FINANCIAL ASSISTANCE
FUNDING OPPORTUNITY ANNOUNCEMENT

U. S. Department of Energy

Idaho Operations Office

Fiscal Year 2013 Consolidated Innovative Nuclear Research

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Pre-Application Due Date:	**January 28, 2013 at 8:00 PM ET**
Application Due Date:	**June 12, 2013 at 8:00 PM ET**

List of Acronyms

ARC - Advanced Reactor Concepts
ATR - Advanced Test Reactor
CFDA - Catalog of Federal Domestic Assistance
CFP - Call for Full Proposal
CFR - Code of Federal Regulations
COI - Conflict of Interest
DOE - Department of Energy
EPAct - Energy Policy Act of 2005
FC R&D - Fuel Cycle Research and Development
FDO - Federal Demonstration Partnership
FFATA - Federal Funding and Transparency Act of 2006
FFRDC- Federally Funded Research and Development Center
FOA - Funding Opportunity Announcement
FSRS - FFATA Subaward Reporting System
GOGO - Government Owned/Government Operated
GSI - General Scientific Infrastructure
ICHMI - Instrumentation, Control, Human, Machine Interface
ID - Identification
IRP - Integrated Research Projects
LWRS - Light Water Reactor Sustainability
M&O - Management and Operating
MOOSE - Multiphysics Object Oriented Simulation Environment
MS - Mission Supporting
MSI - Minority Serving Institution
NE - Office of Nuclear Energy
NEAMS - Nuclear Energy Advanced Modeling and Simulation
NEET - Nuclear Energy Enabling Technologies
NEUP - Nuclear Energy University Programs
NGNP - Next Generation Nuclear Plant Demonstration Project
NSUF - National Scientific User Facility
NNSA - National Nuclear Security Administration
NPPs - Nuclear Power Plants
PD - Program Directed
PDF - Adobe Portable Document Format
PIE - Post-irradiation Examination
PI - Principal Investigator
POC - Point of Contact
QA - Quality Assurance
R&D - Research and Development
RC RD&D - Reactor Concepts Research, Development and Demonstration
RPA - Request for Pre-proposal
RPS - Radioisotope Power Systems
RPV - Reactor Pressure Vessel
SAM - System for Award Management
SBIR - Small Business Innovative Research
SF - Standard Form
SMR - Small Modular Reactors
STTR - Small Business Technology Transfer
TAC - Total Allowable Costs
TIO - Technical Integration Office
TMI-2 - Three Mile Island Unit 2

PART I – FUNDING OPPORTUNITY DESCRIPTIONS

A. STATEMENT OF OBJECTIVES

Background and Objectives

The Department of Energy's (DOE) Office of Nuclear Energy (NE) conducts crosscutting nuclear energy research and development (R&D) and associated infrastructure support activities to develop innovative technologies that offer the promise of dramatically improved performance for advanced reactors and fuel cycle concepts while maximizing the impact of DOE resources.

NE funds research activities through both competitive and direct mechanisms, as required to best meet the needs of NE. These efforts are essential to balancing NE's R&D portfolio and encouraging new nuclear power deployment with creative solutions to the universe of nuclear energy challenges.

The competitive portion of NE's R&D portfolio is accomplished in part by promoting integrated and collaborative research conducted by university, industry, international and national laboratory partners under the direction of NE's programs: e.g., Nuclear Energy University Programs (NEUP); elements of the Nuclear Energy Enabling Technologies (NEET) Crosscutting Technology Development Program; the Advanced Test Reactor (ATR) National Scientific User Facility (NSUF); and NE's participation in Small Business Innovative Research (SBIR) / Small Business Technology Transfer (STTR).

Specifically, NE designates up to 20 percent of funds appropriated to its R&D programs for R&D and infrastructure support at university and research institutions through open, competitive solicitations. Additionally, through the NEET Crosscutting Technology Development Program, NE provides direct and competitive awards for university, industry and national laboratory-led research that crosscuts the NE R&D portfolio.

The primary objective of consolidating fiscal year (FY) 2013 competitive research sought by NE in the area of innovative nuclear research into a single Funding Opportunity Announcement (FOA) is to promote efficiency and the effective use of resources.

NE reserves the right to respond to potential shifts in R&D priorities during FY 2013 that may be driven by events, policy developments, or Congressional/budget direction. NE will factor such considerations into decisions related to the timing and scale of award announcements associated with this FOA.

> **NOTE:** DOE has established as policy that university principal investigators (PIs) who request and receive approved no-cost extensions to existing NE R&D projects will be ineligible to be PIs for new project awards while any no-cost extension remains in effect. In order to provide ample planning time for prospective applicants, this policy will be implemented as follows: Commencing April 1, 2013, university PIs who request and ultimately receive a no-cost extension to any currently-funded NE R&D project will be ineligible as a PI for an award under this FOA if the project completion date is extended beyond September 30, 2013. University PIs with an approved no-cost extension prior to April 1, 2013 will still be eligible to receive an award under this FOA.

Major NE-Funded Research Programs

Fuel Cycle Research and Development (FC R&D) Program. The mission of the FC R&D program is to develop used nuclear fuel management strategies and technologies to support meeting the federal government responsibility to manage and dispose of the Nation's commercial used nuclear fuel and high-level waste and to develop sustainable fuel cycle technologies and options that improve resource utilization and energy generation, reduce waste generation, enhance safety, and limit proliferation risk. The program vision is that by mid-century, strategies and technologies for the safe long-term management and eventual disposal of U.S. commercial used nuclear fuel and any associated nuclear wastes have been

fully implemented. Advanced nuclear fuel and fuel cycle technologies that enhance the accident tolerance of light-water reactors and enable sustainable fuel cycles are demonstrated and deployed. Together, these technologies and solutions support the enhanced availability, affordability, safety, and security of nuclear-generated electricity in the U.S.

Current challenges include the development of high burnup fuel and cladding materials to withstand irradiation for longer periods of time with improved accident tolerance; development of simplified separations, waste management (including storage, transportation, and disposal), and proliferation risk reduction methods; and development of processes and tools to evaluate sustainable fuel cycle system options and to effectively communicate the results of the evaluation to stakeholders.

Reactor Concepts Research, Development and Demonstration (RC RD&D) Program. The mission of the RC RD&D program is to develop new and advanced reactor designs and technologies that broaden the applicability, improve the competitiveness, and ensure the lasting contribution toward meeting our Nation's energy and environmental challenges. Research activities are designed to address the technical, cost, safety, and security issues associated with various reactor concepts. The four technical areas are Light Water Reactor Sustainability (LWRS), Small Modular Reactors (SMR), Next Generation Nuclear Plant Demonstration Project (NGNP), and Advanced Reactor Concepts (ARC). In addition, R&D for the manufacturing of radioisotope power systems for national security and space exploration missions is supported through the Space and Defense Infrastructure Program.

Nuclear Energy Advanced Modeling and Simulation (NEAMS) Program. The mission of the NEAMS program is to create modern computer simulation methods that apply state-of-the-art physics models to powerful multi-processing computers in order to better understand the behavior of nuclear reactor and fuel systems during normal operations and/or transient events. In particular, NEAMS is aimed at creating a toolkit for use by reactor and fuel system designers and researchers who are interested in advanced designs. The NEAMS Toolkit will be capable of answering important safety and economics questions on the operability of the next generation of advanced reactor and fuel systems. It will provide much higher fidelity than current methods and incorporate well-defined and validated prediction capabilities.

This will be achieved by employing advanced software environments and modern high-performance computers to create a set of engineering-level codes in which fuels and materials continuum properties are informed by first-principles modeling of materials at the atomistic and meso scale. A set of simulation tools will be developed that promote interoperability of codes with respect to spatial meshing, materials and fuels models, and achieve a common "look and feel" for setting up problems and displaying results. The tool set to be developed aims to achieve scalability in terms of computing power and the types and couplings of the physics that dominates the system behavior.

Nuclear Energy Enabling Technologies (NEET) Crosscutting Technology Development Program. The NEET Crosscutting Technology Development program conducts R&D in crosscutting technologies that directly support and enable the development of new and advanced reactor designs and fuel cycle technologies. These technologies will advance the state of nuclear technology, improving its competitiveness and promoting continued contribution to meeting our Nation's energy and environmental challenges. The activities undertaken in this program complement those within the RC RD&D and FC R&D programs. The knowledge generated through these activities will allow NE to address key challenges affecting nuclear reactor and fuel cycle deployment with a focus on cross-cutting reactor materials, advanced methods for manufacturing, and new instrumentation and sensor technologies.

B. FUNDING OPPORTUNITIES

Through an open, competitive solicitation process, DOE is seeking applications from United States (U.S.) University PIs to conduct nuclear energy-related research in support of the major NE-funded research programs as described herein and as detailed in Sections A & C and Appendices A & C. In addition, DOE is seeking applications for projects led by industry, national laboratory, or U.S. university PIs to conduct R&D in support of the NEET Crosscutting Technology Development Program as described herein and detailed in

Section B and Appendix B. Specifically, research proposals are sought to conduct *Program Supporting* and *Mission Supporting* R&D in the areas of FC R&D, RC RD&D, NEAMS, and NEET Crosscutting Technology Development, while research proposals are sought to conduct *Program Directed* R&D in the area of RC RD&D.

This FOA is divided into the following three Sections:

- Section A – Solicits Program and/or Mission Supporting projects to be led by U.S. university PIs (workscopes found in Appendix A)
- Section B – Solicits Program and/or Mission Supporting projects to be led by U.S. university, national laboratory, or industry PIs (workscopes found in Appendix B)
- Section C – Solicits Program Directed Integrated Research Project (IRP) to be led by U.S. university PIs (workscopes found in Appendix C)

Descriptive workscopes for each section are detailed in Appendices A, B, & C. Eligible lead applicant institutions are illustrated in Table 1.

Table 1. Eligible Lead Applicant Institutions

	U.S. University PI Led Only	U.S. University, National Laboratory, or Industry, PI Led
Section A	**X**	
Section B		**X**
Section C	**X**	

NOTE: U.S. universities, national laboratories, and industry may collaborate on teams applying to all Sections (A, B & C) within the guidelines provided in each Section.

1. Program Supporting R&D - (Sections A & B)

Program supporting (PS) R&D is focused more directly on programmatic needs and is defined by the workscope statements developed by the responsible programs. This R&D is up to three years in duration and should be focused and responsive to the representative workscope statements, which are not specific to a discipline but can be limiting as defined by scope objective.

2. Mission Supporting (MS) R&D - (Section A)

Mission Supporting (MS) R&D is generally more creative, innovative, and transformative, but must also support the NE mission. Mission supporting activities up to three years in duration that could produce breakthroughs in nuclear technology are also invited in response to this solicitation, including research in the fields or disciplines of nuclear science and engineering that are relevant to NE's mission but may not fully align with the specific initiatives and programs identified in this solicitation.

3. Program Directed R&D: Integrated Research Projects (IRPs) – (Section C)

IRPs comprise a significant element of DOE's innovative nuclear research objectives and represent the Program Directed (PD) component of the NE strategy to provide R&D solutions that are most directly relevant to the near-term, significant needs of the NE R&D programs. IRPs are significant projects within specific research areas. IRPs are up to three years in duration and intended to develop a capability within each area to address specific needs, problems, or capability gaps identified and defined by NE. These projects are multidisciplinary and require multi-institutional partners. IRPs may include a combination of evaluation capability development, research program development, experimental work, and computer simulations.

Note: The funding opportunities in all areas of this FOA are for U.S. based researchers/organizations only. Foreign organizations are encouraged to collaborate as long as they comply with applicable DOE

and Federal requirements including but not limited to not being a denied Person or a Person that requires an export license; however, such participants are not eligible for U.S. government funding.

C. RELATED COLLABORATIVE FUNDING OPPORTUNITIES

Successful execution of an R&D project may be enhanced by the use of irradiation and/or post-irradiation examination (PIE) capabilities available at universities and in government facilities such as research reactors and DOE user facilities. Additionally, new equipment purchases by a university may enhance execution of an R&D project. Therefore, opportunities exist to leverage R&D projects as outlined below.

1. *Advanced Test Reactor (ATR) National Scientific User Facility (NSUF)*. In addition to the research solicited herein, DOE-NE supports research through the ATR NSUF (http://atrnsuf.inl.gov/) which provides access to a variety of capabilities needed by researchers for experiments. However, ATR NSUF research awards, like all DOE user facilities, only cover the cost of the facilities and associated staff support, not the time needed to prepare the project and perform the research. In order to help address this issue and provide other benefits to the nuclear community while enhancing nuclear research, NE is facilitating the ability of researchers to coordinate and enhance their research proposals provided in response to this solicitation with facility/capability access requests made to the ATR NSUF, as appropriate and as described below.

   Researchers may submit proposals in response to Sections A and B of this FOA that also require the capabilities of ATR NSUF. Researchers may also submit a separate proposal to ATR NSUF (http://atrnsuf.inl.gov/) to request related ATR NSUF capabilities. Proposals submitted through this joint solicitation will be reviewed and ranked by both organizations. As funding permits, proposals scored the highest by both reviews will be funded as well as have access to required ATR NSUF capabilities.

   > **NOTE:** These projects must be mature projects that require immediate access, within one year, to ATR NSUF facilities. For example, if the project requires more than a year to develop the fuel or material before it is ready for reactor time, this joint type of proposal is not appropriate. For developmental proposals, an application solely to this FOA is appropriate. For those proposals that do not require personnel support, an application solely through the ATR NSUF system alone would be appropriate.

2. *NEUP General Scientific Infrastructure (GSI)*. DOE-NE supports general scientific infrastructure purchases as part of a separate FOA (DE-FOA-0000814). This GSI FOA seeks applications from U.S. universities and colleges for equipment and instrumentation infrastructure to support nuclear energy-related engineering and science teaching and research laboratories. NE is facilitating the ability of researchers to coordinate and enhance their research proposals provided in response to this solicitation with scientific equipment/capability purchase requests made in response to the GSI FOA, as appropriate and as described below.

   University researchers may submit proposals in response to Sections A and B of this FOA that also require individual, discrete, and definable items or capabilities that directly support and enable the R&D application to be proposed (i.e., the requested equipment must be required to execute the R&D project).

   University researchers may submit a separate proposal to DE-FOA-0000814 to request related equipment. Proposals submitted through this joint mechanism will be reviewed and ranked according to the criteria and processes described in both FOAs. As funding permits, proposals selected for funding by both review processes will be funded. Both proposals must be successful for either to be considered.

SECTION A: UNIVERSITY-LED RESEARCH AND DEVELOPMENT

Program and Mission Supporting projects for only university-led applications (workscopes found in Appendix A)

PART II – AWARD INFORMATION

A. TYPE OF AWARD INSTRUMENT

DOE anticipates awarding cooperative agreements under this funding opportunity announcement (See Section VI.B.2 Statement of Substantial Involvement).

B. ESTIMATED FUNDING

The Department currently estimates that it will fund approximately $33 million in awards in this Section in FY 2013; however, this estimate is contingent upon Congressional appropriations and is subject to significant change.

C. MAXIMUM AND MINIMUM AWARD SIZE

Ceiling – The maximum amount for an individual award made under this Section in Program Supporting projects is approximately $800,000 total for project duration of up to three (3) years. In Mission Supporting projects, the maximum amount for an individual award made under this Section is $400,000 total for project duration of up to three (3) years. Projects will be evaluated annually to determine if funding will continue within the project period.

Floor (i.e., the minimum amount for an individual award made under this announcement): $ NONE SPECIFIED.

D. EXPECTED NUMBER OF AWARDS

DOE anticipates making up to approximately 40 awards under this announcement depending on the size of the awards.

E. ANTICIPATED AWARD SIZE

DOE anticipates that awards will be approximately $800,000/applicant for Program Supporting projects and approximately $400,000/applicant for Mission Supporting projects.

F. PERIOD OF PERFORMANCE

DOE anticipates making awards of up to 3 years. Work must be completed according to the terms and conditions of the award. Projects will be evaluated annually to determine if funding will continue within the project period.

G. TYPE OF APPLICATION

DOE will accept only new applications under this announcement.

PART III - ELIGIBILITY INFORMATION

A. ELIGIBLE APPLICANTS

Eligibility under this section is limited to U.S. universities, colleges, community colleges, and trade schools. Minority Serving Institutions (MSI) are encouraged to apply.

B. COST SHARING

For proposals led by universities, cost-sharing is encouraged, but not required. If cost sharing is provided, see 10 CFR 600 for the applicable cost sharing guidance and UNDERSTANDING COST SHARING REQUIREMENTS in Part VIII.H below.

C. SUBMITTAL LIMITS

- University PIs with a currently funded IRP, or three or more R&D projects that will still be active after September 30, 2013, or who have received a no-cost extension (NCE) on any DOE-NE funded project after March 31, 2013, which will still be active beyond September 30, 2013, are ineligible to apply to any Section of this FOA as a PI.

- For submissions to all Sections of this FOA, university PIs can be included on no more than six pre-applications total, with no more than three of those submissions as the PI.

- For Section B of this FOA, all applying institutions (i.e., university, national laboratory, industry) are limited to three pre-applications per institution per workscope area. If a university PI is designated as the lead, these submissions will count toward the above overall university researcher limitation of being associated with no more than six pre-applications total in response to all sections of this FOA, with no more than three of those associations being as the lead PI.

- For Section C of this FOA (IRP's), an applicant is ineligible to submit an application as the PI if (s)he is designated as PI for more than one currently funded DOE-NE project that will still be active beyond September 30, 2013.

- A PI may have no more than one IRP or three R&D projects funded at any time, and may therefore not submit more full applications than would be allowed by these restrictions should these applications be selected for funding.

D. OTHER ELIGIBILITY REQUIREMENTS

FFRDC Contractors

FFRDC contractors may be proposed as a team member on another entity's application subject to the following guidelines:

Authorization for non-DOE/NNSA FFRDCs. The Federal agency sponsoring the FFRDC contractor must authorize in writing the use of the FFRDC contractor on the proposed project and this authorization must be submitted with the application. The use of a FFRDC contractor must be consistent with the contractor's authority under its award.

Authorization for DOE/NNSA FFRDCs. The cognizant contracting officer for the FFRDC must authorize in writing the use of a DOE/NNSA FFRDC contractor on the proposed project and this authorization must be submitted with the application. The following wording is acceptable for this authorization.

"Authorization is granted for the **Fillin 1: [Name]** Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or complimentary to the missions of the laboratory, will not adversely impact execution of the DOE/NNSA assigned programs at the laboratory."

Value/Funding. The value of, and funding for, the FFRDC contractor portion of the work will not normally be included in the award to a successful applicant. Usually, DOE/NNSA will fund a DOE/NNSA FFRDC contractor through the DOE field work proposal system and other FFRDC contractors through an interagency agreement with the sponsoring agency.

Cost Share. The applicant's cost share requirement will be based on the total cost of the project, including the applicant's and the FFRDC contractor's portions of the effort.

Responsibility. If the FFRDC contractor is proposed as a team member on another entity's application (e.g., as a subawardee) the applicant, if successful, will be the responsible authority regarding the settlement and satisfaction of all contractual and administrative issues, including but not limited to, disputes and claims arising out of any agreement between the applicant and the FFRDC contractor.

National Laboratory Contractors:

A DOE/NNSA National Laboratory Contractor is eligible to apply for funding under this announcement as a collaborator if its cognizant contracting officer provides written authorization and this authorization is submitted with the application. (This is not required for the National Energy Technology Laboratory since it is a Government Owned/Government Operated (GOGO)). If a DOE/NNSA National Laboratory Contractor is selected for award, the proposed work will be authorized under the DOE work authorization process and performed under the laboratory's M&O contract. The following wording is acceptable for the authorization:

"Authorization is granted for the **Fillin 1: [Name]** Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or complimentary to the missions of the laboratory and will not adversely impact execution of the DOE/NNSA assigned programs at the laboratory."

PART IV - APPLICATION AND SUBMISSION INFORMATION

A. ADDRESS TO REQUEST APPLICATION PACKAGE

Apply at http://www.neup.gov

Application forms and instructions are available at the NEUP website. To access these materials, go to http://www.neup.gov, select "Login" from the top right hand corner of the screen, enter your user credentials, select "Proposals" from the menu, and then click on "Create New Proposal" for the type of proposal you are creating.

B. PRE-APPLICATION

1. Pre-applications Are Required for this Section.

- Pre-applications are required for the program supporting and mission supporting R&D elements of this Section. Applicable workscopes descriptions are found in Appendix A.
- Pre-applications must be submitted by the date and time specified in Part IV, Paragraph C.5. No FAX or mail submissions will be accepted.
- Submit pre-applications electronically to http://www.neup.gov.
- The pre-applications should be prepared according to the instructions specified in C.1 – C.9 below. Pre-applications are to be prepared using standard 8.5" X 11" paper with 1 inch margins (top,

bottom, left, right), using a font size not smaller than Times New Roman 11 point.

- Pre-applications that fail to provide ALL items and quantities specified in this Section may be deemed non-responsive in their entirety and may be prohibited to submit full applications.

C. CONTENT AND APPLICATION FORMS: PS AND MS PRE-APPLICATIONS

Each applicant's R&D **pre-application** shall include the items found in Table 2. Applicants may input these pre-application elements on the pre-application form provided at the NEUP website. Access instructions are available at http://www.neup.gov. You must complete the mandatory forms and any applicable optional forms 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, UNLOCKED, WITHOUT PASSWORD PROTECTION) unless otherwise specified in this announcement.

Table 2: Submittal Content and Format for PS and MS Pre-Applications

Item	Description	Page Limit
Pre-Application Narrative	Size 11 Times New Roman font minimum; Three single-spaced pages maximum; One-inch margins all around minimum.	3
Benefit of Collaborations	Size 11 Times New Roman font minimum; Two single-spaced pages maximum; One-inch margins all around minimum.	2
Principal Investigator Vita	Size 11 Times New Roman font minimum; Two single-spaced pages maximum; One-inch margins all around minimum.	2
Agreement Requirements	Agreement Requirements check box at the bottom of the pre-application form. Includes quality assurance requirements and commitment of partners.	N/A

1. Pre-Application Narrative

Applicant shall provide a narrative that addresses the specific information below:

- Title of Project
- Technical Work Scope Identifier No. (enter the number that appears in the Technical Work Scope appendix)
- Name of Project Director/Principal Investigator(s) and associated organization(s)
- A summary of the proposed project, including a description of the project and a clear explanation of its importance and relevance to the objectives covered by this Section
- Explanation of the importance and relevance of the proposed work to the objectives covered by this workscopes section
- Logical path to work accomplishment
- Deliverables and outcomes the R&D will produce
- Timeframe for execution of proposed scope (specify if the R&D is for a one-, two-, or three-year period; see below discussion of project length limitations)
- For Program Supporting research, estimated cost of proposal (order of magnitude); applicants shall not propose costs of more than $800,000 total for cooperative agreements generally up to 3 years. No-cost extensions (up to 1 additional year) must be approved by the Contracting Officer.
- For Mission Supporting research, estimated cost of proposal (order of magnitude); applicants shall not propose costs of more than $400,000 total for cooperative agreements generally up to 3 years. No-cost extensions (up to 1 additional year) must be approved by the Contracting Officer.
- Name File: 2013 RPA Narrative "Insert ID#."

2. Benefit of Collaborations

This document will contain an explanation of the contribution that will be made by the collaborating organizations and/or facilities to be utilized. It can contain brief biographies of collaborators and descriptions of the facilities wherein the research will be conducted. Please indicate within this section if this proposal has benefit or influence on other ongoing or proposed NE projects (e.g. modeling and simulation in one proposal and effect validation in a separate proposal).

- Name File: 2013 RPA Benefit of Collaboration "Insert ID#."

3. Principal Investigator Vita

Provide a vita for the PI. Vita must include:

Contact Information

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.

- Name File: 2013 RPA Last Name of Collaborator "Insert ID#."

4. Agreement Requirements

Institutions will be expected to follow quality assurance (QA) principles and requirements in conducting R&D activities. The integrity of R&D products and their usability by NE is predicated on meeting QA requirements as they apply to a specific scope of work and associated deliverables. In most cases, an institution's process for peer review in support of publishing research results will serve as a basis for QA requirements; however, there may be some instances where additional QA requirements are specified.

While QA requirements are not new to universities and colleges, it is recognized that familiarity with NE programmatic-specific QA requirements will vary; therefore, during the full application process, the NEUP Integration Office will provide assistance, as needed, in understanding possible QA requirements for a specific workscope and in developing options to meet those QA requirements. Examples of typical implementation documents which meet the QA requirements are posted on the NEUP website. Acceptance of these requirements is indicated by the lead applicant checking the Agreement Requirements box at the bottom of the application form.

Further, each institution serving as a team member to the proposed project shall be identified in the pre-application, with their commitment made to collaborate in the FOA process. Acceptance of these requirements is indicated by the lead applicant checking the appropriate box on the application form.

5. Pre-application Due Date

In accordance with the schedule above, pre-applications are due by 8:00 p.m. ET on January 28, 2013.

Submittals to the R&D solicitation MUST be made electronically. Please read the instructions on the form carefully. Pre-applications not submitted via this option will be treated as incomplete and will not be evaluated.

6. Late Pre-Applications

Pre-applications received after the designated date and time, i.e., late, will be treated as nonresponsive and not evaluated. Extension of the R&D pre-application due dates shall be determined at the sole discretion of the Contracting Officer.

7. Workscope Descriptions

Appendix A contains detailed descriptions of research needs in support of each programmatic element for submission to the Program Supporting and Mission Supporting sectors of the call. It should be noted that for Mission Supporting proposals, the submission of novel and creative solutions to the research challenges is strongly encouraged beyond the detailed needs described.

8. Program Contacts

The NEUP website, http://www.neup.gov, provides a list of technical contacts for each program who can be contacted for further information on their respective areas of work. Additional information regarding NE R&D programs may be found at http://nuclear.energy.gov/.

9. Evaluation of Pre-Applications and Invitation to Submit a Full Application

The application evaluation and invitation process will be based on written information, references, and independent pre-award assessment actions as outlined within this solicitation.

NOTE: Applicants who are not specifically invited to submit full proposals may still do so at their own risk. There is no guarantee that uninvited full applications will receive a full review; however, all full applications received will be re-reviewed for relevancy. Only those uninvited full proposals that are scored as Highly Relevant will be forwarded for technical peer review during the evaluation phase for full proposals.

D. CONTENT AND APPLICATION FORMS: PS AND MS FULL APPLICATIONS

Each applicant's R&D **full application** shall include the items found in Table 3. Applicants may input these full application elements on the full application form provided at the NEUP website. Access instructions are available at http://www.neup.gov. You must complete the mandatory forms and any applicable optional forms 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, UNLOCKED, WITHOUT PASSWORD PROTECTION) unless otherwise specified in this announcement.

> **NOTE:** The review process for full applications is a semi-blind process. Consult the requirements Project Narrative section below carefully as non-compliant proposals may be excluded from review.

Table 3: Submittal Content and Format for PS and MS Full Applications

Item	Description	Page Limit
Summary Abstract	Size 11 Times New Roman font minimum; 1 single spaced page maximum-including references; One-inch margins all around minimum. Place proposal ID number on each page in header or footer; Name file: 2013 R&D Summary Abstract "Insert ID#"	1
Project Narrative	Size 11 Times New Roman font minimum; 10 single spaced pages maximum-including references; One-inch margins all around minimum. Place proposal ID number on each page in header or footer; Name file: 2013 CFP Narrative "Insert ID#"	10
Vita(s)	Size 11 Times New Roman font minimum; Up to 5 two-page vitas may be submitted (1 PI, 4 collaborators) for up to a total of 10 single spaced pages maximum; 1-inch margins all around minimum. Place proposal ID number on each page in header or footer; Name file: 2013 CFP last name of collaborator "Insert ID#"	5 vitas allowed (2 pages each)
Capabilities	Size 11 Times New Roman font minimum; 2 single spaced pages maximum; One-inch margins all around minimum. Place proposal ID number on each page in header or footer; name file: 2013 CFP Capabilities "Insert ID#"	2
Budget	Applicants must provide a separate budget for each year of support requested and a cumulative budget for project period. Use the SF 424A Excel, "Budget Information - Non Construction Programs"	N/A
Supplementary Information	Required conflict of interest form. Name file: 2013 CFP COI "Insert ID#" Short description of additional PIs/collaborators/advisors beyond the five participants above. Name file: 2013 CFP Supplemental "Insert ID#"	2
Agreement Requirements	Agreement Requirements check box at the bottom of the application form re-affirms the Quality Assurance and Commitment of Partners as specified in the pre-application.	N/A

1. Summary Abstract

The R&D summary abstract must contain a summary of the proposed activity suitable for dissemination to the public. It should be a self-contained document that identifies the name of the applicant, key personnel proposed for the project, the objectives of the project, a description of the project, including methods to be employed, the potential impact of the project (i.e., benefits, outcomes), and, for collaborative projects, the dollar value of the effort to be performed by each participant over the period of performance and a brief description of the capacity in which the participant will be participating. This document must not include any proprietary or sensitive business information as the Department may make it available to the public.

2. Project Narrative

Applicant shall provide a written narrative addressing its strategy to execute R&D that supports the specified Technical Workscope. The documentation provided shall include the items specified below:

- Proposal Title. (Do not use all CAPS for proposal title.)
- Final Technical Workscope Identification: refer to the communication provided by the DOE program integration office describing the results of the pre-application selection process.
- Proposed Scope Description.
- Logical path to accomplishing scope, including descriptions of tasks. This section will provide a clear, concise statement of the specific objectives/aims of the proposed project. This section should

be formatted to address each of the merit review criterion and sub-criterion listed in Part V.A. Provide sufficient information so that reviewers will be able to evaluate the application in accordance with these merit review criteria.

- Relevance and Outcomes/Impacts: This section will explain the relevance of the effort to the objectives in the program announcement and the expected outcomes and/or impacts.
- Milestones and Deliverables.
- Type/description of facilities that will be used to execute the scope (N/A is acceptable).
- Schedule: Define timelines for executing the specified workscope.
- The roles and responsibilities of each partnering organization in the execution of the workscope.
- Unique challenges to accomplishing the work and innovations expected to mitigate such challenges.
- Information, data, plans, or drawings necessary to explain the details of Applicant's proposal.
- Quality Assurance (QA): Describe the applicable QA requirements and how they will be met. This can be a simple statement agreeing to comply with the QA requirements as described by DOE on the application website and any additional requirements deemed necessary.
- References are included in the 10 page limit. Name file: 2013 CFP Narrative "Insert ID#."

The R&D technical narrative **shall NOT include** the following information:

- Cost and pricing information.
- Identification, by individual name or name of institution, of any teaming partner. Examples of acceptable ways of referring to partners will be posted on the NEUP website.
- Official name or title of facilities used to execute scope. Describe the facility by function and/or technical attributes such as an accelerator, a test reactor, etc.

3. Vitas - Technical Expertise and Qualifications (2 Pages Each)

Applicant shall name all teaming partners by name and organization, as well as their proposed roles and responsibilities. For the Principal Investigator and collaborators, the Applicant shall provide a brief vita that lists the following:

Contact Information

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.

- Name File: 2013 CFP Last Name of Collaborator "Insert ID#."

Technical expertise and qualifications are to be provided for a maximum of five individuals. Submitted individuals (and/or their recipient institutions) must receive at least $50,000 over the life of the project to be considered a collaborator. Minor contributors—anyone not expected to materially participate in the proposal, such as consultants or national laboratory personnel who are not to be paid more than $49,999 to participate in the project—**should be listed on the application form, but do not need to be represented in**

this section.

4. Capabilities

Infrastructure Requirements: In a separate document, Applicant shall identify the infrastructure (e.g., facilities, equipment, and instrumentation) required to execute the proposed scope of work. Describe the non-labor (e.g., facilities, equipment, and instrumentation) resources that are available and accessible to the Applicant and are required to execute the scope of work. Describe any unique equipment and facilities that are needed, are accessible, and will be used to execute the scope of work. Discuss the adequacy of these resources and identify any gaps.

If you are requesting funds through the General Scientific Infrastructure Solicitation to support this research, provide summary detail of the request here.

See the electronic proposal submission form for document guidance. This FOA allows the Applicant to propose the purchase of any needed equipment to conduct the proposed work. (Name file: 2013 CFP Capabilities "Insert ID#.")

5. Budget

Proposals shall not propose costs of more than $800,000 total for cooperative agreements under the PS R&D area and costs of no more than $400,000 total for cooperative agreements under the MS R&D area. Projects are generally up to 3 years. No-cost extensions up to 1 additional year must be approved by the Contracting Officer.

No more than 20 percent of the R&D funds provided by the government can go to non-university participants, including all government-funded national laboratory and industry/utility partner shares combined.

6. Supplementary Information

As requested by the submission form, Applicant shall identify all Federal funding sources by agency source, project name, monetary amount, and length of term that are pending or currently in place for the university PI or collaborators within the past five years.

Within the written proposal, Applicant shall address the requirements of this FOA. Only proposals deemed fully compliant with the mandatory requirements shall be eligible for continued evaluation. All requirements committed to within the pre-application process continue to apply throughout the full application process.

7. Application Due Date

In accordance with the schedule above, Applications are due by 8:00 p.m. ET on June 12, 2013. Submittals to the R&D solicitation MUST be made electronically. Please read the instructions on the form carefully. Applications not submitted via this option will be treated as incomplete and will not be evaluated.

8. Late Applications

Applications received after the designated date and time, i.e., late, will be treated as nonresponsive and not evaluated. Extension of the application due dates shall be determined at the discretion of the Contracting Officer.

9. Workscope Descriptions

Appendix A contains detailed descriptions of research needs in support of each programmatic element for submission to the Program Supporting and Mission Supporting sectors of the call. It should be noted that for Mission Supporting proposals, the submission of novel and creative solutions to the research challenges is

strongly encouraged.

10. Program Contacts

The NEUP website, http://www.neup.gov, provides a list of technical contacts for each program who can be contacted for further information on their respective areas of work. Additional information regarding NE R&D programs may be found at http://nuclear.energy.gov/.

PART V - APPLICATION REVIEW INFORMATION

A. CRITERIA

1. Initial Review Criteria

Prior to a comprehensive merit evaluation, DOE will perform an initial review to determine that (1) the applicant is eligible for an award; (2) an initial project relevancy review; (3) the information required by the announcement has been submitted; (4) all mandatory requirements are satisfied; and (5) the proposed project is responsive to the objectives of the Funding Opportunity Announcement. Only applications meeting these initial review criteria will be considered during the merit review and award selection decision.

2. PS / MS R&D Merit Review Criteria: Pre-Applications

Selection of universities and colleges invited to provide full applications shall be based on how well the pre-applications meet or exceed the technical and relevancy evaluation criteria provided below. All applications submitted under this solicitation will be reviewed and scored by two different groups as described below.

First, a panel of programmatic experts will assess each pre-application's relevancy to NE's R&D mission and associated program/workscope. Points will be assigned according to the following relevancy attributes:

Relevancy attributes:

- Unquestionably Relevant/Unquestionable Program Priority (100 pts): The proposal is fully supportive of, and has significant, easily recognized and demonstrable ties to, the relevant program element(s).
- Highly Relevant/High Program Priority (80 pts): The proposal is supportive of, and has significant and demonstrable ties to, the relevant program element(s).
- Relevant/Intermediate Program Priority (60 pts): The proposal is supportive of, and has tangible ties to, the relevant program element(s).
- Moderate Relevance/Moderate Program Priority (40 pts): The proposal is partially supportive of, and has some ties to, the relevant program element(s).
- Low Relevance/Low Program Priority (20 pts): The proposal is minimally supportive of, and difficult to tie to, the relevant program element(s).
- Not Relevant/No Program Priority (0 pts): The proposal is not supportive of the relevant program element(s) – OR – sufficient work is already being performed.

Second, a separate technical expert/peer will assess each application on its technical merit. Points will be assigned according to the following attributes of technical merit.

Technical merit attributes:

- High Merit (100 pts): The proposal unquestionably advances the technical state of knowledge and understanding of the NE mission or program element, and is creative and based largely on original concepts. The scope is within the technical expertise of the proposed team, and can be executed fully in the facilities available within the proposed budget.

- Moderate Merit (66 pts): The proposal incrementally advances the technical state of knowledge and understanding of the NE mission or program element, and is somewhat creative and based contains several original concepts. The scope will be a challenge to the technical expertise of the proposed team, and may be difficult to execute fully in the facilities available within the proposed budget.

- Low Merit (33 pts): The proposal recognizes the technical state of knowledge and understanding of the NE mission or program element, and is only marginally creative and contains few original concepts. The scope will be a challenge to the technical expertise of the proposed team, and may be difficult to execute fully in the facilities available within the proposed budget. The scope will be a challenge to the technical expertise of the proposed team and require resources not named in the proposal or will require additional facilities or funding to execute.

- No Merit (0 pts): The proposal does not advance or recognize the technical state of knowledge and understanding of the NE mission or program element, and is not creative or original. The scope is beyond the technical expertise of the proposed team, and cannot be executed fully in the facilities available within the proposed budget.

The points determined by evaluating each proposal against the above criteria will then be weighted as defined in Table 4 to determine an overall evaluation score for each application. Different weights are applied depending on whether the application is PS or MS R&D. Note that the program relevancy score may be increased by up to 5 points based on evaluators' determination of the degree to which an effective partnership with MSIs, international or industrial partners, and/or underrepresented groups is proposed.

Table 4. Effective Partnership Evaluation and Weighting of Evaluation Points for Pre-Applications

Partnership Effectiveness[1]	The degree to which minority-serving institutions, international and/or industry partners, and/or underrepresented groups, if any, contribute to the proposal's ability to support the relevant program element or overall NE mission. **Note: effective partnerships are not required for projects to be evaluated as unquestionably relevant, but effective partnerships will increase relevance score from 1 to 5 points, not to exceed maximum available relevancy points, based on meeting one of the following criteria:** The proposal has (1) a substantive contribution by an industrial, international, underrepresented group, or minority serving institution (MSI) collaboration; (2) a demonstrable contribution by an industrial, international, underrepresented group, or MSI collaboration; or (3) some relevant partnership with an industrial, international, underrepresented group, or MSI collaboration.	5 points maximum[2]
Weighting	**Weighted Score Ratio** **(Technical : Relevancy)** **Program Supporting: 65:35** **Mission Supporting: 80:20**	

[1] Supports Program Relevance: This element will be scored by the Federal Program Offices and TIO offices, not by peer review.
[2] Total relevancy points cannot exceed 100% of points available from the relevancy criteria

After considering the overall evaluation scores, available funding, and subjective factors (e.g., balanced research portfolio), NE will make a final determination of applicants who will be invited to provide full applications. Applicants who are not specifically invited to submit full proposals may still do so at their own risk. There is no guarantee that uninvited full applications will receive a full review; however, all full applications received will be re-reviewed for relevancy. Only those uninvited full proposals that are scored as Highly Relevant or better will be forwarded for technical peer review during the evaluation phase for full proposals described below.

3. PS / MS R&D Merit Review Criteria: Full Applications

Upon receipt, DOE will perform an initial review of full applications to determine that (1) the applicant remains eligible for an award; (2) the proposal requires an initial project relevancy review (i.e., it was received uninvited); (3) the information required by the announcement has been submitted; (4) all mandatory requirements are satisfied; and (5) the proposed project remains responsive to the objectives of the FOA. Only applications meeting these initial review criteria will be considered during the merit review and award selection decision.

Review of full applications shall be based on how well the applications meet or exceed the technical and relevancy evaluation criteria provided below. All invited full applications and those uninvited applications that are rated Highly Relevant or better submitted under this solicitation will be reviewed and scored by two different groups. A panel of programmatic experts will assess each pre-application's relevancy to NE's R&D mission or program and three technical peer reviewers will evaluate the proposal for technical merit. The review criteria are weighted differently for PS and MS R&D as defined in Table 5. Effective partnerships will be incorporated into the relevancy evaluation. Any proposals scored as "Not Relevant" at this point will not be evaluated further because NE has received clear Congressional direction that in no instance can NE allocate funds to activities that are not relevant to its mission.

Relevancy attributes:

- Same as for the pre-application evaluation phase. See Section 2 above.

Technical Merit attributes:

Applications will be subjected to formal merit review and will be evaluated against the following criteria. Included within each criterion are the detailed questions that reviewers will consider in evaluating each criterion as listed below.

- How important is the proposed activity to advancing knowledge and understanding within the workscope area and period of performance?
- How well does the activity advance discovery or explore creative, original or potentially transformative concepts? (This last criterion is particularly important in the Mission Supporting categories.)

Review Considerations:

1. Advances the state of scientific knowledge and understanding.
2. Addresses gaps in nuclear science and engineering research.

Points Scoring Criteria

9-10	Outstanding scientific merit; clearly addresses gaps in scientific/engineering knowledge and understanding
6-8	Reasonable contribution; likely to contribute to scientific knowledge and understanding
3-5	Questionable scientific merit; not likely to result in meaningful advances to scientific knowledge and understanding
1-2	Little or no scientific merit; does not advance knowledge and understanding

Research Plan

- How well conceived and organized is the proposed activity?
- Is there a logical path to work accomplishment?
- Are the timeline and milestones well laid out and challenging?

Review Considerations:

1. Proposal outlines a logical technical approach to accomplish project objectives.
2. Proposal outlines the strategy for project management and a timeframe for the proposed work scope that are reasonable and appropriate.

Points	Scoring Criteria
9-10	Outstanding, logical method and approach with no apparent shortcomings
6-8	Reasonably innovative approach with some weaknesses
3-5	Questionable method or approach; weaknesses evident that may impact performance
1-2	Ineffective method or approach posing significant risk of non-performance

R&D Resources and Capabilities

- Are there sufficient resources, budget and facilities to conduct the proposed work?
- Is the budget request too high or low to accomplish the scope?
- Will the facilities support the types of work proposed? If equipment is to be purchased, is it appropriate to the identified scope? The proposal should clearly demonstrate that non-labor resources are adequate to accomplish the proposed work scope. (Costs delineated on the budget worksheet and the capabilities description document will be considered within this section. Some additional information may be found in the supplementary documents.)

Review Considerations:

1. Equipment and facilities supplied by each participating organization are suited to proposed tasks.
2. Proposed costs are reasonable and adequately justified.

Points	Scoring Criteria
9-10	Outstanding equipment resources, with no apparent shortcoming for executing the proposed scope of work
6-8	Reasonable and appropriate personnel and equipment with some weaknesses in either area; cost structure may not be fully supported
3-5	Questionable staffing, equipment, or cost; weaknesses evident that may impact performance
1-2	Unsatisfactory resources or cost structure posing significant risk of non-performance

Team Qualifications

- How well qualified is the proposer (individual or team) to conduct the project? If appropriate, the reviewer should take into consideration the quality of prior work. The credentials, publications, experience and past accomplishments of the principal investigator and all project members should be considered within this section. (See the submitted vitas and supplementary documents for this

section.)

Review Considerations:

1. Principal investigator/project manager have sufficient and relevant qualifications and experience to lead the proposed research.
2. Key collaborators have sufficient and relevant qualifications and experience of for their assigned role.
3. Proposed personnel resources are adequate and appropriate to accomplish the stated research workscope.

Points	Scoring Criteria
9-10	Highly competent PI and collaborators with significant expertise in the research area
6-8	Competent PI and collaborators; some shortcoming in either area
3-5	Questionable team qualifications; notable weaknesses in key areas
1-2	Significant weaknesses in team qualifications posing significant risk of non-performance

Table 5: PS / MS R&D Full Proposals - Weighting of Evaluation Scores

Criterion	Description	
	Technical Proposal – Peer Review	**Percentage of Peer Review Points**
Scientific and Technical Merit	Advances the state of the knowledge in the relevant program element(s); practicality of scope with respect to specified funding range for work scope and period of performance.	35%
Research Plan	Logical path to work accomplishment.	35%
R&D Resources and Capabilities	Demonstrate that labor and non-labor resources are adequate to accomplish the proposed work scope. Costs delineated on the budget worksheet will be considered within this section.	15%
Team Qualification	Relevant credentials, publications, experience, and past accomplishments of Principal Investigator and collaborators.	15%
	Peer Review Score	Sum of ratings x weights
	Relevance[1] (Separate Review Process)	**Percentage of Relevancy Review Points**
Mission/Program Relevance	Alignment with the mission-specific program relevant technical objectives or in the case of the mission-supporting, the judgment will be based upon the overall Office of Nuclear Energy mission relevance, not the specific program element.	Up to 100% (if no partnerships)

Criterion	Description	
Partnership Relevance	The degree to which minority-serving institutions, international and/or industry partners, and/or underrepresented groups, if any, contribute to the proposal's ability to support the relevant program element or overall NE mission. **Note: effective partnerships are not required for projects to be evaluated as unquestionably relevant, but effective partnerships will increase relevance score from 1 to 5 points, not to exceed maximum available relevancy points, based on meeting one of the following criteria:** The proposal has (1) a substantive contribution by an industrial, international, underrepresented group, or minority serving institution (MSI) collaboration; (2) a demonstrable contribution by an industrial, international, underrepresented group, or MSI collaboration; or (3) some relevant partnership with an industrial, international, underrepresented group, or MSI collaboration.	Up to 25% (5 points max.)
	Relevancy Score	Sum of ratings[2] x weights
Weighting	**Weighted Score Ratio (Peer : Relevancy) Program Supporting: 65:35 Mission Supporting: 80:20**	

[1] Supports Program Relevance: This element will be scored by the Federal Program Offices and TIO offices, not by peer review.
[2] Total relevancy points cannot exceed 100% of points available from the relevancy criteria

4. Other Selection Factors

The Selection Official may consider the following program policy factors in the selection process, such as:

1. Technical diversity of projects; applications will be balanced to optimize the selection of the appropriate mix of applications to best achieve the NE goals.
2. Relevance to agency's programmatic needs.
3. Cost/Budget considerations.

Any of the above factors used will be independently considered by the Selection Official in determining the optimum mix of applications that will be selected for support. These factors, while not indicators of the Application's merit, may be essential to the process of selecting the application(s) that, individually or collectively, will best achieve the program objectives. Such factors are often beyond the control of the Applicant. Each Applicant should recognize that some very good applications might not receive an award because they do not fit within a mix of projects that maximized the probability of achieving the DOE's overall development R&D objectives. Therefore, the above factors may be used by the Selection Official to assist in determining which applications shall receive DOE funding support.

B. SUMMARY OF THE REVIEW AND SELECTION PROCESS

1. PS / MS Pre-Applications

Pre-application proposals will be evaluated against the technical and relevancy criteria described above. This peer and program evaluation process will produce a list of recommended proposals for each workscope provided in Appendix A. The Department will consider the overall evaluation results and subjective programmatic factors to select a final set of proposals to be "invited" to provide a full application.

> **NOTE:** Applicants who are not specifically invited to submit full proposals may still do so at their own risk. There is no guarantee that uninvited full applications will receive a full review; however, all full applications received will be re-reviewed for relevancy. Only those uninvited full proposals that are scored as Highly Relevant or better will be forwarded for technical peer review during the evaluation phase for full proposals.

2. PS / MS Full Applications

Three peer reviewers will independently employ a semi-blind process to evaluate and score the proposals in accordance with the peer review evaluation criteria described above. This peer evaluation process will support development of a recommended list of proposals to be awarded for each workscope. Also, a relevancy review process will be completed by DOE in accordance with the scoring criteria described above and support development of a recommended list of proposals to be awarded. DOE will consider the overall evaluation results and subjective programmatic factors to ultimately determine a final set of proposals to be approved by the Selection Official for funding.

3. PS/MS Selection Official Consideration

The Selection Official will consider the merit review recommendation and subjective factors such as program policy considerations, research portfolio diversity, and the amount of funds available.

C. ANTICIPATED NOTICE OF SELECTION AND AWARD DATES

DOE will strive to make selections within six to eight months after receipt of applications.
DOE anticipates having multiple award selection dates.

SECTION B: UNIVERSITY, NATIONAL LABORATORY, OR INDUSTRY-LED RESEARCH AND DEVELOPMENT

Program Supporting projects for University, National Laboratory, or Industry-led applications (workscopes found in Appendix B)

PART II – AWARD INFORMATION

A. TYPE OF AWARD INSTRUMENT

DOE anticipates awarding cooperative agreements under this funding opportunity announcement (See Section VI.B.2 Statement of Substantial Involvement).

B. ESTIMATED FUNDING

The Department currently estimates that it will fund approximately $6.5 million in awards in this Section in FY 2013; however, this estimate is contingent upon Congressional appropriations and is subject to significant change.

C. MAXIMUM AND MINIMUM AWARD SIZE

Ceiling – The maximum amount for an individual award made under this Section in Program Supporting projects is approximately $1,000,000 total for project duration of up to three (3) years and $400,000 for project duration of up to two (2) years. Specific anticipated award size for each work scope is identified in Appendix B. Projects will be evaluated annually to determine if funding will continue within the project period.

Floor (i.e., the minimum amount for an individual award made under this announcement): $ NONE SPECIFIED.

D. EXPECTED NUMBER OF AWARDS

DOE anticipates making up to 9 awards under this announcement depending on the size of the awards.

E. ANTICIPATED AWARD SIZE

DOE anticipates that awards will be approximately $400,000 total for two year, and $1,000,000 total for three year Program Supporting projects. Specific anticipated award size for each workscope is identified in Appendix B.

F. PERIOD OF PERFORMANCE

DOE anticipates making awards that will run for up to 2 or 3 years. Specific period of performance for each workscope is identified in Appendix B. Work must be completed according to the terms and conditions of the award. Projects will be evaluated annually to determine if funding will continue within the project period.

G. TYPE OF APPLICATION

DOE will accept only new applications under this announcement.

PART III - ELIGIBILITY INFORMATION

A. ELIGIBLE APPLICANTS

All types of entities are eligible to apply, except organizations described in section 501(c)(4) of the Internal Revenue Code of 1986 that engaged in lobbying activities after December 31, 1995. However, the lead applicant must be a United States company, university, or National Laboratory. Minority Serving Institutes (MSI) are encouraged to apply.

B. COST SHARING

For proposals led by universities, cost-sharing is encouraged, but not required. However, per the provisions of the Energy Policy Act of 2005, Section 988, a cost share of at least 20 percent of the total allowable costs (TAC) is required for proposals led by domestic companies and must come from non-Federal sources unless otherwise allowed by law. The TAC of the project is the sum of the government share, including Federally Funded Research and Development Center (FFRDC) contractor costs if applicable, and the recipient share of allowable costs. If cost sharing is provided, see 10 CFR 600 for the applicable cost sharing guidance and UNDERSTANDING COST SHARING REQUIREMENTS in Part VIII.H below.

C. SUBMITTAL LIMITS

- University PIs with a currently funded IRP, or three or more R&D projects that will still be active after September 30, 2013, or who have received a no-cost extension (NCE) on any DOE-NE funded project after March 31, 2013, which will still be active beyond September 30, 2013, are ineligible to apply to any Section of this FOA as a PI.

- For submissions to all Sections of this FOA, university PIs can be included on no more than six pre-applications total, with no more than three of those submissions as the PI.

- For Section B of this FOA, all applying institutions (i.e., university, national laboratory, industry) are limited to three pre-applications per institution per workscope area. If a university PI is designated as the lead, these submissions will count toward the above overall university researcher limitation of being associated with no more than six pre-applications total in response to all sections of this FOA, with no more than three of those associations being as the lead PI.

- For Section C of this FOA (IRP's), an applicant is ineligible to submit an application as the PI if (s)he is designated as PI for more than one currently funded DOE-NE project that will still be active beyond September 30, 2013.

- A PI may have no more than one IRP or three R&D projects funded at any time, and may therefore not submit more full applications than would be allowed by these restrictions should these applications be selected for funding.

D. OTHER ELIGIBILITY REQUIREMENTS

FFRDC Contractors

FFRDC contractors may be proposed either as a lead (prime) or a team member on another entity's application subject to the following guidelines:

Authorization for non-DOE/NNSA FFRDCs. The Federal agency sponsoring the FFRDC contractor must authorize in writing the use of the FFRDC contractor on the proposed project and this authorization must be submitted with the application. The use of a FFRDC contractor must be consistent with the contractor's authority under its award.

Authorization for DOE/NNSA FFRDCs. The cognizant contracting officer for the FFRDC must authorize in writing the use of a DOE/NNSA FFRDC contractor on the proposed project and this

authorization must be submitted with the application. The following wording is acceptable for this authorization.

> "Authorization is granted for the **Fillin 1: [Name]** Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or complimentary to the missions of the laboratory, will not adversely impact execution of the DOE/NNSA assigned programs at the laboratory."

Value/Funding. The value of, and funding for, the FFRDC contractor portion of the work will not normally be included in the award to a successful applicant. Usually, DOE/NNSA will fund a DOE/NNSA FFRDC contractor through the DOE field work proposal system and other FFRDC contractors through an interagency agreement with the sponsoring agency.

Cost Share. The applicant's cost share requirement will be based on the total cost of the project, including the applicant's and the FFRDC contractor's portions of the effort.

Responsibility. If the FFRDC contractor is proposed as a team member on another entity's application (e.g., as a subawardee) the applicant, if successful, will be the responsible authority regarding the settlement and satisfaction of all contractual and administrative issues, including but not limited to, disputes and claims arising out of any agreement between the applicant and the FFRDC contractor.

National Laboratory Contractors:

A DOE/NNSA National Laboratory Contractor is eligible to apply for funding under this announcement if its cognizant contracting officer provides written authorization and this authorization is submitted with the application. (This is not required for the National Energy Technology Laboratory since it is a Government Owned/Government Operated (GOGO)). If a DOE/NNSA National Laboratory Contractor is selected for award, the proposed work will be authorized under the DOE work authorization process and performed under the laboratory's M&O contract. The following wording is acceptable for the authorization:

"Authorization is granted for the **Fillin 1: [Name]** Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or complimentary to the missions of the laboratory and will not adversely impact execution of the DOE/NNSA assigned programs at the laboratory."

PART IV - APPLICATION AND SUBMISSION INFORMATION

A. ADDRESS TO REQUEST APPLICATION PACKAGE

Apply at http://www.neup.gov

Application forms and instructions are available at the NEUP website. To access these materials, go to http://www.neup.gov, select "Login" from the top right hand corner of the screen, enter your user credentials, select "Proposals" from the menu, and then click on "Create New Proposal" for the type of proposal you are creating.

B. PRE-APPLICATION

1. Pre-applications Are Required for this Section.

- Pre-applications are required for the program supporting R&D elements of this Section. Applicable workscopes descriptions are found in Appendix B.
- Pre-applications must be submitted by the date and time specified in Part IV, Paragraph C.5. No FAX or mail submissions will be accepted.

- Submit pre-applications electronically to www.neup.gov
- The pre-applications should be prepared according to the instructions specified in C.1 – C.9 below. Pre-applications are to be prepared using standard 8.5" X 11" paper with 1 inch margins (top, bottom, left, right), using a font size not smaller than Times New Roman 11 point.
- Pre-applications that fail to provide ALL items and quantities specified in this Section may be deemed non-responsive in their entirety and may be prohibited to submit full applications.

C. CONTENT AND APPLICATION FORMS: PS PRE-APPLICATIONS

Each applicant's R&D **pre-application** shall include the items found in Table 6. Applicants may input these pre-application elements on the pre-application form provided at the NEUP website. Access instructions are available at http://www.neup.gov. You must complete the mandatory forms and any applicable optional forms 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, UNLOCKED, WITHOUT PASSWORD PROTECTION) unless otherwise specified in this announcement.

Table 6: Submittal Content and Format for PS Pre-Applications

Item	Description	Page Limit
Pre-Application Narrative	Size 11 Times New Roman font minimum; Three single-spaced pages maximum; One-inch margins all around minimum.	3
Benefit of Collaborations	Size 11 Times New Roman font minimum; Two single-spaced pages maximum; One-inch margins all around minimum.	2
Principal Investigator Vita	Size 11 Times New Roman font minimum; Two single-spaced pages maximum; One-inch margins all around minimum.	2
Agreement Requirements	Agreement Requirements check box at the bottom of the pre-application form. Includes quality assurance requirements and commitment of partners.	N/A

1. Pre-Application Narrative

Applicant shall provide a narrative that addresses the specific information below:

- Title of Project
- Technical Work Scope Identifier No. (enter the number that appears in the Technical Work Scope appendix)
- Name of Project Director/Principal Investigator(s) and associated organization(s)
- A summary of the proposed project, including a description of the project and a clear explanation of its importance and relevance to the objectives covered by this Section.
- Explanation of the importance and relevance of the proposed work to the objectives covered by this workscopes section
- Logical path to work accomplishment
- Deliverables and outcomes the R&D will produce
- Timeframe for execution of proposed scope (specify if the R&D is for a one-, two-, or three-year period; see below discussion of project length limitations)
- Estimated cost of proposal (order of magnitude); applicants shall not propose costs of more than $400,000 total for cooperative agreements generally up to 2 years or $1,000,000 total for cooperative agreements generally up to 3 years. Specific details regarding cost and duration are listed in Appendix B.
  No-cost extensions (up to 1 additional year) must be approved by the Contracting Officer.
- Name File: 2013 RPA Narrative "Insert ID#."

2. Benefit of Collaborations

This document will contain an explanation of the contribution that will be made by the collaborating organizations and/or facilities to be utilized. It can contain brief biographies of collaborators and descriptions of the facilities wherein the research will be conducted. Please indicate within this section if this proposal has benefit or influence on other ongoing or proposed NE projects (e.g. modeling and simulation in one proposal and effect validation in a separate proposal).

- Name File: 2013 RPA Benefit of Collaboration "Insert ID#."

3. PI Vita

Provide a vita for the PI. Vita must include:

Contact Information

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.

- Name File: 2013 RPA Last Name of Collaborator "Insert ID#."

4. Agreement Requirements

Institutions will be expected to follow quality assurance (QA) principles and requirements in conducting R&D activities. The integrity of R&D products and their usability by NE is predicated on meeting QA requirements as they apply to a specific scope of work and associated deliverables. In most cases, an institution's process for peer review in support of publishing research results will serve as a basis for QA requirements; however, there may be some instances where additional QA requirements are specified.

While QA requirements are not new to universities and colleges, it is recognized that familiarity with NE programmatic-specific QA requirements will vary; therefore, during the full application process, the NEUP Integration Office will provide assistance, as needed, in understanding possible QA requirements for a specific workscope and in developing options to meet those QA requirements. Examples of typical implementation documents which meet the QA requirements are posted on the NEUP website. Acceptance of these requirements is indicated by the lead applicant checking the Agreement Requirements box at the bottom of the application form.

Further, each institution serving as a team member to the proposed project shall be identified in the pre-application, with their commitment made to collaborate in the FOA process. Acceptance of these requirements is indicated by the lead applicant checking the appropriate box on the application form.

5. Pre-application Due Date

In accordance with the schedule above, pre-applications are due by 8:00 p.m. ET on January 28, 2013. Submittals to the R&D solicitation MUST be made electronically. Please read the instructions on the form carefully. Pre-applications not submitted via this option will be treated as incomplete and will not be evaluated.

6. Late Pre-Applications

Pre-applications received after the designated date and time, i.e., late, will be treated as nonresponsive and not evaluated. Extension of the R&D pre-application due dates shall be determined at the sole discretion of the Contracting Officer.

7. Workscope Descriptions

Appendix B contains detailed descriptions of research needs in support of each programmatic element for submission to the Program Supporting sectors of the call.

8. Program Contacts

The NEUP website, http://www.neup.gov, provides a list of technical contacts for each program who can be contacted for further information on their respective areas of work. Additional information regarding NE R&D programs may be found at http://nuclear.energy.gov/.

9. Evaluation of Pre-Applications and Invitation to Submit a Full Application

The application evaluation and invitation process will be based on written information, references, and independent pre-award assessment actions as outlined within this solicitation.

> **NOTE**: Applicants who are not specifically invited to submit full proposals may still do so at their own risk. There is no guarantee that uninvited full applications will receive a full review; however, all full applications received will be re-reviewed for relevancy. Only those uninvited full proposals that are scored as Highly Relevant or better will be forwarded for technical peer review during the evaluation phase for full proposals.

D. CONTENT AND APPLICATION FORMS: PS FULL APPLICATIONS

Each applicant's R&D **full application** shall include the items found in Table 7. Applicants may input these full application elements on the full application form provided at the NEUP website. Access instructions are available at http://www.neup.gov. You must complete the mandatory forms and any applicable optional forms 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, UNLOCKED, WITHOUT PASSWORD PROTECTION) unless otherwise specified in this announcement.

Table 7: Submittal Content and Format for PS Full Applications

Item	Description	Page Limit

Summary Abstract	Size 11 Times New Roman font minimum; 1 single spaced pages maximum-including references; One-inch margins all around minimum. Place proposal ID number on each page in header or footer; Name file: 2013 R&D Summary Abstract "Insert ID#"	1
Project Narrative	Size 11 Times New Roman font minimum; 10 single spaced pages maximum-including references; One-inch margins all around minimum. Place proposal ID number on each page in header or footer; Name file: 2013 CFP Narrative "Insert ID#"	10
Vita(s)	Size 11 Times New Roman font minimum; Up to 5 two-page vitas may be submitted (1 PI, 4 collaborators) for up to a total of 10 single spaced pages maximum; 1-inch margins all around minimum. Place proposal ID number on each page in header or footer; Name file: 2013 CFP last name of collaborator "Insert ID#"	5 vitas allowed (2 pages each)
Capabilities	Size 11 Times New Roman font minimum; 2 single spaced pages maximum; One-inch margins all around minimum. Place proposal ID number on each page in header or footer; name file: 2013 CFP Capabilities "Insert ID#"	2
Budget	Applicants must provide a separate budget for each year of support requested and a cumulative budget for project period. Use the SF 424A Excel, "Budget Information - Non Construction Programs"	N/A
Supplementary Information	Required conflict of interest form. Name file: 2013 CFP COI "Insert ID#" Short description of additional PIs/collaborators/advisors beyond the five participants above. Name file: 2013 CFP Supplemental "Insert ID#"	2
Agreement Requirements	Agreement Requirements check box at the bottom of the application form re-affirms the Quality Assurance and Commitment of Partners as specified in the pre-application.	N/A

1. Summary Abstract

The R&D summary abstract must contain a summary of the proposed activity suitable for dissemination to the public. It should be a self-contained document that identifies the name of the applicant, key personnel proposed for the project, the objectives of the project, a description of the project, including methods to be employed, the potential impact of the project (i.e., benefits, outcomes), and, for collaborative projects, the dollar value of the effort to be performed by each participant over the period of performance and a brief description of the capacity in which the participant will be participating. This document must not include any proprietary or sensitive business information as the Department may make it available to the public.

2. Project Narrative

Applicant shall provide a written narrative addressing its strategy to execute R&D that supports the specified Technical Workscope. The documentation provided shall include the items specified below:

- Proposal Title. (Do not use all CAPS for proposal title.)
- Final Technical Workscope Identification: refer to the communication provided by the DOE program integration office describing the results of the pre-application selection process.
- Proposed Scope Description.
- Logical path to accomplishing scope, including descriptions of tasks. This section will provide a clear, concise statement of the specific objectives/aims of the proposed project. This section should be formatted to address each of the merit review criterion and sub-criterion listed in Part V.A. Provide sufficient information so that reviewers will be able to evaluate the application in accordance with these merit review criteria.
- Relevance and Outcomes/Impacts: This section will explain the relevance of the effort to the objectives in the program announcement and the expected outcomes and/or impacts.

- Milestones and Deliverables.
- Type/description of facilities that will be used to execute the scope (N/A is acceptable).
- Schedule: Define timelines for executing the specified workscope.
- The roles and responsibilities of each partnering organization in the execution of the workscope.
- Unique challenges to accomplishing the work and innovations expected to mitigate such challenges.
- Information, data, plans, or drawings necessary to explain the details of Applicant's proposal.
- Quality Assurance (QA): Describe the applicable QA requirements and how they will be met. This can be a simple statement agreeing to comply with the QA requirements as described by DOE on the application website and any additional requirements deemed necessary.
- References are included in the 10 page limit. Name file: 2013 CFP Narrative "Insert ID#."

The R&D technical narrative **shall NOT include** the following information:

- Cost and pricing information.
- Identification, by individual name or name of institution, of any teaming partner. Examples of acceptable ways of referring to partners will be posted on the NEUP website.
- Official name or title of facilities used to execute scope. Describe the facility by function and/or technical attributes such as an accelerator, a test reactor, etc.

3. Vitas - Technical Expertise and Qualifications (2 Pages Each)

Applicant shall name all teaming partners by name and organization, as well as their proposed roles and responsibilities. For the PI and collaborators, the Applicant shall provide a brief vita that lists the following:

Contact Information

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.

- Name File: 2013 CFP Last Name of Collaborator "Insert ID#."

Technical expertise and qualifications are to be provided for a maximum of five individuals. Submitted individuals (and/or their recipient institutions) must receive at least $50,000 over the life of the project to be considered a collaborator. Minor contributors—anyone not expected to materially participate in the proposal, such as consultants or national laboratory personnel who are not to be paid more than $49,999 to participate in the project—**should be listed on the application form, but do not need to be represented in this section.**

4. Capabilities

Infrastructure Requirements: In a separate document, Applicant shall identify the infrastructure (e.g., facilities, equipment, and instrumentation) required to execute the proposed scope of work. Describe the

non-labor (e.g., facilities, equipment, and instrumentation) resources that are available and accessible to the Applicant and are required to execute the scope of work. Describe any unique equipment and facilities that are needed, are accessible, and will be used to execute the scope of work. Discuss the adequacy of these resources and identify any gaps.

If you are a university PI requesting funds through the General Scientific Infrastructure Solicitation to support this research, provide summary detail of the request here.

See the electronic proposal submission form for document guidance. This FOA allows the Applicant to propose the purchase of any needed equipment to conduct the proposed work. (Name file: 2013 CFP Capabilities "Insert ID#.")

5. Budget

Proposals shall not propose costs of more than $400,000 total for cooperative agreements generally up to 2 years and $1,000,000 total for cooperative agreements generally up to 3 years. No-cost extensions up to 1 additional year must be approved by the Contracting Officer.

Specific details regarding cost and duration are listed in Appendix B.

6. Supplementary Information

As requested by the submission form, Applicant shall identify all Federal funding sources by agency source, project name, monetary amount, and length of term that are pending or currently in place for the PI or collaborators within the past five years.

Within the written proposal, Applicant shall address the agreement requirements. Only proposals deemed fully compliant with the requirements of this FOA shall be eligible for continued evaluation. All requirements committed to within the pre-application process continue to apply throughout the full application process.

7. Application Due Date

In accordance with the schedule above, Applications are due by 8:00 p.m. ET on June 12, 2013. Submittals to the R&D solicitation MUST be made electronically. Please read the instructions on the form carefully. Applications not submitted via this option will be treated as incomplete and will not be evaluated.

8. Late Applications

Applications received after the designated date and time, i.e., late, will be treated as nonresponsive and not evaluated. Extension of the application due dates shall be determined at the discretion of the Contracting Officer.

9. Workscope Descriptions

Appendix B contains detailed descriptions of research needs in support of each programmatic element for submission to the Program Supporting sectors of the call.

10. Program Contacts

The NEUP website, http://www.neup.gov, provides a list of technical contacts for each program who can be contacted for further information on their respective areas of work. Additional information regarding NE R&D programs may be found at http://nuclear.energy.gov/.

PART V - APPLICATION REVIEW INFORMATION

A. CRITERIA

1. Initial Review Criteria

Prior to a comprehensive merit evaluation, DOE will perform an initial review to determine that (1) the applicant is eligible for an award; (2) an initial project relevancy review; (3) the information required by the announcement has been submitted; (4) all mandatory requirements are satisfied; and (5) the proposed project is responsive to the objectives of the Funding Opportunity Announcement. Only applications meeting these initial review criteria will be considered during the merit review and award selection decision.

2. PS R&D Merit Review Criteria: Pre-Applications

Selection of applying institutions invited to provide full applications shall be based on how well the pre-applications meet or exceed the technical and relevancy evaluation criteria provided below. All applications submitted under this solicitation will be reviewed and scored by two different groups as described below.

First, a panel of programmatic experts will assess each pre-application's relevancy to NE's R&D mission and associated program/workscope. Points will be assigned according to the following relevancy attributes:

Relevancy attributes:

- Unquestionably Relevant/Unquestionable Program Priority (100 pts): The proposal is fully supportive of, and has significant, easily recognized and demonstrable ties to, the relevant program element(s).

- Highly Relevant/High Program Priority (80 pts): The proposal is supportive of, and has significant and demonstrable ties to, the relevant program element(s).

- Relevant/Intermediate Program Priority (60 pts): The proposal is supportive of, and has tangible ties to, the relevant program element(s).

- Moderate Relevance/Moderate Program Priority (40 pts): The proposal is partially supportive of, and has some ties to, the relevant program element(s).

- Low Relevance/Low Program Priority (20 pts): The proposal is minimally supportive of, and difficult to tie to, the relevant program element(s).

- Not Relevant/No Program Priority (0 pts): The proposal is not supportive of the relevant program element(s) – OR – sufficient work is already being performed.

Second, a separate technical expert/peer will assess each application on its technical merit. Points will be assigned according to the following attributes of technical merit.

Technical merit attributes:

- High Merit (100 pts): The proposal unquestionably advances the technical state of knowledge and understanding of the NE mission or program element, and is creative and based largely on original concepts. The scope is within the technical expertise of the proposed team, and can be executed fully in the facilities available within the proposed budget.

- Moderate Merit (66 pts): The proposal incrementally advances the technical state of knowledge and understanding of the NE mission or program element, and is somewhat creative and based contains several original concepts. The scope will be a challenge to the technical expertise of the proposed team, and may be difficult to execute fully in the facilities available within the proposed budget.

- Low Merit (33 pts): The proposal recognizes the technical state of knowledge and understanding of the NE mission or program element, and is only marginally creative and contains few original concepts. The scope will be a challenge to the technical expertise of the proposed team, and may be difficult to execute fully in the facilities available within the proposed budget. The scope will be a challenge to the technical expertise of the proposed team and require resources not named in the proposal or will require additional facilities or funding to execute.

- No Merit (0 pts): The proposal does not advance or recognize the technical state of knowledge and understanding of the NE mission or program element, and is not creative or original. The scope is beyond the technical expertise of the proposed team, and cannot be executed fully in the facilities available within the proposed budget.

The points determined by evaluating each proposal against the above criteria will then be weighted as defined in Table 8 to determine an overall evaluation score for each application. Note that the program relevancy score may be increased by up to 5 points based on evaluators' determination of the degree to which an effective partnership with MSIs, international or industrial partners, and/or underrepresented groups is proposed.

Table 8. Effective Partnership Evaluation and Weighting of Evaluation Points for Pre-Applications

Partnership Effectiveness[1]	The degree to which minority-serving institutions, international and/or industry partners, and/or underrepresented groups, if any, contribute to the proposal's ability to support the relevant program element or overall NE mission. **Note: effective partnerships are not required for projects to be evaluated as unquestionably relevant, but effective partnerships will increase relevance score from 1 to 5 points, not to exceed maximum available relevancy points, based on meeting one of the following criteria:** The proposal has (1) a substantive contribution by an industrial, international, underrepresented group, or minority serving institution (MSI) collaboration; (2) a demonstrable contribution by an industrial, international, underrepresented group, or MSI collaboration; or (3) some relevant partnership with an industrial, international, underrepresented group, or MSI collaboration.	5 points maximum[2]
Weighting	**Weighted Score Ratio** **(Technical : Relevancy)** **Program Supporting: 65:35**	

[1] Supports Program Relevance: This element will be scored by the Federal Program Offices and TIO offices, not by peer review.
[2] Total relevancy points cannot exceed 100% of points available from the relevancy criteria

After considering the overall evaluation scores, available funding, and subjective factors (e.g., balanced research portfolio), NE will make a final determination of applicants who will be invited to provide full applications. Applicants who are not specifically invited to submit full proposals may still do so at their own risk. There is no guarantee that uninvited full applications will receive a full review; however, all full applications received will be re-reviewed for relevancy. Only those uninvited full proposals that are scored as Highly Relevant or better will be forwarded for technical peer review during the evaluation phase for full proposals described below.

3. PS R&D Merit Review Criteria: Full Applications

Upon receipt, DOE will perform an initial review of full applications to determine that (1) the applicant remains eligible for an award; (2) the proposal requires an initial project relevancy review (i.e., it was received uninvited); (3) the information required by the announcement has been submitted; (4) all mandatory requirements are satisfied; and (5) the proposed project remains responsive to the objectives of the FOA. Only applications meeting these initial review criteria will be considered during the merit review and award selection decision.

Review of full applications shall be based on how well the applications meet or exceed the technical and relevancy evaluation criteria provided below and as weighted as described in Table 9. All invited full applications and those uninvited applications that are rated Highly Relevant or better submitted under this solicitation will be reviewed and scored by two different groups. A panel of programmatic experts will assess each pre-application's relevancy to NE's R&D mission or program and three technical peer reviewers will evaluate the proposal for technical merit. Effective partnerships will be incorporated into the relevancy evaluation. Any proposals scored as "Not Relevant" at this point will not be evaluated further because NE has received clear Congressional direction that in no instance can NE allocate funds to activities that are not relevant to its mission.

Relevancy attributes:

- Same as for the pre-application evaluation phase. See Section 2 above.

Technical Merit attributes:

Applications will be subjected to formal merit review and will be evaluated against the following criteria. Included within each criterion are the detailed questions that reviewers will consider in evaluating each criterion as listed below.

- How important is the proposed activity to advancing knowledge and understanding within the workscope area and period of performance?
- How well does the activity advance discovery or explore creative, original or potentially transformative concepts?

Review Considerations:

1. Advances the state of scientific knowledge and understanding.
2. Addresses gaps in nuclear science and engineering research.

Points	Scoring Criteria
9-10	Outstanding scientific merit; clearly addresses gaps in scientific/engineering knowledge and understanding
6-8	Reasonable contribution; likely to contribute to scientific knowledge and understanding
3-5	Questionable scientific merit; not likely to result in meaningful advances to scientific knowledge and understanding
1-2	Little or no scientific merit; does not advance knowledge and understanding

Research Plan

- How well conceived and organized is the proposed activity?
- Is there a logical path to work accomplishment?
- Are the timeline and milestones well laid out and challenging?

Review Considerations:

1. Proposal outlines a logical technical approach to accomplish project objectives.
2. Proposal outlines the strategy for project management and a timeframe for the proposed work scope

that are reasonable and appropriate.

Points	Scoring Criteria
9-10	Outstanding, logical method and approach with no apparent shortcomings
6-8	Reasonably innovative approach with some weaknesses
3-5	Questionable method or approach; weaknesses evident that may impact performance
1-2	Ineffective method or approach posing significant risk of non-performance

R&D Resources and Capabilities

- Are there sufficient resources, budget and facilities to conduct the proposed work?
- Is the budget request too high or low to accomplish the scope?
- Will the facilities support the types of work proposed? If equipment is to be purchased, is it appropriate to the identified scope? The proposal should clearly demonstrate that non-labor resources are adequate to accomplish the proposed work scope. (Costs delineated on the budget worksheet and the capabilities description document will be considered within this section. Some additional information may be found in the supplementary documents.)

Review Considerations:

1. Equipment and facilities supplied by each participating organization are suited to proposed tasks.
2. Proposed costs are reasonable and adequately justified.

Points	Scoring Criteria
9-10	Outstanding equipment resources, with no apparent shortcoming for executing the proposed scope of work
6-8	Reasonable and appropriate personnel and equipment with some weaknesses in either area; cost structure may not be fully supported
3-5	Questionable staffing, equipment, or cost; weaknesses evident that may impact performance
1-2	Unsatisfactory resources or cost structure posing significant risk of non-performance

Team Qualifications

- How well qualified is the proposer (individual or team) to conduct the project? If appropriate, the reviewer should take into consideration the quality of prior work. The credentials, publications, experience and past accomplishments of the principal investigator and all project members should be considered within this section. (See the submitted vitas and supplementary documents for this section.)

Review Considerations:

1. Principal investigator/project manager have sufficient and relevant qualifications and experience to lead the proposed research.
2. Key collaborators have sufficient and relevant qualifications and experience of for their assigned role.
3. Proposed personnel resources are adequate and appropriate to accomplish the stated research workscope.

Points	Scoring Criteria
9-10	Highly competent PI and collaborators with significant expertise in the research area
6-8	Competent PI and collaborators; some shortcoming in either area
3-5	Questionable team qualifications; notable weaknesses in key areas
1-2	Significant weaknesses in team qualifications posing significant risk of non-performance

Table 9: PS R&D Full Proposals - Weighting of Evaluation Scores

Criterion	Description	
	Technical Proposal – Peer Review	**Percentage of Peer Review Points**
Scientific and Technical Merit	Advances the state of the knowledge in the relevant program element(s); practicality of scope with respect to specified funding range for work scope and period of performance.	35%
Research Plan	Logical path to work accomplishment.	35%
R&D Resources and Capabilities	Demonstrate that labor and non-labor resources are adequate to accomplish the proposed work scope. Costs delineated on the budget worksheet will be considered within this section.	15%
Team Qualifications	Relevant credentials, publications, experience, and past accomplishments of Principal Investigator and collaborators.	15%
	Peer Review Score	Sum of ratings x weights
	Relevance[1] (Separate Review Process)	**Percentage of Relevancy Review Points**
Program Relevance	Alignment with the program-specific relevant technical objectives.	Up to 100% (if no partnerships)
Partnership Relevance	The degree to which minority-serving institutions, international and/or industry partners, and/or underrepresented groups, if any, contribute to the proposal's ability to support the relevant program element or overall NE mission. **Note: effective partnerships are not required for projects to be evaluated as unquestionably relevant, but effective partnerships will increase relevance score from 1 to 5 points, not to exceed maximum available relevancy points, based on meeting one of the following criteria:** The proposal has (1) a substantive contribution by an industrial, international, underrepresented group, or minority serving institution (MSI) collaboration; (2) a demonstrable contribution by an industrial, international, underrepresented group, or MSI collaboration; or (3) some relevant partnership with an industrial, international, underrepresented group, or MSI collaboration.	Up to 25% (5 points max.)
	Relevancy Score	Sum of ratings[2] x weights
Weighting	**Weighted Score Ratio** **(Peer : Relevancy)** **Program Supporting: 65:35**	

[1] Supports Program Relevance: This element will be scored by the Federal Program Offices and TIO offices, not by peer review.

[2] Total relevancy points cannot exceed 100% of points available from the relevancy criteria

4. Other Selection Factors

The Selection Official may consider the following program policy factors in the selection process, such as:

1. Technical diversity of projects; applications will be balanced to optimize the selection of the appropriate mix of applications to best achieve the NE goals.

2. Relevance to agency's programmatic needs.

3. Cost/Budget considerations.

Any of the above factors used will be independently considered by the Selection Official in determining the optimum mix of applications that will be selected for support. These factors, while not indicators of the Application's merit, may be essential to the process of selecting the application(s) that, individually or collectively, will best achieve the program objectives. Such factors are often beyond the control of the Applicant. Each Applicant should recognize that some very good applications might not receive an award because they do not fit within a mix of projects that maximized the probability of achieving the DOE's overall development R&D objectives. Therefore, the above factors may be used by the Selection Official to assist in determining which applications shall receive DOE funding support.

B. SUMMARY OF THE REVIEW AND SELECTION PROCESS

1. PS Pre-Applications

Pre-application proposals will be evaluated against the technical and relevancy criteria described above. This peer and program evaluation process will produce a list of recommended proposals for each workscope provided in Appendix A. The Department will consider the overall evaluation results and subjective programmatic factors to select a final set of proposals to be "invited" to provide a full application.

> **NOTE:** Applicants who are not specifically invited to submit full proposals may still do so at their own risk. There is no guarantee that uninvited full applications will receive a full review; however, all full applications received will be re-reviewed for relevancy. Only those uninvited full proposals that are scored as Highly Relevant or better will be forwarded for technical peer review during the evaluation phase for full proposals.

2. PS Full Applications

Three peer reviewers will independently employ a semi-blind process to evaluate and score the proposals in accordance with the peer review evaluation criteria described above. This peer evaluation process will support development of a recommended list of proposals to be awarded for each workscope. Also, a relevancy review process will be completed by DOE in accordance with the scoring criteria described above and support development of a recommended list of proposals to be awarded. DOE will consider the overall evaluation results and subjective programmatic factors to ultimately determine a final set of proposals to be approved by the Selection Official for funding.

3. Selection Official Considerations

The Selection Official will consider the merit review recommendation and subjective factors such as program policy considerations, research portfolio diversity, and the amount of funds available.

C. ANTICIPATED NOTICE OF SELECTION AND AWARD DATES

DOE will strive to make selections within six to eight months after receipt of applications.
DOE anticipates having multiple award selection dates.

SECTION C: UNIVERSITY-LED PROGRAM DIRECTED INTEGRATED RESEARCH PROJECTS

Program Directed (PD) IRPs for only University-led applications (workscopes found in Appendix C)

IRPs will bring together the skills and talents of interdisciplinary investigators to enable fundamental research of a scope and complexity that would not be possible with the standard individual investigator or small group research project. As such, the IRPs will strengthen and complement the existing portfolio of the single PI and small group research projects currently supported within NE. The IRPs will foster unique scientific collaboration that will be critical to success and must be backed by a meaningful and sustained investment. The IRPs are intended to integrate several disciplinary skills in order to present solutions to complex systems design problems that cannot be addressed by a less comprehensive team.

It is critical for IRP research teams to have in depth understanding of potential NE needs in order to implement a sustainable and viable technology. This will be a true collaboration between the NE R&D programs and IRPs; which must combine exceptional skill and creativity in energy technology research. IRP research teams must have cutting-edge expertise in the specific problems to be addressed, either by including researchers specializing in the field or by developing strong partnerships and working relationships with the individuals and institutions, governmental and non-governmental, that have been engaged in research on these or related problems. IRPs are also expected to develop enabling technologies to facilitate and accelerate this research.

University PIs for a currently-funded IRP are precluded from being a PI in response to this solicitation, but are not precluded from being a participant as a collaborator (see SUBMITTAL LIMITS provisions provided in Sections A, B and C). IRP consortiums may be composed of diverse institutions including academia, national laboratories, non-profit research institutes, industry/utilities, and international partners. IRP research teams should strive to achieve the synergies that arise when individuals with forefront expertise in different methodologies, technologies, disciplines, and areas of content knowledge tackle a problem together, overcoming impasses by attacking the issue from fresh angles and discovering novel solutions.

DOE recognizes that effective management of scientific facilities, programs, and projects is critical to research success and its overall contribution to the NE R&D mission. IRPs must have well-designed management plans for their establishment and execution, to include research, technology development, resources (both personnel and physical resources), and scientific data. Management plans should include provisions for coordination with other basic and applied R&D activities supported by the Department. IRP management structure must enable empowered scientist-managers to execute quick decisions to shape the course of research. In addition, each IRP will be monitored and guided by an associated NE technical oversight panel, whose membership will be composed of DOE-NE program personnel and their designated technical liaisons at national laboratories or other sources, as appropriate. IRP execution shall be periodically reported and monitored for continued project funding.

Key elements for successful IRP management include:

- A clear lead university with strong scientific leadership and central location for the IRP;
- To the extent that there is geographic distribution of the IRP participants, a clear commitment to applying state-of-the-art technology and frequent virtual meetings to enable meaningful long distance collaboration; and most importantly
- A clear organization and management plan for achieving the collaborative and synergistic goals of an IRP and "infusing" a culture of empowered central research management throughout the IRP.

IRPs will be subject to regular and rigorous review of their scientific program and their management structure, policies, and practices. Pre-applications are not required. Only full applications will be accepted.

Although a proposing team must have a lead university and at least one other university, the proposed project team may include multiple universities and non-university partners (e.g., industry/utility, international, minority-serving institutions (MSI), national laboratory, and underrepresented groups). The Department strongly encourages diversifying its research portfolio through effective partnerships with industry, underrepresented groups, and MSI, which may receive funding support from the project. International partners are equally encouraged on a non-U.S. government funding basis. The Department will evaluate any such proposed partnerships as part of its program relevancy evaluation and scoring. The following link provides the current list of MSI: http://www.ed.gov/about/offices/list/ocr/edlite-minorityinst.html.

No more than 20 percent of the IRP funds provided by the government can go to non-university participants, including all government-funded national laboratory and industry/ utility partner shares combined. For participating universities, cost-sharing is encouraged, but not required.

PART II – AWARD INFORMATION

A. TYPE OF AWARD INSTRUMENT

DOE anticipates awarding cooperative agreements under this funding opportunity announcement (See Section VI.B.2 Statement of Substantial Involvement).

B. ESTIMATED FUNDING

The Department currently estimates that it will fund approximately $5 million in awards in this Section in FY 2013, however, this estimate is contingent upon Congressional appropriations and is subject to significant change.

C. MAXIMUM AND MINIMUM AWARD SIZE

Ceiling – The maximum amount for an individual award made under this Section is $5,000,000 total for project duration for up to three (3) years. Projects will be evaluated annually to determine if funding will continue within the project period.

Floor (i.e., the minimum amount for an individual award made under this announcement): $ NONE SPECIFIED.

D. EXPECTED NUMBER OF AWARDS

DOE anticipates making 1 award under this announcement depending on the size of the awards.

E. ANTICIPATED AWARD SIZE

DOE anticipates that awards will be approximately $5,000,000/applicant.

F. PERIOD OF PERFORMANCE

DOE anticipates making awards of up to 3 years. Work must be completed according to the terms and conditions of the award. Projects will be evaluated annually to determine if funding will continue within the project period.

G. TYPE OF APPLICATION

DOE will accept only new applications under this announcement.

PART III - ELIGIBILITY INFORMATION

A. ELIGIBLE APPLICANTS

Eligibility under this section is limited to U.S. universities, colleges, community colleges, and trade schools. Minority Serving Institutions (MSI) are encouraged to apply.

B. COST SHARING

For proposals led by universities, cost-sharing is encouraged, but not required. If cost sharing is provided, see 10 CFR 600 for the applicable cost sharing guidance and UNDERSTANDING COST SHARING REQUIREMENTS in Part VIII.H below.

C. SUBMITTAL LIMITS

- University PIs with a currently funded IRP, or three or more R&D projects that will still be active after September 30, 2013, or who have received a no-cost extension (NCE) on any DOE-NE funded project after March 31, 2013, which will still be active beyond September 30, 2013, are ineligible to apply to any Section of this FOA as a PI.

- For submissions to all Sections of this FOA, university PIs can be included on no more than six pre-applications total, with no more than three of those submissions as the PI.

- For Section B of this FOA, all applying institutions (i.e., university, national laboratory, industry) are limited to three pre-applications per institution per workscope area. If a university PI is designated as the lead, these submissions will count toward the above overall university researcher limitation of being associated with no more than six pre-applications total in response to all sections of this FOA, with no more than three of those associations being as the lead PI.

- For Section C of this FOA (IRPs), an applicant is ineligible to submit an application as the PI if (s)he is designated as PI for more than one currently funded DOE-NE project that will still be active beyond September 30, 2013.

- A PI may have no more than one IRP or three R&D projects funded at any time, and may therefore not submit more full applications than would be allowed by these restrictions should these applications be selected for funding.

D. OTHER ELIGIBILITY REQUIREMENTS

FFRDC Contractors

FFRDC contractors may be proposed as a team member on another entity's application subject to the following guidelines:

Authorization for non-DOE/NNSA FFRDCs. The Federal agency sponsoring the FFRDC contractor must authorize in writing the use of the FFRDC contractor on the proposed project and this authorization must be submitted with the application. The use of a FFRDC contractor must be consistent with the contractor's authority under its award.

Authorization for DOE/NNSA FFRDCs. The cognizant contracting officer for the FFRDC must authorize in writing the use of a DOE/NNSA FFRDC contractor on the proposed project and this authorization must be submitted with the application. The following wording is acceptable for this authorization.

> "Authorization is granted for the **Fillin 1: [Name]** Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or

complimentary to the missions of the laboratory, will not adversely impact execution of the DOE/NNSA assigned programs at the laboratory."

Value/Funding. The value of, and funding for, the FFRDC contractor portion of the work will not normally be included in the award to a successful applicant. Usually, DOE/NNSA will fund a DOE/NNSA FFRDC contractor through the DOE field work proposal system and other FFRDC contractors through an interagency agreement with the sponsoring agency.

Cost Share. The applicant's cost share requirement will be based on the total cost of the project, including the applicant's and the FFRDC contractor's portions of the effort.

Responsibility. If the FFRDC contractor is proposed as a team member on another entity's application (e.g., as a subawardee) the applicant, if successful, will be the responsible authority regarding the settlement and satisfaction of all contractual and administrative issues, including but not limited to, disputes and claims arising out of any agreement between the applicant and the FFRDC contractor.

National Laboratory Contractors:

A DOE/NNSA National Laboratory Contractor is eligible to apply for funding under this announcement if its cognizant contracting officer provides written authorization and this authorization is submitted with the application. (This is not required for the National Energy Technology Laboratory since it is a Government Owned/Government Operated (GOGO)). If a DOE/NNSA National Laboratory Contractor is selected for award, the proposed work will be authorized under the DOE work authorization process and performed under the laboratory's M&O contract. The following wording is acceptable for the authorization:

"Authorization is granted for the **Fillin 1: [Name]** Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or complimentary to the missions of the laboratory and will not adversely impact execution of the DOE/NNSA assigned programs at the laboratory."

PART IV - APPLICATION AND SUBMISSION INFORMATION

A. ADDRESS TO REQUEST APPLICATION PACKAGE

Apply at http://www.neup.gov

Application forms and instructions are available at the NEUP website. To access these materials, go to http://www.neup.gov, select "Login" from the top right hand corner of the screen, enter your user credentials, select "Proposals" from the menu, and then click on "Create New Proposal" for the type of proposal you are creating.

B. Pre-applications Not Required for Section C.

C. CONTENT AND APPLICATION FORMS: PD IRP APPLICATIONS

Each applicant's R&D **full application** shall include the items found in Table 10. Applicants may input these full application elements on the NEUP R&D application form provided at the NEUP website. Access instructions are available at http://www.neup.gov. You must complete the mandatory forms and any applicable optional forms 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, UNLOCKED, WITHOUT PASSWORD PROTECTION) unless otherwise specified in this announcement.

Table 10: Submittal Content and Format for PD IRP Applications

Item	Description	Page Limit
Summary Abstract	Size 11 Times New Roman font minimum; 2 single spaced pages maximum-including references; One-inch margins all around minimum. Place proposal ID number on each page in header or footer; Name file: 2013 IRP Summary Abstract "Insert ID#"	2
Project Narrative	Size 11 Times New Roman font minimum; 50 single spaced pages maximum-including references; One-inch margins all around minimum. Place proposal ID number on each page in header or footer; Name file: 2013 IRP Narrative "Insert ID#"	50
Benefit of Collaborations	Applicant shall provide a narrative that includes an explanation of the contribution that will be made by the collaborating organizations and/or facilities to be utilized.	4
Vita(s)	Size 11 Times New Roman font minimum; Up to 5 two-page vitas may be submitted (1 PI, 4 collaborators) for up to a total of 10 single spaced pages maximum; 1-inch margins all around minimum. Place proposal ID number on each page in header or footer; Name file: 2013 IRP last name of collaborator "Insert ID#"	2 pages each
Capabilities	Size 11 Times New Roman font minimum; 4 single spaced pages maximum; One-inch margins all around minimum. Place proposal ID number on each page in header or footer; name file: 2013 IRP Capabilities "Insert ID#"	4
Letters of Support	A letter of support from non-Federal partners (e.g., industry, utility, international) is required to describe the level and type of support contemplated for the project.	2
Budget	Applicants must provide a separate budget for each year of support requested and a cumulative budget for project period. Use the SF 424A Excel, "Budget Information - Non Construction Programs"	N/A
Agreement Requirements	Agreement Requirements check box on bottom of the application form re-affirms the Quality Assurance and Commitment of Partners.	N/A
Supplementary Information	Required conflict of interest form. Name file: 2013 CFP COI "Insert ID#" Short description of additional PIs/collaborators/advisors beyond the five participants above. Name file: 2013 CFP Supplemental "Insert ID#"	2

1. Summary Abstract

The PD IRP summary abstract must contain a summary of the proposed activity suitable for dissemination to the public. It should be a self-contained document that identifies the name of the applicant, key personnel proposed for the project (e.g., the IRP Principal Investigator, the Project Director, Co-Principal Investigator(s)), the project title, the objectives of the project, a description of the project, including methods to be employed, the potential impact of the project (i.e., benefits, outcomes), and, the dollar value of the effort to be performed by each participant over the period of performance and a brief description of the capacity in which the participant will be participating. This document must not include any proprietary or sensitive business information as the Department may make it available to the public.

It will be up to the applicant to define key personnel and the role they will play in accomplishing the project. Key personnel include such positions as IRP Principal Investigator, project manager, deputy project manager, co-principal investigator(s), collaborators, etc., or any other persons having a significant role in the successful outcome of the IRP project. Personnel identified in the application proposal as key personnel will be expected to devote a significant amount of their time toward the project, unless otherwise acceptably justified in the applicant's proposal.

2. Project Narrative

A cover page and table of contents must be included at the beginning of the project narrative but neither will count against the page limit. Furthermore, information required to be submitted in the requested appendices are not subject to the project narrative page limit. Headers/footers containing page numbers and project titles/logos may be inserted within the required 1" margins. The font must not be smaller than Times New Roman 11 point. Do not include any Internet addresses (URLs) that provide information necessary to review the application, because the information contained in these sites will not be reviewed. See Part VIII.D for instructions on how to mark proprietary application information. The contents of the project narrative are specified in order to ensure that the merit reviewers have the necessary information to conduct proper evaluations.

Applicants should describe plans for integrating the results of their fundamental research and technology development with other basic and applied R&D activities supported by the Department, including the work conducted by other IRPs.

If applicants identify essential research and technology capabilities that are beyond the scope of the proposed IRP's skills and resources then the applicant should demonstrate plans for obtaining these additional capabilities, including collaboration with outside experts.

This section must provide a clear, substantive overview of the vision, management, and organization of the proposed IRP. Applicant shall provide a written narrative addressing its strategy to execute R&D that supports the specified Technical Work Scope. The documentation provided shall include the items specified below:

- Proposal Title (Do not use all CAPS for proposal title.)
- Technical Work Scope Identification
- Proposed Scope Description
- Logical path to accomplishing scope including descriptions of tasks
- Milestones and Deliverables
- Type/description of facilities that will be used to execute the scope
- Schedule: Define timelines for executing the specified work scope
- The roles and responsibilities of each partnering organization in the execution of the workscope
- Unique challenges to accomplishing the work and innovations expected to mitigate such challenges
- Information, data, plans, or drawings necessary to explain the details of Applicant's proposal
- Quality Assurance (QA): Describe the applicable QA requirements and how they will be met. This can be a simple statement agreeing to comply with the QA requirements as described by DOE on the application website and any additional requirements deemed necessary.
- References are included in the 50 page limit
- Name file: 2013 IRP Narrative "Insert ID#."

3. Benefit of Collaborations (4 pages):

Applicant shall provide a narrative that includes an explanation of the contribution that will be made by the collaborating organizations and/or facilities to be utilized. It can contain brief biographies of staff and descriptions of the facilities wherein the research will be conducted. Please indicate within this section if this proposal has benefit or influence on other ongoing or proposed NE R&D projects (e.g. modeling and simulation in one proposal and effect validation in a separate proposal).

4. Vitas - Technical Expertise and Qualifications (2 pages each):

Applicant shall name all teaming partners by name and organization, as well as their proposed roles and responsibilities. For the Principal Investigator and collaborators, the Applicant shall provide a brief vita that lists the following:

Contact Information

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.

- Name File: 2013 IRP Last Name of Collaborator "Insert ID#."

5. Capabilities

Infrastructure Requirements: In a separate document, Applicant shall identify the infrastructure (e.g., facilities, equipment, and instrumentation) required to execute the proposed scope of work. Describe the non-labor (e.g., facilities, equipment, and instrumentation) resources available and accessible to the Applicant and are required to execute the scope of work. Describe any unique equipment and/or existing facilities that are needed, are accessible, and will be used to execute the scope of work Discuss the adequacy of these resources and identify any gaps. See the electronic proposal submission form for document guidance.

IRPs must include all technical capabilities considered necessary by the applicant to implement their proposed approach, including experimental and computational tools. In order to carry out the proposed research program, IRPs shall develop core capabilities in or have access to the full range of synthetic, characterization, manipulation, and computational capabilities. A portion of the research may be devoted to developing new technological capabilities for overcoming challenges that cannot be addressed with currently available technologies and instrumentation. Research capabilities and resources to be accessed outside of IRPs should be clearly identified.

While capital investment in instrumentation and equipment may be included as part of the IRP awards, usage and leverage of existing facilities, including the Department's user facilities, is encouraged. DOE user facilities, including nuclear reactors, light sources, neutron sources, nanoscale science research centers, advanced computational facilities, and other specialized user facilities, are considered foundational resources for a vast range of the scientific user community. As such, they are expected to serve as independent resources for IRPs, when appropriate. Funding for activities at DOE user facilities is managed separately from this FOA and should not be included in IRP budget requests in response to this FOA.

6. Letters of Support

When appropriate, IRPs are expected to foster and encourage robust interaction with collaborators to

accomplish the scope of R&D defined by this FOA. Applicants are encouraged to provide information regarding their plans to create a research environment that promotes diverse collaboration, when appropriate, to enable organizational cognizance of international capabilities, industry/utility readiness, technology transfer, and assisting the transition of developed technologies to industrial development.

A letter of support from non-Federal partners (e.g., industry, utility, international) is required to describe the level and type of support contemplated for the project.

The Applicant shall include letters of support on company stationery and signed by an appropriate company official. Name File: 2013 CFP Letter of Support "Insert ID#."

7. Budget

Applicants must provide a separate budget for each year of support requested and a cumulative budget for project period.

Allowable costs include those necessary to purchase research equipment and instrumentation required to execute the proposed project. No new construction (new buildings or major modifications to existing buildings) or major multi-use equipment procurements will be allowed. If equipment is to support multiple projects, its cost shall be appropriately allocated across each supported project.

Applicants should secure access to needed scientific instrumentation and test facilities, including DOE user facilities. Be advised that access to and funding for many DOE user facilities is determined and administered separately from outside of this FOA.

8. Agreement Requirements

Within the submission form, Applicant shall identify all Federal funding sources by agency source, project name, monetary amount, and length of term that are pending or currently in place for the Principal Investigator or collaborators within the past three years.

Within the written proposal, Applicant shall address the agreement requirements. Only proposals deemed fully compliant with the requirements of this FOA shall be eligible for continued evaluation. All requirements committed to within the pre-application process continue to apply throughout the full application process.

Additionally, the Applicant understands that submitted technical reports will be reviewed by a NE technical panel.

9. Application Due Date

In accordance with the schedule above, applications are due by 8:00 p.m. ET on June 12, 2013. Submittals to this FOA MUST be made electronically. Please read the instructions on the form carefully. Applications not submitted via this option will be treated as incomplete and will not be evaluated.

10. Late Applications

Applications received after the designated date and time, i.e., late, will be treated as nonresponsive and not evaluated. Extension of the Application due dates shall be determined at the sole discretion of the NEUP Integration Office on behalf of NE.

11. Workscope Description

Appendix C contains a detailed description of research needs in support of program directed research sector of this Section.

12. Program Contacts

The NEUP website, http://www.neup.gov, provides a list of technical contacts for each program who can be contacted for further information on their respective areas of work. Additional information regarding NE R&D programs may be found at http://nuclear.energy.gov/.

PART V - APPLICATION REVIEW INFORMATION

A. CRITERIA

1. Initial Review Criteria

Prior to a comprehensive merit evaluation, DOE will perform an initial review to determine that (1) the applicant is eligible for an award; (2) an initial project relevancy review; (3) the information required by the announcement has been submitted; (4) all mandatory requirements are satisfied; and (5) the proposed project is responsive to the objectives of the Funding Opportunity Announcement. Only applications meeting these initial review criteria will be considered during the merit review and award selection decision.

2. PD IRP Review Criteria

Applications meeting the initial review criteria will then be evaluated by a panel comprised of Technical Peer Reviewers and DOE NE Program Relevancy Reviewers, which will review applications using the Technical Peer Review and Relevancy criteria listed below. Following completion of the Review Panel evaluations, a recommendation will be made to the Selection Official.

DOE will evaluate and score each Applicant's proposal based on the information submitted in response to this FOA. Points for the technical score will be calculated as specified below:

Technical Peer Review (50%). Applications will be subjected to formal merit review and will be evaluated against the following four criteria. Included within each criterion are the detailed questions that reviewers will consider in evaluating each criterion.

Scientific and/or technical merit of the project (12.5%)

- Does the research proposed directly address the specific need of the appropriate IRP?
- Does the research proposed for the IRP address the described need in an effective and impactful manner?
- Does the application present a balanced and comprehensive program of research that, as needed, supports experimental, theoretical, and computational efforts and develops new approaches in these areas?
- What is the likelihood that the applicant can overcome key scientific challenges and shift research directions in response to promising developments?
- Are the elements of the proposed research appropriately integrated, coordinated, and synergistic?

Appropriateness of the proposed method or approach (12.5%)

- Are the strategy and the plan for the development and operation of the proposed IRP, including the need for an IRP approach involving several senior/key personnel, the means for achieving an integrated IRP, and plans for leadership and guidance for the scientific and technical direction, appropriate?
- Does the applicant present a comprehensive management plan for a world-leading program that encourages high-risk, high-reward research and encourages synergisms among investigators, thus demonstrating that the whole is substantially greater than the sum of the individual parts?
- Does the applicant present an organizational structure that delineates the roles and responsibilities of senior/key personnel and describes the means of providing external oversight and guidance for scientific and technical direction and approval of the research program?

- Are the applicant's plans (if any) for education, outreach and training in the proposed IRP appropriate?
- Are the plans (if any) for external collaborations and partnerships reasonable and appropriate?
- Are the roles and intellectual contributions of the IRP Lead Principal Investigator, Principal Investigator(s), and each senior/key person adequately described and appropriate?
- Does the applicant proposal maximize the use of DOE user facilities and existing equipment?
- How effectively does the proposed research relate to existing and planned research programs at the host institution?
- Are environment, safety and health issues responsibly anticipated and addressed?

Competency of the applicant's personnel and adequacy of the proposed resources (12.5%)

- Do the applicant's senior/key personnel have a proven record of research in the disciplines needed for success in this project?
- Is the proposed access to existing research space, instrumentation and facilities at the host institutions and its partners likely to meet the needs of the proposed IRP?
- Is there adequate access to experimental and computational capabilities as needed to ensure successful completion of the proposed research - including access to research capabilities and resources outside of the IRP?
- Do the lead institution and the senior/key personnel for the IRP have proven records of success in project, program, and personnel management for projects of comparable magnitude?
- Do the lead institution and the IRP Lead Principal Investigator have proven records of success in project, program, and personnel management of diverse teams of science and technical professionals?
- Is the plan for recruiting any additional scientific and technical personnel including new senior staff, students and postdocs reasonable and appropriate?
- Will the IRP leadership have the capability to communicate effectively with scientists of all disciplines?
- Will the IRP Lead Principal Investigator and senior/key personnel be fully available to the proposed IRP, particularly taking into account their potential involvement in other major projects?
- Does each participating institution possess adequate systems for ensuring environmental, health and safety support and oversight?

Reasonableness and appropriateness of the proposed budget (12.5%)

- Is the requested budget for developing the proposed IRP appropriate, including realistically estimated costs for existing and new equipment and instrumentation?
- Is the requested operating budget for the proposed IRP reasonable for the planned scientific program?
- Are all sub-agreements, travel, student costs, and other ancillary expenses adequately justified and estimated?

Relevancy Review (50%): The Relevancy Review Panel will consider the following program policy and management factors in the selection process:

Program Factors (20%)

- Diversity of research activities that will address the scientific challenges and use-inspired research as articulated in the DOE-NE Roadmap;
- Relation of the proposed IRPs to the core research activities within the DOE-NE Fuel Cycle R&D and Reactor Concepts RD&D programs;
- Benefits to the government of making awards for distinct technologies and/or approaches.
- The extent to which the proposed project will address basic science, technology, economic, and policy issues hindering the U.S.'s ability to become energy secure and economically strong while

being good stewards of the planet by reducing green house gas emissions.

Cost Factors (20%)

- The degree to which award of the proposed project optimizes use of the available DOE funding to achieving NE program goals.
- Reasonableness of the proposed project cost. This includes evaluation of the allocation among multiple participating team organizations where applicable, reasonableness of proposed costs for each task, and overall project cost.

Collaboration Factors (10%)

- Potential for developing synergies between the proposed IRP and other DOE-NE research activities;
- Level and contribution of participation by non-university partners (e.g., Industry/Utility, International, and Underrepresented Groups). Effective industrial or international partnerships are required for the proposal to receive the maximum points available.
- The degree to which MSI contribute to the proposal's ability to support the relevant program element or overall NE mission. MSI partnerships are not required for projects to receive maximum points available, but MSI partnerships may result in allocation of additional points under criterion (up to 3%), not to exceed maximum available points, if evaluated to contribute as described above.

3. Other Selection Factors

The Selection Official may consider the following program policy factors in the selection process:

1. Technical diversity of projects; applications will be balanced to optimize the selection of the appropriate mix of applications to best achieve the NE goals.

2. Relevance to agency's programmatic needs.

3. Cost/Budget considerations.

Any of the above factors used will be independently considered by the Selection Official in determining the optimum mix of applications that will be selected for support. These factors, while not indicators of the Application's merit, may be essential to the process of selecting the application(s) that, individually or collectively, will best achieve the program objectives. Such factors are often beyond the control of the Applicant. Each Applicant should recognize that some very good applications might not receive an award because they do not fit within a mix of projects that maximized the probability of achieving the DOE's overall research and development objectives. Therefore, the above factors may be used by the Selection Official to assist in determining which recommended application shall receive DOE funding support.

D. ANTICIPATED NOTICE OF SELECTION AND AWARD DATES

DOE will strive to make selections within six to eight months after receipt of applications.
DOE anticipates having multiple award selection dates.

THE REMAINING PARTS ARE APPLICABLE TO ALL SECTIONS A, B, & C

PART 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.

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

Notice of Award

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

For grants and cooperative agreements made to universities, non-profits and other entities subject to Title 2 CFR the Award also includes the Research Terms and Conditions located at http://www.nsf.gov/bfa/dias/policy/rtc/index.jsp

If award is made to a DOE national laboratory, it will be made against their existing prime contract with the DOE through the work authorization system as outlined in DOE O 412.1A. DOE O 481.1C., Work for Others, is not applicable. DOE national laboratories remain bound by the terms and conditions of their contract with DOE.

B. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS

1. Administrative Requirements

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

DUNS AND SAM REQUIREMENTS

Additional administrative requirements for DOE grants and cooperative agreements are contained in 2 CFR, Part 25 (See: http://ecfr.gpoaccess.gov). Prime awardees must keep their data at SAM current. 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, Part 170. (See:

http://ecfr.gpoaccess.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 SAM.

ARRA 2009 Award Administration Information

Special Provisions relating to work funded under American Recovery and Reinvestment Act of 2009, Pub. L. 111-5 shall apply.

2. Special Terms and Conditions and National Policy Requirements

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

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

Statement of Substantial Involvement

a. DOE anticipates having substantial involvement during the project period, through technical assistance, advice, intervention, integration with other awardees performing related activities, and technical transfer activities. The recipient's responsibilities are listed in paragraph b and DOE's responsibilities are listed in paragraph c.

b. **Recipient's responsibilities**. The recipient is responsible for:
(1) Performing the activities supported by this award, including providing the required personnel, facilities, equipment, supplies and services;
(2) Defining approaches and plans, submitting the plans to DOE for review, and incorporating DOE's comments;
(3) Managing and conducting the project activities, including coordinating with a DOE management and operating (M&O) contractor on activities performed under the M&O contract that are related to the project;
(4) Attending a mid-term program review meeting and reporting project status;
(5) Submitting technical reports as stated in the Federal Assistance Reporting Checklist, and incorporating DOE comments; and
(6) Presenting the project results at appropriate technical conferences or meetings as directed by the DOE Project Officer.

c. **DOE responsibilities**. DOE is responsible for:
(1) Reviewing in a timely manner project plans, including technology transfer plans, and redirecting the work effort if the plans do not address critical programmatic issues;
(2) Conducting a mid-term review meeting to ensure adequate progress and that the work accomplishes the program and project activities. Redirecting work or shifting work emphasis, if needed;
(3) Promoting and facilitating technology transfer activities, including disseminating program results through presentations and publications; and
(4) Serving as scientific/technical liaison between awardees and other program or industry staff.

d. There are limitations on recipient and DOE responsibilities and authorities in the performance of the

project activities. Performance of the project activities must be within the scope of the Statement of Objectives, the terms and conditions of the Cooperative Agreement, and the funding and schedule constraints.

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.

PART VII - QUESTIONS/AGENCY CONTACTS

A. QUESTIONS

Questions regarding the content of the announcement must be submitted through the FedConnect portal. You must register with FedConnect to respond as an interested party to submit questions, and to view responses to questions. It is recommended that you register as soon after release of the FOA as possible to have the benefit of all responses. DOE will try to respond to a question within 3 business days, unless a similar question and answer have already been posted on the website.

Questions and comments concerning this FOA shall be submitted not later than 7 business days prior to the application due date. Questions submitted after that date may not allow the Government sufficient time to respond.

Questions relating to the registration process, system requirements, how an application form works, or the submittal process must be directed to http://www.grants.gov at 1-800-518-4726 or support@grants.gov. DOE cannot answer these questions.

B. AGENCY CONTACT

Name: Mr. Aaron Gravelle
E-mail: gravelap@id.doe.gov

Part VIII - OTHER INFORMATION

A. MODIFICATIONS

Notices of any modifications to this announcement will be posted on http://www.grants.gov and the FedConnect portal. You can receive an email when a modification or an announcement 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 announcements.

B. GOVERNMENT RIGHT TO REJECT OR NEGOTIATE

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

C. COMMITMENT OF PUBLIC FUNDS

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

D. PROPRIETARY APPLICATION INFORMATION

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

"The data contained in pages [*Insert 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 and non-disclosure agreements prior to reviewing an application. Non-Federal personnel conducting administrative activities must sign a non-disclosure agreement.

F. INTELLECTUAL PROPERTY DEVELOPED UNDER THIS PROGRAM

Patent Rights. The government will have certain statutory rights in an invention that is conceived or first actually reduced to practice under a DOE award. 42 U.S.C. 5908 provides that title to such inventions vests in the United States, except where 35 U.S.C. 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 announcement, 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 at http://energy.gov/gc/patents-licensing-and-patent-waivers under the Patent Waivers.

Domestic small businesses and domestic nonprofit organizations will receive the patent rights clause at 37 CFR 401.14, i.e., the implementation of the Bayh-Dole Act. This clause permits domestic small business and

domestic nonprofit organizations to retain title to subject inventions. Therefore, small businesses and nonprofit organizations do not need to request a waiver.

H. UNDERSTANDING COST SHARING REQUIREMENTS

Department-wide cost sharing requirements are established by Section 988 of the Energy Policy Act of 2005 (EPAct). The DOE Financial Assistance Rules at 10 CFR 600 implement cost sharing requirements (see §600.30, §600.123, §600.224, or §600.313). The FOA requires a minimum of 20% cost sharing by awardees, except for applications led by US non-profit educational institutions / universities. The applicant's cost share requirement will be based on the total cost of the project. FFRDC costs are included as part of government cost share.

In accordance with section 988 (d), Calculation of Amount, when calculating the amount of the non-Federal contribution, the Government:

1. May include the following costs as allowable in accordance with the applicable cost principles:
   a. Cash;
   b. Personnel costs;
   c. The value of a service, other resource, or third party in-kind contribution determined in accordance with the applicable circular of the Office of Management and Budget [Note: In-kind contributions, like any other cost, need to be incurred during the award project period, e.g., cannot give credit for costs incurred prior to the award, including prior development costs, unless otherwise authorized by the applicable cost principles.];
   d. Indirect costs or facilities and administrative costs; or
   e. Any funds received under the power program of the Tennessee Valley Authority (except to the extent that such funds are made available under an annual appropriation Act).

2. Shall not include:

   a. Revenues or royalties from the prospective operation of an activity beyond the time considered in the award;
   b. Proceeds from the prospective sale of an asset of an activity; or
   c. Other appropriated Federal funds.

The terms and conditions of the cooperative agreement will include appropriate provisions on allowable costs.

The Federal share shall not be required to be repaid as a condition of award. Royalties should not be used to repay or recover the Federal share, but may be used as a reward for technology transfer activities.

Cost Share is often confused with some form of cost matching. The key to understanding how cost share works is to understand the base from which the cost share percentage is calculated. Cost share percentage is a percentage of the Total Allowable Costs of the project. Note that it is NOT a percentage of the DOE funds, but rather the entire project, including all awardee funds, DOE funds and all FFRDC requirements.

When determining the cost share requirement in dollars, it is first necessary to determine the entire project cost. Initially, no consideration would be given as to where the funds would come from. An applicant would determine that a certain cost (e.g., hours, travel, supplies, etc.) would be needed to complete the project as proposed in the application. Once the project cost is determined, an applicant can then calculate the cost share requirement by multiplying the cost share percentage by the project cost. The resulting dollar figure would be the dollar requirement that the applicant must provide as cost share.

Below are several examples of how the cost share amount would be calculated:

Example 1

The applicant determines that the following budget requirements are needed to carry out the work described in its proposal to DOE:

Direct Labor	$100.000
Travel	3,000
Equipment	17,000
Supplies	10,000
Subcontract	20,000

Total Project Cost	**$150,000**

A cost share requirement of 20% was specified in the funding announcement.

Cost Share = (cost share percentage) x (***total project cost***)
Cost Share = (20%) x ($150,000)
Cost Share = $30,000

The applicant must now identify $30,000 of $150,000 as "Cost Share."
The applicant would then request DOE funding in the amount of $120,000.

DOE Share = $120,000 **Awardee Share = $30,000**

Example 2

The applicant determines that the following budget requirements are needed to carry out the work described in its proposal to DOE:

Direct Labor	$200.000
Travel	10,000
Equipment	20,000
Supplies	10,000
FFRDC Subcontract	60,000
Total Project Cost	**$300,000**

A cost share requirement of 20% was specified in the funding announcement.

Cost Share = (cost share percentage) x (total project cost)
Cost Share = (20%) x ($300,000)
Cost Share = $60,000

The applicant must now identify $60,000 of $300,000 as "Cost Share".
DOE would pay $60,000 directly to the FFRDC.
The applicant would then request DOE funding in the amount of $180,000.

DOE Share = $180,000 (funds to Awardee) + $60,000 (FFRDC) = $240,000

Awardee Share = $60,000

Note: FFRDC funds are paid directly to the FFRDC by DOE. The work provided by the FFRDC is still considered part of the Total Project Cost; therefore, it is included in the base from which the Awardee cost share is calculated.

In all cases, the applicant must specify the individual costs that make up each part of the total project cost and indicate whether DOE or Non-DOE funds will be used to cover the cost.
The budget from **Example 1** might look something like the following:

		DOE	**Non-DOE**
Direct Labor	$100,000	$70,000	$30,000
Travel	3,000	3,000	0
Equipment	17,000	17,000	0
Supplies	10,000	10,000	0
Subcontract	20,000	20,000	0
Total Project Cost	**$150,000**	**$120,000**	**$30,000**

The application forms in this funding opportunity announcement will facilitate the identification of funding sources.

I. 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.

PART IX - APPENDICES/REFERENCE MATERIAL

Appendix A - Workscope for Program and Mission Support – University Only
Appendix B – Workscope for Program Support – University, National Laboratory, or Industry
Appendix C – Workscope for Program Directed Integrated Research Project – University Only
Reporting Requirements Checklist

Appendix A

Workscopes for Program and Mission Support – University Only

Separations and Waste Forms (FC-1)

(Federal POC – Jim Bresee & Technical POC – Terry Todd)

This program element develops innovative methods to separate reusable fractions of used nuclear fuel (UNF) and manage the resulting wastes. These technologies, when combined with advanced fuels and reactors, form the basis of advanced fuel cycles for sustainable and potentially growing nuclear power in the U.S. The campaign supports research through the full range of use-inspired basic research through process engineering with multi-institutional, multi-disciplinary teams comprised of national laboratory researchers with full radioactive laboratory capabilities teamed with industry and university researchers. Priority research efforts revolve around achieving near-zero radioactive off-gas emissions; developing a simplified, single-step recovery of transuranic elements; and significantly lessening the process wastes. Exploratory paths include developing fundamental understanding of separation processes and waste form behavior; understanding the underlying separation driving forces; exploiting thermodynamic properties to effect separations; elucidating waste form corrosion mechanisms; and investigating novel new approaches to used fuel treatment and associated waste forms with significantly improved performance. Key university research needs for separations and waste forms campaign include:

FC-1.1: ELECTROCHEMICAL SEPARATIONS

- Development of fundamental understanding of advanced electrochemical separation methods for the separation of transuranic elements (Np, Pu, Am, and/or Cm) including the development and validation of predictive modeling approaches based on fundamental data rather than empirical approaches;

FC-1.2: ADVANCED SEPARATIONS METHODS

- Development of novel "out of the box" separation methods that have the potential of significantly reducing complexity and cost of processing fuel while reducing proliferation risk and waste generation;

FC-1.3: ADVANCED WASTE FORMS

- Innovative waste forms with orders of magnitude higher chemical durability and equal of lower processing costs compared to currently-employed waste forms such as borosilicate glass particularly for long-lived fission products such as iodine-129 and technetium-99 and for grouped fission products high-level waste;
- Fundamental understanding of waste form performance over geologic time scales; particularly for multi-phase oxide waste forms.

Advanced Fuels (FC-2)

(Federal POC – Frank Goldner & Technical POC – Kemal Pasamehmetoglu)

This program element develops advanced nuclear fuel technologies using a science-based approach focusing on developing a microstructural understanding of nuclear fuels and materials. The science-based approach combines theory, experiments, and multi-scale modeling and simulation to develop a fundamental understanding of the fuel fabrication processes and fuel and clad performance under irradiation. The objective is to use a predictive approach to design fuels and cladding to achieve the desired performance (in contrast to more empirical observation-based approaches traditionally used in fuel development).

The advanced fuels program conducts research and development of innovative next generation LWR and transmutation fuel systems. The major areas of research include, enhancing the accident tolerance of fuels and materials, improving the fuel system's ability to achieve significantly higher fuel and plant performance, and developing innovations that provide for major increases in burn-up and performance. The advanced fuels program is interested in advanced nuclear fuel and materials technologies that are robust, have high performance capability, and are more tolerant to accident conditions than traditional fuel systems. Key

university research needs for this activity include:

FC-2.1: CHARACTERIZATION AND INSTRUMENTATION
Development of novel fuel and cladding material characterization techniques and/or innovative in-pile instrumentation that can be applied to irradiated nuclear fuels and materials that support the goal of understanding the behavior of and predicting the performance of the nuclear fuel system at a microstructural level.

FC-2.2: SEPARATE EFFECTS TESTING TO SUPPORT MODEL & MATERIAL SCIENCE DEVELOPMENT
Developing and conducting separate effects tests to provide fundamental physical and chemical data at a micro-structural level that will support development of predictive, physics-based fuels performance models. These tests should consider: 1) helping validate lower-length scale and engineering scale models (e.g., MARMOT and BISON); and, 2) furthering the understanding of mechanistic material behavior in fuels, including how relevant microstructures affect the mechanical, thermal, and chemical performance.

Nuclear Materials Control and Instrumentation (FC-3)

(Federal POC – Daniel Vega & Technical POC – Mike Miller)

This program element develops technologies and analysis tools to support next generation nuclear materials management and safeguards for future U.S. fuel cycles. This includes both extrinsic measures and safeguards over-laid on a nuclear energy system, as well as the intrinsic design features incorporated into system design. New technologies and approaches to in-facility accounting and control/safeguarding of nuclear materials will be pursued under this research area. This research topic will also pursue nano-technology and nano-materials as they relate to sensors, detectors, and nanoparticle signatures, and other advanced measurement techniques that could complement the ongoing measurement program. Key university research needs for this activity include:

FC-3.1: SENSORS AND INSTRUMENTATION
New and improved detector systems and sensor materials that can be used to increase the accuracy, reliability, and efficiency of nuclear materials quantification and tracking from the perspective of the operator or state-level regulator. Such systems could include new neutron methods, spectroscopic analysis, chemical, calorimetric, or other non-nuclear methods, as well as any other novel methods with potential MC&A benefits.

FC-3.2: ANALYSIS TOOLS
Methods for data integration and analysis include cutting-edge work in multi-variant statistical techniques for process monitoring, risk assessment, plant-wide modeling & simulation directed at the accounting challenges of high-interest fuel cycle processes, including advanced separations processes.

Used Nuclear Fuel Disposition (FC-4)

(Federal POC – JC De La Garza & Technical POC – Peter Swift)

This program element develops technologies for storing, transporting, and disposing of used nuclear fuel and high-level radioactive waste and assessing performance of the used fuel and waste forms in the associated storage and disposal environments.

FC-4.1: STORAGE
Following the issuance of the Blue Ribbon Commission on America's Nuclear Future Final Report in January 2012, interim storage of spent nuclear fuel from reactor sites has gained additional importance and urgency for resolving waste-management-related technical issues. It also provides an opportunity for the scientific community to bring forward new conceptual designs and innovative research in this area. Key university research needs for the storage activities include:

- Innovative approaches to evaluating degradation and aging phenomena of used nuclear fuel, containers and internals, and storage facilities under extended storage;
- Data and risk informed assessment methods for high-burnup used nuclear fuel for extended storage applications;
- Development of a superior concrete by chemical additives and curing improvements to increase the compressive strength, tensile strength and weather ability of the concrete. This work would not include the addition of mechanical additives such as fiberglass or metal wire. This concrete could then be used for extended used nuclear fuel storage;
- Development of non-destructive techniques to monitor long-term effects of wet/dry, freeze/thaw, marine environment effects, the temperature fluctuations and radiation effects on reinforcing steel and concrete used in the over pack of dry storage system; and
- Innovative research in developing poison materials for long-term criticality control.

FC-4.2: TRANSPORTATION

Technical issues related to transportation of used nuclear fuel has been generally addressed by past industry studies. However, issues related to transportation of used nuclear fuel after prolonged storage periods provide new challenges. Key university research needs for transportation activities include:

- Materials research that would facilitate transportation of used nuclear fuel;
- Structural integrity assessment for transporting used nuclear fuel with uncertainty in input considerations;
- Advanced modeling approaches for radiological analyses of disruptive scenarios relevant to transportation; and
- Data relevant to risk-informed cask qualification and transportation behavior of high-burnup and advanced fuels.

FC-4.3: DISPOSAL

Assessments of nuclear waste disposal options start with the degradation of waste forms and consequent mobilization of radionuclides, reactive transport through the near field environment (waste package and engineered barriers), and transport into and through the geosphere. Research needs support the development of modeling tools or data relevant to permanent disposal of used nuclear fuel and high-level radioactive waste in a variety of generic disposal concepts, including mined repositories in clay/shale, salt, and crystalline rock, and deep boreholes in crystalline rocks. Key university research needs for the disposal portion of this activity include:

- Improved understanding of degradation processes (i.e., corrosion and leaching) for used nuclear fuel and waste forms that could be generated in advanced nuclear fuel cycles (i.e., glass, ceramic, metallic) through experimental investigations under variable conditions of saturation, temperature, and water chemistry, leading to the development of improved models to represent these processes;
- Improved understanding of the degradation processes for engineered barrier materials (i.e., waste containers/packages, buffers, seals) and radionuclide transport processes through these materials leading to the development of improved models to represent these processes;
- Improved understanding of coupled thermal-mechanical-hydrologic-chemical processes in the near-field of relevant disposal model environments, leading to the development of improved models to represent these processes;
- Improved understanding of large-scale hydrologic and radionuclide transport processes in the geosphere of relevant disposal model environments, leading to the development of improved models to represent these processes;
- Development of new techniques for in-situ field characterization of hydrologic, mechanical, and chemical properties of host media and groundwater in a borehole or an excavated tunnel;
- Aqueous speciation and surface sorption at elevated temperatures and geochemical conditions (e.g., high ionic strength) relevant to the disposal environments being considered;
- Consideration of how specific waste forms may perform in different disposal environments using

theoretical approaches, models, and/or experiments, with quantitative evaluations including uncertainties of how the long-term performance of waste forms can be matched to different geologic media and disposal concepts.
- Experimental and modeling investigations for the effect of radiolysis on used fuel, high-level waste, and barrier material degradation at temperatures and geochemical conditions relevant to potential storage and disposal environments.

Fuel Cycle Option Analysis (FC-5)

(Federal POC – Kenneth Kellar & Technical POC – Temi Taiwo)

This program element performs analysis and evaluates integrated fuel cycle systems with the purpose of identifying and exploring sustainable nuclear fuel cycles that are candidates for future deployment. Results of these studies and R&D activities must be effectively disseminated to program stakeholders and the public in an accurate, open, and simple manner. Proposals are being solicited in the following areas:

FC-5.1: Fuel Cycle Options Catalogue

A catalog of fuel cycle options is currently being developed within the Fuel Cycle Technologies Program. This sub-element is soliciting fuel cycle analysis from universities for the purposes of populating the fuel cycle catalog, developing university expertise in the analysis of advanced fuel cycle systems, and training the next generation of fuel cycle analysts. A draft Fuel Cycle Data Package template that defines the information needed and associated analysis assumptions is provided here: https://inlportal.inl.gov/portal/server.pt/document/115165/fcdp_template_report_rev04_pdf

Proposals to develop Fuel Cycle Data Packages for fuel cycles in any or all of the following fuel cycle groups will be considered for awards:

- *Multi-stage* fuel cycle options using *only* thermal reactors, with the attribute for significantly reducing actinide content of nuclear waste.
- *Multi-stage* fuel cycle designed for continuous recycle of actinides using *only* fast reactors.
- Fuel cycles using targets containing transuranic elements and/or fission products for reducing their content in nuclear waste.

FC-5.2: Fuel Cycle Simulator

It is important to develop effective methods to communicate the potential benefits of alternative nuclear fuel cycle options and associated enabling technologies that could be developed in the future. A significant activity to achieve this is the development of an open-source fuel cycle simulator that will enhance the program's ability to educate, communicate, and support decision-making about future fuel cycles and related technologies. Key university research needs for this activity include:

- Develop modules for the fuel cycle simulator that support specific types of fuel cycles or fuel cycle technologies;
- Develop capabilities for whole system optimization and economic analyses;
- Assistance in building libraries of historic facility/infrastructure information (national/global)

Project Proposals can be for portions or all of the items above. For information about the Fuel Cycle Simulator see http://cyclus.github.com/.

Nanonuclear R&D (FC-6)

(Federal POC – Ingrid Milton & Technical POC – Stu Maloy)

The Fuel Cycle Technologies program is initiating a new research topic with the purpose of exploring the potential for nano-science and nano-technologies to support the development of sustainable nuclear fuel cycles. Proposals are being solicited that would make a significant contribution in the area of nanonuclear technology and would result in the development of new capabilities that could be useful to nuclear energy.

Program Supporting: Fuel Cycle Technologies

This program element investigates the use of nano-particles, nano-structured materials, and/or nano-scale materials, properties, or processes to enhance mechanical, chemical, physical, or thermo-hydraulic properties and performance in nuclear fuel cycle applications, such as:

- Reactor (in-core) materials with nano-scale precipitates that could improve mechanical performance as well as radiation tolerance.
- Nano-scale coatings that could be included on the exterior or the interior of fuel cladding to improve corrosion resistance and surface hardening, and pellet-clad interactions on the cladding interior.
- Chemical interaction and separation methods using nano-particles and/or nano-porous materials that can enable techniques to capture fission product gases either from reprocessing operations or directly within a reactor fuel assembly thereby reducing the potential for releases from normal or accident conditions.
- Advanced fuels engineered and/or fabricated with nano-technologies to enable longer service lives, reduce fabrication process losses, and/or reduce the potential for failure in normal or accident conditions including increased fission gas retention, plasticity, radiation tolerance, heat transfer capability, as well as reduced fuel cladding chemical and/or mechanical interactions.
- Nano-technology enabled sensors and/or in-service monitors that can directly monitor for radiation, temperature, pressure, in situ diagnostics of material properties and mechanical response, corrosion, neutron flux, stress/strain or even chemistry with little effect on system performance with significantly reduced size and weight and increased sensitivity, performance, and functionality.
- Nanotechnology-based detectors that can discriminate between neutron and gamma radiation and/or have enhanced sensitivity for the detection of fissile materials with very low neutron activation fluxes.

Proposals are sought from research teams, with a demonstrated connection to basic nano-science research.

Mission Supporting: Fuel Cycle Technologies

Fuel Resources (MS-FC1)

(Federal POC – Stephen Kung & Technical POC – Sheng Dai)

The secure and economical supply of nuclear fuel is essential for the long-term use of nuclear power for energy applications. Continued federal R&D investment in uranium resources will be the foundation to enable future nuclear power expansion. The focus of fuel resources R&D is to identify "game-changing" approaches not presently being addressed by private industry or non-governmental organizations. Specific areas of interest include: (1) molecular-level understanding of the coordination modes, sorption mechanisms, and kinetics of uranium extraction; (2) design and synthesis of functional ligands with architectures tailored chemical performance; (3) physical and chemical tools for characterizing of adsorbent materials; (4) development of new polymer sorbents via advanced manufacturing and surface grafting techniques; and (5) development of innovative elution processes.

Nuclear Data and Measurement Techniques (MS-FC2)

(Federal POC – Daniel Vega & Technical POC – Tony Hill)

This research topic will pursue advanced measurement techniques that could complement the ongoing measurement program. Such a topic includes Innovative ideas for detector development and testing to collect high fidelity data for improvements in cross section evaluations, covariance data, multiplicity, and spectrum information for candidate fuel and structural materials. In addition, robust sensitivity analyses are required to prioritize high value data collection and refinement techniques.

Program Supporting: Nuclear Reactor Technologies

Computational Methodologies (RC-1)

(Federal POC – Steve Reeves & Technical POC – Hans Gougar)

Computational methodologies R&D is focused on providing practical tools to analyze the gas-cooled reactor core neutronics/thermal-hydraulics, performance; reactor gas-coolant thermal fluids behavior during normal and transient conditions, and accident scenarios; and safety evaluations for advanced gas reactor reactors and design of scaled experiments. Additionally, the computational fluid dynamics code validation, verification, uncertainty, and qualification benchmark effort is focused on validating practical tools to analyze advanced gas reactor passive cooling systems.

Research efforts have been initiated and/or completed in the areas of neutronics, thermal-hydraulics, and multiphysics, in terms of time-dependent coupled fuel/neutronics/thermal fluids modeling, reactor kinetics effects, and mechanical-neutronics-thermal fluid interactions during graphite dimensional changes under irradiation with thermal and neutronics feedback. Advanced reactor plant simulation and safety analysis methods development has been initiated for uncertainty and sensitivity analysis for statistical importance ranking. Integral effects experiments focused on in-vessel thermal fluids are underway at the High Temperature Test Facility (Oregon State University) and complementary separate and mixed effects experiments have been planned and initiated. Similarly, an ex-vessel integral test is being constructed at Argonne National Laboratory (Natural Circulation Shutdown Test Facility) with complementary experiments underway at some universities to generate data on ex-core heat removal and cavity cooling. A range of supporting scaled fundamental, separate, and mixed effects experiments are needed to complement these integral tests.

Thermal-hydraulics methods proposals are sought in the areas of:

- Steam ingress flow and chemistry particularly among lower support structures,
- Plenum-to-plenum heat transfer under natural circulation,
- Experimentally-validated analyses of heated two-component stratified or bypass flow,
- Methods that integrate externally initiated events (e.g. earthquake, flooding) and core/reactor dynamics and structures vibrations (e.g. graphite reflector and prismatic block movement)
- Validation of models using safety analysis and CFD codes (e.g. RELAP5, TRAC, STAR-CCM+, and FLUENT but other NRC or reactor vendor computer simulation codes will also be considered).

Advanced Technologies, Development and Demonstration (RC-2)

(Federal POC – Brian Robinson & Technical POC – Bob Hill)

Advanced technologies can enable new Small Modular Reactor (SMR) concepts and designs to achieve even greater levels of safety and resilience, flexibility of use, sustainability and construction or operational affordability. SMRs differ from large plants in their fundamental design features, which may require or benefit from new analysis methods to quantitatively characterize the performance and risk factors associated with SMRs. Innovative engineering techniques for operations and reliability are sought that are designed from the outset to provide increased levels of safety and robustness and new functionalities while also maintaining or improving the performance. These advanced technologies or innovative engineering techniques have to lead to economically viable concepts for eventual commercial deployment. We are seeking proposals that support the identified needs of our advanced reactor technology development efforts specifically in the following areas:

RC-2.1: INSTRUMENTATION, CONTROL, HUMAN, MACHINE INTERFACE (ICHMI) (E.G. ADVANCED HIGH TEMPERATURE INSTRUMENTATION, IN-SERVICE INSPECTION TECHNIQUES OR DIAGNOSTIC AND PROGNOSTIC SYSTEMS).

RC-2.2: COMPONENT AND TECHNOLOGY DEVELOPMENT (E.G. CORROSION AND OXYGEN CONTROL

SYSTEMS OR COMPACT HEAT EXCHANGER DESIGNS).

ADVANCED STRUCTURAL MATERIALS (RC-3)

(FEDERAL POC – BILL CORWIN & TECHNICAL POC – JEREMY BUSBY)

Specific areas of materials technology supporting the development of advanced reactor systems are recognized to need additional research and are the focus of requests for proposals this year. The two areas in which work is being solicited are: 1) the long-term prediction of emissivity of structural materials for high temperature reactor systems and 2) the experimental measurement and prediction of creep-fatigue in applicable high-temperature alloy systems.

RC-3.1: LONG-TERM EMISSIVITY

The passive cooling of some high temperature reactor systems depends upon decay heat transfer through the reactor pressure vessel (RPV) wall and its radiative dissipation into the reactor cavity. This process requires an adequately high emissivity on the outer surface of the RPV, as well as any inner surfaces in the vessel interior and internals integrally involved in radiative heat transfer. Building upon existing short-term studies of vessel emissivity, develop and validate models of emissivity of the relevant RPV and internals materials for up to 60 years of operation to predict lifetime emissivity values of pressure vessel and reactor internal materials in air and/or relevant reactor coolants.

RC-3.2: CREEP FATIGUE

Accurate predictions of the interactions of creep and fatigue for structural materials for advanced, high-temperature reactors are critical for safety and design, but are limited by the limitations of the available experimental data upon which such models and predictions are based. Most experimental data developed for creep-fatigue interactions are fundamentally fatigue tests with various types of tensile or compressive hold periods superimposed on them. The resulting data typically includes more fatigue damage than creep damage, whereas in many high temperature nuclear components in long-term service the actual mix of damage often includes more creep than fatigue. Hence, proposals are sought to generate a better mechanistic understanding of creep-fatigue interactions, especially under loading conditions where creep is the predominant damage mechanism. Materials of interest include Alloy 617, Alloy 800H, 9Cr-1MoV and other alloys for advanced high temperature reactor application. Approaches might include novel experimental methods and/or modeling with substantial experimental validation.

MATERIALS AGING AND DEGRADATION: ACCELERATED TEST TECHNIQUES AND VALIDATION (RC-4)

(FEDERAL POC – RICHARD REISTER & TECHNICAL POC – JEREMY BUSBY)

Materials and components under extended service conditions will see very long lifetimes under stress, temperature, corrosive coolant, and/or neutron or gamma radiation fields. Clearly, it is not viable to start laboratory tests at this time to duplicate 80 years of life in a timely manner. Some accelerated testing will be necessary. Techniques and approaches for providing relevant data using accelerated test techniques are sought. Modeling tools, experimental studies, and/or validation of accelerated testing and material response are appropriate for key reactor materials under relevant environments including, but not limited to stress, corrosive environment, radiation, and elevated temperature. Interpretation via modeling and simulation of material aging response using non-destructive evaluation techniques is of particular interest. Materials of interest include, but are not limited to, core internal components (stainless steels), cast stainless steel piping, reactor pressure vessel steels, concrete, and cable insulation. Universities engaging in this effort will be expected to produce concepts, supporting data and/or model predictions demonstrating the viability of these techniques with a high level of quality assurance.

RISK-INFORMED SAFETY MARGIN CHARACTERIZATION (RISMC): ADVANCED MECHANISTIC 3D SPATIAL MODELING AND ANALYSIS METHODS TO ACCURATELY REPRESENT NUCLEAR FACILITY EXTERNAL EVENT SCENARIOS (RC-5)

(FEDERAL POC – RICHARD REISTER & TECHNICAL POC – CURTIS SMITH)

A current gap in safety modeling for nuclear facilities is robust external events modeling such as spatial impacts and interactions from seismic events. Consequently, modeling complex spatial phenomena at current and future nuclear power plants related to external environmental impacts will be important for predictive performance and safety evaluations. To capture both normal and off-normal conditions, the plant behavior and response will seek to allow for mechanistic scenario representations, wherein the developed methods mimic the complicated behavior. Universities helping in this activity will be expected to provide mechanistic approaches that represent spatial types of interactions through a physics-based 3D environment. These environments should be capable of mimicking realistic physics such as water through building flow paths; failures of components and structures; and objects impacting other objects in order to represent probabilistic external events. These methods should be compatible with the INL-developed MOOSE (Multiphysics Object Oriented Simulation Environment) platform that is the platform used in other modeling activities in the LWRS program. It is the goal of the research and development to couple probabilistic and mechanistic calculations together such that we will be able to search for potential vulnerabilities resulting from external events.

INSTRUMENTATION, INFORMATION, AND CONTROL: MONITORING TECHNOLOGIES FOR SEVERE ACCIDENT CONDITIONS (RC-6)

(FEDERAL POC - DAMIAN PEKO & TECHNICAL POC - DWIGHT CLAYTON)

The accidents at the Three Mile Island Unit 2 (TMI-2) and Fukushima Daiichi Units 1, 2, and 3 nuclear power plants demonstrate how monitoring instrumentation can be important to managing severe accidents but that the harsh environments of severe accident challenge those instrumentation systems.

With currently design approaches, the environments such instruments would function in during severe accidents could be significantly harsher in terms of high temperatures, high pressures, high radiation fields, high temperature gradients, etc) and designers also need to consider loss of external power sources. Novel technologies, such as remote (stand-off) sensors, wireless technology, and self-powered instruments have emerged since the design of many current NPPs. Application of these novel technologies could fundamentally change the challenges associated with deploying a severe accident monitoring capability. Self-powered instruments relieve designers of the challenge of ensuring an external power supply. Wireless technologies relieve designers of the burden of routing and protecting wires. Standoff monitoring capabilities relieve designers of the burden of having to design and deploy instrumentation to withstand the harsh environment it is trying to measure by removing the instrument to a more benign location.

Research in novel technologies is sought that, by eliminating or simplifying some of the challenges associated with current design approaches, will result in simpler, more economical instrumentation for monitoring an NPP during severe accident conditions than is possible with current instrumentation design approaches. Possible responses to this call would include novel technologies for monitoring water level, temperature and pressure, fuel and component temperature, reactor power level, containment pressure, temperature, and hydrogen concentration.

Program Supporting: Nuclear Reactor Technologies

RADIOISOTOPE POWER SYSTEMS: INNOVATIVE FUEL FORM PROCESSING DEVELOPMENT OF GENERAL PURPOSE HEAT SOURCES FOR NASA APPLICATIONS (RC-7)

(FEDERAL POC – ALICE CAPONITI & TECHNICAL POC – STEPHEN JOHNSON)

Space and Defense Power Systems program has designed, developed, built and delivered radioisotope power systems (RPS) for space exploration and national security applications for over fifty years. Radioisotope power systems uniquely enable missions that require a long-term, unattended source of electrical power and/or heat in harsh and remote environments. These systems are reliable, maintenance free, and capable of producing heat and electricity for decades. These systems convert the decay heat from Pu-238 into electricity – either using thermoelectric couples to induce direct current electricity flow in the case of radioisotope thermoelectric generators or through a dynamic energy conversion system using free-piston Stirling engines in the case of Stirling radioisotope generators currently under development. Both types of RPS designs use the General Purpose Heat Source – an aero shell module which contains four ceramic fuel pellets clad in iridium and nested in layers of graphitic structures to provide thermal and impact protection. Many of the technologies and materials used in the General Purpose Heat Source were developed decades ago. Proposals for improving current manufacturing processes are encouraged.

Proposals are sought for new and innovative methods of manufacturing ceramic Pu-238 heat sources that are enveloped by the geometry and heat output of current designs and lead to enhanced safety performance. The ceramic product should be compatible with the current iridium alloy used in the encapsulation process. An emphasis on reliable processing parameters and enhanced personnel safety should be considered paramount in a new method of production.

Mission Supporting: Nuclear Reactor Technologies

REACTOR CONCEPTS RD&D - (MS-RC1)

(FEDERAL POC – SAL GOLUB & TECHNICAL POC – BOB HILL)

Development of new reactor concepts that may offer the potential for revolutionary improvements to reactor performance and/or safety is sought. Such advanced reactor concepts could include the incorporation of advanced systems or components into existing concepts (e.g. Generation-IV systems such as the gas fast reactor, molten salt reactor or lead fast reactor), inclusion of innovative design alternatives (e.g., new fuel type, nano-engineered coolants, etc.), or designs employing radically different technology options (e.g., advanced coolants, fuel, or operational regimes). Concepts could also include small modular reactors with unique capabilities to address operational missions other than the delivery of baseload electric power, such as industrial process heat or mobile reactors that can provide temporary power during emergency situations. The scope of the proposed project should include a thorough viability assessment of the concept, a detailed technology gap analysis and a comprehensive technology development roadmap that identifies research needed on key feasibility issues.

RADIOISOTOPE POWER SYSTEMS R&D – (MS-RC2)

(FEDERAL POC – ALICE CAPONITI & TECHNICAL POC – STEPHEN JOHNSON)

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Proposals are sought for the development of alternate materials for the aero shell module that protects radioisotope power system fuel during potential atmospheric reentry events. The material will need ablation resistance, thermal conductivity, and structural strength (compressive and tensile) that meet minimum performance requirements.

Program Supporting: Science and Technology Innovation

NUCLEAR ENERGY ADVANCED MODELING AND SIMULATION (NEAMS)

VALIDATING NEAMS FUEL PIN MODELS (NEAMS-1)

(FEDERAL POC – DAN FUNK & TECHNICAL POC – KEITH BRADLEY)

The Nuclear Energy Advanced Modeling & Simulation (NEAMS) program is focused on developing improved analytical capabilities for simulating the performance of advanced reactors and fuels. NEAMS is producing a comprehensive "pellet-to-plant" simulation toolkit through efforts within two product lines: Fuels and Reactors. The Fuels Product Line is building tools that incorporate mechanistic material behavior models with modern computational methods and up-to-date computer hardware. The Reactor Product Line supports analysis of advanced reactor performance by providing three dimensional, high-fidelity, coupled-physics simulation capability that scales with the needs of the user and the complexity of the problem. This product line also supports Relap-7 development in conjunction with NE's Light Water Reactor Sustainability Program to improve upon 30 years of experience with RELAP 5. NEAMS is soliciting contributions as follows:

Performance of validation studies using the NEAMS tools for predicting fuel performance in a Light Water Reactor (LWR) environment. Of particular interest is the assessment of the engineering-scale tool (BISON) against experimental data for Pressurized Water Reactor (PWR) fuel pins contained in the FRAPCON, FRAPTRAN, and FUMEX-III experimental databases. Both deficiencies in irradiation performance models as well as gaps in the experimental databases should be identified as areas needing further development.

Appendix B

Workscope for Program Support – University, National Laboratory and Industry

NUCLEAR ENERGY ENABLING TECHNOLOGIES (NEET)

ADVANCED METHODS FOR MANUFACTURING: (NEET – 1)

(FEDERAL POC – ALISON KRAGER & TECHNICAL POC – JACK LANCE)

(Up to 2 years and $400,000 total project cost, estimate up to 2 awards)

The Advanced Methods for Manufacturing program seeks to conduct research and technology development to improve the methods by which nuclear equipment, components, and plants are manufactured, fabricated, and assembled. The initial focus and emphasis will be placed on Small Modular Reactor (SMR) technologies. Proposals could draw upon innovative and successful manufacturing and fabrication practices found in related industries such as oil, aircraft, and shipbuilding. These proposals should pursue innovative methods to manufacture or fabricate components faster and with better quality; and to improve factory assembly of plant modules, thereby reducing the cost and schedule requirements for new nuclear plant deployment. Specific goals include:

- Accelerate deployment schedule by 3 to 6 months compared to new plant construction estimates;
- Reduce component fabrication costs by 20% or more;
- Increase performance of key subsystems without cost increase or schedule delay.

The program seeks to develop manufacturing and fabrication innovation, assembly processes and materials innovation that support the "factory fabrication" and expeditious deployment of SMR technologies. Potential areas for exploration can be found in the NEET 2010 Workshop report (), as well as the AMM Roadmap report which will be available on the NEET website and include:

- Advanced software tools that integrate engineering, fabrication, construction, and operations in a single life cycle program;
- Factory and field fabrication techniques that include strength assistance tooling, heavy lift and load leveling equipment;
- Real time monitoring and non-destructive examination systems for high speed welding processes;
- Assembly and material innovation to enhance modular building techniques such as advances in high strength concrete and rebar, inspection equipment, and pre-assembled rebar systems;
- Advances in modular construction to include improved design codes, improved methods for transport and delivery and advancements in integrated prefabrication.

Through innovation in manufacturing, fabrication and assembly, significant advancements in nuclear technology quality, performance and economic improvements will be achieved. One of the key success criteria for the program is the development of products or components that will gain acceptance by the appropriate regulatory or standard-setting bodies and licensed for commercial nuclear plant deployment.

ADVANCED SENSORS AND INSTRUMENTATION: (NEET – 2)

(FEDERAL POC – SUIBEL SCHUPPNER & TECHNICAL POC – DWIGHT CLAYTON AND RICHARD WOOD)

(Up to 2 years and $400,000 total project cost, estimate up to 2 awards)

The Advanced Sensors and Instrumentation program seeks to develop the scientific basis for sensors and instrumentation to address critical technology gaps for monitoring and controlling advanced reactors and fuel cycle technologies.

The goal of this program is to provide crosscutting research that:

- Contributes to the success of the NE R&D programs by obtaining the needed I&C technologies that support experiments, deliver unique sensors and related technologies for each reactor technology concept and fuel cycle facility;

Program Supporting: Science and Technology Innovation

- Enables the broader mission of the Office of Nuclear Energy, by supporting common ASI technology development objectives; and
- Can overcome current barriers to nuclear energy system deployments.

Improvements and advancements are needed in the technical area of Advanced Sensors and Instrumentation technologies to enhance economic competitiveness for nuclear power plants and promote a high level of nuclear safety. Specific ASI research and development proposals are sought for the following topics:

- Design of a custom radiation tolerant electronics system, using the best available commercial or near-commercial technologies necessary for operation in a severe nuclear environment. The proposed system should provide observable evidence that the technology is capable of being implemented in a radiation-tolerant multi-functional robot for in-containment reconnaissance under severe accident conditions.
- Methods to quantify software dependability characteristics that can facilitate the resolution of factors that inhibit the expanded use of modern digital technology by the nuclear power industry. The current reliance of process-oriented software quality assurance programs and the resultant subjective evaluation of digital system safety drive the nuclear industry to choose between maintaining legacy technologies that have proven licensable or embarking on costly, non-optimum implementations that are constrained to pose the least amount of licensing risk. Development of an objective technical basis for evaluating the suitability for software-based instrumentation and control (I&C) systems in safety applications at nuclear power plants would enable a science-based safety case to be demonstrated and thus reduce regulatory uncertainty. Demonstration of measures, metrics, and methods and/or development of design support and analysis tool are sought to permit science-based quantification of the safety, quality, dependability, and reliability characteristics of software-based I&C systems.
- Development of highly secure, wireless communication infrastructures that support flexible, expandable I&C architectures that can reduce the cost of expensive cable runs; enable greater information access and plant automation; and allow add-on sensors and instruments to be introduced as needed. With cable runs costing up to thousands of dollars per foot, there is incentive to adopt wireless technologies in nuclear power plants where possible. However, security, reliability, and electromagnetic compatibility concerns limit its use by the nuclear power industry. Therefore, the proposed wireless communications technology should demonstrate communications resiliency by providing acceptable performance characteristics such as security, data integrity, interference resistance, and quality of service.

Organizations performing this research will be expected to produce concepts, techniques, capabilities, and equipment that are or can be demonstrated in simulated or laboratory test bed environments representative of nuclear plant applications.
Successful applications will describe truly innovative sensors and instrumentation that offer the potential for revolutionary gains in reactor and fuel cycle performance and that can be applied to multiple reactor designs and fuel cycle concepts.

Program Supporting: Science and Technology Innovation

REACTOR MATERIALS: (NEET – 3)

(FEDERAL POC – SUE LESICA & TECHNICAL POC – JEREMY BUSBY)

(Up to 3 years and $1,000,000 total project cost, estimate up to 5 awards)

The NEET Crosscutting Reactor Materials program seeks applications for advanced reactor materials characterization techniques and tools. Successful completion of awards will provide advanced methods for sample preparation and new tools and techniques for examining and understanding material microstructures in a variety of conditions ranging from as-received to treated or irradiated.

Developing an extensive understanding of reactor material behavior in extreme environments is vital to the development of new materials for service in advanced nuclear reactors. This understanding is also needed for the extension of the operating lifetimes of the current fleet of nuclear reactors. Advanced characterization methods utilizing advanced tools and techniques, coupled with modeling and simulation and advanced sample preparation tools will further the understanding of the effects of irradiation, temperature, pressure and corrosive environments on material microstructures and mechanical behavior. Modern sample fabrication tools could also allow for more efficient use of existing irradiated materials and enable fabrication of smaller specimens from previously examined materials.

Appendix C

Workscope for Program Directed – University Only

Program Directed: Nuclear Reactor Technologies
Simulation of Neutron Damage for High Dose Exposure of Advanced Reactor Materials (IRP-RC) **(FEDERAL POC – BILL CORWIN & TECHNICAL POC – JEREMY BUSBY)** **(Up to 3 years and $5,000,000 total project cost, estimate up to 1 award)** Some of the components and structures envisioned for advanced, high temperature reactors will need to operate to cumulative radiation doses that are too high to be obtained in a reasonable time in the test reactors that are available for experimental study today. Neutron exposures to doses of hundreds of displacements per atom (dpa) may be required for certain critical materials. Qualifying those materials for such service will require assurance of their ability to retain their essential properties, such as strength, ductility, geometric stability, etc. at such very high doses. Alternate means of evaluating the properties of materials under these high doses will be necessary. The Department of Energy's NEUP is seeking proposals for an Integrated Research Project (IRP) to demonstrate the capability to predict the properties of structural materials after extremely high radiation exposure. Essential elements of this capability will be the ability to expose materials to surrogate irradiation doses from sources other than test reactors under accelerated dose rates and correlate the results of those exposures to the equivalent exposure from neutrons in the appropriate reactor environment being simulated. It is expected that major components of demonstrating this capability will comprise a combination of ion irradiations and interpretive materials modeling (or the equivalent), plus the post irradiated examinations (PIE) needed to evaluate changes in mechanical, fracture, and thermo-physical properties caused by the irradiation. Effects that will need to be specifically addressed in the interpretation of the surrogate irradiations will include, but not be limited to, those associated with the accelerated rate of irradiation and any related temperature effects of the sample materials, the differences in atomic and macroscopic response of the materials to the type of irradiation particle (i.e., neutron vs. ion), energies and spectrum of the irradiation, and the relative effects of atomic displacement damage vs. He and H production and accumulation. To demonstrate the capability to evaluate materials at high irradiation doses, benchmarking of the required experimental and analytical elements shall be performed via a focused study of comparative results of neutron vs. surrogate irradiations under high-dose conditions specific enough to show the strengths and limitations of the capability. Items that should be addressed in the benchmarking should include: details of the surrogate exposure facility utilized for the study, irradiation rate and spectrum effects, relative effects of displacement damage vs. He or H production, methods for PIE of microstructure and materials properties, impacts of irradiation method on microstructure and materials properties, and strengths and limitations of the analytical methods used to relate the surrogate irradiations to comparable neutron irradiations. Proposals are sought to develop, integrate, and demonstrate capabilities to evaluate the exposure of materials and associated property changes to equivalent irradiation doses that may exceed 200 dpa.

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The proposal should include a detailed description of 1) existing experimental facilities and any proposed modifications thereof that will be utilized for the surrogate irradiations; 2) existing PIE capabilities to assess effects of the irradiations; 3) the interpretive methods planned to evaluate the differences of the impact of the surrogate irradiation methods on the exposed material proposed with those that would occur in future reactor conditions, along with any planned development of them; and 4) the approaches for benchmarking the alternate irradiation exposure with comparable neutron irradiations. Proposals should also include both cost and schedule estimates and descriptions of the technical approach and its proposed outcome of sufficient detail in order to determine the feasibility of the proposal within the time and budget allocated for this project. Favorable consideration will be given to those proposals that allocate greater relative resources towards the combined experimental and analytical studies planned to benchmark the approaches proposed and less resources towards facility development or improvements, inasmuch as a high technical credibility of the approach is maintained. Modification of surrogate irradiation facilities to demonstrate this capability shall be limited to $1.5 million.