FINANCIAL ASSISTANCE
FUNDING OPPORTUNITY ANNOUNCEMENT

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

Scientific Data Management, Analysis and Visualization at Extreme Scale 2

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Announcement Type: Amendment 2
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Note: On page 16 the Encourage/Discourage date in the paragraph below the dates in Section B has been corrected to February 21.

Amendment Issue Date: 01/14/2014

Pre-Application Due Date: 02/07/2014 at 5 PM Eastern Time
Pre-Application is Required

Encourage/Discourage Date: 02/21/2014 at 5 PM Eastern Time

Application Due Date: 04/02/2014 at 5 PM Eastern Time

Pages changed (besides the cover): 15, 16, and 31

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REGISTRATIONS

A. Systems to Register In

There are several one-time actions you must complete in order to submit an application in response to this Announcement. Applicants not currently registered with SAM and Grants.gov should allow **at least 44 days** to complete these requirements. You should start the process as soon as possible.

Applicants must obtain a DUNS number at http://fedgov.dnb.com/webform.

Applicants must register with the System for Award Management (SAM) at http://www.sam.gov/. If you had an active registration in the Central Contractor Registry (CCR), you should have an active registration in SAM. More information about SAM registration for applicants is found at https://www.sam.gov/sam/transcript/Quick_Guide_for_Grants_Registrations_v1.7.pdf.

Applicants must register with FedConnect at www.fedconnect.net. The full, binding version of assistance agreements will be posted to FedConnect.

Recipients must register with the Federal Funding Accountability and Transparency Act Subaward Reporting System at https://www.fsrs.gov. This registration must be completed before an award may be made: you are advised to register while preparing your application.

B. Registering in Grants.gov

Applicants must register with Grants.gov.

For organizations, please follow the procedures detailed below, making use of the checklist provided below:
> http://www.grants.gov/web/grants/applicants/organization-registration.html
> http://www.grants.gov/documents/19/18243/OrganizationRegChecklist.pdf

For individuals, please follow the procedures detailed below:
> http://www.grants.gov/web/grants/applicants/individual-registration.html

Organizations and individuals must have an E-Business (E-Biz) Point of Contact (POC). You may find the checklist at http://www.grants.gov/documents/19/18243/E-Biz_POC_Checklist.pdf useful.

Grants.gov maintains a User Guide at http://www.grants.gov/documents/19/18243/GrantsGovApplicantUserGuide.pdf and a list of Frequently Asked Questions at http://www.grants.gov/web/grants/applicants/applicant-faqs.html. Questions relating to the registration process, **system requirements, or how an application form works** must be directed to Grants.gov at 1-800-518-4726 or **support@grants.gov**.

IMPORTANT NOTICE: When you have completed the grants.gov registration process, you should call the Grants.gov Helpdesk at 1-800-518-4726 to verify that you have completed the final step (i.e., Grants.gov registration).

Applicants must download the application package, application forms and instructions, from Grants.gov at http://www.grants.gov/
(Additional instructions are provided in Section IV A of this FOA.)

Applications must be submitted through Grants.gov to be considered for award. You cannot submit an application through Grants.gov unless you are registered. Please read the registration requirements carefully and start the process immediately. Remember you have to update your SAM registration annually. If you have any questions about your registration, you should contact the Grants.gov Helpdesk at 1-800-518-4726 to verify that you are still registered in Grants.gov.

C. DOE Office of Science Portfolio Analysis and Management System (PAMS)

After you submit your application through Grants.gov, the application will automatically transfer into the Portfolio Analysis and Management System (PAMS) for processing by the DOE Office of Science. Many functions for grants and cooperative agreements can be done in PAMS, which is available at https://pamspublic.science.energy.gov.

You will want to "register to" your application: a process of linking yourself to the application after it has been submitted through grants.gov and processed by DOE.

You must register in PAMS to submit a pre-application or a letter of intent.

You may use the Internet Explorer, Firefox, Google Chrome, or Safari browsers to access PAMS.

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

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.

1. 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. (If you have been an Office of Science merit reviewer or if you have previously submitted an application, you may already be linked to an institution in PAMS. If this happens, you will be taken to the PAMS home page.)

2. 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. A "like" search in PAMS returns results that contain the word or phrase you enter; you do not need to enter the exact name of the institution, but you should enter a word or phrase contained within the institution name. (If your institution has a frequently used acronym, such as ANL for Argonne National Laboratory or UCLA for the Regents of the University of California, Los Angeles, you may find it easiest to 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.

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, 9AM – 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 Funding Opportunity Announcement should reference **DE-FOA-0001043.**

RECOMMENDATION

The Office of Science encourages you to register in all systems as soon as possible. You are also encouraged to submit letters of intent, pre-applications, and applications before the deadline.

Section I – FUNDING OPPORTUNITY DESCRIPTION

GENERAL INQUIRIES ABOUT THIS FOA SHOULD BE DIRECTED TO:

Technical/Scientific Program Contact:
Dr. Lucy Nowell
301-903-3191
Lucy.Nowell@science.doe.gov

STATUTORY AUTHORITY

Public Law 95-91, US Department of Energy Organization Act
Public Law 109-58, Energy Policy Act of 2005

APPLICABLE REGULATIONS

U.S. Department of Energy Financial Assistance Rules, codified at 10 CFR 600
U.S. Department of Energy, Office of Science Financial Assistance Program Rule, codified at 10 CFR 605

SUMMARY

The Office of Advanced Scientific Computing Research (ASCR) in the Office of Science (SC), U.S. Department of Energy (DOE), hereby invites applications for basic research that significantly advances management, analysis and visualization of data in scientific disciplines supported by DOE in the context of emerging architectures for extreme scale computing platforms.

Future extreme scale systems will require fundamental rethinking of the way science is enabled on our largest computing platforms. The current approach to data analysis by the high performance computational science community has been to store simulation data and analyze it at a later time, away from leadership-class supercomputers. However, because the design of new leadership-class machine architectures will be driven by energy efficiency constraints, especially with regard to the memory architecture, this approach will be infeasible. Minimizing data movement will be essential to meeting the power constraints and it will be possible to store only a very small percentage of the data generated by simulations at scale. These limitations will drive science towards increased reliance on *in situ* data reduction and analysis, with implications for data management, resilience, the process of co-design, etc.

The purpose of this announcement is to invite applications for basic computer science research on five major themes:

1. Usability and user interface design;
2. *In situ* methods for data management, analysis and visualization;

3. Design of *in situ* workflows to support data management, processing, analysis and visualization;
4. New approaches to scalable interactive visual analytic environments; and/or
5. Proxy applications or workflows and/or simulations for data management, analysis and visualization software to support co-design of extreme scale systems

The supported research will lay the foundation for building the software infrastructure to support scientific data management, analysis and visualization in the context of extreme scale computing.

While described in the context of extreme scale supercomputing and simulations, these topics also have broad implications for data intensive science at scale and have been called out as synergistic challenges.

A companion Program Announcement to DOE Laboratories (LAB 14-1043) will be posted on the SC Grants and Contracts web site at: http://science.energy.gov/grants/

More specific information is included under SUPPLEMENTARY INFORMATION below.

SUPPLEMENTARY INFORMATION

Significant changes in computer architectures will occur over the next few years and will impact the full spectrum of computational devices. Providing support for unprecedented levels of parallelism in application software, the new architectures will also drive dramatic changes in the way data are managed and analyzed in all scientific disciplines. Continued research is needed across a range of topics and issues to ensure our ability to make sense of data and continue to make scientific discoveries in support of national priorities.

The next-generation of scientific discovery will be enabled by research developments that can effectively harness significant and possibly disruptive advances in computing technology. Extreme scale applications will generate results with orders of magnitude higher resolution and fidelity, achieving a time-to-solution significantly shorter than possible with today's high performance computing (HPC) platforms.

Challenges of Expected Supercomputing Hardware Architecture

In order to support scientific discovery in the context of extreme scale computing platforms and across the spectrum of computational devices, advances in scientific data management and analysis must take into account a variety of challenges:

1. Energy efficient hardware and software will be constrained to a power envelope of approximately 20 Megawatts (MW);
2. Machine architecture that may be heterogeneous or hybrid in chip components;

3. Users will be required to manage deep memory hierarchies and multi-stage storage systems within the severe energy constraints;
4. Data movement will be constrained, both internode and on/off the machine, in the interest of conserving power;
5. The bottleneck for input/output will continue to worsen as improvements in storage device capabilities do not keep pace with those for computing;
6. The presence of predicted high rates of hard and soft faults that will necessitate new approaches to ensuring the integrity of data and processing; and
7. Use of the machines will require managing unprecedented parallelism, especially at the node level of exascale systems.

Additional information about expected changes to the architecture of and system software for DOE supercomputing systems can be found in a variety of sources, including [1], [2] and [3].

Research Themes

The purpose of this announcement is to invite applications for basic computer science research on five major themes:

1. Usability and user interface design;
2. *In situ* methods for data management, analysis and visualization;
3. Design of *in situ* workflows to support data management, processing, analysis and visualization;
4. New approaches to scalable interactive visual analytic environments; and/or
5. Proxy applications or workflows and/or simulations for data management, analysis and visualization software to support co-design of extreme scale systems

While described in the context of extreme scale supercomputing and simulations, these topics also have broad implications for data intensive science at scale and have been called out as synergistic challenges.

Applications may address one or more of the announcement themes. Preference will be given to larger collaborative projects that offer more comprehensive and coherent research and solutions, provided that such applications are appropriately integrated into a whole and not a collection of disjointed efforts.

Applications addressing themes 2-5 must explicitly address the challenges of operating within the expected exascale environment, including severe constraints on data movement, worsening I/O bottleneck, frequent hard and soft faults, and the necessity for extremely high levels of concurrency.

The supported research will lay the foundation for building the software infrastructure to support scientific data management, analysis and visualization in the context of extreme scale computing.

Research Theme 1: Usability and User Interface Design

Computational science rests on the shoulders of scientists who push the boundaries of their disciplines and test the capabilities of the nation's fastest supercomputers, developing software to express computational models of complex phenomena for purposes of discovery and sometimes prediction. *Usability* is a concept too seldom applied to software for data management, analysis and visualization in this context. Providing a software environment for managing and analyzing data that is truly usable requires deep understanding of the culture, expectations, and processes of science in the fields to be supported. True usability is not tacked on at the end by providing a web interface to an application. Rather, usability must be designed and built in from the beginning, helping to drive functional choices at every level.

Research on this theme may involve experts from disciplines outside of computer science, such as cognitive and perceptual psychologists, cultural anthropologists, decision scientists, visual artists, etc., as well as scientists who are potential users of ASCR-supported technology for data management, analysis and visualization.

Research is required on a variety of topics related to usability, including but not limited to the following:

- If subjected to empirical usability evaluation procedures, what improvements to the user interfaces of existing applications for data management, analysis and visualization would increase ease of use and encourage broader adoption?

- Processes of data preparation and curation, analysis and visualization can be complicated to the point that it takes a team of specialists working with scientists to manage and analyze data. Can improvements to user interfaces help to alleviate confusion and give scientists more freedom and power to conduct their investigations without undue distraction by software and hardware complexities? Are the underlying software systems capable of supporting the desired user scientists' interactions with data? If not, what changes are needed from the standpoint of usability?

- Do available data abstractions adequately support scientists' thinking about their data and their science? Do the data abstractions support the types of processing and analysis that are needed? Do they help scientists reason effectively and easily about their data? If not, where are the points of failure? What characteristics are needed in new data abstractions?

- Scientists report difficulty in replicating their own analyses of data after the passage of a few weeks, let alone supporting validation by a third party. What is needed to better support management of scientific workflows and make orchestrating the processes easier and more understandable, as well as improving documentation of what has been done in order to support future validation? What are the barriers to use of existing scientific workflow systems? If we develop new workflow management software, can workflow management systems help to make it easier to explain the process of discovery? How might new workflow management approaches help to ease the burden of data management for scientists and also promote the integrity of science? From the standpoint of usability, what are the requirements for such systems?

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Applications that address this theme must show clear relevance to challenges in scientific data management, analysis and visualization in the context of science disciplines that are supported by the DOE Office of Science and the ASCR supercomputing environment, which consists of the leadership class supercomputing facilities at Argonne National Lab (ANL) and Oak Ridge National Lab (ORNL), as well as the NERSC facility at Lawrence Berkeley National Lab (LBNL)

Applicants are reminded that software usability evaluation and other types of user studies are considered to be human subjects research and plans for such research must be cleared by an Institutional Review Board.

Research Theme 2: *In Situ* Data Management, Analysis and Visualization

Future extreme scale systems will require fundamental rethinking of the way science is enabled on our largest computing platforms. The current approach to data analysis by the high performance computational science community has been to store simulation data and analyze it at a later time, away from leadership-class supercomputers. However, because the new leadership-class machine architectures will be driven by energy efficiency constraints, especially with regard to the memory architecture, this approach will be infeasible. Minimizing data movement will be essential to meeting the power constraints and it will be possible to store only a very small percentage of the data generated by simulations at scale. These limitations are expected to drive science towards increased reliance on *in situ* data management, reduction, analysis and visualization, occurring in parallel with the simulation, either on the same nodes or on specially designated nodes.

A key aspect of in situ processing is that data are intelligently reduced, analyzed, transformed and indexed while they are still in memory and before being written disk or transferred over networks. In situ analysis and visualization can extract and preserve salient features of the raw data that would be lost as a result of aggressive data reduction and can characterize the extent of the data to enable runtime monitoring and even steering of the simulation. In situ data triage can effectively facilitate interactive post-processing visualization.

At the same time, changing government policies mandate that data associated with publications must be shared in order to support validation of research results. It is thus required that sufficient data must be preserved after the conclusion of a simulation, along with provenance about the data, to enable subsequent re-analysis. Furthermore, scientists observe that replicating their own analyses of data can be impossible as soon as a few weeks after completion, making it very difficult to support validation of results by a third party.

Research is needed to improve our understanding of and ability to utilize in situ methods for data management, analysis and visualization. [4] [5] Issues to be investigated include the following:

- How do simulations, data analysis and visualization calculations and data manipulations best share the same processors, memory space and domain decomposition to exploit data locality? If sharing is not feasible, how can data be reduced and shipped to processors dedicated to data analysis and visualization?
- Which data processing, analysis and visualization operations are best performed in situ? To what extent is a monitoring scenario relevant and how is monitoring effectively coupled with domain knowledge-driven data reduction? What types of reduction or transformation are appropriate to support both exploratory analysis and validation of results? As we store less raw data to disk, what metadata (e.g., data provenance) and supplemental information (e.g., uncertainty) should be generated and captured in situ?
- To date, in situ processing has been used primarily for operations that are known to be necessary a priori. Will this continue to be the case? If the scientist has little a priori knowledge about what is interesting or important in the data, how should data reduction be done? Will it be possible to do sufficient in situ data reduction that scientists will be able to do subsequent exploratory analysis offline? Will scientists be able to engage in exploration-oriented activities that have a scientist user "in the loop"? If so, will these activities occur concurrently with the simulation? Will the user be able to interact with the simulation and perhaps change its course, based on discoveries or observations of system behavior?
- What are the unique requirements of in situ data analysis and visualization algorithms? Some are fundamentally memory-heavy and some are compute-heavy, so that some algorithms may not be usable for in situ processing. Are reformulations for those algorithms possible and/or necessary? Can we create data abstractions or data structures and related traversal algorithms that minimize data movement while supporting both *in situ* and *post hoc* data management, analysis and visualization? Some analysis requires looking at large windows of time. Are incremental analysis methods needed to meet this requirement?
- What fraction of the supercomputer time should be devoted to in situ data processing/ analysis/visualization? As in situ data analysis and visualization become a necessity rather than an option, scientists must accept "embedded analysis" as an integral part of the simulation. What can be done to make this an attractive approach rather than an unwelcome disruption?
- What similarities can be exploited over multiple simulation projects? Can the Data Management, Analysis and Visualization communities develop a code base that can be re-used across a variety of simulations? Can existing commercial and/or open-source visualization software tools be directly extended to support in situ visualization at extreme scale?

Research Theme 3: In Situ Data Management and Workflow Management Systems

As datasets increase in size and complexity, assumptions and educated guesses will be made to reduce dataset size and manage the output. These assumptions and educated guesses need to be captured to provide context and increase reproducibility. A provenance infrastructure is needed

that makes the capture and curation of datasets automatic. On the simulation side, it needs to capture metadata information about the environment and settings of the simulation. On the analysis side, the captured information needs to accessible as feedback to the user. [4]

Furthermore, the shift to in situ data reduction and analysis that are more tightly coupled with simulations represents a new kind of workflow for scientists, creating both challenges and opportunities. Existing workflow engines coordinate tasks within the HPC environment through the scheduler and remote connections to the HPC machine. They do little to help orchestrate tasks that must run concurrently and share memory-based data objects.

A new kind of workflow management system for science is needed. Like the score for an orchestra, a scientific workflow should be both sharable and portable. This means that a workflow must be readily understandable by scientists other than those who created it and that it must be capable of operation on diverse hardware systems. It should also include the capability to capture and reuse data provenance during both in situ and post hoc processing, providing support for replicating an analysis and/or validation of results. Such workflows should be useful in the education of those entering a discipline or beginning research in a new area.

Research is needed to design in situ workflow management methods and/or systems to support data management, processing, analysis and visualization in residence with simulations at scale, as well as providing for capture of sufficient data provenance to support subsequent re-analysis and/or validation of results. [4] [5] [6]

Challenges to be addressed include but are not limited to:
- How and to what degree must codes for data management, analysis and visualization be tightly coupled to application codes to address power constraints on data movement on extreme-scale platforms? How will in situ data processing, analysis and visualization activities be controlled by and/or coordinated with simulations?
- What data transformations or adaptations are required to allow data analysis and visualization to share memory and data access with applications, preferably in a zero-copy manner?
- Given the need to support replication of results and possible post-hoc analysis, how can the capture of data provenance metadata be automated for in situ workflows in the face of a dynamic software stack and frequent hard and soft faults? What knowledge representation schemes and machine reasoning capability are required to support the use and re-use of data provenance metadata for subsequent in situ and/or post hoc use?

Research Theme 4: Visualization and Interactive Visual Analytics

Research is required to design and develop more powerful visual analytic environments for representation of and interaction with scientific data. New scientific visual analytic systems must be sufficiently scalable to address the challenges of extreme scale simulations and data intensive science and provide better understanding for multi-physics ensemble data, comparative analysis of data, and/or integrated analysis of simulation and experimental data. New methods must be

developed that leverage the knowledge of domain scientists to improve the efficiency and efficacy of the resulting analysis, including research in related areas of knowledge representation and machine reasoning methods to support scientific data analysis and visual analytics. [4] [5] [6][7]

Real time or near real time analysis of data, coupled with the shift to asynchronous models of computation, offers the possibility for a more interactive kind of computational science, allowing scientists an option to intervene in simulations in ways that have not been possible in the past. Exploratory research is needed to develop visual analytic methods and interfaces that enable scientists to assess the state of a simulation and the system running it, along with mechanisms that support interaction with the simulation environment and parameters.

A key challenge will be to develop and validate visual analysis systems that support scientific discovery, in addition to confirmatory analysis and communication, while maintaining user scientists' ability to control the course of analysis and ensuring their faith (and that of policy makers and the public) in the integrity of the process of scientific analysis. It is not enough to produce an answer; scientists must be able to understand, trust and explain the results of analytic processes, communicating them effectively to other scientists and sometimes to policy makers. Providing deep integration of visualization processes with data analytic engines and the data will be especially challenging on the I/O-constrained platforms of the future. Such integration is essential to support scientists' interaction with their data, and such interaction is essential to supporting human insight, intuition, and learning. Visualization alone is not enough.

Challenges to be addressed in scientific visual analysis include but are not limited to the following:

- Can real time or near real time visual analytics provide for new kinds of interactivity with simulations? What are the implications of such interactivity in terms of capturing data provenance and/or support for validation of results? Would increased interactivity enhance scientific understanding, increase the pace of scientific discovery, and/or improve the utilization or usability of supercomputing platforms? Can we increase the ability of scientists to interact with their simulations without adverse effects on the resiliency of the applications and the supercomputing system itself?
- How can we increase the level of interaction with scientific data so as to better support the perceptual and cognitive abilities of the user scientists, increasing their ability to understand the phenomena represented in their data, detect patterns and anomalies, and increase the pace of scientific discovery?
- How can systems for visual analysis represent and leverage the knowledge of user scientists to improve the accuracy and speed of analysis? Can such knowledge representations be preserved and made reusable or possibly sharable?
- How can a visual analytics system represent data sets for which there is not even one pixel per data point without falsely conveying a sense of uniformity in data? How can small anomalies in petascale to exascale data be made perceptible? How can data from multi-scale, multi-physics simulations and experiments be represented so that the

complexity of the science is accessible while also maintaining comprehensibility of the displays?

- How can we validate the efficacy of scientific visualizations and visual analytic environments in supporting scientific understanding and discovery and also improve their usability?

Applications that address this theme must provide for formative usability evaluation of user interface designs that will result from the research. Applicants are reminded that software usability evaluation and other types of user studies are considered to be human subjects research and plans for such research must be cleared by an Institutional Review Board.

Research Theme 5: Proxy Applications and/or Simulation Support for Co-Design

To support co-design of supercomputing systems that will support in situ management, processing, analysis, and visualization of data, research is also needed to design and develop proxy applications for data management, processing, analysis and visualization software and/or simulations of the behavior of these tools. In the past supercomputers have been designed to support scientific simulation, with the assumption that data analysis and visualization would occur post hoc on machines with a different architecture. Tighter integration of simulation and analytics in the scientific workflow on the same system that runs the simulation will impact the system architecture and operating and runtime systems in ways that are not well understood and will impact co-design of the systems for future workloads. Use of proxy applications and modeling and simulation to support system design is becoming the norm in the extreme scale research community [8] and it is important that data management, analysis and visualization software should be represented. [4] [5][7]

- What aspects of scientific data management, analysis and visualization software and/or workflows should be captured in proxy applications or mini-apps? Are additional representations of these technologies needed to support co-design of the hardware, operating and runtime systems, and applications?
- Because data management, analysis and visualization will occur in situ, perhaps using the same memory as simulations that generate the data, execution may be interleaved with that of the simulation or they may occur in parallel. Can we build proxy applications that are composable so as to represent the entire in situ data life cycle? Do we need to do so?
- What models and simulations of the behavior of data management, analysis and visualization software and/or workflows are needed to support design of extreme scale systems?

Proposed projects that address this theme should develop and deliver proxy applications and/or modeling and simulation software that will be useful in the co-design of extreme scale system hardware and the software stack. To be successful in this research theme, applications must reveal sufficient awareness of ongoing activities in the areas of co-design, development of the

software stack, and modeling and simulation for design of DOE extreme scale HPC systems [1] [5] to make the case for potential impact.

Program Objective

With this announcement DOE invites applications for basic computer science research that will lay the foundation for building the software infrastructure to support scientific data management, analysis and visualization in the context of extreme scale computing.

Support for Partnerships

Data management, analysis and visualization are inherently involved in the process of scientific discovery at scale. Especially in the context of in situ processing, changes in data management, analysis and visualization technology could have potentially dramatic impact on scientific applications and discovery processes. Close collaboration with domain scientists is thus essential to successful design and deployment in these areas.

The ASCR Computer Science program does not ordinarily provide support for research that is applicable to only one domain of science. Therefore, applications must clearly make the case that the proposed research is relevant to multiple scientific disciplines that are supported by the DOE Office of Science and/or propose discipline-specific research with the potential for a co-funding partnership with the relevant Office of Science program office.

Applications that propose funding partnerships with other Office of Science program offices are welcome, but such partnerships are not required. If a partnership application is considered, applicants should contact the ASCR program manager and the relevant program manager in the other Office of Science program office(s) to discuss potential partnership applications in order to ensure that the application will benefit both ASCR and the other Office of Science program office(s) and that funds are available in the other office(s).

Additional Information

Applications may address one or more of the announcement themes. Preference will be given to larger collaborative projects that offer more comprehensive and coherent research and solutions, provided that such applications are appropriately integrated into a whole and not a collection of disjointed efforts.

Applications that address Theme 1 must show clear relevance to challenges in scientific data management, analysis and visualization in the context of science disciplines that are supported by the DOE Office of Science and the ASCR supercomputing environment at ANL, ORNL and LBNL .

Applications addressing Themes 2-5 must explicitly address the challenges of operating within the expected exascale environment, including severe constraints on data movement, worsening

I/O bottleneck, frequent hard and soft faults, and the necessity for extremely high levels of concurrency.

Applications that address a combination of Theme 1 with one or more of Themes 2-5 are welcome.

Applications must clearly establish that the proposed research supports the missions of the Advanced Scientific Computing Research office and the Computer Science program, as well as showing relevance to other Office of Science disciplines. Proposed research must also be relevant to future extreme scale computing platforms operated by ASCR and must advance pertinent aspects of computer science.

All recipients of awards resulting from this Funding Opportunity Announcement (FOA) must comply with the terms of the ASCR policy on open source software: http://science.energy.gov/~/media/ascr/pdf/research/docs/Doe_lab_developed_software_policy.pdf.

Limitations of Scope

Applications previously submitted to DE-FOA-0000918 [or Lab13-918] Mathematical and Statistical Methodologies for DOE Data-Centric Science at Scale or substantially the same will be deemed out of scope and declined without review.

Also out of scope for this announcement are research aimed at quantum computing; networking; computer supported collaboration; social network analysis; analysis of Internet or network traffic data; natural language understanding and/or generation; digital data preservation and/or archiving; data discovery, creation and/or use of data registries; generalized research in human computer interaction that is not responsive to Research Theme 1; and/or research which is only or primarily applicable to hand-held, portable, desktop, cluster or cloud computing.

Applications for discipline-specific approaches to data management and/or analysis and visualization are within scope only if there is potential support from the relevant Office of Science program component.

REFERENCES

1. *The Opportunities and Challenges of Exascale Computing, ASCAC Subcommittee Report,* http://science.energy.gov/~/media/ascr/ascac/pdf/reports/Exascale_subcommittee_report.pdf
2. *Final Report of the U.S. Department of Energy Fault Management Workshop,* June 6, 2012, http://science.energy.gov/~/media/ascr/pdf/program-documents/docs/FaultManagement-wrkshpRpt-v4-final.pdf
3. Exascale Research Conference meeting materials: http://exascaleresearch.labworks.org/oct2012/

4. *Scientific Discovery at the Exascale: Report from the DOE ASCR 2011 Workshop on Exascale Data Management, Analysis and Visualization*, Houston, TX, http://science.energy.gov/~/media/ascr/pdf/program-documents/docs/Exascale-ASCR-Analysis.pdf

5. *Synergistic Challenges in Data-Intensive Science and Exascale Computing, DOE ASCAC Data Subcommittee Report*, March 2013, http://science.energy.gov/~/media/ascr/ascac/pdf/reports/2013/ASCAC_Data_Intensive_Computing_report_final.pdf
6. *Data Crosscutting Requirements Review, April 4-5, 2013*, http://science.energy.gov/~/media/ascr/pdf/program-documents/docs/ASCR_DataCrosscutting2_8_28_13.pdf
7. Report out from the *Exascale Research Planning Workshop Working Session on Data Management, Visualization, IO and Storage,* http://exascaleresearch.labworks.org/apr2012planningworkshop/application/layouts/exascale-planning-workshop//public/docs/PRES_WorkingSession-DataIO_120420.pdf
8. *Report on the ASCR Workshop on Modeling and Simulation of Exascale Systems and Applications, August 2012,* http://science.energy.gov/~/media/ascr/pdf/program-documents/docs/ModSim_Report-2012_AH_5.pdf

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 applications submitted from different institutions should clearly indicate they are part of a proposed collaboration. All collaborative applications must use the same title, abstract and technical narrative. In addition, such applications 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 applications 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 applications should all have the same title as the lead institution. Each collaborating institution submitting a application must use the same title.

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

Collaborative applications from institutions other than DOE National Laboratories should be submitted following the above rules in response to the companion announcement, LAB 14-1043.

<center>**Section II – AWARD INFORMATION**</center>

A. TYPE OF AWARD INSTRUMENT

DOE anticipates awarding cooperative agreements under this FOA.

DOE will consider funding multi-institution collaborations under this FOA.

B. ESTIMATED FUNDING

It is anticipated that up to $4,000,000 per year will be available under this Funding Opportunity Announcement and the Laboratory Announcement LAB 14-1043, contingent on satisfactory peer review and the availability of appropriate funds. Applicants should request project support for three years, commensurate with the scope of proposed research, with out-year support contingent on the availability of appropriated funds, progress of the research, and programmatic needs. Awards are expected to begin in Fiscal Year 2014, which ends on September 30, 2014. Some awards may be made in Fiscal Year 2015, depending on the availability of funds.

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

C. MAXIMUM AND MINIMUM AWARD SIZE

(See B. Estimated Funding section above.)

The award size will depend on the number of meritorious applications and the availability of appropriated funds.

Ceiling

$500,000 per year for non-laboratory applications that are part of a collaborative project with at least one DOE national laboratory.

$350,000 per year for applications for projects that do not involve one or more DOE national laboratories.

Floor

$100,000 for applications submitted as part of collaborative project that involves a DOE national laboratory.

$200,000 for applications submitted as single-investigator or single-institution projects that do not involve one or more DOE national laboratories.

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D. EXPECTED NUMBER OF AWARDS

(See B. Estimated Funding Section above.)

The number of awards will depend on the number of meritorious applications and the availability of appropriated funds. A total of 4-6 projects are likely to be funded.

The Advanced Scientific Computing Research Program reserves the right to make no awards, or fewer awards than would be possible at the $4,000,000 grand-total level, if an insufficient number of applications are judged to be of suitable scientific quality or relevance to the programs described in Part I. The cost effectiveness of each application will be considered. A single award or multiple awards may be made depending on the number and quality of the applications that are received and favorably reviewed. If multiple awards are made, it is anticipated that award sizes may range from $100,000 per year to $500,000 per year, typically less than $425,000 per year. Programmatic relevance and portfolio balance are factors in evaluating all applications.

E. ANTICIPATED AWARD SIZE

(See B. Estimated Funding Section above.)

It is anticipated that award sizes may range from $100,000 per year to $500,000 per year, typically less than $425,000 per year. Programmatic relevance and portfolio balance are factors in evaluating all applications.

The award size will depend on the number of meritorious applications and the availability of appropriated funds.

F. PERIOD OF PERFORMANCE

(See B. Estimated Funding section above.)

Research Awards are expected to be made for a period of three years.

Out-year funding will depend upon suitable progress and the availability of appropriated funds.

G. TYPE OF APPLICATION

DOE will accept new/renewal applications under this FOA.

Section III – ELIGIBILITY INFORMATION

A. ELIGIBLE APPLICANTS

All types of applicants are eligible to apply, except Federally Funded Research and Development Center (FFRDC) Contractors, and nonprofit organizations described in section 501(c)(4) of the Internal Revenue Code of 1986 that engaged in lobbying activities after December 31, 1995.

A given institution may submit at most three applications to this FOA as a project lead institution.There is no limit on the number of proposals that may be submitted as a sub-awardee or collaborating institution.

B. COST SHARING

Cost sharing is not required.

C. ELIGIBLE INDIVIDUALS

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

A given individual may participate in at most three applications to this FOA, including participation as a sub-awardee or collaborator.

Section IV – APPLICATION AND SUBMISSION INFORMATION

A. ADDRESS TO REQUEST APPLICATION PACKAGE

Application forms and instructions are available at Grants.gov. To access these materials, go to http://www.grants.gov, select "Apply for Grants", and then select "Download Application Package." Enter the CFDA number (81.049) and/or the funding opportunity number (DE-FOA-0001043) shown on the cover of this FOA and then follow the prompts to download the application package.

Applications submitted through www.FedConnect.net will not be accepted.

B. LETTER OF INTENT AND PRE-APPLICATION

1. Letter of Intent

A Letter of Intent is not required.

2. Pre-application (Required)

PRE-APPLICATION DUE DATE
February 7, 2014, by 5 PM Eastern Time

ENCOURAGE/DISCOURAGE DATE
February 21, 2014, by 5 PM Eastern Time

Pre-applications will be reviewed for responsiveness of the proposed work to the research topics identified in this FOA. DOE will send a response by email to each applicant encouraging or discouraging the submission of a full application by February 21, 2014. Applicants who have not received a response regarding the status of their pre-application by this date are responsible for contacting the program to confirm this status.

Only those applicants that receive notification from DOE encouraging a full application may submit full applications. No other full applications will be considered.

The pre-application attachment should include, at the top of the first page, the following information:

Title of Pre-application
Principal Investigator Name, Job Title
Institution
PI Phone Number, PI Email Address
Funding Opportunity Announcement Number: DE-FOA-0001043
A list of the technical topics from the FOA that are addressed in the pre-application.
A copy of the funding summary table described in the budget section below.

This information should be followed by a clear and concise description of the objectives and technical approach of the proposed research. The pre-application 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-application must also include a list of the names and institutional affiliations of all participating investigators, including collaborators and consultants on the proposed project**. A single, consolidated COI list for the Lead Principal Investigator and each project collaborator (supported or unsupported) is required that includes, for all project participants collectively, an alphabetized list** of collaborative co-investigators including co-authors of the past 48 months, co-editors of the past 24 months, graduate and postdoctoral advisors/advisees.

Those pre-applications that are encouraged will be used to help the Office of Science begin planning for the full application peer review process. The intent of the Office of Science in discouraging submission of certain full applications is to save the time and effort of applicants in preparing and submitting full applications not responsive to this funding opportunity announcement.

The Principal Investigator will be automatically notified when the pre-application is encouraged or discouraged. The DOE Office of Science Portfolio Analysis and Management System (PAMS) will send an email to the Principal Investigator from PAMS.Autoreply@science.doe.gov, and the status of the pre-application will be updated at the PAMS website https://pamspublic.science.energy.gov/. Notifications are sent as soon as the decisions to encourage or discourage are finalized.

It is important that the pre-application be a single file with extension .pdf, .docx, or .doc. The pre-application 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 pre-application. All PIs and those submitting pre-applications on behalf of PIs are encouraged to establish PAMS accounts as soon as possible to avoid submission delays.

You may use the Internet Explorer, Firefox, Google Chrome, or Safari browsers to access PAMS.

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. (If you have been an Office of Science merit reviewer or if you have previously submitted an application, you may already be linked to an institution in PAMS. If this happens, you will be taken to the PAMS home 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. A "like" search in PAMS returns results that contain the word or phrase you enter; you do not need to enter the exact name of the institution, but you should enter a word or phrase contained within the institution name. (If your institution has a frequently used acronym, such as ANL for Argonne National Laboratory or UCLA for the Regents of the University of California, Los Angeles, you may find it easiest to 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 Pre-Application:
- Create your pre-application (called a pre-application in PAMS) 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 Applications tab. Click the "View / Respond to Funding Opportunity 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 Pre-application" from the dropdown.
- On the Submit Pre-application page, select the institution from which you are submitting this pre-application 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 pre-application; 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 pre-application. Save the pre-application for later work by clicking the "Save" button at the bottom of the screen. It will be stored in "My Pre-applications" for later editing.
- Enter a title for your pre-application.
- Select the appropriate technical contact from the Program Manager dropdown.
- To upload the pre-application 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.
- At the bottom of the screen, click the "Submit to DOE" button to save and submit the pre-application to DOE.
- Upon submission, the PI will receive an email from the PAMS system <PAMS.Autoreply@science.doe.gov> acknowledging receipt of the pre-application.

You are encouraged to register for an account in PAMS at least a week in advance of the pre-application 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 Funding Opportunity Announcement should reference **DE-FOA-0001043.**

Pre-applications submitted outside PAMS will not be considered. Pre-applications may not be submitted through grants.gov or www.FedConnect.net.

C. CONTENT AND APPLICATION FORMS

You must complete the mandatory forms and any applicable optional forms (e.g., Disclosure of Lobbying Activities (SF-LLL)) in accordance with the instructions on the forms and the additional instructions below. Files that are attached to the forms must be in Adobe Portable Document Format (PDF) unless otherwise specified in this announcement.

LETTERS

Letters of collaboration are encouraged for any unfunded participants. However, letters of support should not be included and will not be reviewed.

1. SF-424 (R&R)

Complete this form first to populate data in other forms. Complete all the required fields in accordance with the pop-up instructions on the form. The list of certifications and assurances referenced in Field 17 is available on the DOE Financial Assistance Forms Page at http://energy.gov/management/office-management/operational-management/financial-assistance/financial-assistance-forms under Certifications and Assurances.

CERTIFICATIONS AND REPRESENTATIONS

By submitting an application in response to this FOA the Applicant makes the following representations and certifications:
- It is **not** a corporation that has been convicted (or had an officer or agent of such corporation acting on behalf of the corporation convicted) of a felony criminal violation under **any** Federal law within the preceding 24 months.
- **No** officer or agent of the corporation have been convicted of a felony criminal violation for an offense arising out of actions for or on behalf of the corporation under Federal law in the past 24 months.
- It is **not** a corporation that has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.
- If chosen for a grant award in excess of $1,000,000, it will, by the end of the Federal Government's fiscal year, upgrade the efficiency of its facilities by replacing any incandescent lighting of the type for which section 325 of the Energy Policy and Conservation Act (42 USC 6295) establishes a standard that does not meet or exceed the energy efficiency standard for incandescent light bulbs set forth in that section with a lamp that meets or exceeds the standards for lamps established in or pursuant to that section.

PUBLIC POLICY REQUIREMENTS

The applicant assures DOE of its compliance with applicable public policy requirements, including the following:

Animal Welfare Act	7 USC 2131 et seq., 10 CFR 600, 10 CFR 602
Buy American Act	41 USC 10 et seq.
Cargo Preference Act	46 USC 55305, 46 CFR 381.7
Civil Rights Protections	10 CFR 1040, 10 CFR 600
Debarment and Suspension	10 CFR 600, 2 CFR 180, 2 CFR 901
Drug-Free Workplace Act	41 USC 701, 10 CFR 607
Environmental Protections	42 USC 7401, 33 USC 1251, 42 USC 4321, 10 CFR 600
False Claims Act	31 USC 3729, 18 USC 287, 18 USC 1001, 10 CFR 1013
Federal Funding Accountability and Transparency Act	P.L. 109-282, 2 CFR 170
Fly America Act	49 USC 40118
Hatch Act	5 USC 1501 et seq., 10 CFR 600
Human Research Subjects Protections	10 CFR 745, 10 CFR 600
Lobbying Disclosure Act	2 USC 1601 et seq.
Lobbying Prohibitions	31 USC 1352, 10 CFR 601
Metric System use	EO 12770
Non-delinquency on Federal Debt	28 USC 3201
Prohibition on benefitting Members of Congress	41 USC 6306
Seat Belt Use	EO 13043
Terrorist Financing	EO 13224, 66 FR 49079
Text Messaging While Driving	EO 13513, 74 FR 51225
Trafficking in Persons	22 USC 7104, 2 CFR 175

2. Research and Related Other Project Information

Complete questions 1 through 6 and attach files. The files must comply with the following instructions:

PROJECT SUMMARY/ABSTRACT (FIELD 7 ON THE FORM)

The project summary/abstract is a summary of the proposed activity suitable for distribution to the public and sufficient to permit potential reviewers to identify conflicts of interest. It must be a self-contained document. Provide the name of the applicant, the project title, the project director/principal investigator(s) (PD/PI) and the PD/PI's institutional affiliation, any co-investigators and their institutional affiliations, the objectives of the project, a description of the project, including methods to be employed, and the potential impact of the project (i.e., benefits, outcomes. A sample is provided below:

A Really Great Idea
A. Smith, Lead Institution (Principal Investigator)
A. Brown, Institution 2 (Co-Investigator)
A. Jones, Institution 3 (Co-Investigator)
Text of abstract

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. To attach a Project Summary/Abstract, click "Add Attachment."

- Do not include any proprietary or sensitive business information.
- DOE may use the abstract may to prepare public reports about supported research.

DOE COVER PAGE
(PART OF PROJECT NARRATIVE attached to FIELD 8 ON THE FORM)

The application 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:
- Funding Opportunity FOA Number: DE-FOA-0001043
- DOE/Office of Science Program Office:
- DOE/Office of Science Program Office Technical Contact:
- DOE Award Number (if Renewal Application):
- PAMS Pre-application tracking number (if applicable):
- Research themes identified in Section I of this FOA
- A copy of the budget summary table described in the budget section below:

COVER PAGE SUPPLEMENT FOR COLLABORATIONS
(PART OF PROJECT NARRATIVE attached to field 8 ON THE FORM)

Collaborative applications submitted from different institutions must clearly indicate they are part of a collaborative project/group. Every partner institution must submit an application through its own sponsored research office. Each application within the collaborative group, including the narrative and all required appendices and attachments, must be identical with one exception: The exception is that each application must contain unique budget and budget justification documents corresponding to the expenditures for that application's submitting institution only. Each collaborative group can have only one lead institution. The common narrative must identify the lead institution and must contain a summary table describing the budget breakdown by institution for all participants.

Each application belonging to a collaborative group should have the same title in Block 11 of the SF 424 (R&R) form.

The Office of Science will use the multiple applications associated with a collaborative group to create one consolidated document for merit review that consists of the common, identical application materials combined with a set of detailed budgets from the partner institutions. It is very important that every application in the collaborative group be identical (including the title) with the exception of the budget and budget justification pages.

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.

	Names	Institution	Collaborative Application Information				
			Fiscal Year 1 Budget	Fiscal Year 2 Budget	Fiscal Year 3 Budget	Fiscal Year 4 Budget	Total Budget
Lead PI							
Co-PI							
Co-PI							
		Total Budget per Fiscal Year					

Example budget table ($ in thousands)

* Note that collaborating applications must be submitted separately.

PROJECT NARRATIVE (FIELD 8 ON THE FORM)

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. This page limit does not apply to the Cover Page, Budget Page(s), Budget Justification, biographical material, publications and references, and appendices, each of which may have its own page limit.

Do not include any Internet addresses (URLs) that provide supplementary or additional information that constitutes a part of the application. Merit reviewers are not required to access Internet sites; however, Internet publications in a list of references will be treated identically to print publications. See Part VIII.D for instructions on how to mark proprietary application information. 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.

APPENDIX 1: BIOGRAPHICAL SKETCH

Provide a biographical sketch for the project director/principal investigator (PD/PI) and each senior/key person listed in Section A on the R&R 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 application. 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 application. 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). Also, list the names and current organizational affiliations of your graduate students and postdoctoral associates.

Personally Identifiable Information: Do not include sensitive personally identifiable information such as a Social Security Number, date of birth, or city of birth. Do not include information that a merit reviewer should not make use of.

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 applications. 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 an application 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. 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 application. 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 ATTACHMENT

If you need to elaborate on your responses to questions 1-6 on the "Other Project Information" document, please provide the Other Attachment information as an appendix to your project narrative. 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 application. Reviewers are not required to consider information in this appendix.

- Do not attach a separate file.
- This appendix will not count in the project narrative page limitation.
- **Do not attach any of the requested appendices described above as files for fields 9, 10, 11, and 12.**
- **Follow the above instructions to include the information as appendices to the project narrative file.**
- **These appendices will not count toward the project narrative's page limitation.**

3. Research And Related Budget

Complete the Research and Related Budget form in accordance with the instructions on the form (Activate Help Mode to see instructions) and the following instructions. You must complete a separate budget for each year of support requested. The form will generate a cumulative budget for the total project period. You must complete all the mandatory information on the form before the NEXT PERIOD button is activated. You may request funds under any of the categories listed as long as the item and amount are necessary to perform the proposed work, meet all the criteria for allowability under the applicable Federal cost principles, and are not prohibited by the funding restrictions in this FOA (See PART IV, G).

Budget Fields

Section A Senior/Key Person	For each Senior/Key Person, enter the requested information. List personnel, base salary, the number of months that person will be allocated to the project, requested salary fringe benefits, and the total funds requested for each person. The requested salary must be the product of the base salary and the effort. Include a written narrative in the budget justification that justifies the need for requested personnel.
Section B Other Personnel	List personnel, the number of months that person will be allocated to the project, requested salary fringe benefits, and the total funds requested for each person. Include a written narrative in the budget justification that fully justifies the need for requested personnel.
Section C Equipment	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 application 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. Do not aggregate items of equipment. Allowable items ordinarily will be limited to research equipment and apparatus not already available for the conduct of the work. General-purpose office equipment is not eligible for support unless primarily or exclusively used in the actual conduct of scientific research.
Section D Travel	For purposes of this section only, travel to Canada or to Mexico is considered domestic 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 the basis for the cost estimate (quotes from vendors or suppliers, past experience of similar items, or some other basis). 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. Domestic travel is to be justified separately from foreign travel.

	The travel budget should allow for the cost of attending an initial kickoff meeting and an annual PI meeting, as well as costs for coordination among collaborating institutions.
Section 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. Indicate the basis for the cost estimate (quotes from vendors or suppliers, past experience of similar items, or some other basis).
Section F Other Direct Costs	**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. Indicate the basis for the cost estimate (quotes from vendors or suppliers, past experience of similar items, or some other basis). **Publication Costs:** Enter the total publication funds requested. The application 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. Indicate the basis for the cost estimate (quotes from vendors or suppliers, past experience of similar items, or some other basis). **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. Indicate the basis for the cost estimate (quotes from vendors or suppliers, past experience of similar items, or some other basis). **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. Indicate the basis for the cost estimate (quotes from vendors or suppliers, past experience of similar items, or some other basis).

	• **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. Indicate the basis for the cost estimate (quotes from vendors or suppliers, past experience of similar items, or some other basis). • **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.
Section G Direct Costs	This represents Total Direct Costs (Sections A through F)
Section 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. Include the cognizant Federal agency and contact information if using a negotiated rate agreement.
Section I Total Direct and Indirect Costs	This is the total of Sections G and H

BUDGET JUSTIFICATION (FIELD K ON THE FORM)

Provide the required supporting information for the following costs (See R&R Budget instructions): equipment; domestic and foreign travel; participant/trainees; materials and supplies; publication; consultant services; ADP/computer services; subaward/consortium/contractual; equipment or facility rental/user fees; alterations and renovations; and indirect cost type. Provide any other information you wish to submit to justify your budget request. **Attach a single budget justification file for the entire project period in field K.** The file automatically carries over to each budget year.

4. R&R Subaward Budget Attachment(s) Form

Budgets for Subawardees, other than DOE FFRDC Contractors: You must provide a separate cumulative R&R budget for each subawardee that is expected to perform work estimated to be more than $100,000 or 50 percent of the total work effort (whichever is less). If you are selected for award, you must submit a multi-year budget for each of these subawardees (See Section IV.D for submission of Subawardees' multi-year budgets). Download the R&R Budget Attachment from the R&R SUBAWARD BUDGET ATTACHMENT(S) FORM and e-mail it to each subawardee that is required to submit a separate budget. After the subawardee has

e-mailed its completed budget back to you, attach it to one of the blocks provided on the form. Use up to 10 letters of the subawardee's name (plus.xfd) as the file name (e.g., ucla.xfd or energyres.xfd).

5. Project/Performance Site Location(s)

Indicate the primary site where the work will be performed. If a portion of the project will be performed at any other site(s), identify the site location(s) in the blocks provided.

Note that the Project/Performance Site Congressional District is entered in the format of the 2 digit state code followed by a dash and a 3 digit Congressional district code, for example VA-001. Hover over this field for additional instructions.

Use the Next Site button to expand the form to add additional Project/Performance Site Locations.

6. Summary of Required Forms/Files

Your application must include the following items:

Name of Document	Format	Attach to
SF 424 (R&R)	Form	N/A
RESEARCH AND RELATED Other Project Information	Form	N/A
Project Summary/Abstract	PDF	Field 7
Project Narrative, including required appendices	PDF	Field 8
RESEARCH & RELATED BUDGET	Form	N/A
Budget Justification	PDF	Field K
PROJECT/PERFORMANCE SITE LOCATION(S)	Form	N/A
SF-LLL Disclosure of Lobbying Activities, if applicable	Form	N/A

D. SUBMISSIONS FROM SUCCESSFUL APPLICANTS

If selected for award, DOE reserves the right to request additional or clarifying information for any reason deemed necessary, including, but not limited to:

- Indirect cost information
- Other budget information
- Name and phone number of the Designated Responsible Employee for complying with national policies prohibiting discrimination (See 10 CFR 1040.5)
- Representation of Limited Rights Data and Restricted Software, if applicable
- Commitment Letter from Third Parties Contributing to Cost Sharing, if applicable

E. SUBMISSION DATES AND TIMES

1. Letter of Intent Due Date

Not required.

2. Pre-application Due Date

February 7, 2014, by 5 PM Eastern Time

3. Application Due Date

April 2, 2014, by 5 PM Eastern Time

You are encouraged to transmit your application well before the deadline.

4. Late Submissions

Applications received after the deadline will not be reviewed or considered for award.

F. INTERGOVERNMENTAL REVIEW

This program is not subject to Executive Order 12372 Intergovernmental Review of Federal Programs.

G. FUNDING RESTRICTIONS

Funding for all awards and future budget periods are contingent upon the availability of funds appropriated by Congress for the purpose of this program and the availability of future-year budget authority.

Cost Principles: Costs must be allowable, allocable and reasonable in accordance with the applicable Federal cost principles referenced in 10 CFR 600. The cost principles for commercial organization are in FAR Part 31.

Pre-award Costs: Recipients may charge to an award resulting from this announcement pre-award costs that were incurred within the ninety (90) calendar day period immediately preceding the effective date of the award, if the costs are allowable in accordance with the applicable Federal cost principles referenced in 10 CFR 600 and 2 CFR 215. Recipients must obtain the prior approval of the contracting officer for any pre-award costs that are for periods greater than this 90 day calendar period.

Pre-award costs are incurred at the applicant's risk. DOE is under no obligation to reimburse such costs if for any reason the applicant does not receive an award or if the award is made for a lesser amount than the applicant expected.

H. OTHER SUBMISSION AND REGISTRATION REQUIREMENTS

1. Where to Submit

Applications must be submitted through grants.gov to be considered for award.

Submit electronic applications through the "Apply for Grants" function at www.Grants.gov. If you have problems completing the registration process or submitting your application, call Grants.gov at 1-800-518-4726 or send an email to support@grants.gov.

Please ensure that you have read the applicable instructions, guides, help notices, frequently asked questions, and other forms of technical support on grants.gov.

2. Registration Process

ONE-TIME REGISTRATION PROCESS

You must complete the one-time registration process (all steps) before you can submit your first application through Grants.gov (See http://www.grants.gov/web/grants/applicants/grant-application-process.html). We recommend that you start this process at least six weeks before the application due date. It may take 44 days or more to complete the entire process. Use the Grants.gov Organizational Registration Checklists at http://www.grants.gov/web/grants/applicants/organization-registration.html to guide you through the process. IMPORTANT: During the SAM registration process, you will be asked to designate an E-Business Point of Contact (EBIZ POC). The EBIZ POC must obtain a special password called "Marketing Partner Identification Number" (MPIN). When you have completed the process, you should call the Grants.gov Helpdesk at 1-800-518-4726 to verify that you have completed the final step (i.e., Grants.gov registration).3. Application Receipt Notices

After an application is submitted, the Authorized Organization Representative (AOR) will receive a series of four e-mails. It is extremely important that the AOR watch for and save each of the emails. It may take up to two (2) business days from application submission to receipt of email Number 2. The titles of the four e-mails are:

Number 1 - Grants.gov Submission Receipt Number
Number 2 - Grants.gov Submission Validation Receipt for Application Number
Number 3 - Grants.gov Grantor Agency Retrieval Receipt for Application Number
Number 4 - Grants.gov Agency Tracking Number Assignment for Application Number

4. Viewing Submitted Applications

Each Grants.gov application submitted to the DOE Office of Science (SC) automatically transfers into PAMS and is subsequently assigned to a program manager. At the time of program manager assignment, the three people listed on the SF-424 (R&R) cover page will receive an email with the subject line, "Receipt of Application 0000xxxxxx by the DOE Office of Science."

These three people are the Principal Investigator (Block 14), Authorized Representative (Block 19), and Point of Contact (Block 5). In PAMS notation, applications are known as proposals, the Principal Investigator is known as the PI, the Authorized Representative is known as the Sponsored Research Officer/Business Officer/Administrative Officer (SRO/BO/AO), and the Point of Contact is known as the POC.

There will be a period of time between the application's receipt at grants.gov and its assignment to a DOE Office of Science program manager. Program managers are typically assigned two weeks after applications are due at grants.gov: please refrain from attempting to view the proposal in PAMS until you receive an email providing the assignment of a program manager.

Once the email is sent, the PI, SRO/BO/PO, and POC will each be able to view the submitted proposal in PAMS. Viewing the proposal is optional.

You may use the Internet Explorer, Firefox, Google Chrome, or Safari browsers to access PAMS.

Following are two sets of instructions for viewing the submitted proposal, one for individuals who already have PAMS accounts and one for those who do not.

If you already have a PAMS account, follow these instructions:
1. Log in to PAMS at https://pamspublic.science.energy.gov/.
2. Click the "Proposals" tab and click "Access Previously Submitted Grants.gov Proposal."
3. Enter the following information:
   - Proposal ID: Enter the ten-digit PAMS proposal ID, including the leading zeros (e.g., 00002xxxxx). Do not use the Grants.gov proposal number. Use the PAMS number previously sent to you in the email with subject line, "Receipt of Proposal …".
   - Email (as entered in Grants.gov proposal): Enter your email address as it appears on the SF424(R&R) Cover Page.
   - Choose Role: Select the radio button in front of the role corresponding to the SF-424 (R&R) cover page. If your name appears in block 19 of the SF-424 (R&R) cover page as the authorizing representative, select "SRO/BO/AO (Sponsored Research Officer/Business Officer/Administrative Officer)." If your name appears in block 14 of the SF424 R&R cover page as the PI, select "Principal Investigator (PI)." If your name appears in block 5 of the SF424 R&R as the point of contact, select "Other (POC)."
4. Click the "Save and Continue" button. You will be taken to your "My Proposals" page. The Grants.gov proposal will now appear in your list of proposals. Click the "Actions/Views" link in the options column next to this proposal to obtain a dropdown list. Select "Proposal" from the dropdown to see the proposal. Note that the steps above will work only for proposals submitted to the DOE Office of Science since May 2012.

If you do not already have a PAMS account, follow these instructions:
1. To register, click the "Create New PAMS Account" link on the website https://pamspublic.science.energy.gov/.
2. Click the "No, I have never had an account" link and then the "Create Account" button.

3. 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.
4. 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.
5. 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.
6. You will be taken to the Register to Institution page. Select the link labeled, "Option 1: My institution has submitted a proposal in Grants.gov. I am here to register as an SRO, PI, or POC (Sponsored Research Officer, Principal Investigator, or Point of Contact)."
7. Enter the following information:
   - Proposal ID: Enter the ten-digit PAMS proposal ID, including the leading zeros (e.g., 00002xxxxx). Do not use the Grants.gov proposal number. Use the PAMS number previously sent to you in the email with subject line, "Receipt of Proposal …".
   - Email (as entered in Grants.gov proposal): Enter your email address as it appears on the SF424(R&R) Cover Page.
   - Choose Role: Select the radio button in front of the role corresponding to the SF-424 (R&R) cover page. If your name appears in block 19 of the SF-424 (R&R) cover page as the authorizing representative, select "SRO/BO/AO (Sponsored Research Officer/Business Officer/Administrative Officer)." If your name appears in block 14 of the SF424 R&R cover page as the PI, select "Principal Investigator (PI)." If your name appears in block 5 of the SF424 R&R as the point of contact, select "Other (POC)."
8. Click the "Save and Continue" button. You will be taken to your "My Proposals" page. The Grants.gov proposal will now appear in your list of proposals. Click the "Actions/Views" link in the options column next to this proposal to obtain a dropdown list. Select "Proposal" from the dropdown to see the proposal.

If you were listed as the PI on a prior submission but you have not previously created an account, you may already be listed in PAMS. If this is the case, you will be taken to the PAMS home page after agreeing to the Rules of Behavior. If that happens, follow the instructions listed above under "If you already have a PAMS account…" to access your Grants.gov proposal.

The steps above will work only for proposals submitted to the DOE Office of Science since May 2012.

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 Funding Opportunity Announcement should reference **DE-FOA-0001043.**

A. CRITERIA

1. Initial Review Criteria

Prior to a comprehensive merit evaluation, DOE will perform an initial review in accordance with 10 CFR 605.10(b) to determine that (1) the applicant is eligible for the award; (2) the information required by the FOA has been submitted; (3) all mandatory requirements are satisfied; (4) the proposed project is responsive to the objectives of the funding opportunity announcement, (5) the proposed project is not duplicative of programmatic work and (6) the proposed research is relevant to the mission of the Advanced Scientific Computing Research Program. Applications that fail to pass the initial review will not be forwarded for merit review and will be eliminated from further consideration.

2. Merit Review Criteria

Applications will be subjected to scientific merit review (peer review) and will be evaluated against the following criteria, listed in descending order of importance as found in 10 CFR 605.10 (d), the Office of Science Financial Assistance Program Rule.

- 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;
- Reasonableness and Appropriateness of the Proposed Budget; and
- Relevance to the mission of and systems operated by the Advanced Scientific Computing Research program.

The evaluation process will include program policy factors such as the relevance of the proposed research to the terms of the FOA 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 application constitutes agreement that this is acceptable to the investigator(s) and the submitting institution.

    1. **SCIENTIFIC AND/OR TECHNICAL MERIT OF THE PROPOSED RESEARCH**

What is the scientific innovation of proposed effort? What is the likelihood of achieving valuable results? How might the results of the proposed research impact the direction, progress, and thinking in relevant scientific fields of research? How does the proposed research compare with other research in its field, both in terms of scientific and/or technical merit and originality?

    1.1 Briefly summarize the proposal technical content in your own words.
    1.2 What are the strengths and weaknesses of the proposed research with respect to each of the themes in the call for proposals that are addressed in the proposal?
    1.3 Evaluate the overall responsiveness of the proposed research to the call for

proposals and the potential of the proposed research to have a significant impact on scientific data management, analysis and visualization on extreme scale platforms. If successful, to what degree is the proposed research likely to improve the ability of scientists to manage, analyze and understand their data and increase the pace of scientific discovery?

2. **APPROPRIATENESS OF THE PROPOSED METHOD OR APPROACH**

How logical and feasible are the research approaches? Does the proposed research employ innovative concepts or methods? Are the conceptual framework, methods, and analyses well justified, adequately developed, and likely to lead to scientifically valid conclusions? Does the applicant recognize significant potential problems and consider alternative strategies?

2.1 Evaluate the plan for conducting the research. Is there a clear and coherent plan for the proposed research so that it is an integrated endeavor? Is there strong enough leadership, communication and coordination? Does the proposal include a clear plan for deliverables, a reasonable timeline, and sound methods for assessing the effectiveness of the research?
2.2 What is the proposed plan for sharing the results of the proposed research and making available under open source license any software that is developed? Is the plan appropriate and credible?

3. **COMPETENCY OF APPLICANT'S PERSONNEL AND ADEQUACY OF PROPOSED RESOURCES**

What are the past performance and the potential of the Principal Investigator (PI)? How well qualified is the research team to carry out the proposed research? Is the number of personnel appropriate and sufficient to conduct the proposed research? Are the research environment and facilities adequate for performing the research? Does the proposed work take advantage of unique facilities and capabilities? What is the past performance of the team?

4. **REASONABLENESS AND APPROPRIATENESS OF THE PROPOSED BUDGET**

Are the proposed budget and staffing levels adequate to carry out the proposed work? Is the budget reasonable and appropriate for the scope?

4.1 Are the levels of support and commitment requested by the PI and other senior personnel appropriate and necessary to meet the research objectives?
4.2 Is the proposed budget for travel reasonable and appropriate for the number of people supported and the level of coordination that is necessary for the project to succeed?

5. RELEVANCE TO THE MISSION OF AND SYSTEMS OPERATED BY THE ADVANCED SCIENTIFIC COMPUTING RESEARCH PROGRAM

Does the proposal reflect awareness and understanding of Office of Science and ASCR mission drivers and constraints? How important is the proposed research to fulfilling these missions?

B. REVIEW AND SELECTION PROCESS

1. Merit Review

Applications that pass the initial review will be subjected to a formal merit review and will be evaluated based on the criteria 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. The additional review criteria described above will also apply.

2. Selection

The Selection Officials will consider the following items, listed in no order of significance:
- Scientific and technical merit of the proposed activity as determined by merit review
- Availability of funds
- Relevance of the proposed activity to Office of Science priorities
- Ensuring an appropriate balance of activities within Office of Science programs
- Previous performance
- Relevance to the mission of and systems operated by the Advanced Scientific Computing Research program.

3. Discussions and Award

The Government may enter into discussions with a selected applicant for any reason deemed necessary, including but not limited to the following: (1) the budget is not appropriate or reasonable for the requirement; (2) only a portion of the application is selected for award; (3) the Government needs additional information to determine that the recipient is capable of complying with the requirements in 10 CFR 600 and 10 CFR 605; and/or (4) special terms and conditions are required. Failure to resolve satisfactorily the issues identified by the Government will preclude award to the applicant.

C. ANTICIPATED NOTICE OF SELECTION AND AWARD DATES

It is anticipated that the award selection will be completed in April 2014. It is expected that awards will be made in Fiscal Year 2014 and possibly Fiscal Year 2015, depending on the availability of funds.

DOE is interested in seeing projects supported under this Announcement begin work by September 1, 2014, for awards made in Fiscal Year 2014.

Section VI - AWARD ADMINISTRATION INFORMATION

A. AWARD NOTICES

1. Notice of Selection

Selected Applicants Notification: DOE will notify applicants selected for award. This notice of selection is not an authorization to begin performance. (See Part IV.G with respect to the allowability of pre-award costs.)

Non-selected Notification: Organizations whose applications have not been selected will be advised as promptly as possible. This notice will explain why the application was not selected.

2. Notice of Award

An Assistance Agreement issued by the contracting officer is the authorizing award document. It normally includes, either as an attachment or by reference, the following items: (1) Special Terms and Conditions; (2) Applicable program regulations, if any; (3) Application as approved by DOE; (4) DOE assistance regulations at 10 CFR 600, or, for Federal Demonstration Partnership (FDP) institutions, the FDP terms and conditions; (5) National Policy Assurances To Be Incorporated As Award Terms; (6) Budget Summary; and (7) Federal Assistance Reporting Checklist, which identifies the reporting requirements.

B. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS

1. Administrative Requirements

The administrative requirements for DOE grants and cooperative agreements are contained in 10 CFR 600 and 10 CFR 605. Grants and cooperative agreements made to universities, non-profits and other entities subject to 2 CFR 215 are subject to the Research Terms and Conditions located on the National Science Foundation web site at http://www.nsf.gov/bfa/dias/policy/rtc/index.jsp .

REGISTRATION REQUIREMENTS

Additional administrative requirements for DOE grants and cooperative agreements are contained in 2 CFR 25 (See: http://www.ecfr.gov). Prime awardees must keep their data at the System for Award Management (SAM) current at http://www.sam.gov. SAM is the government-wide system that replaced the Central Contractor Registry (CCR). If you had an active registration in the CCR, you have an active registration in SAM. Subawardees at all tiers must obtain DUNS numbers and provide the DUNS to the prime awardee before the subaward can be issued.

Additional administrative requirements necessary for DOE grants and cooperative agreements to comply with the Federal Funding and Transparency Act of 2006 (FFATA) are contained in 2 CFR 170. (See: http://www.ecfr.gov). Prime awardees must register with the new FSRS database and report the required data on their first tier subawardees. Prime awardees must report the executive compensation for their own executives as part of their registration profile in the System for Award Management (SAM).

PROHIBITION ON LOBBYING ACTIVITY

By accepting funds under this award, you agree that none of the funds obligated on the award shall be expended, directly or indirectly, to influence congressional action on any legislation or appropriation matters pending before Congress, other than to communicate to Members of Congress as described in 18 USC 1913. This restriction is in addition to those prescribed elsewhere in statute and regulation.

2. Terms and Conditions

The DOE Special Terms and Conditions for Use in Most Grants and Cooperative Agreements are located at http://energy.gov/management/office-management/operational-management/financial-assistance/financial-assistance-forms under Award Terms.

The standard DOE financial assistance intellectual property provisions applicable to various types of recipients are located at:
http://energy.gov/gc/standard-intellectual-property-ip-provisions-financial-assistance-awards

3. National Policy Assurances

The National Policy Assurances To Be Incorporated As Award Terms are located at http://www.nsf.gov/bfa/dias/policy/rtc/appc.pdf and at http://energy.gov/management/office-management/operational-management/financial-assistance/financial-assistance-forms under Award Terms.

4. Statement of Substantial Involvement

Cooperative agreements may be awarded under this FOA. The DOE Contract Specialist and DOE Project Officer will negotiate a Statement of Substantial Involvement prior to award.

C. REPORTING

Reporting requirements are identified on the Federal Assistance Reporting Checklist, DOE F 4600.2, attached to the award agreement. The checklist is available at http://energy.gov/management/office-management/operational-management/financial-assistance/financial-assistance-forms under Award Forms.

Section VII - QUESTIONS/AGENCY CONTACTS

A. QUESTIONS

Questions relating to the grants.gov registration process, system requirements, how an application form works, or the submittal process must be directed to Grants.gov at 1-800-518-4726 or support@grants.gov. DOE cannot answer these questions.
      Please only contact the grants.gov help desk for questions related to grants.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, 9AM – 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 Funding Opportunity Announcement should reference **DE-FOA-0001043.**
      Please contact the PAMS help desk for technological issues with the PAMS system.

Questions regarding the specific program areas and technical requirements may be directed to the technical contacts listed for each program within the FOA or below.
      Please contact the program staff with all questions not directly related to the grants.gov or PAMS systems.

B. AGENCY CONTACTS

Grants.gov Customer Support	800-518-4726 (toll-free) support@grants.gov
PAMS Customer Support	855-818-1846 (toll-free) 301-903-9610 sc.pams-helpdesk@science.doe.gov
Program Manager Scientific Contact	**Lucy Nowell, Ph.D.** **301-903-3191** **Lucy.Nowell@science.doe.gov**

<center>**Section VIII - OTHER INFORMATION**</center>

A. MODIFICATIONS

Notices of any modifications to this FOA will be posted on Grants.gov and the FedConnect portal. You can receive an email when a modification or an FOA message is posted by registering with FedConnect as an interested party for this FOA. It is recommended that you register as soon after release of the FOA as possible to ensure you receive timely notice of any modifications or other FOAs. More information is available at http://www.fedconnect.net.

B. GOVERNMENT RIGHT TO REJECT OR NEGOTIATE

DOE reserves the right, without qualification, to reject any or all applications received in response to this FOA and to select any application, in whole or in part, as a basis for negotiation and/or award.

C. COMMITMENT OF PUBLIC FUNDS

The Contracting Officer is the only individual who can make awards or commit the Government to the expenditure of public funds. A commitment by other than the Contracting Officer, either explicit or implied, is invalid.

D. PROPRIETARY APPLICATION INFORMATION

Patentable ideas, trade secrets, proprietary or confidential commercial or financial information, disclosure of which may harm the applicant, should be included in an application only when such information is necessary to convey an understanding of the proposed project. The use and disclosure of such data may be restricted, provided the applicant includes the following legend on the first page of the project narrative and specifies the pages of the application which are to be restricted:

"The data contained in pages _____ of this application have been submitted in confidence and contain trade secrets or proprietary information, and such data shall be used or disclosed only for evaluation purposes, provided that if this applicant receives an award as a result of or in connection with the submission of this application, DOE shall have the right to use or disclose the data herein to the extent provided in the award. This restriction does not limit the government's right to use or disclose data obtained without restriction from any source, including the applicant."

To protect such data, each line or paragraph on the pages containing such data must be specifically identified and marked with a legend similar to the following:

"The following contains proprietary information that (name of applicant) requests not be released to persons outside the Government, except for purposes of review and evaluation."

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E. EVALUATION AND ADMINISTRATION BY NON-FEDERAL PERSONNEL

In conducting the merit review evaluation, the Government may seek the advice of qualified non-Federal personnel as reviewers. The Government may also use non-Federal personnel to conduct routine, nondiscretionary administrative activities. The applicant, by submitting its application, consents to the use of non-Federal reviewers/administrators. Non-Federal reviewers must sign conflict of interest and non-disclosure agreements prior to reviewing an application. Non-Federal personnel conducting administrative activities must sign a non-disclosure agreement.

F. INTELLECTUAL PROPERTY DEVELOPED UNDER THIS PROGRAM

Patent Rights: The government will have certain statutory rights in an invention that is conceived or first actually reduced to practice under a DOE award. 42 USC 5908 provides that title to such inventions vests in the United States, except where 35 USC 202 provides otherwise for nonprofit organizations or small business firms. However, the Secretary of Energy may waive all or any part of the rights of the United States subject to certain conditions. (See "Notice of Right to Request Patent Waiver" in paragraph G below.)

Rights in Technical Data: Normally, the government has unlimited rights in technical data created under a DOE agreement. Delivery or third party licensing of proprietary software or data developed solely at private expense will not normally be required except as specifically negotiated in a particular agreement to satisfy DOE's own needs or to insure the commercialization of technology developed under a DOE agreement.

G. NOTICE OF RIGHT TO REQUEST PATENT WAIVER

Applicants may request a waiver of all or any part of the rights of the United States in inventions conceived or first actually reduced to practice in performance of an agreement as a result of this FOA, in advance of or within 30 days after the effective date of the award. Even if such advance waiver is not requested or the request is denied, the recipient will have a continuing right under the award to request a waiver of the rights of the United States in identified inventions, i.e., individual inventions conceived or first actually reduced to practice in performance of the award. Any patent waiver that may be granted is subject to certain terms and conditions in 10 CFR 784. For more information, see http://energy.gov/gc/patents-licensing-and-patent-waivers.

Domestic small businesses and domestic nonprofit organizations will receive the patent rights clause at 37 CFR 401.14, i.e., the implementation of the Bayh-Dole Act. This clause permits domestic small business and domestic nonprofit organizations to retain title to subject inventions. Therefore, small businesses and nonprofit organizations do not need to request a waiver.

H. NOTICE REGARDING ELIGIBLE/INELIGIBLE ACTIVITIES

Eligible activities under this program include those which describe and promote the understanding of scientific and technical aspects of specific energy technologies, but not those which encourage or support political activities such as the collection and dissemination of information related to potential, planned or pending legislation.

I. 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.