy.gov/ and follow the instructions for creating an account.

The following information is provided to help with proposal submission. Detailed instructions and screen shots can be found in the user guide. To find the user guide, click the "External User Guide" link on the PAMS home page. Onscreen instructions are available within PAMS.

- Log into PAMS. From the proposals tab, click the "View DOE National Laboratory Announcements" link and find the current announcement in the list. Click the "Actions/Views" link in the Options column next to this announcement to obtain a dropdown menu. Select "Submit Proposal" from the dropdown.
- Note that you must select one and only one Principal Investigator (PI) per proposal; to do so, click the "Select PI" button on the far right side of the screen. Find the appropriate PI from the list of all registered users from your institution returned by PAMS. (Hint: You may have to sort, filter, or search through the list if it has multiple pages.) Click the "Actions" link in the Options column next to the appropriate PI to obtain a dropdown menu. From the dropdown, choose "Select PI."
- If the PI for whom you are submitting does not appear on the list, it means he or she has not yet registered in PAMS. For your convenience, you may have PAMS send an email invitation to the PI to register in PAMS. To do so, click the "Invite PI" link at the top left of the "Select PI" screen. You can enter an optional personal message to the PI in the "Comments" box, and it will be included in the email sent by PAMS to the PI. You must wait until the PI registers before you can submit the proposal. Save the proposal for later work by selecting "Save" from the dropdown at the bottom of the screen and then clicking the "Go" button. It will be stored in "My Proposals" for later editing. As a minimum, you must complete all the required fields on the PAMS cover page before you can save the proposal for the first time.
- The cover page, budget, and attachments sections of the lab proposal are required by PAMS before it can be submitted to DOE.
- Complete the sections in PAMS one at a time, starting with the cover page and following the instructions for each section.
- Click the "+View More" link at the top of each section to expand the onscreen instructions. On the budget section, click the "Budget Tab Instructions" link to obtain detailed guidance on completing the budget form.
- Save each section by selecting either "Save" (to stay in the same section) or "Save… and Continue to the Next Section" (to move to the next section) from the dropdown menu at the bottom of the screen, followed by clicking the "Go" button.
- If you save the proposal and navigate away from it, you may return later to edit the proposal by clicking the "View My Existing Proposals" or "My Proposals" links within PAMS.
- You must enter a budget for each annual budget period.
- You must also enter a budget for each proposed sub-award. The sub-award section can be completed using the same steps used for the budget section.
- In the attachments section of the lab proposal, the abstract, the budget justification, and the proposal narrative are required and must be submitted as separate files.
- You must bundle everything other than the budget, abstract, and budget justification into one single PDF file to be attached under "Proposal Attachment."
- Do not attach anything under "Other Attachments."

- To upload a file into PAMS, click the "Attach File" button at the far right side of the screen. Click the "Browse" (or "Choose File" depending on your browser) button to search for your file. You may enter an optional description of the file you are attaching. Click the "Upload" button to upload the file.
- Once you have saved all of the sections, the "Submit to DOE" option will appear in the dropdown menu at the bottom of the screen.
- To submit the proposal, select "Submit to DOE" from the dropdown menu and then click the "Go" button.
- Upon submission, the PI will receive an email from the PAMS system acknowledging receipt of the proposal.
- The proposal will also appear under My Proposals with a Proposal Status of "Submitted to DOE."

Please only submit a PAMS lab technical proposal in response to this announcement; do not submit a DOE Field Work Proposal (FWP) at this time. The Office of Advanced Scientific Computing Research will request FWPs later from those who are selected for funding under this announcement.

For help with PAMS, click the "External User Guide" link on the PAMS website, https://pamspublic.science.energy.gov/. You may also contact the PAMS Help Desk, which can be reached Monday through Friday, 9:00 AM – 5:30 PM Eastern Time. Telephone: (855) 818-1846 (toll free number) or (301) 903-9610, Email: sc.pams-helpdesk@science.doe.gov. All submission and inquiries about this Program Announcement should reference **LAB 13-895.**

SUPPLEMENTARY INFORMATION
Extreme-scale science research recognizes that fundamentally different techniques, tools, and approaches will likely be needed to reap significant scientific benefits from disruptive, but potentially revolutionary, changes in technology [1,2]. Major advances in science are often closely intertwined with increases in technology capabilities, as typified by "Moore's law" in computing performance. Scientific high-performance computing is a prime example in which needs and expectations for continued exponential scaling in performance are driving, and being influenced by, fundamental changes in underlying technologies such as processors, memory and interconnect systems, and the scientific computing software stack [3].

Over the past two decades, performance improvements were mainly achieved through a combination of: increasing processor speed; bulk-synchronous parallelism - where each programming element executes the same code with regular communication between processors; and advances in applied mathematics in such areas as mathematical modeling, adaptive algorithms and discretization techniques, and numerical analysis. Since 2004, processor speeds have plateaued at about 1-3 gigahertz due to physical limitations in today's materials and fabrication technologies. Fortunately, aside from the performance of hardware component technology, innovations in computational modeling and algorithms for simulations have traditionally outpaced Moore's law in getting more science done per second [4].

Numerous challenges arise in enabling applications to run effectively on next-generation, extreme-scale computing systems. Higher levels of computing performance will require that careful attention is given to the anticipated architectural features, such as:

- Extreme levels of concurrency. Improvements in performance will be achieved only through much higher levels of parallelism.
- Costly data storage and movement, and complex memory hierarchies. On a node, data movement will be much more costly, relative to other operations. Across nodes, networks will provide similar challenges and opportunities.
- Reduced memory sizes per core. The overall cost of memory technology is expected to limit the memory available.
- Resilience and non-deterministic behavior. A high number of hardware faults are expected due to the large number of computing system components.

Additionally, performance portability likely will be more challenging given the technology trends for highly heterogeneous architectures, deep memory hierarchies with reduced memory sizes per core, and other features [1,5,6,7].

UQ methodologies will play a key role in enabling the confident and effective use of extreme-scale computation as a major scientific tool for the DOE mission. In the context of this Program Announcement, a "UQ methodology" is a generic term that covers a broad range of research topics which, when selectively taken together, form a foundation and significant integrated capability for enabling extreme-scale science. UQ methodology basic research topics includes, but is not limited to: verification and validation; representation of uncertainty and error; sensitivity and uncertainty analysis; multi-scale modeling and simulation; model uncertainty; multi-model ensembles; UQ for inverse problems and model calibration; decision-making and optimization under uncertainty; detection and forecasting of rare events; dealing with high-dimensional probability spaces; statistical modeling and sampling techniques; uncertainty reduction; and other related areas. Given that computational models provide only partial physical understanding, a proposed UQ methodology may also pursue effective strategies for incorporating results from theoretical analysis and/or the use of data from observational or experimental science activities [5,6,7,8,9,10].

The DOE "Scientific Grand Challenges Workshop Series" provides a well-documented set of reports on the grand challenges of specific DOE-mission science domains and the role of extreme-scale scientific computing in addressing those challenges [11,12]. Proposed extreme-scale UQ methodologies will vary across disciplines, along with relevant scientific quantities of interest (QOIs) and the intended use of the computational models. The approach to extreme-scale UQ will also be guided by relevant computational considerations, such as achieving the requisite accuracy and level of confidence in results at some combination of lowest energy and shortest execution time. Computational science is the so-called third pillar of scientific inquiry, beside theory and experimentation, and the rigorous development of extreme-scale UQ methodologies will be essential as an enabling technology for DOE-mission science on future architectures.

Proposals submitted in response to this Program Announcement must substantively address the following areas with regard to extreme-scale scientific computing:

1. Impact for DOE-mission science: What are the most significant or compelling scientific challenges that are driving the development of the proposed UQ methodology? If successfully developed, how will the advanced UQ capabilities be demonstrated?
2. Rigorous UQ methodology: Does the UQ methodology provide a new and/or significant integrated capability for enabling extreme-scale science? What are the potential merits and limitations of the UQ methodology given the anticipated characteristics and challenges of using extreme-scale computing systems?
3. Advances in applied mathematics and/or statistics basic research: Does the proposed research develop a strong mathematical or statistical foundation for the UQ methodology?

The proposed research is expected to demonstrate the UQ methodology and level of capability through a combination of mathematical or statistical analysis, computational experiments, and a suite of relevant, nontrivial metrics as specified within the proposal [13].

References

[1] "Scientific Grand Challenges: Architectures and Technology for Extreme Scale Computing", Report from the workshop held December 8-10, 2009.
http://science.energy.gov/~/media/ascr/pdf/program-documents/docs/Arch_tech_grand_challenges_report.pdf

[2] "Report on the Workshop on Extreme-Scale Solvers: Transition to Future Architectures", Report from the workshop held on March 8-9, 2012.
http://science.energy.gov/~/media/ascr/pdf/program-documents/docs/reportExtremeScaleSolvers2012.pdf

[3] "Future Computing Performance: Game Over or Next Level?",
http://www.nap.edu/openbook.php?record_id=12980

[4] "Taking on the ITER Challenge, Scientists Look to Innovative Algorithms, Petascale Computers", SIAM News, Volume 39, Number 7, September 2006.
http://www.siam.org/pdf/news/1005.pdf

[5] "Science Based Nuclear Energy Systems Enabled by Advanced Modeling and Simulation at the Extreme Scale", Report from the workshop held May 11-12, 2009.
http://science.energy.gov/~/media/ascr/pdf/program-documents/docs/Sc_nework_shop_report.pdf

[6] "Scientific Grand Challenges in National Security: The Role of Computing at the Extreme Scale", Report from the workshop held October 6-8, 2009.
http://science.energy.gov/~/media/ascr/pdf/program-documents/docs/Nnsa_grand_challenges_report.pdf

[7] "Scientific Grand Challenges: Crosscutting Technologies for Computing at the Exascale", Report from the workshop held February 2-4, 2010.
http://science.energy.gov/~/media/ascr/pdf/program-documents/docs/Crosscutting_grand_challenges.pdf

[8] "Assessing the Reliability of Complex Models - Mathematical and Statistical Foundations of Verification, Validation, and Uncertainty Quantification", National Research Council 2012.

Washington, D.C.: The National Academies Press. http://www.nap.edu/catalog.php?record_id=13395

[9] "A Multifaceted Mathematical Approach for Complex Systems", Report of the DOE Workshop on Mathematics for the Analysis, Simulation, and Optimization of Complex Systems held on September 13-14, 2011. http://science.energy.gov/~/media/ascr/pdf/program-documents/docs/Multifaceted_Mathematical_Approach_for_Complex_Systems.pdf

[10] "Data and Communications in Basic Energy Sciences - Creating a Pathway for Scientific Discovery", Report from the workshop held on October 24-25, 2011. http://science.energy.gov/~/media/ascr/pdf/research/scidac/ASCR_BES_Data_Report.pdf

[11] "The Opportunity and Challenges of Exascale Computing", Summary Report of the Advanced Scientific Computing Advisory Committee (ASCAC) Subcommittee, Fall 2010. http://science.energy.gov/~/media/ascr/ascac/pdf/reports/Exascale_subcommittee_report.pdf
[12] DOE Scientific Grand Challenges Workshop Series - http://science.energy.gov/ascr/news-and-resources/workshops-and-conferences/grand-challenges/
[13] "Evaluation of Quantification of Margins and Uncertainties Methodology for Assessing and Certifying the Reliability of the Nuclear Stockpile", http://www.nap.edu/catalog.php?record_id=12531

Collaboration

Collaborative research projects with other institutions such as universities, industry, non- profit organizations, and Federally Funded Research and Development Centers (FFRDCs), including the DOE National Laboratories are strongly encouraged but not required. Collaborative proposals submitted from different institutions should clearly indicate they are part of a proposed collaboration. All collaborative proposals must use the same title, abstract and technical narrative. In addition, such proposals must describe the work and the associated budget for the research effort to be performed under the leadership of the principal investigator in each participating institution. The first page of collaborative proposals should contain the project title followed by a tabular list of the researcher names, institutions, annual budget, and role as lead PI or co-PI of each participant. These collaborative proposals should all have the same title as the lead institution. Each collaborating institution submitting a proposal must use the same title**.**

Our intent is to create from the various proposals associated with a collaborative group one document for merit review that consists of the common, identical proposal materials combined with a set of detailed budgets from the partner institutions. Thus, it is very important that every proposal in the collaborative group be exactly identical (including the title) with the exception of the budget and budget justification pages.

Collaborative proposals from institutions other than DOE National Laboratories should be submitted following the above rules in response to the companion announcement, DE-FOA-0000895.

Award Information

TYPE OF AWARD INSTRUMENT

DOE anticipates awarding laboratory work authorization awards under this DOE National Laboratory Announcement.

ESTIMATED FUNDING

It is anticipated that up to $5,000,000 per year will be available under this DOE National Laboratory Announcement and Funding Opportunity Announcement DE-FOA-0000895, contingent on satisfactory peer review and the availability of appropriated funds. Applicants should request project support for up to three years, with out-year support contingent on the availability of appropriated funds, progress of the research, and programmatic needs. Awards are expected to begin in FY 2013.

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 DOE National Laboratory Announcement.

MAXIMUM AND MINIMUM AWARD SIZE

It is anticipated that approximately 4 to 9 projects will be funded, each with a total project budget ranging from $150,000 to $1,400,000 per year. Each institution that participates in a funded project receives a separate award. The minimum and maximum award size to an institution ranges from $150,000 per year to $1,400,000 per year.

EXPECTED NUMBER OF AWARDS

It is anticipated that approximately 4 to 9 projects will be funded, each with a total project budget ranging from $150,000 to $1,400,000 per year. Each institution that participates in a funded project receives a separate award. The number of awards to institutions is expected to range between 5 and 25 (approximately).

ANTICIPATED AWARD SIZE

It is anticipated that approximately 4 to 9 projects will be funded, each with a total project budget ranging from $150,000 to $1,400,000 per year. Each institution that participates in a funded project receives a separate award. The award size to an institution is anticipated to range between $150,000 per year to $1,400,000 per year.

PERIOD OF PERFORMANCE

DOE anticipates making awards with a project period of three years. Out-year funding will depend upon suitable progress and the availability of appropriated funds.

TYPE OF PROPOSAL

DOE will accept new laboratory technical proposals through the Portfolio Analysis and Management System (PAMS, located at https://pamspublic.science.energy.gov) under this Announcement. DOE is only accepting laboratory technical proposals submitted into PAMS for this announcement. Do not submit or attach a DOE Field Work Proposal (FWP) at this time. Do not use Searchable FWP to respond to this announcement.

The program office will request submission of Field Work Proposals later from only those who are being considered for funding.

All PIs and those submitting on behalf of PIs are encouraged to establish PAMS accounts as soon as possible to avoid submission delays. You may establish a PAMS account at https://pamspublic.science.energy.gov/.

For help with PAMS, click the "External User Guide" link on the PAMS website, https://pamspublic.science.energy.gov/. You may also contact the PAMS Help Desk, which can be reached Monday through Friday, 9:00 AM – 5:30 PM Eastern Time. Telephone: (855) 818-1846 (toll free number) or (301) 903-9610, Email: sc.pams-helpdesk@science.doe.gov. All submission and inquiries about this Program Announcement should reference **LAB 13-895.**

Everything other than the budget, the abstract, and the budget justification should be combined into a single Portable Document Format (PDF) file. Submit the budget, abstract, budget justification, and proposal pdf into PAMS. Each DOE national laboratory has already appointed and registered at least one administrative business officer into PAMS. If you need contact information for your Administrative business officer, please contact the PAMS Support Center.

ELIGIBILITY

This is a DOE Lab-only Announcement. FFRDCs from other Federal agencies are not eligible to submit in response to this Program Announcement.

For official postings see the Office of Science Grants and Contracts web site, http://www.science.doe.gov/grants.

COST SHARING

Cost sharing is not required.

ELIGIBLE INDIVIDUALS

Individuals with the skills, knowledge, and resources necessary to carry out the proposed research as a Program Director/Principal Investigator are invited to work with their organizations to develop a proposal. Individuals from underrepresented groups as well as individuals with disabilities are always encouraged to apply for funding.

MERIT REVIEW

Proposals will be subjected to a formal merit review and will be evaluated based on criteria based on those codified at 10 CFR 605.10(d) in accordance with the guidance provided in the "Office of Science Merit Review System for Financial Assistance," which is available at: http://www.sc.doe.gov/grants/merit.asp.

SELECTION

The Selection Officials will consider merit review recommendations as well as program policy factors, such as ensuring a programmatically appropriate balance within the program areas, and quality of previous performance. Selection of proposals for award will be based upon the findings of the technical evaluations, the importance and relevance of the proposed research to the SC mission, and funding availability.

AWARD NOTICES

It is anticipated that the award selection will be completed by June 30, 2013. DOE will notify proposers selected for award. This notice of selection is not an authorization to begin performance. Organizations whose proposals have not been selected will be advised as promptly as possible. This notice will explain why the proposal was not selected.

LATE SUBMISSIONS

Late submissions will not be accepted in this DOE National Laboratory Announcement. However, delays in submitting letters of intent, pre-proposals, and proposals may be unavoidable. DOE has accepted late submissions when applicants have been unable to make timely submissions because of technological disruptions or significant natural disasters. Other circumstances do not justify late submissions. Unacceptable justifications include the following:
- Failure to begin submission process early enough.
- Failure to provide sufficient time to complete the process.
- Failure to understand the submission process.
- Failure to understand the deadlines for submissions.
- Failure to satisfy prerequisite registrations.
- Unavailability of administrative personnel.

AVAILABILITY OF FUNDS

Funds are not presently available for this award. The Government's obligation under this award is contingent upon the availability of appropriated funds from which payment for award purposes can be made. No legal liability on the part of the Government for any payment may arise until funds are made available to the Contracting Officer for this award and until the awardee receives notice of such availability, to be confirmed in writing by the Contracting Officer.

The instructions and format described below should be followed. You must reference Program Announcement LAB 13-895 on all submissions and inquiries about this program.

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

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.

Prior to a comprehensive merit evaluation, SC will perform an initial review to determine that (1) the applicant is eligible for the award; (2) the information required by this announcement has been submitted; (3) all mandatory requirements are satisfied; (4) the proposed project is responsive to the objectives of the announcement, and (5) the proposed project is not duplicative of programmatic work. Proposals that fail to pass the initial review will not be forwarded for merit review and will be eliminated from further consideration.

Evaluation Criteria

- Scientific and/or Technical Merit of the Project;
- Appropriateness of the Proposed Method or Approach;
- Competency of Applicant's Personnel and Adequacy of Proposed Resources; and
- Reasonableness and Appropriateness of the Proposed Budget.

The evaluation process will include program policy factors such as the relevance of the proposed research to the terms of the National Laboratory Announcement and the agency's programmatic needs. Note that 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 an proposal constitutes agreement that this is acceptable to the investigator(s) and the submitting institution.

The questions below will be provided to the merit reviewers to elaborate the criteria established by regulation:

SCIENTIFIC AND/OR TECHNICAL MERIT OF THE PROPOSED RESEARCH

- To what extent does the proposal articulate significant or compelling scientific challenges that are driving the development of the proposed UQ methodology? To what extent does the proposal clearly describe a plan for demonstrating the successful development of the advanced UQ capabilities? To what extent does the proposed research develop a strong mathematical or statistical foundation for the UQ methodology?

APPROPRIATENESS OF THE PROPOSED METHOD OR APPROACH

- To what extent does the UQ methodology provide a new and/or significant integrated capability for enabling extreme-scale science? What are the potential merits and limitations of the UQ methodology given the anticipated characteristics and challenges of using

extreme-scale computing systems? To what extent does the proposal identify significant potential problems and consider alternative strategies? How will intermediate results be generated and how will progress be measured?

COMPETENCY OF APPLICANT'S PERSONNEL AND ADEQUACY OF PROPOSED RESOURCES

- To what extent does the project team have the requisite background and level of expertise to accomplish the proposed research? To what extent are the technical responsibilities of senior or key personnel clearly and adequately described? How well organized is the timeline for major research goals and objectives?

REASONABLENESS AND APPROPRIATENESS OF THE PROPOSED BUDGET

- To what extent are the personnel staffing levels adequate to carry out the proposed research? To what extent is the travel budget appropriate and reasonable?

Summary of Proposal Contents and Information about PAMS

LETTERS

Do not submit letters of support or endorsement as these are not used in making funding decisions and can interfere with the selection of peer reviewers.

Each proposal will contain the following sections:

- Budget, entered into PAMS as structured data using the PAMS budget form
- Abstract (one page), entered into PAMS as a separate pdf
- Budget justification, entered into PAMS as a separate pdf
- Proposal, combined into a single pdf containing the following information:
    o Proposal Cover Page
    o Table of Contents
    o Project Narrative (main technical portion of the proposal, including background/introduction, proposed research and methods, timetable of activities, management plan and responsibilities of key project personnel – 15 page limit)
    o Appendix 1: Biographical Sketch(es)
    o Appendix 2: Current and Pending Support
    o Appendix 3: Bibliography and References Cited
    o Appendix 4: Facilities and Other Resources
    o Appendix 5: Equipment
    o Appendix 6: Other Attachments (optional)

SUBMISSION INSTRUCTIONS

Full proposals must be submitted into the DOE Office of Science Portfolio Analysis and Management System (PAMS). For help with PAMS, click the "External User Guide" link on the PAMS website, https://pamspublic.science.energy.gov/. You may also contact the PAMS Help

Desk, which can be reached Monday through Friday, 9:00 AM – 5:30 PM Eastern Time. Telephone: (855) 818-1846 (toll free number) or (301) 903-9610, Email: sc.pams-helpdesk@science.doe.gov. All submission and inquiries about this Program Announcement should reference **LAB 13-895.** Full proposals submitted in response to this Program Announcement must be submitted to PAMS no later than **May 24, 2013, 5:00 PM Eastern Time.**

Detailed Contents of the Proposal

BUDGET AND BUDGET EXPLANATION

The budget must be submitted into PAMS using the PAMS budget form. Research proposed under this announcement should have five annual budget periods. Please enter the following budget period start and end dates into PAMS for proposals submitted to this announcement:
- Budget Period 1: 9/1/2013 – 8/31/2014
- Budget Period 2: 9/1/2014 – 8/31/2015
- Budget Period 3: 9/1/2015 – 8/31/2016

PAMS will calculate the cumulative budget totals for you.

A written justification of each budget item is to follow the budget pages. The budget justification should be placed in a separate, single pdf document and attached on the appropriate screen in PAMS.

Further instructions regarding the budget and justification are given below and in the PAMS software.

Project Summary/Abstract (no more than one page)

The project summary/abstract must contain a summary of the proposed activity suitable for dissemination to the public. It should be a self-contained document that identifies the name of the applicant, the project director/principal investigator(s) (PD/PI), the project title, the objectives of the project, a description of the project, including methods to be employed, the potential impact of the project (i.e., benefits, outcomes), and major participants (for collaborative projects). This document must not include any proprietary or sensitive business information as the Department may make it available to the public. The project summary must not exceed 1 page when printed using standard 8.5" by 11" paper with 1" margins (top, bottom, left and right) with font not smaller than 11 point.

The abstract may be used to prepare publicly accessible reports about DOE-supported research. The one-page project summary/abstract should be placed in a separate, single pdf document and attached on the appropriate screen in PAMS.

The proposal narrative should begin with a cover page that will not count toward the project narrative page limitation. The cover page must include the following items:

- The project title
- Applicant/Institution:
- Street Address/City/State/Zip:
- Postal Address:
- Lead PI name, telephone number, email:
- Administrative Point of Contact name, telephone number, email:
- Program Announcement number: **LAB 13-895**
- DOE/Office of Science Program Office: **Office of Advanced Scientific Computing Research**
- DOE/Office of Science Program Office Technical Contact: **Dr. Steven L. Lee**
- Research area or areas (as identified in Supplementary Information)

COVER PAGE SUPPLEMENT FOR COLLABORATIONS

If the project is a collaboration, provide the following information on a separate page as a supplement to the cover page.
- List all collaborating institutions by name with each institution's principal investigator on the same line.
- Indicate the lead PI who will be the point of contact and coordinator for the combined research activity.
- Include a table modeled on the following chart providing summary budget information from all collaborating institutions. Provide the total costs of the budget request in each year for each institution and totals for all rows and columns.

Collaborative Proposal Information

Name of Collaborative Project						
	Names	Institution	Year 1 Budget	Year 2 Budget	Year 3 Budget	Total Budget
Lead PI			$	$	$	$
Co-PI			$	$	$	$
Co-PI			$	$	$	$
TOTALS			$	$	$	$

Example budget table ($ in thousands)

* Note that collaborating proposals must be submitted separately.

PROJECT NARRATIVE (NO MORE THAN 15 PAGES LONG)

The project narrative must not exceed 15 pages of technical information, including charts, graphs, maps, photographs, and other pictorial presentations, when printed using standard 8.5" by 11" paper with 1 inch margins (top, bottom, left, and right). The font must not be smaller than 11 point. Merit reviewers will only consider the number of pages specified in the first sentence of this paragraph. Proposals exceeding the page limit will be rejected without review.

Do not include any Internet addresses (URLs) that provide supplementary or additional information that constitutes a part of the proposal. Using Internet sites in an attempt to avoid page limits will fail: the content of those sites will not be reviewed. References posted to an Internet-based archive or publications are permitted in a list of references. To attach a Project Narrative, click "Add Attachment."

Background/Introduction: Explanation of the importance and relevance of the proposed work as well as a review of the relevant literature.

Proposed Research and Methods: Identify the hypotheses to be tested (if any) and details of the methods to be used including the integration of experiments with theoretical and computational research efforts.

Timetable of Activities: Timeline for all major activities including milestones and deliverables.

Project Objectives: This section should provide a clear, concise statement of the specific objectives/aims of the proposed project.

The Project Narrative comprises the research plan for the project. 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 method 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 15-page project narrative 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 or the first 15 pages may be reviewed without regard to the remainder. The page count of 15 does not include the Cover Page and Budget Pages, the Title Page, the biographical material and publication information, or any Appendices.

Provide a biographical sketch for the project director/principal investigator (PD/PI) and each senior/key person listed in the PAMS Budget form.

- Provide the biographical sketch information as an appendix to your project narrative.
- Do not attach a separate file.
- The biographical sketch appendix will not count in the project narrative page limitation.

The biographical information (curriculum vitae) for each person must not exceed 2 pages when printed on 8.5" by 11" paper with 1 inch margins (top, bottom, left, and right) with font not smaller than 11 point 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.

Identification of Potential Conflicts of Interest or Bias in Selection of Reviewers: Provide the following information in this section:

Collaborators and Co-editors: List in alphabetical order all persons, including their current organizational affiliation, who are, or who have been, collaborators or co-authors with you on a research project, book or book article, report, abstract, or paper during the 48 months preceding the submission of this proposal. For publications or collaborations with more than 10 authors or participants, only list those individuals in the core group with whom the Principal Investigator interacted on a regular basis while the research was being done. Also, list any individuals who are currently, or have been, co-editors with you on a special issue of a journal, compendium, or conference proceedings during the 24 months preceding the submission of this proposal. If there are no collaborators or co-editors to report, state "None."

Graduate and Postdoctoral Advisors and Advisees: List the names and current organizational affiliations of your graduate advisor(s) and principal postdoctoral sponsor(s) during the last 5 years. Also, list the names and current organizational affiliations of your graduate students and postdoctoral associates during the past 5 years.

APPENDIX 2: CURRENT AND PENDING SUPPORT

Provide a list of all current and pending support (both Federal and non-Federal) for the Project Director/Principal Investigator(s) (PD/PI) and senior/key persons, including subawardees, for ongoing projects and pending proposals. For each organization providing support, show the total award amount for the entire award period (including indirect costs) and the number of person-months per year to be devoted to the project by the senior/key person. Provide the Current and Pending Support as an appendix to your project narrative. Concurrent submission of a proposal to other organizations for simultaneous consideration will not prejudice its review.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

APPENDIX 3: BIBLIOGRAPHY & REFERENCES CITED

Provide a bibliography of any references cited in the Project 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. For research areas where there are routinely more than ten coauthors of archival publications, you may use an abbreviated style such as the Physical Review Letters (PRL) convention for citations (listing only the first author). For example, your paper may be listed as, "A Really Important New Result," A. Aardvark et. al. (MONGO Collaboration), PRL 999. You may also use this convention in the proposal bibliography. Include only bibliographic citations. Applicants should be especially careful to follow scholarly practices in providing citations for source materials relied upon when preparing any section of the proposal. Provide the Bibliography and References Cited information as an appendix to your project narrative.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

APPENDIX 4: FACILITIES & OTHER RESOURCES

This information is used to assess the capability of the organizational resources, including subawardee resources, available to perform the effort proposed. Identify the facilities to be used (Laboratory, Animal, Computer, Office, Clinical and Other). If appropriate, indicate their capacities, pertinent capabilities, relative proximity, and extent of availability to the project. Describe only those resources that are directly applicable to the proposed work. Describe other resources available to the project (e.g., machine shop, electronic shop) and the extent to which they would be available to the project. For proposed investigations requiring access to experimental user facilities maintained by institutions other than the applicant, please provide a document from the facility manager confirming that the researchers will have access to the facility. Please provide the Facility and Other Resource information as an appendix to your project narrative.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

APPENDIX 5: EQUIPMENT

List major items of equipment already available for this project and, if appropriate identify location and pertinent capabilities. Provide the Equipment information as an appendix to your project narrative.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

APPENDIX 6: OTHER ATTACHMENTS

Information not easily accessible to a reviewer may be included in this appendix, but do not use this 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.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.

Detailed Instructions for the Budget

Budgets are required for the entire project period. A budget form should be completed for each budget period of the award, and a cumulative budget form for the entire project period will be populated by PAMS. A detailed budget justification narrative should be included after the budget pages. The justification should cover labor, domestic travel, equipment, materials and supplies, and anything else that will be covered with project funds.

To edit a section on the budget, click the edit icon (🖉) for each section on the page. Remember to save all budget periods before moving on to the next section.

A. Senior/Key Person (Required)
For each Senior/Key Person, enter the appropriate information. List personnel, salary funds, and the number of months that person will be allocated to the project. Also include a written narrative in the budget justification that fully justifies the need for requested personnel.

B. Other Personnel
List personnel, salary funds, and the number of months that person will be allocated to the project. Also include a written narrative in the budget justification that fully justifies the need for requested personnel.

C. Equipment Description
For the purpose of this budget, equipment is designated as an item of property that has an acquisition cost of $5,000 or more and an expected service life of more than one year. (Note that this designation applies for proposal budgeting only and differs from the DOE definition of capital equipment.) List each item of equipment separately and justify each in the budget justification section. Allowable items ordinarily will be limited to research equipment and

apparatus not already available for the conduct of the work. General-purpose office equipment, such as a personal computer, is not eligible for support unless primarily or exclusively used in the actual conduct of scientific research.

D. Travel
In the budget justification, list each trip's destination, dates, estimated costs including transportation and subsistence, number of staff traveling, the purpose of the travel, and how it relates to the project. Indicate whether travel cost estimates are based upon quotes from travel agencies; upon past experience of similar number of trips to similar travel destinations; or something else (describe). 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.

E. Participant/Trainee Support Costs:
If applicable, submit training support costs. Educational projects that intend to support trainees (precollege, college, graduate and post graduate) must list each trainee cost that includes stipend levels and amounts, cost of tuition for each trainee, cost of any travel (provide the same information as needed under the regular travel category), and costs for any related training expenses. Participant costs are those costs associated with conferences, workshops, symposia or institutes and breakout items should indicate the number of participants, cost for each participant, purpose of the conference, dates and places of meetings and any related administrative expenses. In the budget justification, indicate whether trainee cost estimates are based upon past experience of support of similar number of trainees on similar projects; past experience of support of similar number of participants attending similar conferences/workshops/symposia; or something else (describe).

F. Other Direct Costs:
Enter Other Direct Costs information for each item listed.
- **Materials and Supplies:** Enter total funds requested for materials and supplies in the appropriate fields. In the budget justification, indicate general categories such as glassware, and chemicals, including an amount for each category (items not identified under "Equipment"). Categories less than $1,000 are not required to be itemized. In the budget justification, indicate whether cost estimates are based upon past experience of purchase of similar or like items; quotes/catalog prices of similar or like items; or something else (describe).
- **Publication Costs:** Enter the total publication funds requested. The proposal budget may request funds for the costs of documenting, preparing, publishing or otherwise making available to others the findings and products of the work conducted under the award. In the budget justification, include supporting information. In the budget justification, indicate whether cost estimates are based upon past experience of purchase of similar or like items; vendor quotes of similar publication services; or something else (describe).
- **Consultant Services:** Enter total funds requested for all consultant services. In the budget justification, identify each consultant, the services he/she will perform, total number of days, travel costs, and total estimated costs. In the budget justification, indicate whether consultant cost estimate is based upon previous experience/quotes for similar or like services; or something else (describe).

- **ADP/Computer Services:** Enter total funds requested for ADP/Computer Services. The cost of computer services, including computer-based retrieval of scientific, technical and education information may be requested. In the budget justification, include the established computer service rates at the proposing organization if applicable. In the budget justification, indicate whether cost estimates are based upon quotes/past experience of purchase of similar computer services; established computer service rates at the proposing institution; or something else (describe).
- **Subawards/Consortium/Contractual Costs:** Enter total costs for all subawards/consortium organizations and other contractual costs proposed for the project. In the budget justification, justify the details.
- **Equipment or Facility Rental/User Fees:** Enter total funds requested for Equipment or Facility Rental/User Fees. In the budget justification, identify each rental/user fee and justify. In the budget justification, indicate whether cost estimates are based upon past experience with similar or like items; vendor quotes of similar items; or something else (describe).
- **Alterations and Renovations:** Enter total funds requested for Alterations and Renovations.
- **In the budget justification**, itemize by category and justify the costs of alterations and renovations, including repairs, painting, removal or installation of partitions, shielding, or air conditioning. Where applicable, provide the square footage and costs.
- **Other:** Add text to describe any other Direct Costs not requested above. Enter costs associated with "Other" item(s). Use the budget justification to further itemize and justify.

G. Direct Costs
This represents Total Direct Costs (Sections A thru F) and will be calculated by PAMS.

H. Other Indirect Costs
Enter the Indirect Cost information for each field. Only four general categories of indirect costs are allowed/requested on this form, so please consolidate if needed.

I. Total Direct and Indirect Costs
This amount will be calculated by PAMS (Sections G + H)