FINANCIAL ASSISTANCE
FUNDING OPPORTUNITY ANNOUNCEMENT

U. S. Department of Energy
Office of Science

FY 2017 Continuation of Solicitation for the Office of Science Financial Assistance Program

Funding Opportunity Number: DE-FOA-0001664
Announcement Type: Amendment 000005
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Issue Date:	**09/30/2016**
Pre-Application Due Date:	**Optional**
Application Due Date:	**Not Applicable**

AMENDMENT 5: This amendment will change the end date to March 23, 2018

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UPDATES AND REMINDERS

GRANTS.GOV WORKSPACE

Applications submitted through Grants.gov at https://www.Grants.gov may make use of the new online collaborative tool called "Workspace" to permit teams to simultaneously work on their application. For each funding opportunity announcement (FOA), you can create individual instances of a workspace.

Below is an overview of applying on Grants.gov. For access to complete instructions on how to apply for opportunities, refer to:

https://www.grants.gov/web/grants/applicants/apply-for-grants.html

1) Create a Workspace: Creating a workspace allows you to complete it online and route it through your organization for review before submitting.

2) Complete a Workspace: Add participants to the workspace, complete all the required forms, and check for errors before submission.

a. Adobe Reader: If you decide not to apply by filling out webforms you can download individual PDF forms in Workspace so that they will appear similar to other Standard forms. The individual PDF forms can be downloaded and saved to your local device storage, network drive(s), or external drives, then accessed through Adobe Reader.

NOTE: Visit the Adobe Software Compatibility page on Grants.gov to download the appropriate version of the software at: https://www.grants.gov/web/grants/applicants/adobe-software-compatibility.html

b. Mandatory Fields in Forms: In the forms, you will note fields marked with an asterisk and a different background color. These fields are mandatory fields that must be completed to successfully submit your application.

c. Complete SF-424 Fields First: The forms are designed to fill in common required fields across other forms, such as the applicant name, address, and DUNS number. To trigger this feature, an applicant must complete the SF-424 information first. Once it is completed, the information will transfer to the other forms.

3) Submit a Workspace: An application may be submitted through workspace by clicking the Sign and Submit button on the Manage Workspace page, under the Forms tab. Grants.gov recommends submitting your application package at least 24-48 hours prior to the close date to provide you with time to correct any potential technical issues that may disrupt the application submission.

4) Track a Workspace: After successfully submitting a workspace package, a Grants.gov Tracking Number (GRANTXXXXXXXX) is automatically assigned to the package. The number

will be listed on the Confirmation page that is generated after submission.

GRANTS.GOV APPLICATION FORMS

This amendment uses a new package of application forms that are compatible with Grants.gov's Workspace function. Application packages that were downloaded prior to this amendment's publication on December 8, 2017, must be submitted before March 31, 2018.

REGULATIONS

This Funding Opportunity Announcement (FOA) and any awards made under it are controlled by 2 CFR 200, the Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards, as modified by 2 CFR 910, the Department of Energy Financial Assistance Rules, and 10 CFR 605, the Office of Science Financial Assistance Program.

RENEWAL APPLICATIONS

The Principal Investigator for any application submitted for a renewal (an addition of a project period) of an existing award will be required to submit a Renewal Proposal Products section through the Office of Science's PAMS website at https://pamspublic.science.energy.gov. The submitted product list will be sent for merit review as part of the application. The application will not be considered complete and cannot be sent for review until the product list has been submitted.

DATA MANAGEMENT PLAN

The Office of Science has published a new Statement on Digital Data Management, published at http://science.energy.gov/funding-opportunities/digital-data-management/, which governs applications submitted under this FOA, and is detailed in Part IV of this FOA.

ACKNOWLEDGMENT OF FEDERAL SUPPORT

The Office of Science published guidance about how its support should be acknowledged at http://science.energy.gov/funding-opportunities/acknowledgements/.

REPORTING

The Office of Science has implemented the federal-wide Research Performance Progress Report (RPPR) through the Portfolio Analysis and Management System (PAMS). The common RPPR format is described at http://www.nsf.gov/bfa/dias/policy/rppr/. Progress Reports are generally due 90 days before the end of each budget period. The Principal Investigator (PI) will receive an automated email from PAMS (<PAMS.Autoreply@science.doe.gov>) thirty days prior to the progress report due date. Some information will be prepopulated. Additional details and changes will be contained in the Reporting Requirements Checklist attached to the Assistance Agreement.

AVOIDING ERRORS

The following advice is compiled from the experiences of applicants for Office of Science financial assistance awards.

- Please ensure that the research narrative is comprised of one and only one PDF file, including all appendices, when it is attached to the SF-424(R&R) form.
- Please ensure that the application contains no sensitive and protected personally identifiable information (PII).
- Please ensure that the budget is calculated using the applicable negotiated indirect cost and fringe benefit rates.

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 well before the deadline.

GRANTS.GOV UPDATE

Grants.gov is upgrading its security features to require secure connections via https://www.Grants.gov rather than using http://www.Grants.gov. The secure connection is expected to be available after February 18, 2017, and to become mandatory on April 15, 2017.

Section I – FUNDING OPPORTUNITY DESCRIPTION

GENERAL INQUIRIES ABOUT THIS FOA SHOULD BE DIRECTED TO:

Technical/Scientific Program Contact: Questions regarding the program technical requirements must be directed to the point of contact listed for each program area within this FOA.

STATUTORY AUTHORITY

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

APPLICABLE REGULATIONS

Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards, codified at 2 CFR 200
U.S. Department of Energy Financial Assistance Rules, codified at 2 CFR 910
U.S. Department of Energy, Office of Science Financial Assistance Program Rule, codified at 10 CFR 605

SUMMARY

The Office of Science (SC) of the Department of Energy hereby announces its continuing interest in receiving grant applications for support of work in the following program areas: Advanced Scientific Computing Research, Basic Energy Sciences, Biological and Environmental Research, Fusion Energy Sciences, High Energy Physics, and Nuclear Physics. On September 3, 1992, DOE published in the Federal Register the Office of Energy Research Financial Assistance Program (now called the Office of Science Financial Assistance Program), 10 CFR 605, as a Final Rule, which contained a solicitation for this program. Information about submission of applications, eligibility, limitations, evaluation and selection processes and other policies and procedures are specified in 10 CFR 605.

This FOA DE-FOA-0001664 is our annual, broad, open solicitation that covers all of the research areas in the Office of Science and is open throughout the Fiscal Year.

This FOA will remain open until March 23, 2018, 11:59 PM Eastern Time, or until it is succeeded by another issuance, whichever occurs first. This annual FOA DE-FOA-0001664 succeeds FOA DE-FOA-0001414, which was published October 1, 2015.

SUPPLEMENTARY INFORMATION

The Office of Science's (SC) mission is to deliver scientific discoveries and major scientific tools to transform our understanding of nature and advance the energy, economic, and national security of the United States. SC is the Nation's largest Federal sponsor of basic research in the physical sciences and the lead Federal agency supporting fundamental scientific research for our Nation's energy future.

The Office of Science accomplishes its mission and advances national goals by supporting:

- The frontiers of science—discovering nature's mysteries from the study of fundamental subatomic particles, atoms, and molecules that are the building blocks of the materials of our universe and everything in it to the DNA, proteins, and cells that are the building blocks of life. Each of the programs in the SC supports research probing the most fundamental disciplinary questions.

- The 21st Century tools of science—providing the Nation's researchers with 27 state-of-the-art national scientific user facilities, the most advanced tools of modern science propelling the U.S. to the forefront of science, technology development and deployment through innovation.

- Science for energy and the environment—advancing a clean energy agenda through fundamental research on energy production, conversion, storage, transmission, and use by advancing our understanding of the earth and its climate. Targeted investments include three DOE Bioenergy Research Centers (BRCs), the Energy Frontier Research Centers (EFRCs), two Energy Innovation Hubs, and atmospheric process and climate modeling research.

The Office of Science manages its research portfolio through six scientific program offices. The following program descriptions, websites, and technical points of contact are offered to provide more in-depth information on scientific and technical areas of interest to the Office of Science:

1. Advanced Scientific Computing Research (ASCR)
(a) Applied Mathematics
(b) Computer Science
(c) Computational Partnerships
(d) Network Environment Research

2. Basic Energy Sciences (BES)
(a) Materials Chemistry
(b) Biomolecular Materials
(c) Synthesis and Processing Science
(d) Experimental Condensed Matter Physics
(e) Theoretical Condensed Matter Physics
(f) Physical Behavior of Materials
(g) Mechanical Behavior and Radiation Effects

(h) X-ray Scattering
(i) Neutron Scattering
(j) Electron and Scanning Probe Microscopies
(k) Atomic, Molecular, and Optical Sciences
(l) Gas Phase Chemical Physics
(m) Computation and Theoretical Chemistry
(n) Condensed Phase and Interfacial Molecular Science
(o) Catalysis Science
(p) Separations and Analysis
(q) Heavy Element Chemistry
(r) Geosciences
(s) Solar Photochemistry
(t) Photosynthetic Systems
(u) Physical Biosciences
(v) BES Accelerator and Detector Research

3. Biological and Environmental Research (BER)
(a) Biological Systems Science
(b) Climate and Environmental Sciences

4. Fusion Energy Sciences (FES)
(a) Burning Plasma Science: Foundations—Advanced Tokamak and Spherical Tokamak
(b) Burning Plasma Science: Foundations—Theory & Simulation
(c) Burning Plasma Science: Long Pulse—Tokamak & Stellarator
(d) Burning Plasma Science: Long Pulse—Materials & Fusion Nuclear Science
(e) Discovery Plasma Science: Plasma Science Frontiers
(f) Discovery Plasma Science: Measurement Innovation

5. High Energy Physics (HEP)
(a) Experimental Research at the Energy Frontier in High Energy Physics
(b) Experimental Research at the Intensity Frontier in High Energy Physics
(c) Experimental Research at the Cosmic Frontier in High Energy Physics
(d) Theoretical Research in High Energy Physics
(e) Computational Research in High Energy Physics
(f) Accelerator Science and Technology Research & Development in High Energy Physics
(g) Detector Research and Development in High Energy Physics

6. Nuclear Physics (NP)
(a) Medium Energy Nuclear Physics
(b) Heavy Ion Nuclear Physics
(c) Low Energy Nuclear Physics
(d) Fundamental Symmetries
(e) Nuclear Theory
(f) Nuclear Data and Nuclear Theory Computing
(g) Isotope Development and Production for Research and Applications
(h) Accelerator Research and Development for Current and Future Nuclear Physics Facilities

1. Advanced Scientific Computing Research (ASCR)
Program Website: http://science.energy.gov/ascr/

The mission of the Advanced Scientific Computing Research (ASCR) program is to advance applied mathematics and computer science; deliver the most advanced computational scientific applications in partnership with disciplinary science; advance computing and networking capabilities; and develop future generations of computing hardware and software tools for science, in partnership with the research community, including U.S. industry. The strategy to accomplish this has two thrusts: developing and maintaining world-class computing and network facilities for science; and advancing research in applied mathematics, computer science and advanced networking.

The priority areas for ASCR include the following:

- Develop mathematical models, methods and algorithms to accurately describe and predict the behavior of complex systems involving processes that span vastly different time and/or length scales.
- Advance key areas of computer science that:
  - Enable the design and development of extreme scale computing systems and their effective use in the path to scientific discoveries; and
  - Transform extreme scale data from experiments and simulations into scientific insight.
- Advance key areas of computational science and discovery that support the missions of the Office of Science through mutually beneficial partnerships.
- Develop and deliver forefront computational, networking and collaboration tools and facilities that enable scientists worldwide to work together to extend the frontiers of science.

The computing resources and high-speed networks required to meet Office of Science needs exceed the state-of- the-art by a significant margin. Furthermore, the system software, algorithms, software tools and libraries, programming models and the distributed software environments needed to accelerate scientific discovery through modeling and simulation are beyond the realm of commercial interest. To establish and maintain DOE's modeling and simulation leadership in scientific areas that are important to its mission, ASCR operates Leadership Computing facilities, a high-performance production computing center, and a high-speed network, implementing a broad base research portfolio in applied mathematics, computer science, computational science and network research to solve complex problems on computational resources that are on a trajectory to reach exascale within a few years.

The ASCR subprograms and their objectives follow:

(a) Applied Mathematics

This subprogram supports research and development of applied mathematical models, methods, and algorithms for understanding complex natural and engineered systems related to DOE's mission. Important areas of supported research include: (1) novel numerical methods for the scalable solution of large-scale, linear and nonlinear systems of equations, including those solution methods that take into consideration the possibilities brought about by future HPC architectures; (2) optimization techniques and next-generation solvers; (3) numerical methods for modeling multiscale, multi-physics or multi-component continuous or discrete systems that span a wide range of time and length scales; (4) methods of simulation and analysis of systems that account for the uncertainties of the systems, or are inherently stochastic or uncertain; and (5) innovative approaches for analyzing and extracting insight from large-scale data sets. Submission of preliminary research descriptions (e.g., preproposals, preapplications) is strongly encouraged. They will be reviewed for responsiveness of the proposed work to the research topics. Send e-mail to the Subprogram Contact for information regarding format and content.

Subprogram Contact: Steven Lee, (301) 903-5710, Steven.Lee@science.doe.gov
Website: http://science.energy.gov/ascr/research/applied-mathematics/

(b) Computer Science

This subprogram supports basic research to utilize computing at extreme scales and to understand extreme scale data from both simulations and experiments. It also supports research in computer science that enables scientific applications and data-driven computational science through advances in petascale and future exascale computing systems.

In the context of ASCR-supported high performance computing environments, research topics of interest are:

- Data analysis and visualization: visual analytic techniques for comparative and/or integrated analysis of two or more data sets; visual analytic approaches to understanding the state and behavior of a supercomputing system at scale; visual analysis of uncertainty and the sources thereof.
- Knowledge representation and machine learning for analysis of extreme scale scientific data from simulations and/or experiments.
- Storage system software and/or scientific databases for extreme scale data that support scientists' models of their data and the use thereof.
- Automated methods for optimizing mappings and transformations of algorithms, libraries, and applications expressed in a high level abstraction or language into platform independent implementations.
- New functional or declarative programming paradigms to deal with asynchronous communications, fine-grained nested parallelism, irregular data and computations, memory locality, placement, synchronization, scheduling, power, and resilience challenges of exascale computing.

- Theories, services, and tools needed to create productive software development and execution environments.
- Neuromorphic Computing and/or Quantum Computing: research focused on information processing and computation systems beyond von Neumann/Turing architectures and Moore's Law Limits, including hardware architectures, development of programming environments, languages, libraries, compilers, simulators, and research and development on their algorithms for physical simulation.
- Cybersecurity for scientific computing integrity: research on security techniques appropriate for open scientific environments, with a focus on ensuring scientific integrity in the context of extreme scale high performance computing and to deliver means that assure trustworthiness within open high-end networking and data centers.

Topics that are out of scope for Computer Science include:

- Proposals with primary emphasis on hardware design, resilient solvers, and/or new development of machine probabilistic methods and their mathematical formalisms;
- All aspects of networking, computer-supported collaboration, social computing, natural language processing / understanding / generation and/or analysis, and generalized research in human-computer interaction;
- Discipline-specific data analytics and informatics;
- Research focused on the World Wide Web and/or Internet and/or data about them;
- Research that is primarily applicable to hand-held, portable, desktop, embedded or cloud computing; and
- Research and applications not motivated and justified in the context of current and future Office of Science user facilities, including those supported by ASCR (i.e., Argonne Leadership Computing Facility or ALCF, Oak Ridge Leadership Computing Facility or OLCF, and National Energy Research Scientific Computing Center or NERSC): http://science.energy.gov/ascr/facilities/

Subprogram Contacts: Lucy Nowell, (301) 903-3191, Lucy.Nowell@science.doe.gov; Sonia R. McCarthy, (301) 903-0060, Sonia.Sachs@science.doe.gov; and Robinson Pino, (301) 903-1263, Robinson.Pino@science.doe.gov
Website: http://science.energy.gov/ascr/research/computer-science/

(c) Computational Partnerships

This subprogram supports research in pioneering science applications for the next generation of high-performance computing. It also supports research that incorporates and integrates applied mathematics, computer science, and computational sciences, and enables scientists to exploit effectively extreme scale computers in their pursuit of transformational scientific discovery through simulation and modeling. In order to advance science relevant to the DOE mission, it is expected that the research will utilize or lead to partnerships with SC, National Nuclear Security Administration (NNSA), or other DOE programs. For examples of computational partnerships, refer to the website http://www.scidac.gov. For examples of extreme scale computing systems, refer to the website:

http://science.energy.gov/~/media/ascr/pdf/facilities/ASCR_Computiing_Facility_Upgrades.pdf.

Subprogram Contacts: Randall Laviolette, (301) 903-5195, Randall.Laviolette@science.doe.gov; Steven Lee, (301) 903-5710, Steven.Lee@science.doe.gov; and Ceren Susut, (301)903-0366, Ceren.Susut-Bennett@science.doe.gov
Website: http://science.energy.gov/ascr/research/scidac/

(d) Network Environment Research

This subprogram supports basic research to enable scientists, individually or in teams, to easily find and access the unique scientific facilities and data, and to interact with peers or facilities staff involved in a scientific discovery process. Research topics of interest include: (1) software defined network control plane algorithms and mechanisms needed to build and operate future end-to-end terabit rate networks; (2) data management algorithms, tools, and services needed to support distributed science activities; (3) theories, algorithms, tools, and services needed to create diverse computing environments where multiple resources can be combined in unique ways to suit the needs of the science community; (4) mechanisms and theories needed to support distributed data intensive scientific discovery; (5) mechanisms and theories to enable scientists to interact with their peers and technical staff that operate a scientific facility; (6) analytical models and simulation environments needed to understand how distributed applications behave in network infrastructures; and (7) tools and services needed to support physical experiments in testbeds and production networks.

Subprogram Contacts: Richard Carlson, (301) 903-9486, Richard.Carlson@science.doe.gov; and Thomas Ndousse-Fetter, (301) 903-9960, Thomas.Ndousse-Fetter@science.doe.gov
Website: http://science.energy.gov/ascr/research/next-generation-networking/

Proposed research may include one or more of the areas listed above.

2. Basic Energy Sciences (BES)
Program Website: http://science.energy.gov/bes/

The mission of the Basic Energy Sciences (BES) program is to support fundamental research to understand, predict, and ultimately control matter and energy at the electronic, atomic, and molecular levels in order to provide the foundations for new energy technologies and to support DOE missions in energy, environment, and national security. The portfolio supports work in the natural sciences by emphasizing fundamental research in materials sciences, chemistry, geosciences, and biosciences. BES-supported scientific user facilities provide specialized instrumentation and expertise that enable scientists to carry out experiments not possible at individual laboratories.

The BES divisions, program areas, and their objectives follow:

Materials Sciences and Engineering

The Materials Sciences and Engineering (MSE) Division supports fundamental experimental and theoretical research to provide the knowledge base for the discovery and design of new materials with novel structures, functions, and properties. This knowledge serves as a basis for the development of new materials for the generation, storage, and use of energy and for mitigation of the environmental impacts of energy use. The MSE research portfolio consists of the research program areas listed below.

MSE Division Website: http://science.energy.gov/bes/mse/

(a) Materials Chemistry

This program supports research on materials with a focus on the role of chemical reactivity, chemical transformation, and chemical dynamics on the material composition, structure, function, and lifetime across the range of length scales from atomic to mesoscopic. The overarching goals of materials chemistry research are to elucidate fundamental chemical aspects of materials' composition-structure-property relationships and to provide the *knowledge* needed to design and produce materials with tailored properties from first principles. Emphasis is on hypothesis-driven research on the chemistry-based synthesis of materials and/or morphologies that have the potential to enable next-generation energy-relevant technologies and on the chemical transformations that occur in functional materials in operating environments. Included are the study of chemical processes that direct and control the covalent and non-covalent assembly of materials, the discovery of the mechanistic detail of chemical transformations and dynamics, and the utilization of chemistry to control interfacial properties and interactions of materials. New approaches involving the integration of theory and experiment will also be supported.

Major scientific areas of interest include: Fundamental aspects of the chemical assembly of material structures and control of multi-scale material morphology; Synthesis and characterization of new classes of organic, inorganic, polymeric and composite materials (crystalline and non-crystalline) with novel functionality; Control of surface and interfacial chemistry and morphology; Fundamental electrochemistry of solid state materials; Chemical dynamics and transformations of functional materials in operational environments; and Development of new, science-driven laboratory-based analytical tools and techniques for the elucidation of chemical processes in materials, particularly *in situ* or *in operando* in energy-relevant applications.

Research primarily aimed at the *optimization* of synthetic methods or properties of materials for applications, and research with a primary goal of device fabrication and testing will not be supported.

Subprogram Contacts: Michael Sennett, (301) 903-6051, michael.sennett@science.doe.gov; and Craig Henderson, (301) 903-0805, craig.henderson@science.doe.gov

Website: http://science.energy.gov/bes/mse/research-areas/materials-chemistry/

(b) Biomolecular Materials

This activity supports fundamental research in the discovery, design and synthesis of functional materials and complex structures, and materials aspects of energy conversion processes based on principles and concepts of biology. Since biology provides a blueprint for translating atomic and nanoscale phenomena into mesoscale materials that display complex yet well-coordinated collective behavior, the major programmatic focus is on the hypothesis-driven creation of energy-relevant versions of these materials capable of functioning under harsher, non-biological environments. New fundamental science approaches are sought that will lead to predictable and scalable synthesis of novel, hierarchically structured polymeric, inorganic, and hybrid functional materials *in vitro* with controllable morphology, content, behavior and performance.
Major current thrust areas include: Science-based development of bioinspired strategies for spatial and temporal control of energy-efficient synthetic pathways to generate new materials capable of operating under a broad range of non-biological conditions; Bioinspired approaches for self-, directed-, and dissipative-assembly with control of mechanisms and kinetics to form materials that display novel, unexpected properties that are far from equilibrium; Adaptive, resilient materials with self-repairing capabilities; and Development of science-driven tools and techniques, particularly *in situ* capabilities, to achieve fundamental real-time understanding of synthetic and assembly pathways, and enable active, precise manipulation of structure and function. Integrated theory and experiment approaches also are emphasized to understand how materials complexity leads to new functionalities, development of new design ideas, and opportunities for accelerated discovery.

The activity will expand research on methods to create mesoscale materials with high fidelity and in appreciable quantities. Programmatic focus will be on predictive, scalable *in vitro* assembly incorporating error correcting and defect-managing mechanisms to create beyond-equilibrium multicomponent hierarchical materials designed to work under non-biological conditions. Another area of interest is materials that can function autonomously and respond to environmental stresses without losing function; reconfigure and re-route energy transfer, transport, and communication pathways; coordinate collective behavior; self-regulate and rebuild structure; and self-replicate. This activity also will expand research to design and create next-generation materials for energy conversion and storage with programmable selectivity and transport based on biological gating and pumping functions; to understand and precisely control bioinspired mechanisms for directing synthesis and function at organic-inorganic interfaces; and to develop new synthetic approaches for achieving targeted functionality and precise functional group positioning.

Research that does not have a clear focus on materials science or is aimed at optimization of materials properties for any applications, device fabrication, sensor development, tissue engineering, and biomedical research will not be supported in this program.

Subprogram Contact: Michael Markowitz, (301) 903-6779, mike.markowitz@science.doe.gov
Website: http://science.energy.gov/bes/mse/research-areas/biomolecular-materials/

(c) Synthesis and Processing Science

This program supports research to understand the physical phenomena and unifying principles in different classes of materials that underpin their synthesis including diffusion, nucleation, and phase transitions, often using *in situ* diagnostics, and developing new techniques to synthesize materials with tailored structure and desired properties. An important element of this activity is the development of real-time monitoring tools, diagnostic techniques, and instrumentation that can provide information on the progression of structure and properties as a material is formed in order to understand the underlying physical dynamic pathways and to gain atomic and molecular level control of material synthesis and processing. The emphasis is on fundamental research to enable discovery of new functional materials and the development of new crystal growth methods and thin film deposition techniques to create complex materials, perhaps in new states of matter and under non-equilibrium conditions, with targeted structure and properties.

The Synthesis and Processing Science activity continues to focus on the area of predictive design and synthesis of materials across multiple length scales, with a particular emphasis on the mesoscale, and the role imperfections and interfaces can play into the emergence of materials' functionality. Proposals to accelerate progress in understanding synthesis pathways and the discovery of new materials through coupling creative physical experimental synthesis and processing techniques, computational approaches, and/or *in situ* diagnostic tools and characterization techniques developed in the laboratory or at DOE-BES user facilities are encouraged. The program has an increasing focus on understanding of kinetics and mechanisms of materials growth including: bulk material processes, organic and inorganic film deposition, plasma synthesis and the organization of mesoscopic hierarchical assemblies across a range of length scales, especially underpinning many energy-related technological areas.

Projects aimed at engineering scale-up, device fabrication and development are not supported.

Subprogram Contact: Bonnie Gersten, (301) 903-0002, bonnie.gersten@science.doe.gov
Website: http://science.energy.gov/bes/mse/research-areas/synthesis-and-processing-science/

(d) Experimental Condensed Matter Physics

The Experimental Condensed Matter Physics program supports research that will advance our fundamental understanding of the relationships between intrinsic electronic structure and properties of complex materials. The program focus is largely on systems whose behavior derives from strong electron correlation effects, competing or coherent quantum interactions, topology, effects of interfaces, defects, anisotropy and reduced dimensionality. Scientific themes include superconductivity, magnetism, topological materials, low-dimensional electron systems, and nanoscale systems. The program also supports research that involves characterization of the electronic states and properties of materials under extreme conditions, such as ultra-low temperatures and ultra-high magnetic fields.

This program will support the synthesis and characterization of new material systems with which to explore the central scientific themes. This includes research on materials in bulk and thin film form, at interfaces, and in reduced dimensionality, as well as the development of experimental

techniques that enable such studies. Efforts will continue to support research leading to a fundamental understanding of unconventional superconductivity. Growth in research support is expected in the areas of quantum spin physics, strongly correlated electron materials, and topological states of matter.

Proposals emphasizing conventional superconductivity and semiconductor physics will not be considered.

Subprogram Contact: Michael (Mick) Pechan, (301) 903-0540, michael.pechan@science.doe.gov
Website: http://science.energy.gov/bes/mse/research-areas/experimental-condensed-matter-physics/

(e) Theoretical Condensed Matter Physics

This program supports research in Theoretical Condensed Matter Physics with an emphasis on quantum materials, materials discovery, systems out of equilibrium (including transport and ultrafast response), and fundamental research in materials related to energy technologies. Examples of current research include strongly correlated electron systems, quantum phase transitions, topological states, magnetism, superconductivity, semiconductors, thermoelectric materials, computational and data-driven materials design, optical response, and neutron and photon scattering. Approaches from purely analytical to computational are supported, as are methods that incorporate multiple length and time scales. Development of validated, open-source codes and data analytics, as well as high throughput computations, related to the Materials Genome Initiative is also supported.

Research in predictive theory and modeling has an emphasis on functional materials, excited states, and high throughput computation. Novel, physics-based computational techniques are supported including quantum Monte Carlo, extensions of dynamical mean field theory, density matrix renormalization group and self-consistent GW calculations. The program will continue to emphasize basic research on matter at the atomic, nano, and meso length scales. Research supported by this program is motivated by the newest science of materials, advancing the understanding of fundamental physics, and the potential for impact on energy technologies.

Cold atom physics, soft matter and biomolecular physics, polymers, granular materials, ionic liquids, surface chemistry, and quantum computing are not current priorities.

Subprogram Contact: James Davenport, (301) 903-0035, james.davenport@science.doe.gov, Matthias Graf, (301) 903-0874, matthias.graf@science.doe.gov
Website: http://science.energy.gov/bes/mse/research-areas/theoretical-condensed-matter-physics/

(f) Physical Behavior of Materials

This program supports basic research to advance our knowledge and understanding of fundamental processes that take place in materials in response to external stimuli, such as temperature, electromagnetic fields, presence of chemical environments, and the proximity

effects of surfaces and interfaces. The program emphasizes the revealing of structure-behavior relationships in materials, such as the behavior of nano- or micro-structured material exposed to external stimuli and includes the relationship of atomic structure and crystal defects to semiconducting, superconducting, and magnetic properties; phase equilibria and kinetics of reactions in materials in hostile environments; and diffusion and transport phenomena.

The research is necessary to improve materials reliability and performance in chemical, electrical, and electrochemical applications and to improve the ability to generate and store energy in materials. Materials in energy-relevant systems are increasingly being exposed to environments such as extreme temperatures, strong magnetic fields, and harsh chemical conditions. A detailed understanding of how the materials behavior is influenced by the surroundings and treatment history is critical to the understanding of corrosion, photovoltaics, fast-ion conducting electrolytes for batteries and fuel cells, novel magnetic materials for low magnetic loss power generation, magnetocaloric materials for high-efficiency refrigeration, and the development of new energy-relevant materials.

Subprogram Contact: Refik Kortan, (301) 903-3308, refik.kortan@science.doe.gov
Website: http://science.energy.gov/bes/mse/research-areas/physical-behavior-of-materials/

(g) Mechanical Behavior and Radiation Effects

This activity supports basic research to understand defects in materials and their effects on the properties of strength, structure, deformation, and failure. Defect formation, growth, migration, and propagation are examined by coordinated experimental and modeling efforts over a wide range of spatial and temporal scales. Topics include deformation of ultra-fine scale materials, radiation-resistant material fundamentals, and research that would lead to microstructural design for increased strength, formability, and fracture resistance in energy-relevant materials. In addition to traditional structural materials, it is also important to understand deformation and failure mechanisms in other materials used in energy systems (e.g. membranes, coating materials, electrodes) so this will become an increasing part of the portfolio. Within these areas, research on topics such as driven systems, mesoscale science and non-linear cooperative phenomena (multiple inputs, e.g. radiation + stress + corrosion) are of interest.

The long-term goal of this program is to develop the scientific underpinning of defect behavior that will allow the development of predictive models for the design of materials having superior mechanical properties and radiation resistance. Towards this goal, research that takes advantage of the new capabilities to fabricate and test tailored structures down to the nanoscale, as well as utilizing newly developed and more powerful parallel-computational platforms and experimental tools, will be emphasized.

Proposals emphasizing mechanics of materials, rather than materials science, will not be considered responsive.

Subprogram Contact: John Vetrano, (301) 903-5976, john.vetrano@science.doe.gov
Website: http://science.energy.gov/bes/mse/research-areas/mechanical-behavior-and-radiation-effects/

(h) X-Ray Scattering

This activity supports basic research on the fundamental interactions of photons with matter to achieve an understanding of atomic, electronic, and magnetic structures and excitations and their relationships to materials properties. The main emphasis is on x-ray scattering, spectroscopy, and imaging research, primarily at major BES-supported user facilities. Instrumentation development and experimental research in ultrafast materials science, across the full electromagnetic spectrum, including research aimed at manipulating and detecting ultrafast transient physical phenomena in materials (especially at excitation levels consistent with energy conversion and transport), is an integral part of the portfolio.

Advances in x-ray scattering and ultrafast sciences will continue to be driven by scientific opportunities presented by improved source performance and optimized instrumentation. The x-ray scattering activity will expand current capabilities at the DOE facilities by providing support for independent external researchers who motivate and lead new instrumentation and technique development at those facilities. A continuing theme in the scattering program will be the integration and support of materials preparation, especially when coupled to operational investigation of materials processing and realistic, energy-related materials environments. New investments in ultrafast science will focus on research that uses radiation sources associated with BES facilities and beam lines but also includes research performed with ultra-short pulse radiation probes created by tabletop laser sources.

The program will not support research considered "mature use" of existing x-ray or ultrafast techniques.

Subprogram Contact: Lane Wilson, (301) 903-5877, lane.wilson@science.doe.gov
Website: http://science.energy.gov/bes/mse/research-areas/x-ray-scattering/

(i) Neutron Scattering

This activity supports basic research on the unique interactions of neutrons with matter to achieve a fundamental understanding of the atomic, electronic, and magnetic structures and excitations of materials and their relationship to macroscopic properties. The program will develop novel approaches that will exploit the unique aspects of neutron scattering and *in situ* capabilities to investigate materials with hierarchical structures and excitations in a wide range of length and time scales. It will focus on transformational research that uniquely requires neutron scattering as a major tool and could serve as a driver for the concomitant advancement of neutron scattering techniques. It will continue its stewardship role in fostering growth of the US neutron scattering community by developing innovative, time-of-flight neutron scattering and imaging instrumentation concepts and their effective utilization for materials research at the BES user facilities.

Topics emphasized in FY 2017 are new states of matter and phenomena in hard and soft condensed matter, spintronics, self-assembly, design principles and collective behavior of multi-component systems, interfacial science and the science at the mesoscale where macroscopic properties are manifested. Major emphasis is to foster strong interaction between synthesis,

neutron scattering experiments, and theory and simulations to accelerate the fundamental understanding needed for predictive design of advanced materials for future energy needs.

In FY 2017, the program will not consider applications with a major focus on conventional and high temperature superconductivity.

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Website: http://science.energy.gov/bes/mse/research-areas/neutron-scattering/

(j) Electron and Scanning Probe Microscopies

This activity supports basic research in materials sciences using advanced electron and scanning probe microscopy and related spectroscopy techniques to understand the atomic, electronic, and magnetic structures and properties of materials. This activity also supports the development of new instrumentation concepts and quantitative techniques, including ultrafast electron diffraction and imaging techniques, to advance basic science and materials characterizations for energy applications. The goal is to develop a fundamental understanding of materials through advanced microscopy and spectroscopy.

Significant improvements in resolution and sensitivity continue to provide opportunities for groundbreaking science. This activity will continue to support the development and use of advanced microscopy instrumentation and techniques, and the associated theoretical tools to understand the experiments, for research on: Imaging the functionality of materials and understanding the electronic structure, spin dynamics, magnetism, and transport properties from atomistic to mesoscopic scales; Understanding the interplay between charge, orbital, spin and lattice structures in complex materials; and Correlation of structure and properties of nano- and meso-structured materials for energy applications with quantitative *in situ* analysis capabilities.

The program will not support research considered to be "mature use" of microscopy techniques.

Subprogram Contact: Jane Zhu, (301) 903-3811, jane.zhu@science.doe.gov
Website: http://science.energy.gov/bes/mse/research-areas/electron-and-scanning-probe-microscopies/

Chemical Sciences, Geosciences, and Biosciences

The Chemical Sciences, Geosciences, and Biosciences (CSGB) Division supports experimental, theoretical, and computational research to provide fundamental understanding of chemical transformations and energy flow in systems relevant to DOE missions. This knowledge serves as a basis for the development of new processes for the generation, storage, and use of energy and for mitigation of the environmental impacts of energy use. The CSGB research portfolio consists of the research focus areas listed below.

CSGB Division Website: http://science.energy.gov/bes/csgb/

(k) Atomic, Molecular, and Optical Sciences

This program supports basic experimental and theoretical research aimed at understanding the structural and dynamical properties of atomic and molecular systems. The research focuses on fundamental interactions of these systems with photons and electrons to characterize and control their behavior. The goal is to develop accurate quantum mechanical descriptions of dynamical processes such as chemical bond breaking and forming, interactions in strong fields, and electron correlation. Topics of interest include the development and application of novel, ultrafast probes of matter; the interactions of atoms and molecules with intense electromagnetic fields; and quantum control of atomic and molecular systems.

The program emphasizes ultrafast, strong-field, short-wavelength science, and correlated dynamics in atoms and molecules. The AMOS Program will continue to have a prominent role at BES facilities in understanding and controlling the interaction of intense, ultrafast x-ray pulses with matter. Examples include the use of high-harmonic generation or its variants as soft x-ray sources; intense, ultrafast x-ray science at the Linac Coherent Light Source; and development and characterization of femtosecond and attosecond pulses of x-rays at accelerator-based and table-top sources. Applications at these light sources include ultrafast imaging of chemical reactions, diffraction and harmonic generation from aligned molecules, and inner-shell photoionization of atoms and molecules. Coherent control of nonlinear optical processes and tailoring of quantum mechanical wave functions with lasers will continue to be of interest, particularly in molecular systems. Experimental and theoretical tools will be used to study low-energy electron-molecule interactions in the gas and condensed phases. Key targets for greater investment include attosecond science, ultrafast x-ray science, and ultrafast electron diffraction from molecular systems.

The Atomic, Molecular, and Optical Sciences program **is not** accepting applications in the areas of quantum information science, nanoscience, bioscience, and science of ultracold systems.

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Website: http://science.energy.gov/bes/csgb/research-areas/atomic-molecular-and-optical-science/

(l) Gas Phase Chemical Physics

This program supports research that improves our understanding of the dynamics and rates of chemical reactions at energies characteristic of combustion, and the chemical and physical properties of key combustion intermediates. The impact of combustion on the atmosphere is also supported. The overall aim is the development of a fundamental understanding of chemical reactivity enabling validated theories, models and computational tools for predicting rates, products, and dynamics of chemical processes involved in energy utilization by combustion devices. Important to this aim is the development of experimental tools for discovery of fundamental dynamics and processes affecting chemical reactivity. Combustion models using this input are developed that incorporate complex chemistry with the turbulent flow and energy transport characteristics of realistic combustion processes.

Major thrust areas supported by the Gas Phase Chemical Physics program include quantum chemistry, reactive molecule dynamics, chemical kinetics, spectroscopy, predictive combustion models, combustion diagnostics, and soot formation and growth. Currently, increased emphasis in gas-phase chemical physics is on experimental and theoretical investigations of the effect of non-thermal initial distributions on the reactions of radicals, experimental investigations of radical-radical reactions, better insight into combustion reactions at high pressures, expediting gas phase chemical physics calculations via computer automation, and an improved understanding of the interaction of chemistry with fluid dynamics and stochastic in-cylinder processes.

The Gas Phase Chemical Physics program does *not* support research in non-reacting fluid dynamics and spray dynamics, data-sharing software development, end-use combustion device development, and characterization or optimization of end-use combustion devices.

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Website: http://science.energy.gov/bes/csgb/research-areas/gas-phase-chemical-physics/

(m) Computational and Theoretical Chemistry

The Computational and Theoretical Chemistry program supports development, improvement and integration of new and existing theoretical and massively parallel computational or data-driven strategies for the accurate and efficient prediction or simulation of processes and mechanisms relevant to the BES mission. Focus is on non-empirical next-generation simulation of complex processes that require simultaneous computational implementation, testing, and development of new theories and algorithms. Efforts should provide fundamental solutions to problems associated with efficient conversion to clean, sustainable, renewable, novel or highly efficient energy use. Efforts must, directly or as part of multi-scale simulation methods, improve the ability to simulate processes at the molecular- and nano- scales. This includes computational and theoretical tools that enhance analysis of spectroscopic measurements or efforts aimed at enhancing accuracy, precision, applicability, scalability, or the fundamental basis of all variants of quantum-mechanical simulation methods. Developments of spatial and temporal multi-scale/multistage methodologies that allow for time-dependent simulations of resonant, non-resonant and dissipative processes as well as rare events are encouraged. Developments of capabilities for simulation of light-matter interactions, bond breaking, conversion of light to chemical energy or electricity, and the ability to model and control externally driven electronic, magnetic and spin-dependent transport processes in laboratory or natural/solvated environments are encouraged.

Topics of interest include practical predictive methods for (1) excited-state or collective phenomena in complex molecular systems, (2) nontraditional or novel basis sets, meshes or representation of quantum-mechanical degrees of freedom, and (3) simulation and coupling of all interactions/scales that depend upon electronic, vibrational and atomistic structure to improve descriptions of dissipative interactions due to weak and strong interactions among matter, radiation, fields, environment, and solvents. Projects relevant to this program that could achieve significant benefit through joint collaborations with applied mathematicians or computer

scientists may seek joint support with the Office of Advanced Scientific Computing Research.

Methods for or applications to systems that do not explicitly consider rearrangements of quantum-mechanical degrees of freedom are not supported.

Subprogram Contact: Mark Pederson, (301) 903-9956, mark.pederson@science.doe.gov
Website: http://science.energy.gov/bes/csgb/research-areas/computational-and-theoretical-chemistry/

(n) Condensed Phase and Interfacial Molecular Science (CPIMS)

The CPIMS program emphasizes basic research at the boundary of chemistry and physics, pursuing a molecular-level understanding of chemical, physical, and electron- and photon-driven processes in liquids and at interfaces. With its foundation in chemical physics, the impact of this crosscutting program on DOE missions is far reaching, including energy utilization, catalytic and separation processes, chemical synthesis, energy storage, and environmental chemical and transport processes. Experimental and theoretical investigations in the condensed phase and at interfaces aim at elucidating the molecular-scale chemical and physical properties and interactions that govern chemical reactivity, solute/solvent structure and transport. Studies of reaction dynamics at well-characterized surfaces and clusters lead to the development of theories on the molecular origins of surface-mediated catalysis and heterogeneous chemistry. Studies of model condensed-phase systems target first-principles understanding of molecular reactivity and dynamical processes in solution and at interfaces. Fundamental studies of reactive processes driven by radiolysis in condensed phases and at interfaces provide improved understanding of radiation-driven chemistry in nuclear fuel and waste environments.

Basic research is also supported to develop new experimental and theoretical tools that push the horizon of spatial and temporal resolution needed to probe chemical behavior selectively at interfaces and in solution, enabling studies of composition, structure, bonding and reactivity at the molecular level. The transition from molecular-scale chemistry to collective phenomena in complex systems is also of interest, allowing knowledge gained at the molecular level to be exploited through the dynamics and kinetics of collective interactions. In this manner, the desired evolution is toward predictive capabilities that span the microscopic to mesoscale domains enabling the computation of individual molecular interactions as well as their role in complex, collective behavior in real-world devices.

Some examples of recent awards managed in the CPIMS portfolio: (1) Studies of how applied electric fields influence ion hydration properties and water organization at the air/aqueous interface; (2) research that pushes accurate quantum simulations toward large mesoscale systems; (3) explorations of multidimensional infrared microscopy for visualizing chemical dynamics in heterogeneous environments; (4) investigations of photochemical reactions of relevance to chemical synthesis in charged micro-droplets; (5) theoretical studies of rare events in molecular simulations in aqueous systems, such as heterogeneous nucleation; (6) development of theoretical models for solution phase reactions that pursue a deeper understanding of the role of solvent and hydrogen bonding in excited state and electron transfer processes; and (7) research on how hot electrons/holes generated by plasmonic resonances play a role in catalytic efficiency

of nanoparticles. Descriptions of all awards are found in CPIMS Meeting Reports at the link http://science.energy.gov/bes/csgb/principal-investigators-meetings/, under "Condensed-Phase and Interfacial Molecular Science".

The CPIMS program **does not** fund research in bulk fluid mechanics or fluid dynamics, applications such as the development of micro-scale devices, and research that is of principal importance to medical sciences and applications.

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Website: http://science.energy.gov/bes/csgb/research-areas/condensed-phase-and-interfacial-molecular-sciences/

(o) Catalysis Science

This program supports rational catalyst design, and mechanistic understanding and control of novel reactions relevant to the energy mission of the Department of Energy. Research includes the identification of the elementary steps of catalytic reaction mechanisms and their kinetics; construction of catalytic sites at the atomic level; synthesis of ligands, metal clusters, and reaction centers designed to tune molecular-level catalytic activity and selectivity; the study of structure-reactivity relationships of inorganic, organic, bio-inspired or hybrid catalytic materials in solution or solids; the dynamics of catalyst structure relevant to catalyst activity and stability; the theoretical and experimental determination of free energy landscapes for catalytic reactions; the development of novel spectroscopic techniques and structural probes for *in situ* and *in operando* characterization of the dynamics of catalytic, electrocatalytic, and photocatalytic processes; the development of surface science methods involving well-defined model systems closely related to practical catalysts and energy-relevant catalytic reaction conditions; and the development of new theory, modeling, data handling and simulation methods specialized for catalysis and integrated with experiments aimed to design and predict reacting system behavior. Catalytic structure, activity, selectivity, reaction mechanisms and kinetic phenomena must be linked at various levels; from the synthesis of catalyst structures that are reproducible under working conditions to the fast and ultrafast characterization of intermediate and transition states, and to the micro-kinetics analysis of complex reactions.

A long-term goal is to promote the convergence of heterogeneous, homogeneous, and bio catalysis as a means to derive novel inorganic, organic, and hybrid catalysts selective for fuel and chemical production from both fossil and renewable feedstocks. Another long-term goal is to maximize the atom and energy efficiency of chemical transformations. In addition, we seek to develop several emerging areas of catalysis, including: identification of catalytic carbon-neutral routes to long-term energy sustainability, such as thermocatalytic production of H_2 and other chemicals without secondary greenhouse gas emissions; selective and low-temperature activation of lower or higher alkanes or multifunctional molecules using non-precious or non-metallic catalysts; catalytic reaction mechanisms influenced by weak forces in confined or open catalytic environments; electrochemical and photo-electrochemical conversion of natural compounds or secondary products into chemicals and fuels; reactions in water, ionic liquids, and under extreme conditions; and quantitative and reproducible determination of kinetics and mechanisms, open source computational approaches and shared databases leading to benchmarks for catalytic

properties.

This program does not support the study of reactions appropriate for pharmaceutical applications, or the development of specific energy technologies.

Subprogram Contact: Viviane Schwartz, (301) 903-0448, viviane.schwartz@science.doe.gov; and Charles (Chuck) Peden, (301) 903-1411, charles.peden@science.doe.gov
Website: http://science.energy.gov/bes/csgb/research-areas/catalysis-science/

(p) Separations and Analysis

This program supports fundamental research to predict and control the atomic and molecular interactions between target species and separations media; and the resulting molecular structures, dynamics, kinetics, and transport properties with the desired nano-, meso-, and macroscopic functionality. This basic research is motivated by a desire to advance discovery and predictive design of future chemical separations utilizing novel, multifunctional, and/or more energy- and atom-efficient methods. Research topics include inorganic and organic/hybrid membrane science; soft, hard or hybrid membranes; ultraselective separations under extreme chemical environments (acid/base, saline, high T); chiral resolution of enantiomers; molecular trapping and controlled/dynamic release of various types of isomers (constitutional, stereoisomers, isotomers, topoisomers, spin isomers, etc.); reactive separations, and complex mixture separations; electrochemical processes, and non-traditional solvents such as ionic liquids. Also supported is the underlying analytical science that enables improvement of the sensitivity, reliability, and productivity of chemical determinations and the development of new approaches to analysis in complex, heterogeneous environments. A range of basic research multidisciplinary experimental and computational approaches are employed, inspired by the common fundamental underpinnings associated with a wide range of DOE mission-related chemical recognition, separation, as well as analysis problems.

Advances in fundamental science describing the speciation and chemical behavior of actinides and fission products has been identified as essential for the treatment of high-level radioactive wastes in the *Basic Research Needs for Environmental Management,* the DOE report of the Basic Energy Sciences Workshop on this topic. Research that is responsive to this report, and in particular, speciation and reactivity of non-equilibrium systems, including the prediction of oxidation states, chemical forms and reaction pathways in these unique systems, is well aligned with the goals of this program.

The Separations and Analysis program does not support engineering or scale up of processes, devices or sensors, activities directed at lab-on-a-chip development, or research directed toward medical applications; nor does the program support applied research or research focusing exclusively on the extraction of critical materials.

Subprogram Contact: Philip Wilk, (301) 903-4537, philip.wilk@science.doe.gov
Website: http://science.energy.gov/bes/csgb/research-areas/separations-and-analysis/

(q) Heavy Element Chemistry

The Heavy Element Chemistry (HEC) program supports basic chemical research of the actinide and transactinide elements. The unique molecular bonding of these elements is explored using experiment and theory to elucidate electronic and molecular structure as well as reaction thermodynamics. Emphasis is on resolving the f-electron challenge and determining the chemical and physical properties of these elements – particularly those elements that are least understood – to identify solution, interfacial and solid-state bonding and reactivity. Synthetic inorganic research is pursued within this program on molecules that contain heavy elements, with a focus on gaining a fundamental understanding of how the f-electrons participate in bonding. Ligand synthesis is supported only with an aim toward the discovery of novel interactions or to determine electronic structure. Spectroscopic research on the bonding and chemical reactivity of heavy-element-containing molecules is supported. Better characterization and modeling of the interactions of actinides at liquid-solid and liquid-liquid interfaces is motivated by deepening our understanding of the fundamental science within the DOE missions in energy, environment, and national security.

Resolving the role of the f-electrons is one of the three grand challenges identified in *Basic Research Needs for Advanced Nuclear Energy Systems,* the DOE report of the Basic Energy Sciences Workshop on this topic. Research to address this challenge is a central goal of this program and includes efforts aimed at implementing for actinide and transactinide elements, quantum-mechanical theories that correctly describe spin-orbit interactions and relativistic effects, which will expand our ability to predict heavy element chemical behavior.

Based on programmatic priorities, the HEC program does not fund research on: the processes affecting the transport of subsurface contaminants, the form and mobility of contaminants including wasteforms, projects using heavy-element surrogates, projects aimed at optimization of materials properties including radiation damage, device fabrication, or biological systems, which are all more appropriately supported through other DOE programs. Research focused primarily on separations that does not address the unique properties of the heavy elements is aligned better with the BES Separations and Analysis program, which is described in section p.

Subprogram Contact: Philip Wilk, (301) 903-4537, Philip.Wilk@science.doe.gov
Website: http://science.energy.gov/bes/csgb/research-areas/heavy-element-chemistry/

(r) Geosciences

The Geosciences program supports basic experimental, theoretical and computational research in geochemistry and geophysics. Geochemical research emphasizes fundamental understanding of the thermodynamics, phase equilibria, and reaction rates associated with geochemical processes, focusing on nanoscale materials and interfaces, and on the molecular origins of isotopic distributions and migration pathways in natural systems. Geophysical research focuses on new approaches to understand the subsurface physical properties and material response of fluids, rocks, and minerals and develops techniques for determining such properties at a distance.

In both geophysics and geochemistry, the emphasis is on pushing the boundaries of current measurement techniques and modeling approaches and on designing experiments and models that connect with one another in transformative ways.

Priority in Basic Energy Sciences funding is given to research that has multiple potential application areas. Projects with unique applications should contact the appropriate technology program.

Subprogram Contact: James Rustad, (301) 903-1717, james.rustad@science.doe.gov
Website: http://science.energy.gov/bes/csgb/research-areas/geosciences/

(s) Solar Photochemistry

This program supports fundamental, molecular-level research on solar energy capture and conversion in the condensed phase and at interfaces. These investigations of solar photochemical energy conversion focus on the elementary steps of light absorption, charge separation, and charge transport within a number of chemical systems, including those with significant nanostructured composition. Supported research areas include organic and inorganic photochemistry, catalysis and photocatalysis, photoinduced electron and energy transfer in the condensed phase and across interfaces, photoelectrochemistry, and artificial assemblies for charge separation and transport that mimic natural photosynthetic systems. An enhanced theory and modeling effort is needed for rational design of these artificial solar conversion systems.

Among the challenges in catalytic fuels production, knowledge gained in electron transfer needs to be applied in a meaningful way to activation of small molecules including, among others, CO_2 in its reduction to fuels, the fixation of N_2, and H_2O in its oxidation or reduction via transformative catalytic cycles. This spans the range from dark catalytic reactions to those driven by the energy of an absorbed photon and in both homogeneous and heterogeneous environments.

Another regime of interest is the chemistry initiated through creation of excited states with ionizing radiation, as can be produced through electron pulse radiolysis, to investigate reaction dynamics, structure, and energetics of short-lived transient intermediates in the condensed phase, solutions, and interfaces.

The Solar Photochemistry program does not fund research on device development or optimization.

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Website: http://science.energy.gov/bes/csgb/research-areas/solar-photochemistry/

(t) Photosynthetic Systems

This program supports basic research on the capture of solar energy and its conversion to and storage as chemical energy in plants, algae, and photosynthetic prokaryotes. Research topics

supported include, but are not limited to, light harvesting, photosynthetic proton and electron transport, photosynthetic reduction of carbon dioxide into organic compounds, and the self-assembly, dynamics, and self-repair of photosynthetic proteins, complexes and membranes. The goal of the program is to foster greater knowledge of the structure and function of the diverse photosynthetic systems found in nature.

Projects funded by the program combine biochemistry, biophysics, molecular biology, computational chemistry, and other approaches to understand the biological capture of sunlight and its conversion to and storage as chemical energy at a fundamental level. This multidisciplinary approach is a key strength of Photosynthetic Systems and will enable a multidimensional mechanistic understanding of photosynthetic structures and processes. Such knowledge will provide insights for the future development of bio-inspired, bio-hybrid, and biomimetic energy systems and inform strategies for improvement of natural photosynthesis.

All submitted applications must clearly state the energy relevance of the proposed research: How will the knowledge gained from the proposed work better our understanding of the ways plants, algae, and photosynthetic prokaryotes capture, convert, and/or store energy?

Photosynthetic Systems does not fund: 1) development or optimization of devices or processes; 2) development or optimization of microbial strains or plant varieties for biofuel or biomass production; 3) phenotype analyses that do not test specific hypotheses relevant to the program; 4) genomic or other "omic" data acquisition that does not test specific hypotheses relevant to the program; and 5) theory or modeling projects that lack empirical testing.

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Website: http://science.energy.gov/bes/csgb/research-areas/photosynthetic-systems/

(u) Physical Biosciences

This program supports basic research that combines tools from the physical sciences with biochemical, chemical and molecular biological approaches to further our understanding of the ways plants and non-medical microbes capture, convert, and store energy. Research supported includes studies that investigate the active site chemistries of multi-electron redox reactions, identify factors that direct and regulate the flow of electrons through energy-relevant metabolic pathways, and provide insight into the self-assembly and maintenance of enzymes and biological energy transduction systems downstream from photosynthesis.

Future impact is, in general, envisioned through increased integration of physical science and computational tools to probe structural, functional and mechanistic properties of enzymes, enzyme systems, and energy-relevant biological reactions. Such studies will lead to the identification of principles that will, for example, provide a basis for the design and synthesis of highly selective and efficient bioinspired catalysts. Of particular interest in this regard are enzymes and their affiliated co-factors involved in biological proton and nitrogen reduction, carbon-carbon bond formation, and carbon dioxide assimilation and reduction (including *Archaeal* systems). Complementary studies that determine how the flow of electrons in biological systems are gated and controlled over multiple spatial and temporal scales will

provide the foundational knowledge that can enable the redirection of a greater fraction of metabolic reductant to more desirable end products (fuels and chemicals). Other currently supported areas of research include studies of the roles played by ion gradients in storing energy and driving transport processes, and investigations of other non-photosynthetic assemblies involved in energy capture, conversion, and storage. Research traditionally supported by this program in plant cell wall biosynthesis and structure will be de-emphasized in FY 2017.

All submitted applications must clearly state the energy relevance of the proposed research: How will the knowledge gained from the proposed work better our understanding of the ways plants, algae, and non-medical microbes capture, convert, and/or store energy?

Physical Biosciences does not fund: 1) animal systems; 2) prokaryotic systems related to human/animal health or disease; 3) development and/or optimization of devices and/or processes; 4) development and/or optimization of microbial strains or plant varieties for biofuel/biomass production; 5) cell wall breakdown or deconstruction; 6) transcriptional or translational regulatory mechanisms and/or processes; and 7) environmental remediation and/or identification of environmental hazards. Projects should ideally be hypothesis-driven; projects that develop or rely primarily on high-throughput screening approaches will not be supported, nor will theory/modeling projects that lack experimental verification.

Subprogram Contact: Robert Stack, (301) 903-5652, robert.stack@science.doe.gov
Website: http://science.energy.gov/bes/csgb/research-areas/physical-biosciences/

Scientific User Facilities

The Scientific User Facilities (SUF) Division supports the research and development, planning, construction, and operation of scientific user facilities for a vast range of science spanning the fields of biology, chemistry, geoscience, material science, and the physical sciences using x-ray, neutron, and electron beam scattering as fundamental probes of matter. These facilities provide unique capabilities to the scientific community and are a critical component of maintaining U.S. leadership in this diverse range of scientific disciplines. The SUF Division also supports research activities leading to the improvement of today's facilities, and research that lays the foundation for the development of the next generation of facilities.

SUF Division Website: http://science.energy.gov/bes/suf/

(v) BES Accelerator and Detector Research

This program supports research that advances the instruments, techniques, and capabilities of the existing and/or future scientific user facilities. Research includes studies on creating, manipulating, transporting, and performing diagnostics of ultrahigh brightness electron beams, studies of the properties of cathodes materials and factors that limit cathode lifetime, and modeling of ultrashort electron beam dynamics. Research is supported that aims at developing techniques that will strongly benefit the next generation of free electron lasers (FELs). Development studies of loss control methods in high-intensity proton sources used for neutron spallation facilities are also supported.

Major areas of interest include: Development of novel high-brightness electron sources, innovative methods of beam acceleration, seeding and beam manipulation techniques that enhance temporal control of x-ray FELs, and lead to higher peak and average brightness, enhanced energy stability, and reduction of temporal and intensity fluctuations. Methods to control and shape the spectrum of x-ray FELs, such as the generation of controlled multi-color (multi-frequency) photon beams that will enable many experimental techniques in ultrafast chemical and material dynamics studies. High-precision timing techniques for synchronization of accelerator and laser systems and for high-resolution measurements of electron and sub-femtosecond photon beam pulses. Methods to stimulate electron-photon conversion efficiency leading to enhanced output beam power. Development of advanced instrumentation for beam characterization, control, and optimization to enable the full utilization of the high flux, brilliance, and ultra-short pulses provided by the new light sources, and increased intensity at the neutron sources.

Also of interest are detector developments that will allow efficient use of the high-intensity x-rays and neutrons produced by the new sources. Improved detectors are especially important in the study of multi-length-scale systems such as protein-membrane interactions as well as nucleation and crystallization in nanophase materials.

Advanced x-ray optics developments are needed to respond to increasing demands for higher energy resolution, focusing, and preservation of coherence. Innovative and precise optical elements are required to transport and manipulate x-ray beams possessing varying degrees of both longitudinal and transverse coherence.

New developments in data resource management techniques are sought to address the increasing volume and complexity of experimental data generated at the BES light sources and neutron scattering facilities.

Research aimed at the optimization of materials properties for accelerator, detector, and optics components, device fabrication, and sensor development will be discouraged.

Subprogram Contact: Eliane Lessner, (301) 903-9365, eliane.lessner@science.doe.gov
Website: http://science.energy.gov/bes/suf/accelerator-and-detector-research/

3. Biological and Environmental Research (BER)
Program Website: http://science.energy.gov/ber/

The mission of the Biological and Environmental Research (BER) program is to support fundamental research and scientific user facilities to achieve a predictive understanding of complex biological, climatic, and environmental systems for a secure and sustainable energy future.

The BER subprograms and their objectives follow:

(a) Biological Systems Science

Research is focused on using DOE's unique resources and facilities to achieve a predictive systems-level understanding of complex biological systems to advance DOE missions in energy and the environment. By integrating genome science with advanced computational and experimental approaches, the Division seeks to gain a predictive understanding of living systems, from microbes and microbial communities to plants and ecosystems. This foundational knowledge serves as the basis for the confident redesign of microbes and plants for sustainable biofuel production, improved carbon storage and contaminant remediation.

The major research objectives are:

1. to determine the molecular mechanisms, regulatory elements, and integrated networks needed to understand genome-scale functional properties of microbes, plants, and communities (including the study of natural microbiomes and model microbiomes in targeted field environments relevant to BER's bioenergy and climate science research efforts); develop "-omics" experimental capabilities and enabling technologies needed to achieve a dynamic, system-level understanding of organism and community functions; and develop the knowledgebase, computational infrastructure, and modeling capabilities to advance predictive understanding, manipulation and design of biological systems; and
2. to develop advanced measurement and imaging technologies to visualize the spatial and temporal relationships of key metabolic processes governing phenotypic expression in plants and microbes, information crucial for developing an understanding of the impact of various environmental and/or biosystems designs on whole cell or community function.

Subprogram Contact: Robert (Todd) Anderson, (301) 903-3213,
todd.anderson@science.doe.gov,
Website: http://science.energy.gov/ber/research/bssd/

(b) Climate and Environmental Sciences

Research is focused on using DOE's unique resources and facilities to achieve a predictive understand of the Earth's climate and environmental systems, using strategic investments to improve both understanding and representation of the governing physical, chemical, and biological processes and how these processes may be affected by energy production and use. Research is designed to provide new and/or improved theory, observational data, and interdisciplinary analysis to enable an objective, scientifically based assessment of the potential for, and the consequences of, human-induced climate change at global and regional scales. The program also supports strategically aligned workshops, and it provides data and models to enable assessments of mitigation options to prevent such change.

The major research objectives are:

1. understand the physics, chemistry, and dynamics governing clouds, aerosols, and precipitation interactions, with a goal to advance the predictive understanding of the climate system;
2. improve the understanding and representation of physical and hydro-biogeochemical processes that govern terrestrial surface and subsurface ecosystems, that in turn can be represented in system models to improve confidence in climate change projections and to better inform DOE's energy and environmental management decisions; and
3. develop, evaluate and analyze complex models of climate, earth, and environmental systems, in order to understand climate variability, environmental change, and the interactions and co-evolution of human and natural systems.

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Gerald.Geernaert@science.doe.gov
Website: http://science.energy.gov/ber/research/cesd/

4. Fusion Energy Sciences (FES)
Program Website: http://science.energy.gov/fes/

The mission of the Fusion Energy Sciences (FES) program is to expand the fundamental understanding of matter at very high temperatures and densities and to build the scientific foundation needed to develop a fusion energy source. This is accomplished through the study of plasma, the fourth state of matter, and how it interacts with its surroundings.

The next frontier for the FES program is the study of the burning plasma state, in which the fusion process itself provides the dominant heat source for sustaining the plasma temperature (i.e., self-heating). Production of strongly self-heated fusion plasma will allow the discovery and study of a number of new scientific phenomena.

To accomplish its mission, the FES program is organized into four subprograms.

- The *Burning Plasma Science: Foundations* subprogram supports foundational experimental and theoretical research aimed at resolving magnetic-confinement plasma science issues for the next generations of machines, including ITER. The key objectives of this subprogram are to establish the scientific basis for the optimization of the advanced tokamak and spherical tokamak approaches to magnetic confinement fusion, develop a predictive understanding of burning plasma behavior, develop technologies that will enhance the performance of existing and next-step machines, and provide necessary infrastructure improvements.
- The *Burning Plasma Science: Long Pulse* subprogram supports experimental research in new scientific regimes achievable with long-duration superconducting international machines and research in the development of materials to withstand the harsh conditions in a burning plasma environment. The key objectives of this subprogram are to utilize these new long-pulse capabilities to accelerate our scientific understanding of how to control and operate burning plasmas, as well as to develop the basis for future experiments.

- The *Burning Plasma Science: High Power* subprogram supports the U.S. Contributions to ITER Project, which includes in-kind hardware components, personnel, and direct funding to the ITER Organization for the ITER construction phase, established by the terms of the ITER Joint Implementing Agreement. The key objective of this subprogram is the completion of all activities of the U.S. Contributions to ITER project. These activities are performed by the U.S. ITER Program Office and therefore are not part of this Open Solicitation.
- The *Discovery Plasma Science* subprogram supports investigations into fundamental plasma properties and processes and the development of innovative diagnostic techniques, on small- and intermediate-scale, single-purpose experimental platforms. The key objectives of this subprogram are to expand the knowledge base of general plasma physics and to uncover directions for future plasma-related contributions to the DOE missions.

Specific information about FES program areas is as follows:

(a) Burning Plasma Science: Foundations—Advanced Tokamak and Spherical Tokamak

This program element uses magnetic confinement fusion research facilities in the U.S. to develop the physics understanding needed to advance the FES mission and demonstrate the ultimate potential of the tokamak for fusion energy production. The FES large-scale experimental facilities provide essential tools to explore and solve many fundamental issues of fusion plasma physics in integrated systems at fusion-relevant parameters. Research at small-scale facilities addresses critical issues that may affect the tokamak concept. This program element also includes research and development in technology areas that enable improvements in tokamak plasma performance. A high priority for these facilities is to resolve important issues for ITER, develop the predictive understanding needed for ITER operation, and advance the physics understanding needed to design future experiments. Major themes of this program element are (1) the physics basis for the spherical tokamak (ST) and the advanced tokamak (AT) concepts as candidates to support a fusion nuclear science program; (2) techniques to minimize the impact of transient plasma events; (3) solutions to the tokamak divertor and plasma-material interface (PMI) challenge; and (4) toroidal confinement physics understanding for ITER and beyond.

Subprogram Contact: Mark Foster, (858) 455-3360, Mark.Foster@science.doe.gov;
Joshua (Josh) King, (301) 903-9707, Josh.King@science.doe.gov;
Barry Sullivan, (301) 903-8438, Barry.Sullivan@science.doe.gov;
Francis Thio, (301) 903-4678, Francis.Thio@science.doe.gov
Website: http://science.energy.gov/fes/research/

(b) Burning Plasma Science: Foundations—Theory & Simulation

This program element focuses on advancing the scientific understanding of the fundamental physical processes governing the behavior of magnetically confined plasmas. Specific areas of interest include:

- Macroscopic stability and dynamics of fusion plasmas, with a strong focus on the prediction, avoidance, control, and mitigation of deleterious or performance-limiting

instabilities;

- Understanding and control of the multiscale, collisional and turbulent physical mechanisms responsible for the loss of heat, momentum, and particles from the confining region;
- Interaction of externally launched radiofrequency waves designed to heat the plasma and drive current, with the background plasma and surrounding structures;
- Nonlinear interaction between background plasma, various instabilities, and energetic particle populations, including the alpha particles generated by the fusion reactions, and its impact on the confinement of these particles and the overall plasma performance; and,
- The effect of multiscale and multiphysics processes at the plasma boundary on the plasma performance and on the interaction and interface of the hot plasma boundary with the material walls.

The efforts supported by this program provide the foundations for integrated simulations of fusion systems and range from analytical work to the development and application of advanced simulation codes capable of exploiting the potential of next generation high performance computers.

Subprogram Contact: John Mandrekas, (301) 903-0552, John.Mandrekas@science.doe.gov
Website: http://science.energy.gov/fes/research/

(c) Burning Plasma Science: Long Pulse—Tokamak & Stellarator

This program element supports research conducted by U.S. teams on long pulse superconducting international tokamaks as well as unique short pulse international tokamaks and stellarators that are currently operating or will be operating in the near future. These teams build on the experience gained from U.S. fusion facilities to conduct research on these international machines. This research will enable the exploration of scientific regimes that cannot be reached on domestic machines, which will allow the U.S. fusion program to gain the knowledge needed to control and sustain plasma discharges in ITER and other fusion energy devices. In addition, this category includes the U.S. stellarator domestic research program focused on optimization of confinement through quasi-symmetric shaping of the toroidal magnetic field.

Subprogram Contact: John Mandrekas, (301) 903-0552, John.Mandrekas@science.doe.gov; Samuel (Sam) Barish, (301) 903-2917, Sam.Barish@science.doe.gov
Website: http://science.energy.gov/fes/research/

(d) Burning Plasma Science: Long Pulse—Materials & Fusion Nuclear Science

This program element focuses on advancing the scientific understanding required to design and deploy the materials and technologies needed to support a steady-state burning plasma device. The main technical issues of interest stem largely from the uniquely extreme operating environment associate with future fusion reactors. There are three broad research topics of interest: (1) taming the plasma-material interface, (2) conquering nuclear degradation of materials and structures, and (3) harnessing fusion power (fuel cycle, chamber technology, and systems studies). Scientific proposals of interest are those aimed at resolving key hurdles in

order to establish the scientific proof of principle for fusion energy from a materials science and engineering perspective.

Subprogram Contact: Daniel Clark, (301) 903-4883, Daniel.Clark@science.doe.gov;
Barry Sullivan, (301) 903-8438, Barry.Sullivan@science.doe.gov;
Albert (Al) Opdenaker, (301) 903-4927, Albert.Opdenaker@science.doe.gov
Website: http://science.energy.gov/fes/research/

(e) Discovery Plasma Science: Plasma Science Frontiers

General plasma science is a broad, multidisciplinary area that spans many science issues, such as interaction of waves with plasmas; plasma kinetics, properties, and processes; magnetic reconnection and particle acceleration; physics of non-neutral and dusty plasmas; and chaos, turbulence, and structure in plasmas. Areas of research responsive to this subprogram may include: (1) energy conversion and particle energization processes in astrophysical, solar, and space plasmas, (2) collective effects and properties of dusty, non-neutral and antimatter plasmas, (3) interaction of plasma with biomaterials, and (4) improved understanding of the plasma state in the synthesis of nanomaterials. Since many of these research topics are covered under the regular annual solicitation of the DOE/National Science Foundation Partnership in Basic Plasma Science and Engineering, it is advisable to check the website below:
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5602

Subprogram Contact: Nirmol Podder, (301) 903-9536, Nirmol.Podder@science.doe.gov;
Sean Finnegan, (301) 903-4920, Sean.Finnegan@science.doe.gov;
Francis Thio, (301) 903-4678, Francis.Thio@science.doe.gov
Curtis (Curt) Bolton, (301) 903-4914, Curt.Bolton@science.doe.gov
Website: http://science.energy.gov/fes/research/

High Energy Density Laboratory Plasmas supports the study of ionized matter at extremely high density and temperature, specifically, when matter is heated and compressed to a point that the stored energy in the matter reaches approximately 100 billion Joules per cubic meter, corresponding to a pressure of approximately 1 million atmospheres. Systems in which free electrons play a significant role in the dynamics and for which the underlying assumptions and methods of traditional ideal-plasma theory and standard condensed matter theory do not apply (e.g., Warm Dense Matter at temperatures of a few electron volts) can have pressures as low as 0.1 Mbar and are also considered high-energy-density plasmas.

Subprogram Contact: Sean Finnegan, (301) 903-4920, Sean.Finnegan@science.doe.gov
Website: http://science.energy.gov/fes/research/

Exploratory Magnetized Plasma supports basic and applied research directed at developing the understanding of magnetized plasma behavior necessary to advance capabilities for the creation, control, and manipulation of magnetically confined plasmas for both terrestrial and space applications.

Subprogram Contact: Francis Thio, (301) 903-4678, Francis.Thio@science.doe.gov;
Nirmol Podder, (301) 903-9536, Nirmol.Podder@science.doe.gov;
Sean Finnegan, (301) 903-4920, Sean.Finnegan@science.doe.gov
Website: http://science.energy.gov/fes/research/

(f) Discovery Plasma Science: Measurement Innovation

This program element supports the development of innovative diagnostics to make detailed measurements of the behavior of plasmas. Advances in diagnostic systems with higher

resolution, higher reliability, reduced complexity, or access to previously unmeasured parameters enable breakthroughs in scientific understanding, the linking of theory/computation with experiments, and active control of plasma properties to optimize device operation and plasma performance in a variety of device configurations. The program also supports development of ITER-relevant diagnostic systems.

Subprogram Contact: Francis Thio, (301) 903-4678, Francis.Thio@science.doe.gov
Website: http://science.energy.gov/fes/research/

5. High Energy Physics (HEP)
Program Website: http://science.energy.gov/hep

The mission of the High Energy Physics (HEP) program is to understand how the universe works at its most fundamental level by discovering the elementary constituents of matter and energy, probing the interactions between them, and exploring the basic nature of space and time.

The scientific objectives and priorities for the field recommended by the High Energy Physics Advisory Panel (HEPAP) are detailed in its recent long-range strategic Particle Physics Project Prioritization Plan (P5), available at: http://science.energy.gov/~/media/hep/hepap/pdf/May-2014/FINAL_P5_Report_Interactive_060214.pdf.

The HEP program focuses on three experimental scientific frontiers:

- *The Energy Frontier*, where powerful accelerators are used to create new particles, reveal their interactions, and investigate fundamental forces;

- *The Intensity Frontier*, where intense particle beams and highly sensitive detectors are used to pursue alternate pathways to investigate fundamental forces and particle interactions by studying events that occur rarely in nature, and to provide precision measurements of these phenomena; and

- *The Cosmic Frontier*, where non-accelerator-based experiments observe the cosmos and detect cosmic particles, making measurements of natural phenomena that can provide information about the nature of dark matter, dark energy, and other fundamental properties of the universe that impact our understanding of matter and energy.

Together, these three interrelated and complementary discovery frontiers offer the opportunity to answer some of the most basic questions about the world around us. Also integral to the mission of HEP are four cross-cutting research areas that enable new scientific opportunities by developing the necessary tools and methods for discoveries:

- *Theoretical Particle Physics*, where the vision and mathematical framework for understanding and extending the knowledge of particles, forces, space-time, and the universe are developed;

- *Computational Particle Physics*, where the framework of simulation and computational techniques are developed for advancing the HEP mission;

- *Accelerator Science and Technology Research and Development*, where the technologies and basic science needed to design, build, and operate the accelerator facilities essential for making new discoveries are developed; and

- *Detector Research and Development*, where the basic science and technologies needed to design and build the High Energy Physics detectors essential for making new discoveries are developed.

Applications in response to this FOA may propose activities *in support of* HEP research, which include, but are not limited to: conferences, experimental operations, conceptual research and development (R&D), design or fabrication directed towards a specific project within the HEP scientific program.

Applicants addressing *specific HEP research or technology development* activities in one or more of the six research subprograms (as in the examples given below, excluding Computational Research in High Energy Physics), are *strongly encouraged* to submit applications to either the annual HEP Comparative Review Funding Opportunity Announcement and/or to the annual Early Career Research Program Funding Opportunity Announcement, each available through http://www.grants.gov. Applications that are in direct support of HEP research activities in the six subprograms may be submitted to this open solicitation but will likely be assigned a lower programmatic priority than those from the comparative review process. Prior to any submission to this Funding Opportunity Announcement, applicants are *strongly encouraged* to contact the relevant HEP subprogram managers listed below to develop applications that address proper program goals.

Applications submitted to this FOA for support of *generic particle detector R&D* efforts should be directed to the Detector Research and Development research area described below. However, applicants proposing physics studies and pre-conceptual R&D efforts directed towards a *specific experiment* within an experimental frontier should submit their application to the relevant HEP scientific frontier research area.

(a) Experimental Research at the Energy Frontier in High Energy Physics

This research area seeks to support studies of fundamental particles and their interactions using proton-(anti)proton collisions at the highest possible energies. This is accomplished through direct detection of new phenomena or through sensitive measurements that probe the Standard Model and new physics beyond it. In particular, applications are sought for physics research utilizing data being collected at the Large Hadron Collider (LHC) by the ATLAS and CMS experiments. This research area also provides graduate and postdoctoral research training for the next generation of scientists, and equipment and computational support for physics research activities. Applications addressing physics studies and pre-conceptual R&D directed towards specific future Energy Frontier experiments are also accepted. Support for Heavy Ion Physics research is not provided under this research area.

Subprogram Contact: Abid Patwa, (301) 903-0408, abid.patwa@science.doe.gov
Website: http://science.energy.gov/hep/research

(b) Experimental Research at the Intensity Frontier in High Energy Physics

This research area seeks to support precision studies that are sensitive to new physical processes at very high energy scales, beyond what can be directly probed with energy frontier colliders, and that often require intense particle beams. This research area includes studies of the fundamental properties of neutrinos produced by a variety of sources, including accelerators and nuclear reactors; studies of rare processes or precision measurements probing new physics processes as described above with either high intensity stored beams or beams incident on fixed targets; and studies of high intensity electron-positron collisions. In addition, this research area includes searches for proton decay. Graduate and postdoctoral research training for the next generation of scientists, and equipment and computational support for physics research activities are also provided. Applications addressing physics studies and pre-conceptual R&D directed towards specific future Intensity Frontier experiments are also accepted. Support for LHCb research or studies of neutrinoless double beta decay is not provided under this research area.

Subprogram Contact: Glen Crawford, (301) 903-4829, glen.crawford@science.doe.gov
Website: http://science.energy.gov/hep/research

(c) Experimental Research at the Cosmic Frontier in High Energy Physics

This research area seeks to support precision studies using observations of the cosmos and naturally occurring cosmic particles to understand the properties of fundamental particles and fields. Priorities include studies of the nature of dark energy, direct-detection searches for dark matter particles and research efforts towards planning the next generation of ground-based cosmic microwave background experiments to explore the inflationary epoch, the nature of dark energy and place constraints on neutrino masses. Measurements using high-energy cosmic rays, gamma rays and other phenomena are included, but at a lower priority.

This research area provides support for scientists to participate in these research areas, including graduate and postdoctoral research training for the next generation of scientists, and equipment and computational efforts to support the physics research activities. Applications addressing researcher support for physics studies and pre-conceptual R&D directed towards specific future Cosmic Frontier experiments being considered for the DOE HEP program are also accepted. Research aimed at developing techniques or understanding experimental data within the context of theoretical models, expressly for or as part of an experimental research collaboration, *is* included in this area. General theoretical or computational research proposals not specifically carried out as part of a particular Cosmic Frontier experimental collaboration should be directed to the Theoretical Research subprogram. Studies of gravitational physics (other than for cosmic acceleration), classical astrophysics phenomena, fundamental symmetries, or planning for future cosmic ray or gamma ray experiments are not included in this research area.

Subprogram Contact: Kathleen (Kathy) Turner, (301) 903-1759, kathy.turner@science.doe.gov
Website: http://science.energy.gov/hep/research

(d) Theoretical Research in High Energy Physics

This research area supports activities that range from detailed calculations of the predictions of the Standard Model, to the extrapolation of current knowledge to a new level of understanding, and the identification of the means to experimentally verify such predictions. Thus a thriving theory program is essential for identifying new directions and opportunities for the field. Topics studied in theoretical high energy physics research include, but are not limited to: phenomenological and theoretical studies that support experimental HEP research at the Energy, Intensity and Cosmic Frontiers, both in understanding the data and in finding new directions for experimental exploration; development of analytical and numerical computational techniques for these studies; and construction and exploration of theoretical frameworks for understanding fundamental particles and forces at the deepest level possible. This research area also provides graduate and postdoctoral research training for the next generation of scientists and computational resources needed for theoretical calculations. Activities that rely on experimental data, performed expressly for or with an experimental research collaboration, are not included in this research area.

Subprogram Contact: Simona Rolli, (301) 903-0504, simona.rolli@science.doe.gov
Website: http://science.energy.gov/hep/research

(e) Computational Research in High Energy Physics

This research area currently supports partnership (SciDAC - Scientific Discovery through Advanced Computing) projects and specific computational tools (Scientific Computing) that target the cross-cutting needs of HEP. Sponsored support within this area is confined to computational science and simulations that broadly advance scientific discovery aligned with the HEP mission, and research on computing and data management tools that benefit multiple parts of the program.

This subprogram does not support computing research and/or activities specific to individual projects in any of the other six research and technology R&D subprograms described in this open solicitation. Support for specific operation efforts and/or hardware requests in each of the other subprograms are also outside the scope of this area. Applicants proposing such activities should submit their application to the relevant subprogram.

Subprogram Contact: Lali Chatterjee, (301) 903-0435, lali.chatterjee@science.doe.gov
Website: http://science.energy.gov/hep/research

(f) Accelerator Science and Technology Research & Development in High Energy Physics

The accelerator technology R&D subprogram develops the next generation of particle accelerators and related technologies that are essential for discoveries in HEP. This research area supports world-leading research in the physics of particle beams and long-range, exploratory

research aimed at developing new concepts. This research area also provides graduate and postdoctoral research training, equipment for experiments and related computational efforts.

Topics studied in the accelerator science and technology R&D subprogram include, but are not limited to: accelerator and beam physics, including analytic and computational techniques for modeling particle beams and simulation of accelerator systems; novel acceleration concepts; the science of high gradients in accelerating cavities and structures; high-power radio-frequency sources; high-brightness beam sources; and beam instrumentation. Also of interest are superconducting materials and conductor development; innovative magnet design and development of high-field superconducting magnets; as well as associated testing and cryogenic systems. R&D proposals, which are focused on accelerator applications outside of high-energy physics, are now coordinated through the Accelerator Stewardship program and are outside the scope of this particular FOA.

Subprogram Contact: Lek (L. K.) Len, (301) 903-3233, lk.len@science.doe.gov
Website: http://science.energy.gov/hep/research

(g) Detector Research and Development in High Energy Physics

The detector R&D subprogram develops the next generation of instrumentation for HEP. It supports research leading to fundamental advances in the science of particle and radiation detection, and the development of new experimental techniques. This is typically long-term, "generic" R&D that is high-risk, but has the potential for wide applicability and/or high-impact. Proposals for "Blue-Sky" scientific research on innovative technologies not already in contention for implementation in future DOE HEP projects are specifically encouraged.

Topics studied in the detector R&D research area include, but are not limited to: low-mass, high channel density charged particle tracking detectors; high resolution, fast-readout calorimeters and particle identification detectors; techniques for improving the radiation tolerance of particle detectors; detectors for photons from ultraviolet to infrared wavelengths; detectors for cosmic microwave background radiation; detectors and experimental techniques for ultralow-background experiments; and advanced electronics and data acquisition systems. Support for graduate and postdoctoral research training, engineering and other technical efforts, and equipment and computational efforts required for experimental detector R&D and fabrication *is* included in this research area.

Subprogram Contact: Helmut Marsiske, (301) 903-6989, helmut.marsiske@science.doe.gov
Website: http://science.energy.gov/hep/research

6. Nuclear Physics (NP)
Program Website: http://science.energy.gov/np/

One of the enduring mysteries of the universe is the nature of matter—what are its basic constituents and how do they interact to form the properties we observe? The largest contribution by far to the mass of the matter we are familiar with comes from protons and heavier nuclei. The mission of the Nuclear Physics (NP) program is to discover, explore, and understand all forms of

nuclear matter. Although the fundamental particles that compose nuclear matter—quarks and gluons—are themselves relatively well understood, exactly how they interact and combine to form the different types of matter observed in the universe today and during its evolution remains largely unknown.

The priority areas for NP include the following:

- Understand how nucleons—protons and neutrons—combine to form atomic nuclei and how these nuclei have emerged since the origin of the cosmos.
- Using particle accelerators, illuminate the structure of the nucleon—the core building block of matter; understand how quarks and gluons assemble to form matter's core; and search for undiscovered forms of matter.
- Penetrate mysteries surrounding the fundamental properties of the neutron and the neutrino.
- Conceive, construct, and operate national scientific user facilities.
- Steward isotope development, production, and technologies for research and applications.

NP places a priority on supporting Program Directors and Principle Investigators who are active-career tenured or tenure-track faculty researchers to advance knowledge in nuclear science and effectively train and mentor the next generation of nuclear scientists.

To carry out its mission and address these priorities, the NP program addresses three broad, yet tightly interrelated, scientific thrusts:, Quantum Chromodynamics; Nuclei and Nuclear Astrophysics; and Fundamental Symmetries. NP supports basic research in six subprograms or areas: Medium Energy, Heavy Ion, Low Energy, Nuclear Theory, and Nuclear Data and Nuclear Theory Computing (a through e). The program is the steward of the DOE Isotope Program for the nation (f) and supports basic research in the development of the tools and capabilities to produce and process isotopes (g).

The NP subprograms and their objectives follow:

(a) Medium Energy Nuclear Physics

The Medium Energy Nuclear Physics subprogram focuses primarily on understanding the structure of hadrons, how quarks move within a hadron and tests of the theory of the strong interaction, known as Quantum Chromodynamics (QCD). According to QCD, all observed nuclear particles, collectively known as hadrons, arise from the strong interaction of quarks, antiquarks, and gluons. The protons and neutrons inside nuclei are the best known examples of hadrons. QCD, although difficult to solve computationally, predicts what hadrons exist in nature, and how they interact and decay. Specific questions addressed include: *What is the internal landscape of the protons and neutrons (collectively known as nucleons)? What does QCD predict for the properties of strongly interacting matter? What governs the transition of quarks and gluons into pions (hadronic subatomic particle) and nucleons? What is the role of gluons and gluon self-interactions in nucleons and nuclei?* The objectives of this subprogram are to develop a comprehensive picture of the spatial, momentum and angular momentum structure of the nucleon, elucidate quark confinement and hadron excitations, and understand the strong

interaction in nuclei. Various experimental approaches are used to determine the distribution of "up", "down", and "strange" quarks, their antiquarks, and gluons within protons and neutrons, as well as clarifying the role of gluons in confining the quarks and antiquarks within hadrons. Polarized electron and proton beams are typically used to study the effects of the quark and gluon spins within nucleons, and the effect of the nuclear environment on the quarks and gluons. The subprogram also supports experimental searches for higher-mass "excited state" and exotic hadrons predicted by QCD, as well as studies of their various production mechanisms and decay properties. In pursuing these topics, the Medium Energy subprogram supports experimental research at the subprogram's primary research facility, the Continuous Electron Beam Accelerator Facility (CEBAF) at the Thomas Jefferson National Accelerator Facility (TJNAF), and at other facilities, including the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory (BNL) and the High Intensity Gamma Source (HIGS) at the Triangle Universities Nuclear Laboratory (TUNL).

Subprogram Contact: Gulshan Rai, (301) 903-4702, Gulshan.Rai@science.doe.gov
Website: http://science.energy.gov/np/research/

(b) Heavy Ion Nuclear Physics

The Heavy Ion Nuclear Physics subprogram focuses on studies of condensed quark-gluon matter at extremely high densities and temperatures characteristic of the infant universe. In the aftermath of collisions at RHIC and at the LHC, researchers have seen signs of the same quark-gluon plasma that is believed to have existed shortly after the Big Bang. The goal is to explore and understand unique manifestations of QCD in this many-body environment and their influence on the universe's evolution. Important avenues of investigation are directed at resolving properties of the quark gluon plasma at different length scales and learning more about its physical characteristics including exploring the energy loss mechanism for quarks and gluons traversing the plasma, determining the speed of sound in the plasma, and locating the critical point for the transition between the plasma and normal matter. Experimental research is carried out primarily using the U.S. Relativistic Heavy Ion Collider (RHIC) facility and the Large Hadron Collider (LHC) at the European Organization for Nuclear Research (CERN).

Subprogram Contact: James Sowinski, (301) 903-7587, james.sowinski@science.doe.gov
Website: http://science.energy.gov/np/research/

(c) Low Energy Nuclear Physics

The Low Energy subprogram aims primarily at answering the overarching questions associated with the second frontier identified by NSAC— Nuclei and Nuclear Astrophysics. These questions include: *What is the nature of the nucleonic matter? What is the origin of simple patterns in complex nuclei? What is the nature of neutron stars and dense nuclear matter? What is the origin of the elements in the cosmos? What are the nuclear reactions that drive stars and stellar explosions?* Major goals of this subprogram are to develop a comprehensive description of nuclei across the entire nuclear chart, to utilize rare isotope beams to reveal new nuclear phenomena and structures unlike those that are derived from studies using stable ion beams, and to measure the cross sections of nuclear reactions that power stars and spectacular stellar

explosions and are responsible for the synthesis of the elements.

Subprogram Contact: Chris Gould, (301) 903-1963, Chris.Gould@science.doe.gov
Website: http://science.energy.gov/np/research/

(d) Fundamental Symmetries

This subprogram investigates aspects of the third frontier of Fundamental Symmetries and Neutrinos. Questions addressed in this frontier include: *What is the nature of the neutrinos, what are their masses, and how have they shaped the evolution of the universe? Why is there now more matter than antimatter in the universe? What are the unseen forces that were present at the dawn of the universe but disappeared from view as the universe evolved?* The subprogram seeks to measure, or set a limit on the neutrino mass and to determine if the neutrino is its own antiparticle. Experiments with cold neutrons also investigate the dominance of matter over antimatter in the universe, as well as other aspects of Fundamental Symmetries and Interactions.

Subprogram Contact: Paul Sorensen, (301) 903-1952, Paul.Sorensen@science.doe.gov
Website: http://science.energy.gov/np/research/

(e) Nuclear Theory

The Nuclear Theory subprogram provides the theoretical support needed to interpret the wide range of data obtained from the experimental nuclear science subprograms and to advance new ideas and hypotheses that identify potential areas for future experimental investigations. This subprogram addresses all of the field's scientific thrusts described in NSAC's long range plan, as well as the specific questions listed for the experimental subprograms above. Theoretical research on QCD (the fundamental theory of quarks and gluons) addresses the questions of how the properties of the nuclei, hadrons, and nuclear matter observed experimentally arise from this theory, how the phenomenon of quark confinement arises, and what phases of nuclear matter occur at high densities and temperatures. In Nuclei and Nuclear Astrophysics, theorists investigate a broad range of topics, including calculations of the properties of stable and unstable nuclear species, the limits of nuclear stability, the various types of nuclear transitions and decays, how nuclei arise from the forces between nucleons, and how nuclei are formed in cataclysmic astronomical events such as supernovae and neutron star mergers. In Fundamental Symmetries and Neutrinos, nucleons and nuclei are used to test the Standard Model, which describes the interactions of elementary particles at the most fundamental level. Theoretical research in this area is concerned with determining how various (beyond) Standard Model aspects can be explored through nuclear physics experiments, including the interactions of neutrinos, unusual nuclear transitions, rare decays, and high-precision studies of cold neutrons.

Subprogram Contact: George Fai, (301) 903-8954, george.fai@science.doe.gov
Website: http://science.energy.gov/np/research/

(f) Nuclear Data and Nuclear Theory Computing

The mission of the United States Nuclear Data Program (USNDP) is to provide current, accurate, authoritative data for workers in pure and applied areas of nuclear science and engineering. This is accomplished primarily through the compilation, evaluation, dissemination, and archiving of extensive nuclear datasets. The USNDP also addresses gaps in the data, through targeted experimental studies and the use of theoretical models. The USNDP involves the efforts of ~ 50 nuclear physicists at ~ 15 national labs, research centers, institutes and universities, and is an important resource for workers in a wide range of pure and applied topics in nuclear physics. Research opportunities in Nuclear Data include both experimental and theoretical work.

Nuclear Theory Computing supports research in nuclear physics with "extreme" computational requirements, which has been enabled by the advent of high performance computing (HPC). Funding for HPC-driven NP research is provided primarily through the programs Scientific Discovery through Advanced Computation (SciDAC) and the new Exascale Computing Project (ECP), through joint projects with the Office of Advanced Scientific Computing Research (ASCR). There are currently three NP SciDAC projects, which are five-year multisite collaborations on specific projects in computational nuclear physics, funded jointly by NP, ASCR, and the National Nuclear Security Administration (NNSA). These projects are closely aligned with the NP experimental program, and investigate 1) the properties of quark and gluon bound states and the QCD phase diagram using lattice QCD; 2) the properties of nuclei calculated using various approximate techniques, with applications including nuclear astrophysics; and 3) the QCD origins of nuclear forces, and their implications for NP. Some computational resources needed for the HPC research activities managed by NP are also provided by the National Energy Research Scientific Computing center (NERSC).

Subprogram Contact: Frank E. (Ted) Barnes, (301) 903-3212, ted.barnes@science.doe.gov
Website: http://science.energy.gov/np/research/

(g) Isotope Development and Production for Research and Applications

The mission of the Isotope Development and Production for Research and Applications subprogram (DOE Isotope Program) is to support isotope production and research into novel technologies for production of isotopes to assure availability of critical isotopes that are in short supply to address the needs of the Nation. The program provides facilities and capabilities for the production and/or distribution of research and commercial stable and radioactive isotopes. The scientific and technical staff associated with general isotope production and isotope production research are also supported. Isotopes are made available by using unique facilities stewarded by the DOE Isotope Program at Brookhaven National Laboratory, Los Alamos National Laboratory, and Oak Ridge National Laboratory. The Program also coordinates and supports isotope production at a suite of university, national laboratory, and other federal accelerator and reactor facilities throughout the Nation to promote a reliable supply of isotopes domestically. Topics of interest are focused on the development of advanced, cost-effective and efficient technologies for producing, processing, recycling and distributing isotopes in short supply. This includes technologies for production of radioisotopes using reactor and accelerator facilities and new technologies for enriching stable isotopes. Excluded from this solicitation are

proposals related to the production of Mo-99, as this isotope is under the purview of the NNSA Office of Materials Management and Minimization. A primary document currently guiding Isotope Program priorities is entitled "Meeting Isotope Needs and Capturing Opportunities for the Future: The 2015 Long Range Plan for the DOE-NP Isotope Program." This document may be accessed at http://science.energy.gov/~/media/np/nsac/pdf/docs/2015/2015_NSACI_Report_to_NSAC_Final.pdf.

Subprogram Contact: Dennis Phillips, (301) 903-7866, dennis.phillips@science.doe.gov
Website: http://science.energy.gov/np/research/

(h) Accelerator Research and Development for Current and Future Nuclear Physics Facilities

The Nuclear Physics program supports a broad range of activities aimed at research and development related to the science, engineering, and technology of heavy-ion, electron, and proton accelerators and associated systems. Areas of interest include R&D of technologies for the Brookhaven National Laboratory's Relativistic Heavy Ion Collider (RHIC), with heavy ion and polarized proton beams; linear accelerators such as the Continuous Electron Beam Accelerator Facility (CEBAF) at the Thomas Jefferson National Accelerator Facility (TJNAF); development of devices and/or methods that would be useful in the generation of intense rare isotope beams for the Facility for Rare Isotope Beams (FRIB) currently under construction at Michigan State University, and R&D in accelerator science and technology in support of next generation Nuclear Physics accelerator facilities such as an electron-ion collider (EIC).

Subprogram Contact: Manouchehr Farkhondeh, (301) 903-4398,
manouchehr.farkhondeh@science.doe.gov
Website: http://science.energy.gov/np/research/

Section II – AWARD INFORMATION

A. TYPE OF AWARD INSTRUMENT

DOE anticipates awarding grants and cooperative agreements under this FOA. If it is determined that a cooperative agreement is the appropriate award instrument, the nature of the Federal involvement will be included in a special award condition.

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

B. ESTIMATED FUNDING

It is anticipated that approximately $400 million will be available for DOE Office of Science new, renewal, continuing, and supplemental grant and cooperative agreement awards under this and other, more targeted FOAs in FY 2017, subject to the availability of FY 2017 appropriated funds. The amount of funding allocated under this specific FOA will be decided based on a number of factors, including peer review, the number of applications received, and the availability of appropriated 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

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

Ceiling
$ The largest award made under the Fiscal Year 2015 version of this FOA received no more than $4,000,000 in annual funding.

Floor
$ The smallest award made under the Fiscal Year 2015 version of this FOA received $2,000 in annual funding.

The ceiling and floor described in this FOA represent historical experience. Past practice is not an obligation to stay within the historic ceiling and floor for this open solicitation.

D. EXPECTED NUMBER OF AWARDS

The number of awards is subject to availability of FY 2017 appropriated funds. Historically, applications that arrive in response to the FOA have resulted in 200 to 350 new awards per year.

The exact number of awards will depend on the number of meritorious applications and the availability of appropriated funds.

E. ANTICIPATED AWARD SIZE

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

F. PERIOD OF PERFORMANCE

Awards are expected to be made for a project period of six months to five years as befitting the project, with the most common project period being three years in duration.

Continuation funding (funding for the second and subsequent budget periods) is contingent on: (1) availability of funds appropriated by Congress and future year budget authority; (2) progress towards meeting the objectives of the approved application; (3) submission of required reports; and (4) compliance with the terms and conditions of the award.

G. TYPE OF APPLICATION

DOE will accept new, renewal, and supplemental applications under this FOA.

For renewal applications only, the Principal Investigator is required to submit a Renewal Proposal Products section through the Office of Science's PAMS website at https://pamspublic.science.energy.gov. The Principal Investigator must enter into PAMS each product created during the course of the previous project period. Types of products include publications, intellectual property, technologies or techniques, and other products such as databases or software. As soon as the renewal application is assigned to a program manager, the Principal Investigator will receive an automated email from PAMS (<PAMS.Autoreply@science.doe.gov>) instructing him or her to navigate to the PAMS Task tab to complete and submit the Renewal Proposal Products. The submitted product list will be sent for merit review as part of the application. The application will not be considered complete and cannot be sent for review until the product list has been submitted.

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.

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 Program Director/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.

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-0001664) 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

Letters of intent are not required.

2. Pre-application

A pre-application (also called a white paper) is recommended but optional. Before submitting a pre-application, read the information in Section I of this FOA carefully to make sure your idea is responsive and to select the topical subprogram most relevant to your idea.

The pre-application should be concise (up to three pages), provide a summary of the proposed research, provide a list of proposed collaborators/co-investigators/consultants with their institutions, and contain brief biographical information of the principal investigator(s). Please also include an order-of-magnitude estimate of the proposed work's total cost.

You will be required to select a program manager when you submit your pre-application using the DOE Office of Science Portfolio Analysis and Management System (PAMS) website. Choose the subprogram contact for the topical area most relevant to your idea from those listed in Section I of this FOA.

Feedback from DOE to the principal investigator is optional, but you are encouraged to use your submitted pre-application/white paper to initiate a discussion with the listed program manager about the appropriateness of the proposed research for this solicitation.

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

Title of Preapplication
Principal Investigator Name, Job Title
Institution
PI Phone Number, PI Email Address
DOE/Office of Science Program Office:
Funding Opportunity Announcement Number: DE-FOA-0001664

The absence of a pre-application will not negatively affect a thorough evaluation of a responsive full application submitted in a timely fashion.

It is important that the pre-application be a single file with extension .pdf, .docx, or .doc. The filename should not exceed 50 characters. 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. For best results, please use Internet Explorer.

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

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

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-0001664.**

C. CONTENT AND APPLICATION FORMS

APPLICATION PREPARATION

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

You are required to use the compatible version of Adobe Reader software to complete a Grants.gov Adobe application package. To ensure you have the Grants.gov compatible version of Adobe Reader, visit the download software page at http://www.grants.gov/web/grants/applicants/adobe-software-compatibility.html.

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. Attached PDF files must be plain files consisting of text, numbers, and images without editable fields, signatures, passwords, redactions, or other advanced features available in some PDF-compatible software. Do not use PDF portfolios or binders.

Please note: you may only use the following UTF-8 characters when naming your application attachments: A-Z, a-z, 0-9, underscore (_), hyphen (-), space, period. You must limit the file name to 50 or fewer characters. Attachments that do not follow this rule may cause the entire application to be rejected or cause issues during processing.

APPLICATIONS FOR NEW AWARDS

A new application is one in which DOE support for the proposed research is being requested for the first time.

Applicants should contact the appropriate DOE Program Manager or see the SC Program Website to determine if additional, program-specific guidance and/or limitations exist for the submission of new applications.

APPLICATIONS FOR RENEWAL AWARDS

Renewal applications are requests for additional funding for a period subsequent to that provided by a current award. In preparing a renewal application, applicants should assume that reviewers will not have access to previous applications. The application should be developed as fully as though the applicant were applying for the first time. The application must include all the information required for a new project; additionally, the project narrative section should discuss the results from prior work.

Renewal applications must include the same forms and information categories as a new application, except for the following changes:

- Include under the project description section information on any changes that affect the overall direction of the research being pursued.
- Include an estimate of anticipated unexpended funds that will remain at the end of the current project period.
- Include a progress report as a separate section that describes the results of work accomplished through the date of the renewal application and how such results relate to the activities proposed to be undertaken in the renewal period.

A renewal application generally will be subjected to the Office of Science merit review requirements. Should an application be approved and funded, the extended period of support is treated as an extension of the original project period.

Applicants should contact the appropriate DOE Program Manager or see the SC Program Website to determine if additional, program-specific guidance and/or limitations exist for the submission of renewal applications.

For renewal applications only, the Principal Investigator is required to submit a Renewal Proposal Products section through the Office of Science's PAMS website at https://pamspublic.science.energy.gov. The Principal Investigator must enter into PAMS each product created during the course of the previous project period. Types of products include publications, intellectual property, technologies or techniques, and other products such as databases or software. As soon as the renewal application is assigned to a program manager, the Principal Investigator will receive an automated email from PAMS (<PAMS.Autoreply@science.doe.gov>) instructing him or her to navigate to the PAMS Task tab to complete and submit the Renewal Proposal Products. The submitted product list will be sent for merit review as part of the application. The application will not be considered complete and

cannot be sent for review until the product list has been submitted.

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 submitted into grants.gov: please refrain from attempting to submit the Renewal Proposal Products in PAMS until you receive an email with the subject line, "Receipt of Proposal 0000xxxxxx by the DOE Office of Science," providing the assignment of a program manager. Shortly thereafter, the PI will receive an email with the subject line, "DOE…Request to Submit Renewal Proposal Products for Proposal xxxxxx," indicating that the Renewal Proposal Products task is available for completion in PAMS.

APPLICATIONS FOR SUPPLEMENTAL AWARDS

Two types of supplemental applications may be submitted:

- If the grantee is requesting support for a new task or activity to be added to the approved project, a supplemental application shall contain the same information categories as a new application. These applications will undergo merit review and will compete for funding with other new applications.
- If the awardee needs additional funds:
    - for increased costs that could not have been predicted when the application was originally approved; or
    - to increase the "level of effort" or accelerate the project with no change to the project description as contained in the approved application.

A supplemental application, completed and submitted by the appropriate official, shall contain forms as instructed in Grants.gov and an explanation of the need for the additional funding.

Applicants should contact the appropriate DOE Program Manager or see the SC Program Website to determine if additional, program-specific guidance and/or limitations exist for the submission of supplemental applications.

COLLABORATIVE APPLICATIONS

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 collaborative group can have only one lead institution. Each application within the collaborative group, including the narrative and all required appendices and attachments, must be identical with the following exceptions:

- Each application must contain a correct SF-424 (R&R) cover page for the submitting institution only.
- Each application must contain a unique budget corresponding to the expenditures for that application's submitting institution only.
- Each application must contain a unique budget justification corresponding to the expenditures for that application's submitting institution only.

RESUBMISSION OF APPLICATIONS

Applications submitted under this FOA may be withdrawn from consideration by using the Office of Science's PAMS website at https://pamspublic.science.energy.gov. Applications may be withdrawn at any time between when the applicant submits the application and when DOE makes the application available to merit reviewers. Such withdrawals take effect immediately and cannot be reversed.

After an application is withdrawn, it may be resubmitted if this FOA is still open for the submission of applications.

Note that there may be a delay between the application's submission in Grants.gov and when it is available to be withdrawn in PAMS. The Office of Science will usually consider the last submission, according to its Grants.gov timestamp, to be the intended version. Please consult with your program manager to resolve any confusion about which version of an application should be considered.

IMPROPER CONTENTS OF APPLICATIONS

Applications submitted under this FOA will be stored in controlled-access systems, but they may be made publicly available if an award is made. As such, it is critical that applicants follow these guidelines:

- Do not include information subject to any legal restriction on its open distribution, whether classified, export control, or unclassified controlled nuclear information.
- Do not include sensitive and protected personally identifiable information, including social security numbers, birthdates, citizenship, marital status, or home addresses. Pay particular attention to the content of biographical sketches and curriculum vitae.
- Do not include letters of support from Federal officials.
- Do not include letters of support on Federal letterhead. Letters that are not letters of support (such as letters confirming access to sites, facilities, equipment, or data; or letters from cognizant contracting officers) may be on Federal letterhead.
- Clearly mark all proprietary or trade-secret information.

CHANGE OF AWARDEE INSTITUTION

If an awardee chooses to relinquish an award made under this FOA to permit the transfer of the award to a new institution, the new institution must submit an application under the then-available Office of Science "annual" or "open" FOA.

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.

DUNS AND EIN NUMBERS

The DUNS and EIN number fields on the SF-424 (R&R) form are used in PAMS to confirm the identity of the individual or organization submitting an application.

- Enter each number as a nine-digit number.
- Do not use hyphens or dashes.
- The Office of Science does not use the twelve-digit EIN format required by some other agencies.
- The Office of Science does not use the DUNS+4 format.

TYPE OF APPLICATION (FIELD 8)

A **new** application is one in which DOE support for the proposed research is being requested for the first time. A **renewal** application requests additional funding for a period of time following a current award. If the application requests a significant change in the scope of work, please consult with the Program contact identified in this FOA to determine if the application should be considered new or a renewal.

The Office of Science does not make use of the Resubmission, Continuation, or Revision options.

Applications for supplemental support of an existing award should be marked as "New."

Please answer "yes" to the question "Is this application being submitted to other agencies?" if substantially similar, identical, or closely related research objectives are being submitted to another Federal agency. Indicate the agency or agencies to which the similar objectives have been submitted.

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.,
Buy American Act	41 USC 10 et seq.
Cargo Preference Act	46 USC 55305, 46 CFR 381.7
Civil Rights Protections	10 CFR 1040
Debarment and Suspension	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
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.
Human Research Subjects Protections	10 CFR 745
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

Note concerning question 4.a. and 4.b.

If any environmental impact, positive or negative, is anticipated, indicate "yes" in response to question 4.a., "potential impact – positive or negative - on the environment." Disclosure of the impact should be provided in response to question 4.b. First indicate whether the impact is positive or negative and then identify the area of concern (e.g., air, water, exposure to radiation, etc.).

DOE understands the phrase in field 4.a., "potential impact … *negative*" to apply if the work described in the application could potentially have any of the impacts listed in (1) through (5) of 10 CFR 1021, Appendix B, Conditions that Are Integral Elements of the Classes of Action. (http://www.ecfr.gov)

Additionally, for actions which could have any other adverse impacts to the environment or have any possibility for adverse impacts to human health (e.g., use of human subjects, Biosafety Level 3-4 laboratory construction/operation, manufacture or use of certain nanoscale materials which are known to impact human health, or any activities involving transuranic or high level radioactive waste, or use of or exposure to any radioactive materials beyond de minimis levels), applicants should indicate a "negative" impact on the environment.

Lastly, if there would be 1) extraordinary circumstances (i.e., scientific or public controversy) related to the significance of environmental effects (10 CFR 1021.410 (b)(2)), 2) if the work is connected to other actions with potentially significant impacts (10 CFR 1021.410 (b)(3), or 3) if the work is related to other nearby actions with the potential for cumulatively significant impacts (10 CFR 1021.410 (b)(3)), applicants should indicate a "negative" impact on the environment.

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 coinvestigators 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. 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-0001664
- DOE/Office of Science Program Office (ASCR, BER, BES, FES, HEP, or NP):
- Topic Area*:
- Topic Area Program Manager (from Section I of this FOA):
- DOE Award Number (if Renewal or Supplemental Application):
- PAMS Preproposal tracking number (if applicable):

*****The topic area can be found in Part I, Supplementary Information, of this FOA. For example, the topic area might be Synthesis and Processing Science or Medium Energy Nuclear Physics. Please select from the list in Part I.

Important Instructions to the Sponsored Research Office of Submitting Institutions: The DOE Office of Science requires that you create one single PDF file that contains the DOE Cover Page, project narrative, biographical sketch, current and pending support, bibliography and references cited, facilities and other resources, equipment, data management plan, and other attachments. This single PDF file must be attached in Field 8 on the Grants.gov form. Do not attach any of the items listed in this paragraph separately in any other field in Grants.gov. If you do, these additional attachments will not become part of the application in PAMS.

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 collaborative group can have only one lead institution. Each application within the collaborative group, including the narrative and all required appendices and attachments, must be identical with the following exceptions:

- Each application must contain a correct SF-424 (R&R) cover page for the submitting institution only.
- Each application must contain a unique budget corresponding to the expenditures for that application's submitting institution only.
- Each application must contain a unique budget justification corresponding to the expenditures for that application's submitting institution only.

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.
- Provide a statement explaining the leadership structure of the collaboration.
- Include a description of each collaborating institution's facilities, equipment, and resources that will be made available to the collaborative group.

- If applicable, explain how students and junior researchers will be trained and mentored by the collaborators.
- Include a table modeled on the following chart providing summary budget information from all collaborating institutions. Provide the total costs of the budget request in each year for each institution and totals for all rows and columns.

Collaborative Application Information						
	Names	**Institution**	**Year 1 Budget**	**…**	**Year 5 Budget**	**Total Budget**
Lead PI						
Co-PI						
Co-PI						
Co-PI						

Example budget table ($ in thousands)

* Note that collaborating applications must be submitted separately.

PROJECT NARRATIVE (FIELD 8 ON THE FORM)

The project narrative consists 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.

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."

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. There should be no ambiguity about which personnel will perform particular parts of the project or the time at which these activities will take place.

For Collaborative Proposals Only: Each collaborating institution must submit an identical common narrative. Collaborative proposals will necessarily be longer than single-institution proposals. The common narrative must identify which tasks and activities will be performed by which of the collaborating institutions in every budget period of the proposed project. The budget and the budget justification—which are unique to each collaborating institution—may refer to parts of the

common narrative to further identify each collaborating institution's activities in the joint project. There should be no ambiguity about each institution's role and participation in the collaborative group.

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.

Do not attach any of the requested appendices described below as files for fields 9, 10, 11, and 12 in Grants.gov. Follow the below instructions to include the information as appendices in the single, bundled project narrative file.

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 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 and protected personally identifiable information such as a Social Security Number, birthdates, citizenship, marital status, or home addresses. Pay particular attention to the content of biographical sketches and curriculum vitae. 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. List all sponsored activities or awards requiring a measurable commitment of effort, whether paid or unpaid.
For every activity, list the following items:

- The sponsor of the activity or the source of funding
- The award or other identifying number
- The title of the award or activity
- The total cost or value of the award or activity, including direct and indirect costs. For pending proposals, provide the total amount of requested funding.
- The person-months of effort per year being dedicated to the award or activity

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.

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.

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. Please provide the Facility and Other Resource information as an appendix to your project narrative.

- Do not attach a separate file.

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.

APPENDIX 6: DATA MANAGEMENT PLAN

Provide a Data Management Plan (DMP) that addresses the following requirements:

1. DMPs should describe whether and how data generated in the course of the proposed research will be shared and preserved. If the plan is not to share and/or preserve certain data, then the plan must explain the basis of the decision (for example, cost/benefit considerations, other parameters of feasibility, scientific appropriateness, or limitations discussed in #4). At a minimum, DMPs must describe how data sharing and preservation will enable validation of results, or how results could be validated if data are not shared or preserved.
2. DMPs should provide a plan for making all research data displayed in publications resulting from the proposed research open, machine-readable, and digitally accessible to the public at the time of publication. This includes data that are displayed in charts, figures, images, etc. In addition, the underlying digital research data used to generate the displayed data should be made as accessible as possible to the public in accordance with the principles stated in the Office of Science Statement on Digital Data Management (http://science.energy.gov/funding-opportunities/digital-data-management/). This requirement could be met by including the data as supplementary information to the published article, or through other means. The published article should indicate how these data can be accessed.
3. DMPs should consult and reference available information about data management resources to be used in the course of the proposed research. In particular, DMPs that explicitly or implicitly commit data management resources at a facility beyond what is

conventionally made available to approved users should be accompanied by written approval from that facility. In determining the resources available for data management at Office of Science User Facilities, researchers should consult the published description of data management resources and practices at that facility and reference it in the DMP. Information about other Office of Science facilities can be found in the additional guidance from the sponsoring program.

4. DMPs must protect confidentiality, personal privacy, Personally Identifiable Information, and U.S. national, homeland, and economic security; recognize proprietary interests, business confidential information, and intellectual property rights; avoid significant negative impact on innovation, and U.S. competitiveness; and otherwise be consistent with all applicable laws, and regulations. There is no requirement to share proprietary data.
5. Applications must meet the published additional requirements of the program office to which the application is submitted, as identified on the DOE Cover Page of the application. Program office requirements will be considered during merit review and award selection. Advanced Scientific Computing Research (ASCR) and Biological and Environmental Research (BER) have published additional requirements, available through http://science.energy.gov/funding-opportunities/digital-data-management/. If an application is transferred between program offices, an opportunity to withdraw and resubmit the application will be offered.

DMPs will be reviewed as part of the overall Office of Science research proposal merit review process. Applicants are encouraged to consult the Office of Science website for further information and suggestions for how to structure a DMP: http://science.energy.gov/funding-opportunities/digital-data-management/

Office of Science program offices may provide additional guidance, available through http://science.energy.gov/funding-opportunities/digital-data-management/. Compliance with a program office's additional guidance will not be considered during merit review and award selection.

DMPs are NOT required for conference or workshop applications.

DMPs are required for all New and Renewal applications submitted to this FOA.

DMPS are required for supplemental applications that expand the scope of work beyond that of the originally funded project. Supplemental application DMPs should address the research products of the expanded, supplemental research scope.

- This appendix should not exceed 2 pages 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)
- Do not attach a separate file.

APPENDIX 7: 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. Reviewers are not required to consider information in this appendix.

- Do not attach a separate file.

- **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.**
- **Do not attach any files to fields 9, 10, 11, or 12.**

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).

The following advice will improve the accuracy of your budget request:

- Funds requested for personnel (senior, key, and other) must be justified as the product of their effort on the project and their institutional base salary.
- Funds requested for fringe benefits must be calculated as the product of the requested salary and, if present, the negotiated fringe benefit rate contained in an institution's negotiated indirect cost rate agreement.
- Funds requested for indirect costs must be calculated using the correct indirect cost base and the negotiated indirect cost rate.
- You are encouraged to include the rate agreement used in preparing a budget as a part of the budget justification.

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 proposal budgeting only and differs from the DOE definition of capital equipment.) List **each** item of equipment separately and justify each in the budget justification section. 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.
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 proposal budget may request funds for the costs of documenting, preparing, publishing or otherwise making available to others the findings and products of the work conducted under the award. In the budget justification, include supporting information. 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 R&R budget for each subawardee. 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.pdf) as the file name (e.g., ucla.pdf or energyres.pdf). Filenames should not exceed 50 characters.

If the project involves more subawardees than there are places in the SUBAWARD BUDGET ATTACHMENT(S) FORM, the additional subaward budgets may be saved as PDF files and appended to the Budget Justification attached to Field K.

Ensure that any files received from subawardees are the PDF files extracted from the SUBAWARD BUDGET ATTACHMENT(S) FORM. Errors will be created if a subawardee sends a prime applicant a budget form that was not extracted from the application package.

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
- Environmental Information

E. SUBMISSION DATES AND TIMES

1. Letter of Intent Due Date

None

2. Pre-application Due Date

None

3. Application Due Date

This FOA will remain open until March 23, 2018, 11:59 PM Eastern Time, or until it is succeeded by another issuance, whichever occurs first. This Annual FOA DE-FOA-0001664 succeeds FOA DE-FOA-0001414, which was published October 1, 2015.

Applications for conference or workshop support must be submitted at least six months before the meeting date and no later than April 1, 2017, to be considered for FY 2017 funding.

Renewal applications compete with all other applications and must be submitted through Grants.gov at least six months before the scheduled expiration of the current award's project period. Earlier submission is strongly encouraged to allow for timely processing.

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 2 CFR 200 as modified by 2 CFR 910 (DOE Financial Assistance Regulation).

Pre-award Costs: Recipients may charge to an award resulting from this FOA 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 2 CFR 200 as modified by 2 CFR 910 (DOE Financial Assistance Regulation). 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. Systems to Register In

There are several one-time actions you must complete in order to submit an application in response to this FOA. 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.pdf. SAM maintains a complete user guide at https://www.sam.gov/sam/SAM_Guide/SAM_User_Guide.htm.

Applicants must provide a Taxpayer Identification Number (TIN) to complete their registration in SAM.gov. An applicant's TIN is an Employer Identification Number (EIN) assigned by the Internal Revenue Service (IRS). In limited circumstances, a Social Security Number (SSN) assigned by the Social Security Administration (SSA) may be used as a TIN. You may obtain an EIN from the IRS at http://www.irs.gov/Businesses/Small-Businesses-%26-Self-Employed/Apply-for-an-Employer-Identification-Number-(EIN)-Online.

DOE discourages the use of a SSN as a TIN. You are encouraged to obtain a TIN from the Internal Revenue Service (IRS) using the website listed above.

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.

2. 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

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/web/grants/applicants/organization-registration/step-4-aor-authorization.html useful.

Grants.gov maintains a User Guide at http://www.grants.gov/help/html/help/table_of_contents.htm 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**.

FIRST-TIME REGISTRATION PROCESS IN GRANTS.GOV

You must complete the one-time registration process (all steps) before you can submit your first application through www.grants.gov. (See http://www.grants.gov/web/grants/applicants/organization-registration.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/learn-grants/grants-101/getting-started-checklist.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

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).

3. Where to Submit an Application

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

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.)

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.

4. 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. For best results, please use Internet Explorer.

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 to 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.

Collection of demographic data such as gender, race, and ethnicity allows the DOE Office of Science to gauge whether its programs and opportunities are fairly reaching and benefiting everyone regardless of demographic category. Knowledge of the demographic distributions within a portfolio, particularly those collected over many years, allows assessments of trends and demonstrates responses to actions taken on the part of agencies. To gather the information needed, we ask that registrants provide the demographic information requested in their PAMS user profiles. Submission of the requested information is voluntary and is not a precondition of award.

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-0001664.

5. 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 Proposal 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 submitted into 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. For best results, please use Internet Explorer.

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 application): 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-0001664.**

Section V - APPLICATION REVIEW INFORMATION

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, and (5) the proposed project is not duplicative of programmatic work. 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; and
- Reasonableness and Appropriateness of the Proposed Budget.

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

SCIENTIFIC AND/OR TECHNICAL MERIT OF THE PROPOSED RESEARCH

- What is the scientific innovation of proposed research?
- What is the likelihood of achieving valuable results?
- How might the results of the proposed work impact the direction, progress, and thinking in relevant scientific fields of research?
- How does the proposed work compare with other efforts in its field, both in terms of scientific and/or technical merit and originality?
- Is the Data Management Plan suitable for the proposed research and to what extent does it support the validation of research results?

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?

COMPETENCY OF APPLICANT'S PERSONNEL AND ADEQUACY OF PROPOSED RESOURCES

- What is the past performance and potential of the Principal Investigator (PI)?
- How well qualified is the research team to carry out 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?

REASONABLENESS AND APPROPRIATENESS OF THE PROPOSED BUDGET

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

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://science.energy.gov/grants/policy-and-guidance/merit-review-system/.

2. Program Policy Factors

The Selection Officials may consider any of the following Program Policy Factors in making the selection.

- Availability of funds
- Relevance of the proposed activity to Office of Science priorities and programmatic needs.
- Ensuring an appropriate balance of activities within Office of Science programs
- Past performance

3. Selection

The Selection Officials will consider the findings of the Merit Review and may consider any of the Program Policy Factors described above.

4. Review of Risk

Pursuant to 2 CFR 200.205, DOE will conduct an additional review of the risk posed by applications submitted under this FOA. Such review of risk will include:

- Technical merit of the application,

- Reports and findings from audits performed under 2 CFR 200 or OMB Circular A-133, and
- Systems maintained under 2 CFR 180, including the SAM "Exclusions" and "Do Not Pay" systems.

DOE may make use of other publicly available information and the history of an applicant's performance under DOE or other Federal agency awards.

Applicants with no prior performance of DOE awards may be asked to provide information about their financial stability and or their ability to comply with the management standards of 2 CFR 200.

REPORTING OF MATTERS RELATED TO RECIPIENT INTEGRITY AND PERFORMANCE (DECEMBER 2015)

DOE, prior to making a Federal award with a total amount of Federal share greater than the simplified acquisition threshold, is required to review and consider any information about the applicant that is in the designated integrity and performance system accessible through SAM (currently FAPIIS) (see 41 U.S.C. 2313); The applicant, at its option, may review information in the designated integrity and performance systems accessible through SAM and comment on any information about itself that a Federal awarding agency previously entered and is currently in the designated integrity and performance system accessible through SAM; DOE will consider any written comments by the applicant, in addition to the other information in the designated integrity and performance system, in making a judgment about the applicant's integrity, business ethics, and record of performance under Federal awards when completing the review of risk posed by applicants as described in §200.205 Federal awarding agency review of risk posed by applicants.

5. 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 2 CFR 200 as modified by 2 CFR 910 (DOE Financial Assistance Regulation); 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

The DOE Office of Science aims to make award selection within six months. The time interval begins on the date the application is received.

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) 2 CFR 200 as modified by 2 CFR 910 (DOE Financial Assistance Regulation); (5) National Policy Assurances To Be Incorporated As Award Terms; (6) Budget Summary; and (7) Federal Assistance Reporting Checklist, which identifies the reporting requirements.

For grants and cooperative agreements made to universities, non-profits and other entities subject to Title 2 CFR, awards made under this funding opportunity should include the government-wide Research Terms and Conditions. A new version of the Terms and Conditions based on the changes to 2 CFR 200 is not yet available. Once the Terms and Conditions become available, they will be located at http://www.nsf.gov/bfa/dias/policy/rtc/index.jsp If an award is made under this funding opportunity before the Terms and Conditions are posted, alternative Terms and Conditions may be included in the award.

B. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS

1. Administrative Requirements

The administrative requirements for DOE grants and cooperative agreements are contained in 2 CFR 200 as modified by 2 CFR 910 (DOE Financial Assistance Regulation).

NONDISCLOSURE AND CONFIDENTIALITY AGREEMENTS REPRESENTATIONS (JUNE 2015)

In submitting an application in response to this FOA the Applicant represents that:

(1) It **does not and will not** require its employees or contractors to sign internal nondisclosure or confidentiality agreements or statements prohibiting or otherwise restricting its employees or contactors from lawfully reporting waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information.

(2) It **does not and will not** use any Federal funds to implement or enforce any nondisclosure and/or confidentiality policy, form, or agreement it uses unless it contains the following provisions:

a. *''These provisions are consistent with and do not supersede, conflict with, or otherwise alter the employee obligations, rights, or liabilities created by existing statute or Executive order relating to (1) classified information, (2) communications to Congress, (3) the reporting to an Inspector General of a violation of any law, rule, or regulation, or mismanagement, a gross waste of funds, an abuse of authority, or a substantial and specific danger to public health or safety, or (4) any other whistleblower protection. The definitions, requirements, obligations, rights, sanctions, and liabilities created by controlling Executive orders and statutory provisions are incorporated into this agreement and are controlling.''*

b. The limitation above shall not contravene requirements applicable to Standard Form 312, Form 4414, or any other form issued by a Federal department or agency governing the nondisclosure of classified information.

c. Notwithstanding provision listed in paragraph (a), a nondisclosure or confidentiality policy form or agreement that is to be executed by a person connected with the conduct of an intelligence or intelligence-related activity, other than an employee or officer of the United States Government, may contain provisions appropriate to the particular activity for which such document is to be used. Such form or agreement shall, at a minimum, require that the person will not disclose any classified information received in the course of such activity unless specifically authorized to do so by the United States Government. Such nondisclosure or confidentiality forms shall also make it clear that they do not bar disclosures to Congress, or to an authorized official of an executive agency or the Department of Justice, that are essential to reporting a substantial violation of law.

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.

SUBAWARD AND EXECUTIVE REPORTING

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://energy.gov/management/office-management/operational-management/financial-assistance/financial-assistance-forms under Award Terms.

4. Statement of Substantial Involvement

Either a grant or cooperative agreement may be awarded under this FOA. If the award is a cooperative agreement, the DOE contract specialist and DOE project officer will negotiate a Statement of Substantial Involvement prior to award.

5. Additional Conditions

CONFERENCE SPENDING (FEBRUARY 2015)

The recipient shall not expend any funds on a conference not directly and programmatically related to the purpose for which the grant or cooperative agreement was awarded that would defray the cost to the United States Government of a conference held by any Executive branch department, agency, board, commission, or office for which the cost to the United States Government would otherwise exceed $20,000, thereby circumventing the required notification by the head of any such Executive Branch department, agency, board, commission, or office to the Inspector General (or senior ethics official for any entity without an Inspector General), of the date, location, and number of employees attending such conference.

CORPORATE FELONY CONVICTION AND FEDERAL TAX LIABILITY REPRESENTATIONS (MARCH 2014)

In submitting an application in response to this FOA the Applicant represents that:

- It is **not** a corporation that has been convicted of a felony criminal violation under any Federal law within the preceding 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.

For purposes of these representations the following definitions apply:

- A Corporation includes any entity that has filed articles of incorporation in any of the 50 states, the District of Columbia, or the various territories of the United States [but not foreign corporations]. It includes both for-profit and non-profit organizations.

PUBLICATIONS

The recipient is expected to publish or otherwise make publicly available the results of the work conducted under any award resulting from this Funding Opportunity Announcement. Publications and other methods of public communication describing any work based on or developed under an award resulting from this Funding Opportunity Announcement must contain an acknowledgment of DOE Office of Science support. The format for such acknowledgments is provided at http://science.energy.gov/funding-opportunities/acknowledgements/. The author's copy of any peer-reviewed manuscript accepted for funding must be announced to DOE's Office of Scientific and Technical Information and made publicly available in accordance with the instructions contained in the Reporting Requirements Checklist incorporated in all Assistance Agreements.

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-0001664.**

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	Questions regarding the specific program areas/technical requirements should be directed to the point of contact listed for each program office within the FOA

Section VIII - OTHER INFORMATION

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

(a) A DOE financial assistance award is valid only if it is in writing and is signed, either in writing or electronically, by a DOE Contracting Officer.

(b) Recipients are free to accept or reject the award. A request to draw down DOE funds constitutes the Recipient's acceptance of the terms and conditions of this Award.

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."

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 agreement 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/services/technology-transfer-and-procurement/office-assistant-general-counsel-technology-transf-1.

Domestic small businesses and domestic nonprofit organizations will receive the patent rights permitting the retention oftitle 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.

J. ENVIRONMENTAL, SAFETY AND HEALTH (ES&H) PERFORMANCE OF WORK AT DOE FACILITIES

With respect to the performance of any portion of the work under this award which is performed at a DOE-owned or controlled site, the recipient agrees to comply with all state and Federal ES&H regulations, and with all other ES&H requirements of the operator of such site. The recipient shall apply this provision to all subawardees at any tier.

K. FEDERAL, STATE, AND LOCAL REQUIREMENTS

With respect to the performance of any portion of the work under this award, the recipient agrees to comply with all applicable local, state, and Federal ES&H regulations. The recipient shall apply this provision to all sub awardees at any tier.

L. NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) COMPLIANCE

If question 4.a. on the "Research and Related Other Project Information" document indicates "potential impact on the environment", or if DOE's own review indicates it, DOE may ask the applicant to provide additional information on those impacts in order to prepare an environmental critique/synopsis per 10 CFR 1021.216. Note that this pre-award environmental critique/synopsis process would be separate from the preparation of a NEPA document such as an environmental impact statement (EIS) or an environmental assessment (EA). If DOE determines the latter documentation is necessary, this process would need to be completed, funded by and with the participation of the awardee, prior to them taking any action on the proposed project that could have adverse environmental effects or that could limit the choice of reasonable alternatives. The inability to satisfy the NEPA requirements after an award would result in cancellation of the award. Note that in most cases, even where potential impact on the environment exists, preparation of such NEPA documents is rarely necessary, but DOE has the expectation that the Applicant will disclose the potential, which would serve to initiate dialog with DOE if necessary. Should the applicant have any uncertainty, they should check "yes."