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Revision 0

Results and Analysis of the Research and Development Work Scope Request for Information (DE-SOL-0008246)

Brenden Heidrich

July 2015

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Nuclear Scientific User Facilities

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July 2015

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SUMMARY

The Department of Energy (DOE) Office of Nuclear Energy (NE) released a request for information (RFI) (DE-SOL-0008246) for "University, National Laboratory, Industry and International Input to the Office of Nuclear Energy's Competitive Research and Development Work Scope Development" on April 13, 2015. DOE-NE solicited information for work scopes for the four main program areas as well as any others suggested by the community. The RFI proposal period closed on June 19, 2015.

From the 124 responses, 238 individual work scopes were extracted. Thirty-three were associated with a DOE national laboratory, including Argonne National Laboratory (ANL), Brookhaven National Laboratory (BNL), Idaho National Laboratory (INL), Los Alamos National Laboratory (LANL), Pacific Northwest National Laboratory (PNNL) and Oak Ridge National Laboratory (ORNL).

Thirty US universities submitted proposals as well as ten industrial/commercial institutions.

Four major R&D areas emerged from the submissions, appearing in more than 15% of the proposed work scopes. These were: nuclear fuel studies, safety and risk analysis, nuclear systems analysis and design and advanced instrumentation and controls. Structural materials for nuclear power plants, used nuclear fuel disposition and various types of systems analysis were also popular, each appearing in more than 10% of the proposals.

Nuclear Energy Enabling Technologies (NEET) was the most popular program area with 42% of the proposals referencing the NEET-CTD program. The order of the remaining programs was Fuel Cycle Technologies (FC) at 34%, Nuclear Energy Advanced Modeling and Simulation (NEAMS) at 29% and Reactor Concepts at 17%.

CONTENTS

ACRONYMS

ART	Advanced Reactor Technology
ATR	Advanced Test Reactor
DOE	Department of Energy
DRP	Database Review Panel
FIMS	Facility Information Management System
FY	fiscal year
FC R&D	Fuel Cycle Research and Development Program
GIS	Geographical Information System
IAEA	International Atomic Energy Agency
IM	Information Management
INL	Idaho National Laboratory
LWRS	Light-Water Reactor Sustainability
NE	Nuclear Energy
NEAMS	Nuclear Energy Advanced Modeling and Simulation
NEET-CTD	Nuclear Energy Enabling Technologies – Crosscutting Technology Development
NEID	Nuclear Energy Infrastructure Database
NSUF	Nuclear Science User Facilities
POC	point of contact
RC RD&D	Reactor Concepts Research, Development and Demonstration Program
R&D	research and development
RFI	Request for Information

Introduction

The Department of Energy (DOE) Office of Nuclear Energy (NE) released a request for information (RFI) (DE-SOL-0008246) for "University, National Laboratory, Industry and International Input to the Office of Nuclear Energy's Competitive Research and Development Work Scope Development" on April 13, 2015. DOE-NE solicited information for work scopes for the four main program areas as well as any others suggested by the community. The RFI proposal period closed on June 19, 2015.

From the 124 responses, 238 individual work scopes were extracted. Thirty-three were associated with a DOE national laboratory, including Argonne National Laboratory (ANL), Brookhaven National Laboratory (BNL), Idaho National Laboratory (INL), Los Alamos National Laboratory (LANL), Pacific Northwest National Laboratory (PNNL) and Oak Ridge National Laboratory (ORNL). Thirty US universities submitted proposals as well as ten industrial/commercial institutions.

The four main R&D programs are:

1. Fuel Cycle Research and Development (FC R&D) Program
2. Reactor Concepts Research, Development and Demonstration (RC RD&D) Program
3. Nuclear Energy Advanced Modeling and Simulation (NEAMS) Program
4. Nuclear Energy Enabling Technologies (NEET) Crosscutting Technology Development (CTD).

The RFI posed five questions to better describe the proposed work scopes. The questions are summarized below.

RFI Questions

1. **Definition:** Clearly define your proposed work scope, and how it relates to any part of NE's mission described in this RFI. Describe any defined goals in achieving the desired outcomes, along with appropriate metrics to assess how well those goals have been achieved.

2. **Cost Estimates:** What would be the estimated cost of the work scope?

3. **Timeliness and Priority:** Would the work scope be more focused on immediate NE program needs, or more creative, innovative and transformative?

4. **Partner Requirements:** Would the work scope require multiple partners?

5. **Duration and Milestones:** What would be a reasonable schedule duration and key milestones?

Link to Infrastructure RFI (DE-SOL-0008318)

The work scope proposals were also compared using the same infrastructure and R&D areas utilized in the analysis of the Infrastructure RFI (DE-SOL-00008318). This allowed an extension of that analysis to include infrastructure needs not addressed in those submissions, but required to complete the research proposed in this RFI.

1. R&D Infrastructure Capability Type

The capability categories in Table 1 represent the consolidated categories from the infrastructure analysis. This data was Table 11 of INL/EXT-15-35978. Each proposed work scope was assigned to 1-3 capability categories based on expert judgement.

Table 1: Capability Categories

Name	Abbreviation
Ion/Photon Beam Facility	IPBF
Materials Examination	MatEx
Reactor	MS
Radio-chemistry Laboratory	RX
Thermal-Hydraulic	FDF
High-Performance Computing	RCL
Microscope	THF
Fuel Development	HPC
Advanced Instrumentation	AIN
Advanced Manufacturing	AM
Shipping Cask (UNF)	INC
NPP I&C	CSK
Concrete and Seismic Equipment	CON

2. Office of Nuclear Energy Mission Areas.
Each proposed work scope was assigned to 1-2 NE mission areas. Some proposals mentioned these missions; others were assigned using expert judgement.

Table 2: Office of Nuclear Energy Missions

Number	Abbreviation	Category
1	LWRS	Improve the reliability and performance, sustain the safety and security, and extend the life of current reactors by developing advanced technological solutions.
2	ART	Meet the Administration's energy security and climate change goals by developing technologies to support the deployment of affordable advanced reactors.
3	FC	Optimize energy and waste generation, safety, and nonproliferation attributes by developing sustainable fuel cycles.
4	RD&D	Enable future nuclear energy options by developing and maintaining an integrated national RD&D framework.
5	INTL	Maintain U.S. leadership at the international level by engaging nations that pursue peaceful uses of nuclear energy.

3. Nuclear Energy-related research areas

Table 3: Research Areas Supported by the Proposed Capability

Abbreviation	Category
STM	Structural Materials
NFL	Nuclear Fuels (including cladding)
NSY	Nuclear Systems Design Studies
PCS	Power Conversion Systems
DRY	Dry Heat Rejection Systems
PRO	Process Heat Transport Systems
INC	Instrumentation and Controls
REC	Material Recovery Processes
WST	Waste Forms
SST	Safeguards and Security Tech.
UNF	Used Fuel Disposition
RSK	Safety and Risk Assessment
AM	Advanced Manufacturing Technologies
SYS	Systems Analysis
SDP	Space and Defense Power Systems
CON	Concrete and Seismic Studies

4. Respondent Type
Each respondent to the RFI was placed in one of the following categories, based on their type of organization.

Table 4: Capability Location Categories

Category	Definition
University	A US academic institution of higher learning.
National Laboratory	A government-owned contractor-operated entity.
Industry	An entity that is not a University or National Laboratory. This can be a for-profit entity, like a utility or a vendor, or a not-for-profit entity, like EPRI.

Data Summary

The RFI proposal period closed on June 19, 2015. At this point, 46 institutions had submitted complete responses. The quality of the responses varied, with the majority of proposers adhering to the suggested format supplied in the RFI. Some of the requested cost data was missing, with only 198 of 238 respondents supplying both cost estimates and planned durations (83%).

From the 124 responses, 238 individual work scopes were extracted.

Proposing Institutions

Forty-Six institutions proposed work scopes through this RFI. Thirty-three were associated with a DOE national laboratory, including Argonne National Laboratory (ANL), Brookhaven National Laboratory (BNL), Idaho National Laboratory (INL), Los Alamos National Laboratory (LANL), Pacific Northwest National Laboratory (PNNL) and Oak Ridge National Laboratory (ORNL). Thirty US universities submitted proposals as well as ten industrial/commercial institutions. The raw distributions are shown in Table 5 and Figure 1.

Table 5: Proposing Institution Types

Institution Type	Count	Frequency
Industry	62	26%
National Laboratory	70	29%
University	106	45%
Total	238	100%

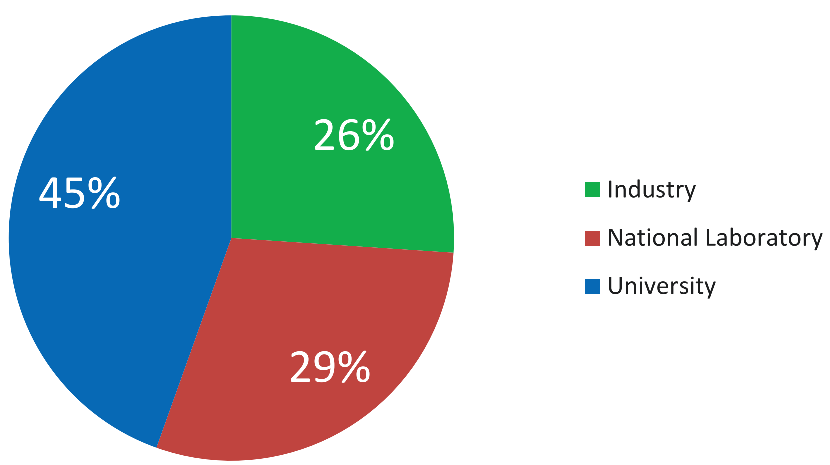

Figure 1: Distribution of Proposing Institutions to Work Scope RFI

Many of the proposing institutions suggested multiple work scopes. Some of this was a result of multiple proposals and some were multiple work scopes within a single proposal. Table 6 shows the top 20 institutions. Figure 2 shows the distribution of institutions.

Table 6: Top 20 Institutions with most Work Scope Proposals

Institution	total work scopes
Argonne National Laboratory	24
GE Hitachi	20
AREVA Federal Services	17
Pacific Northwest National Laboratory	13
Oak Ridge National Laboratory	12
University of California, Berkeley	12
NuScale Power	11
Idaho National Laboratory	11
Pennsylvania State University	9
University of Michigan	8
University of Illinois, Urbana Champaign	8
Brookhaven National Laboratory	7
North Carolina State University	7
Westinghouse Electric Company LLC	6
Rensselaer Polytechnic Institute	6
Texas A&M University	6
Louisiana State University	5
Purdue University	5
University of Pittsburgh	5
Kansas State University	5

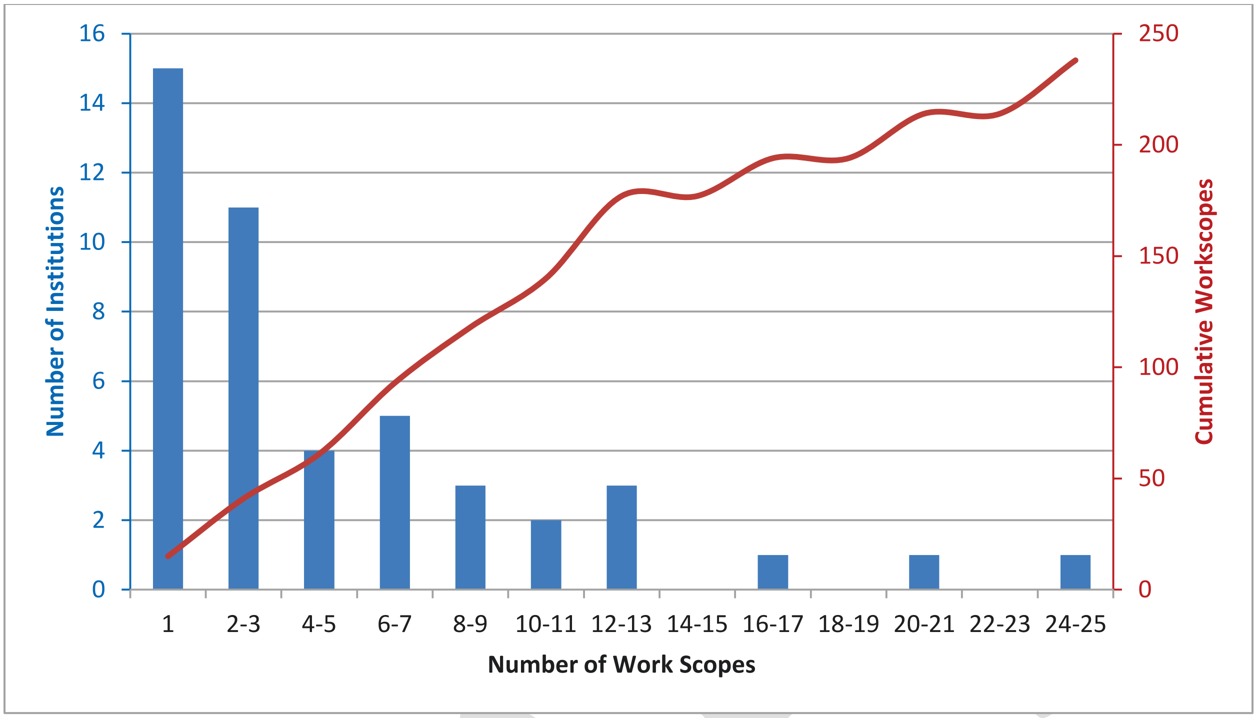

Figure 2: Distribution of Work Scope Proposals and Institutions

Office of Nuclear Energy R&D Areas

The proposer was able to state particular NE R&D areas as well as programs to which the proposed work scope would apply. Both a primary and a secondary choice could be made. Not all proposers made a secondary choice. Table 7 is a summary of the data. Figures 3, 4 and 5 show the distribution of the primary, secondary and aggregate choices. Figure 6 shows the probability that a given R&D area would be in any given proposal. NEET-CTD is the most common primary and secondary choice by proposers.

Table 7: NE R&D Area Data Summary

Program	NE Primary	NE Secondary	Total	Primary Frequency	Secondary Frequency	Total Frequency	% in any proposal
NEET-CTD	81	18	99	34%	35%	34%	42%
FC R&D	70	10	80	29%	20%	28%	34%
NEAMS	64	6	70	27%	12%	24%	29%
RC RD&D	23	17	40	10%	33%	14%	17%

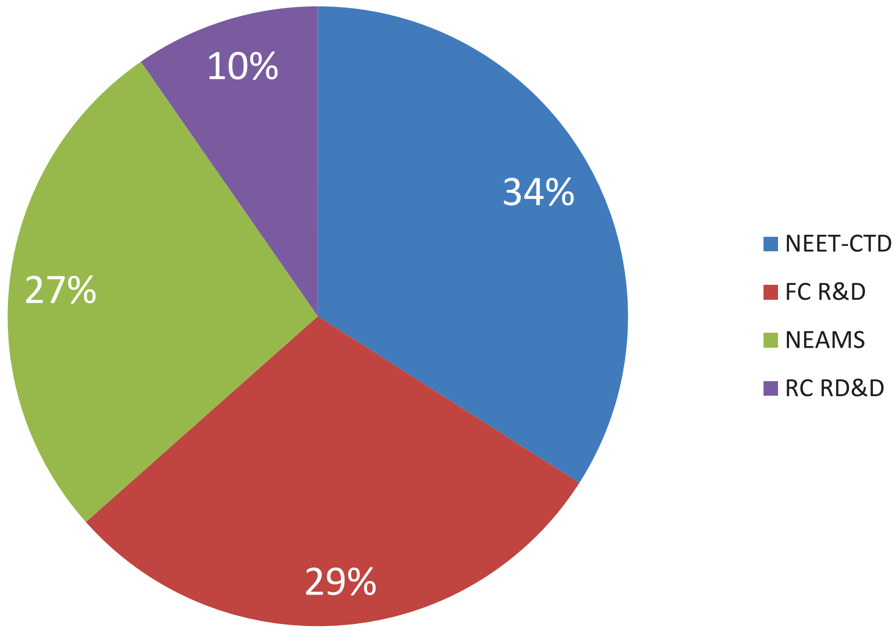

Figure 3: Primary Mission Frequency

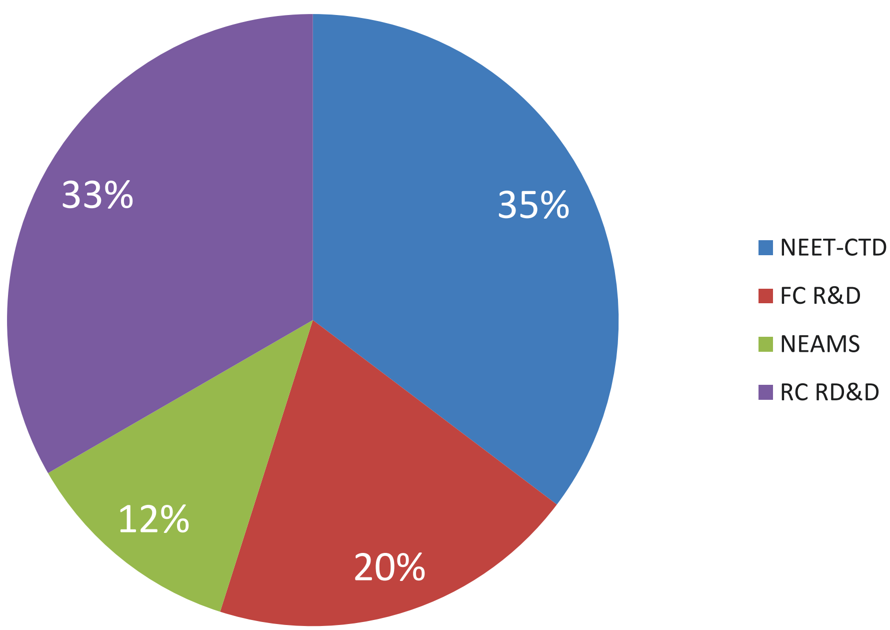

Figure 4: Secondary Mission Frequency

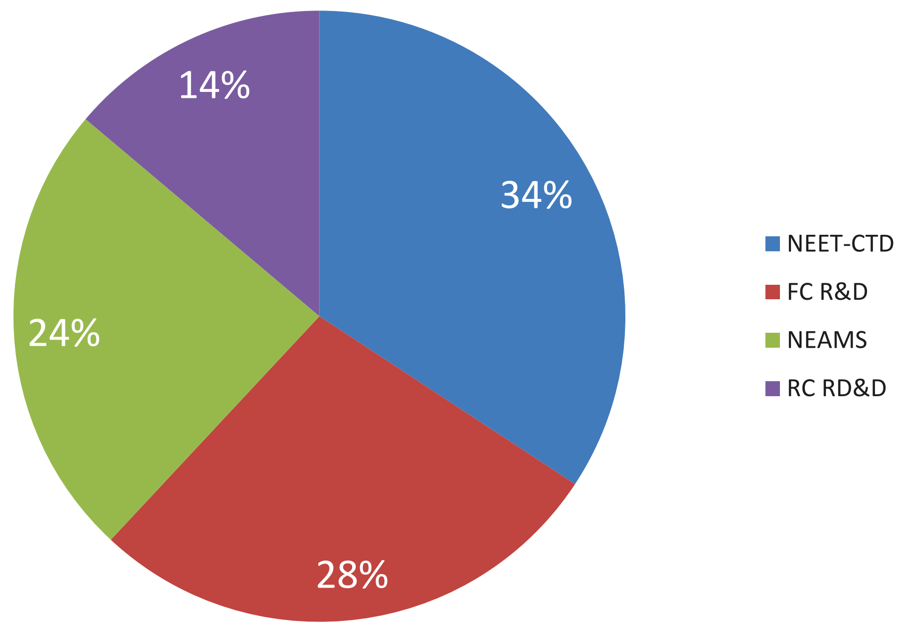

Figure 5: Total R&D Area Frequency

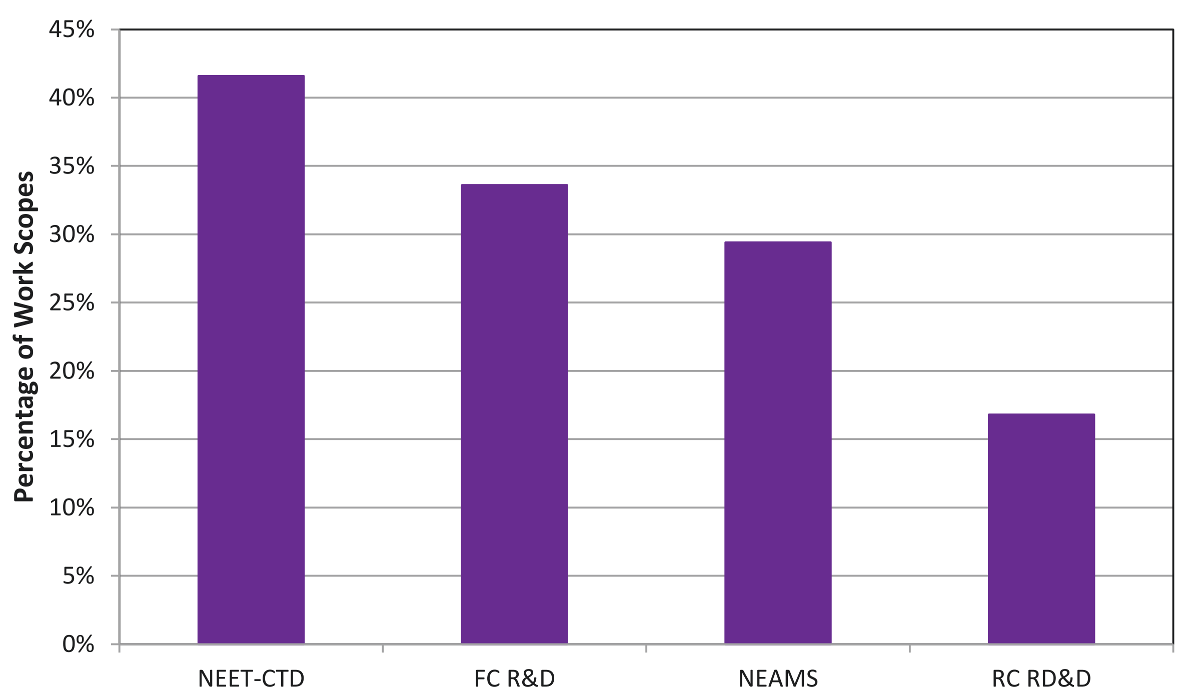

Figure 6: Percentage of Work scopes within each NE Mission Area

The program areas where work scopes were proposed were correlated to the type of institution proposing the work. Table 8 and Figure 7 show the distribution of proposing institutions by program area. Universities were most likely to propose into the NEAMS area, likely because the infrastructure requirements for computer simulation are very small. Industry proposed most often into the Reactor Concepts area, likely in support of the LWRS program. National Laboratories were less skewed in their behavior, but were predisposed to the NEET-CTD program area, likely to support the multi-mission capabilities of the laboratories.

Table 8: NE Program Area by Institution Type

Institution Type	NEAMS	FC R&D	NEET-CTD	RC RD&D
Industry	18%	32%	24%	50%
National Laboratory	32%	25%	45%	28%
University	50%	42%	31%	22%
Total	100%	100%	100%	100%

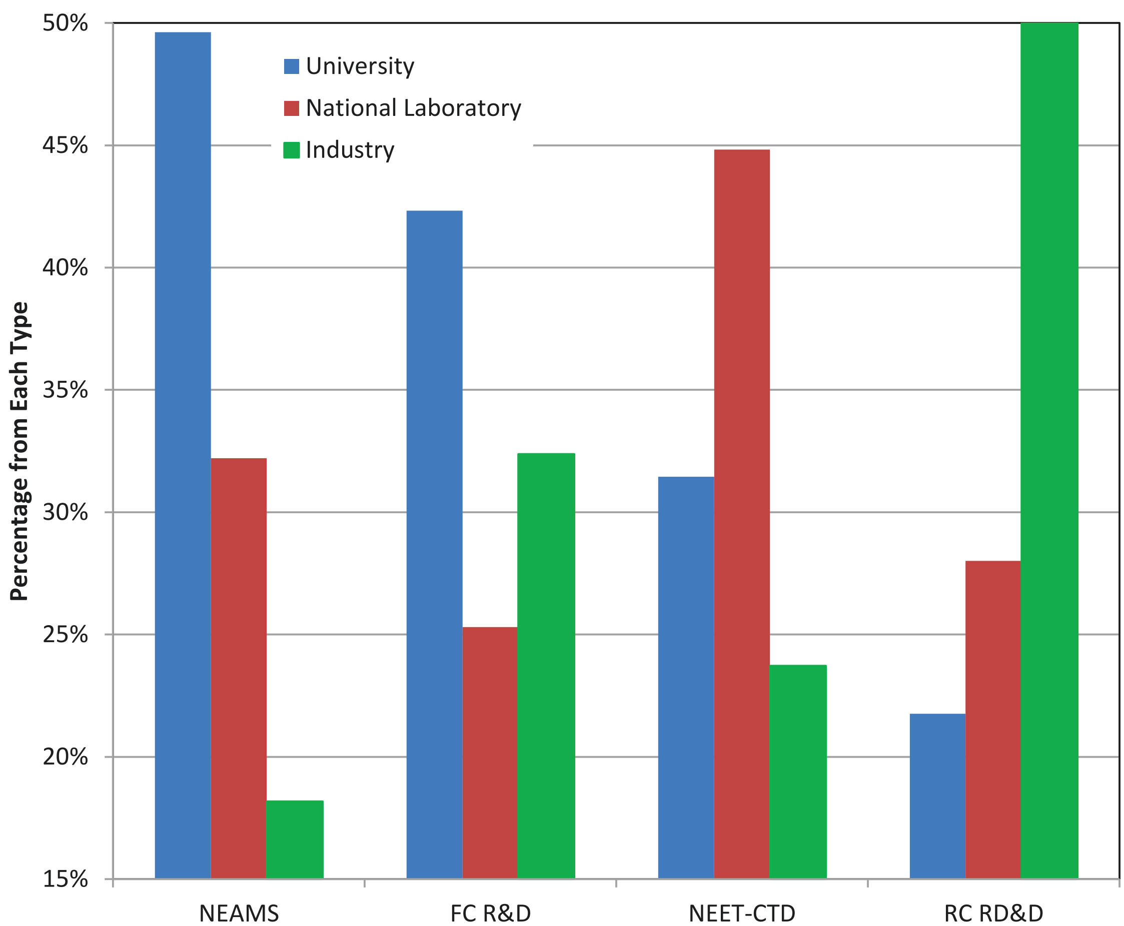

Figure 7: Program Application Normalized to Participation Level

Infrastructure Requirements for R&D Work Scopes

This RFI was focused on work scopes for research and development work, but that work often requires significant infrastructure capabilities. Each proposed work scope was linked to one or more of the combined infrastructure categories from the Infrastructure RFI analysis. Thirty-two of the 238 proposals did not require associated infrastructure. These were mostly in the systems analysis, safety and risk and nuclear systems design studies R&D areas (71%).

Tables 9 and 10 and Figure 8 show the distribution of infrastructure required for the proposed work scopes. Up to three infrastructure areas could be attached to a proposal and two R&D areas. All of this data was aggregated so that any of the infrastructure areas were linked to all of the R&D areas. Because of this technique, some of the correlations may not be very strong.

Table 9 shows the important infrastructure requirements for each R&D area. The data has been converted to a percent of all infrastructure associated with each of the R&D work scope proposals. The data is summed across the rows (work scopes). Most of the R&D areas have strong preferences for one or two infrastructure types.

Table 9: Important Infrastructure Requirements for Each Proposed R&D Area

	Infrastructure Areas												
R&D Areas	**AIN**	**AM**	**CON**	**CSK**	**FDF**	**HPC**	**IGBF**	**INC**	**MatEx**	**RCL**	**RX**	**THF**	**Total**
AM	17%	48%			7%		3%	3%	14%	3%		3%	100%
CON		7%	43%						50%				100%
INC	46%	5%			2%			43%			2%	3%	100%
NFL	4%	4%		1%	22%	7%	7%	1%	26%	7%	18%	4%	100%
NSY	6%				3%	24%	3%	5%		2%	11%	46%	100%
PCS				50%								50%	100%
PRO	8%	8%						8%		8%		69%	100%
REC										100%			100%
RSK	15%		6%	1%	3%	16%	2%	20%	11%	6%	4%	16%	100%
SDP		50%			50%								100%
SST	50%				33%			17%					100%
STM	5%	7%				2%	14%		47%	14%	12%		100%
SYS	21%			14%		21%		14%	7%	7%	7%	7%	100%
UNF	3%	3%		22%	27%				8%	30%		8%	100%
WST		10%			30%		3%		10%	37%	3%	7%	100%

Table 10 is based on the same data, analyzed to show the R&D areas that are supported by a particular type of infrastructure. The data is summed over the columns. Once again, there are specific R&D areas that a type of infrastructure will support.

Table 10: Infrastructure Types that Support Various R&D Areas

	Infrastructure Areas											
R&D Areas	**AIN**	**AM**	**CON**	**CSK**	**FDF**	**HPC**	**IGBF**	**INC**	**MatEx**	**RCL**	**RX**	**THF**
AM	8%	45%			4%		5%	2%	5%	2%		2%
CON		3%	55%						9%			
INC	44%	10%			2%			49%			3%	3%
NFL	6%	13%		8%	42%	18%	37%	2%	36%	16%	49%	6%
NSY	6%				4%	38%	11%	6%		2%	19%	44%
PCS				8%								2%
PRO	2%	3%						2%		2%		14%
REC										2%		
RSK	20%		45%	8%	6%	35%	11%	34%	13%	11%	11%	21%
SDP		3%			2%							
SST	5%				4%			2%				
STM	3%	10%				3%	32%		27%	13%	14%	
SYS	5%			15%		8%		4%	1%	2%	3%	2%
UNF	2%	3%		62%	19%				4%	24%		5%
WST		10%			17%		5%		4%	24%	3%	3%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Finally, Figure 8 displays the probability that a given type of infrastructure was required for any given proposed work scope. This is the relative popularity of each type of infrastructure in this RFI.

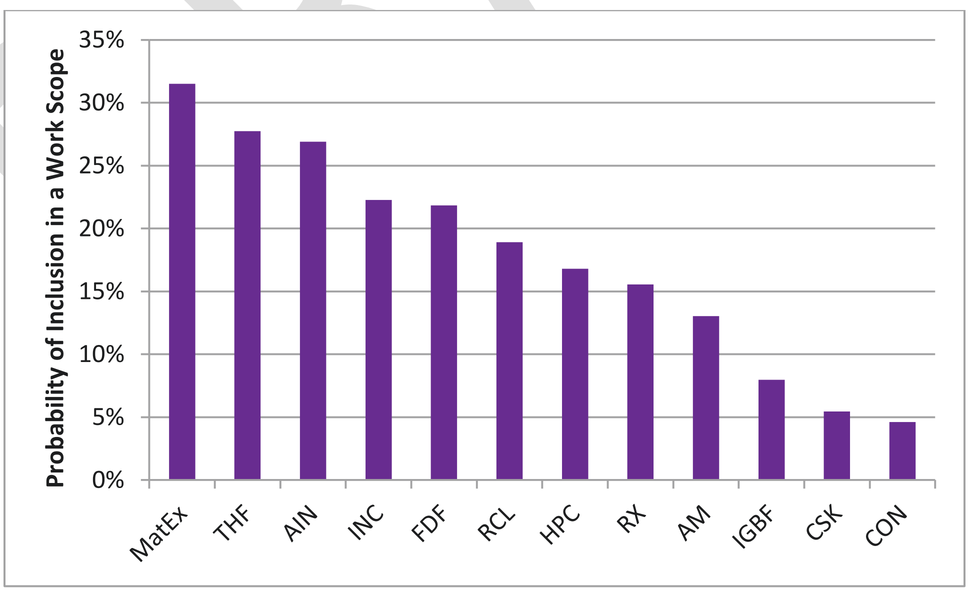

Figure 8: Probability of requiring a given Type of Infrastructure

NE Research Areas

Each proposed work scope was matched to a set of research areas originally used for the Infrastructure RFI. Up to two areas could be assigned to a given proposed work scope. Table 11 and Figure 9 show the distribution of these research areas. Figure 10 shows the probability of a given research area appearing in any given work scope proposal.

Table 11: Frequency of Research Areas in the set of Proposed Work Scopes

Research Area	Abbreviation	TOTAL	Frequency
Nuclear Fuels (including cladding)	NFL	72	19%
Safety and Risk Assessment	RSK	72	19%
Nuclear Systems Design Studies	NSY	57	15%
Instrumentation and Controls	INC	36	10%
Structural Materials	STM	28	7%
Used Fuel Disposition	UNF	28	7%
Systems Analysis	SYS	24	6%
Waste Forms	WST	19	5%
Advanced Manufacturing Technologies	AM	15	4%
Process Heat Transport Systems	PRO	11	3%
Concrete and Seismic	CON	7	2%
Safeguards and Security Tech.	SST	4	1%
Power Conversion Systems	PCS	2	1%
Space and Defense Power Systems	SDP	1	0%
Dry Heat Rejection Systems	DRY	0	0%
Material Recovery Processes	REC	0	0%

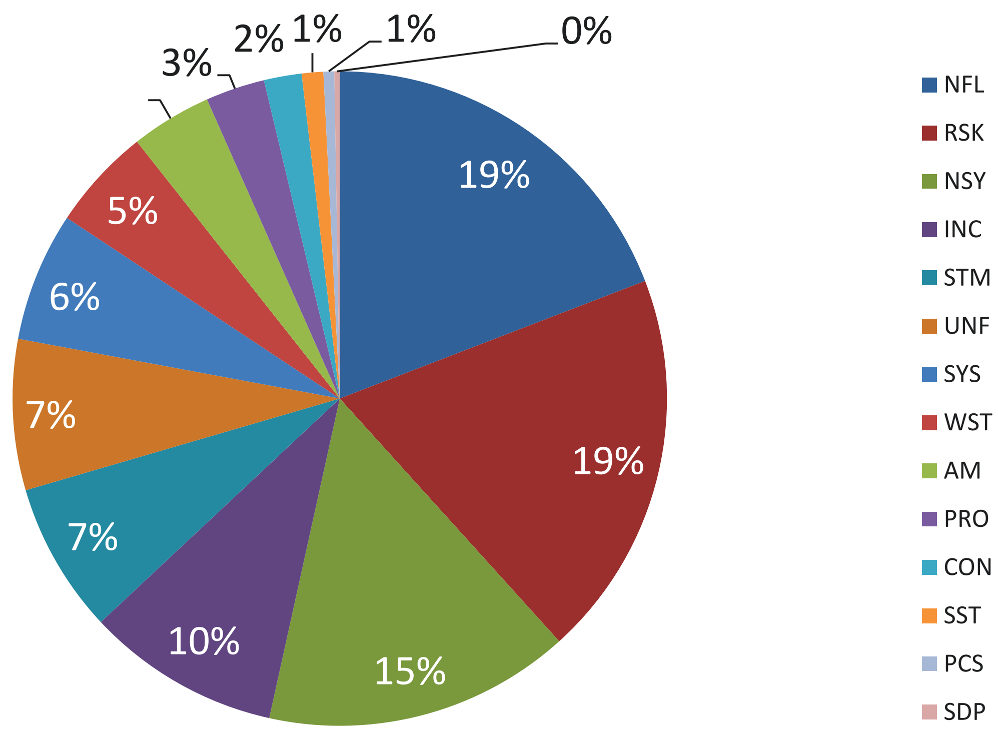

Figure 9: Distribution of NE R&D Areas listed in RFI Reponses

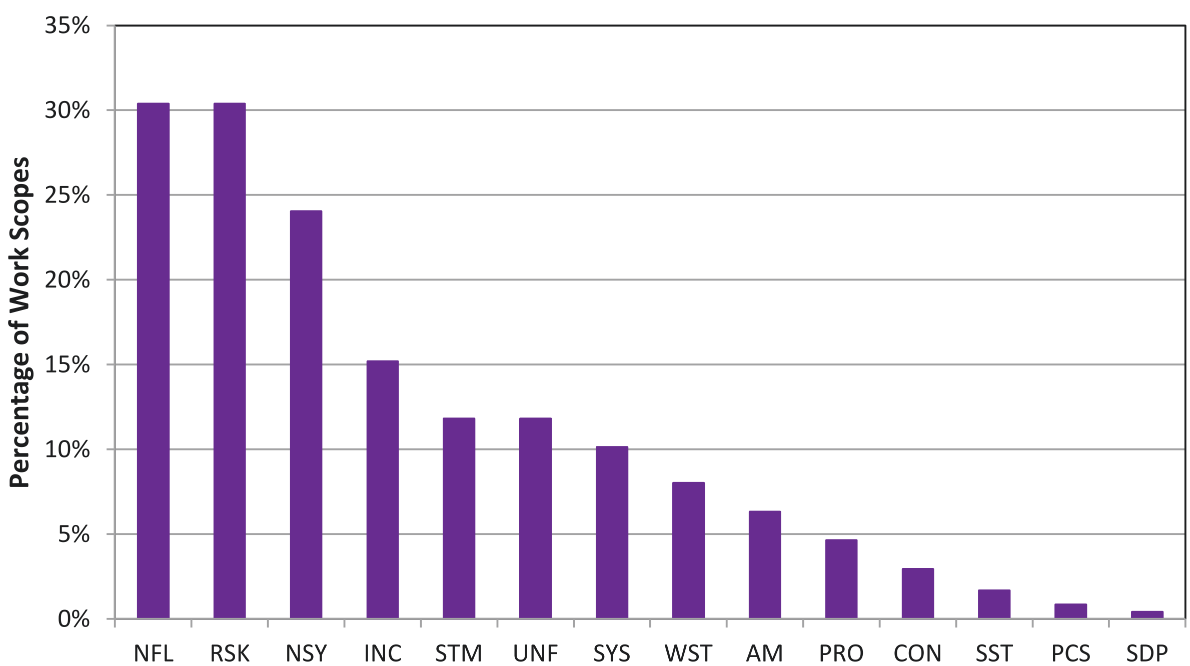

Figure 10: Percentage of Proposals that Included each NE R&D Area

While the distribution of research areas is clear, the relationship among them is also important. Two choices were allowed for each proposal. The selection of the first area had a strong influence on the second choice. Figure 11 shows the relationship among the research areas with respect to first and second choices. Safety and Risk Analysis is the most probable secondary choice of research areas. This may be real, or it may be a function of the proposer adding a statement about safety in order to provide gravitas to the proposal.

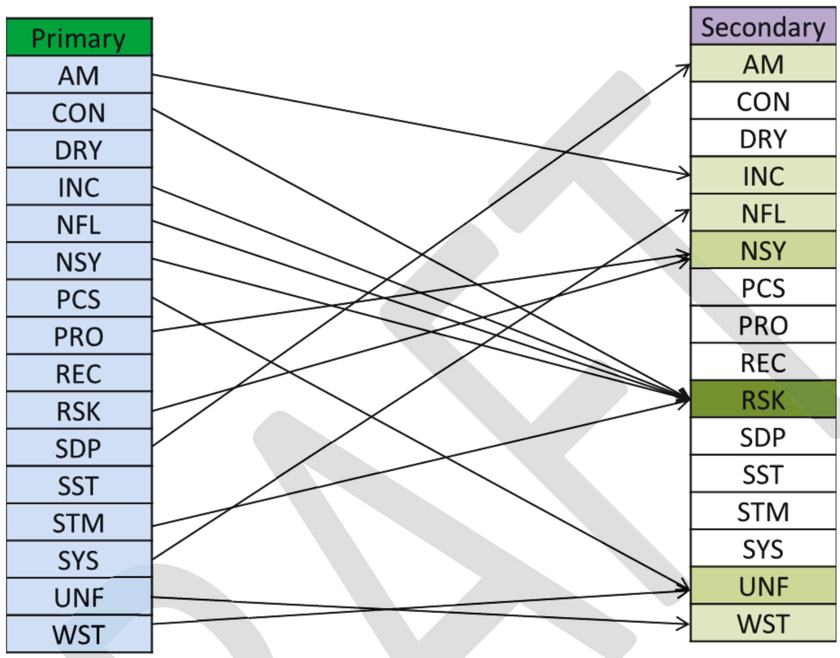

Figure 11: Preferred Secondary Research Area Choices in set of Proposed Work Scopes

Costs Associated with Funding the Proposed Work Scopes

The respondents were asked to provide a cost and schedule estimate for the proposed work scopes. Figures 12, 13 and 14 show the distribution of total costs, expected schedule duration and the associated cost per year for each work scope. Most of the proposals provided an estimate of $800,000 and a three-year duration, which has been the typical cost and length. The distributions were as expected, with a few high-cost and long-term proposals.

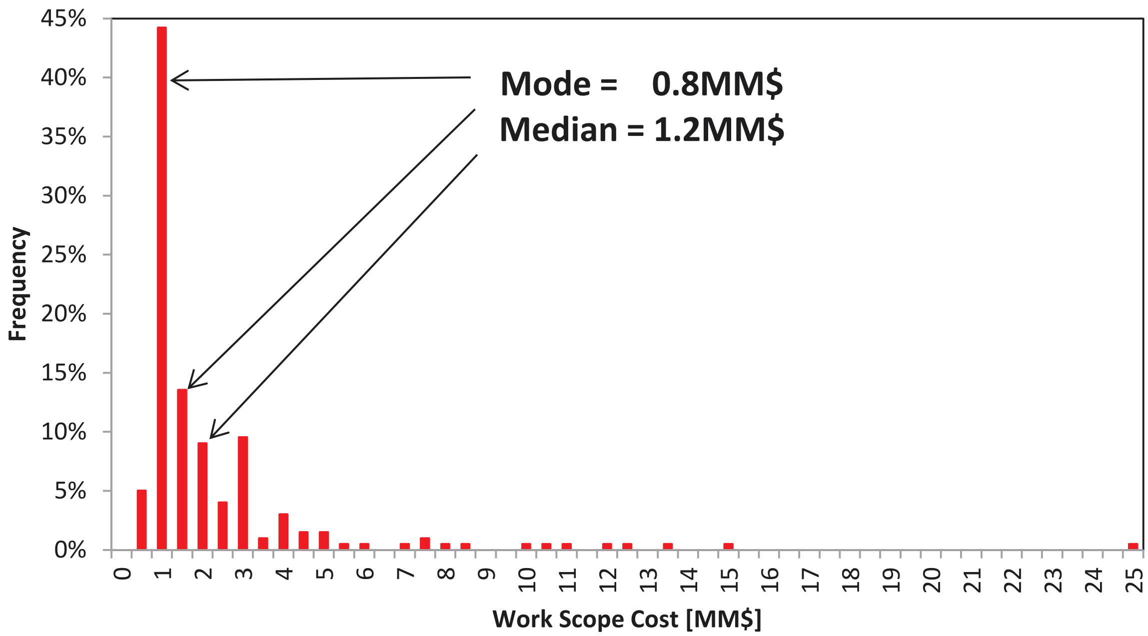

Figure 12: Total Work Scope Cost

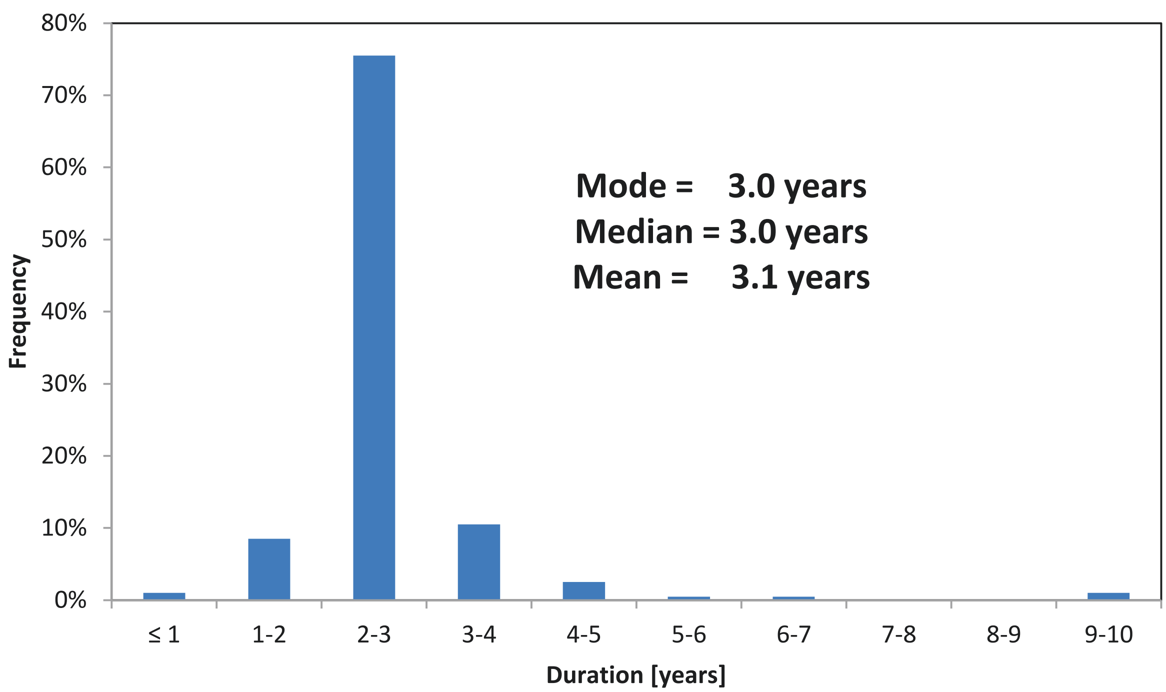

Figure 13: Expected Work Scope Duration

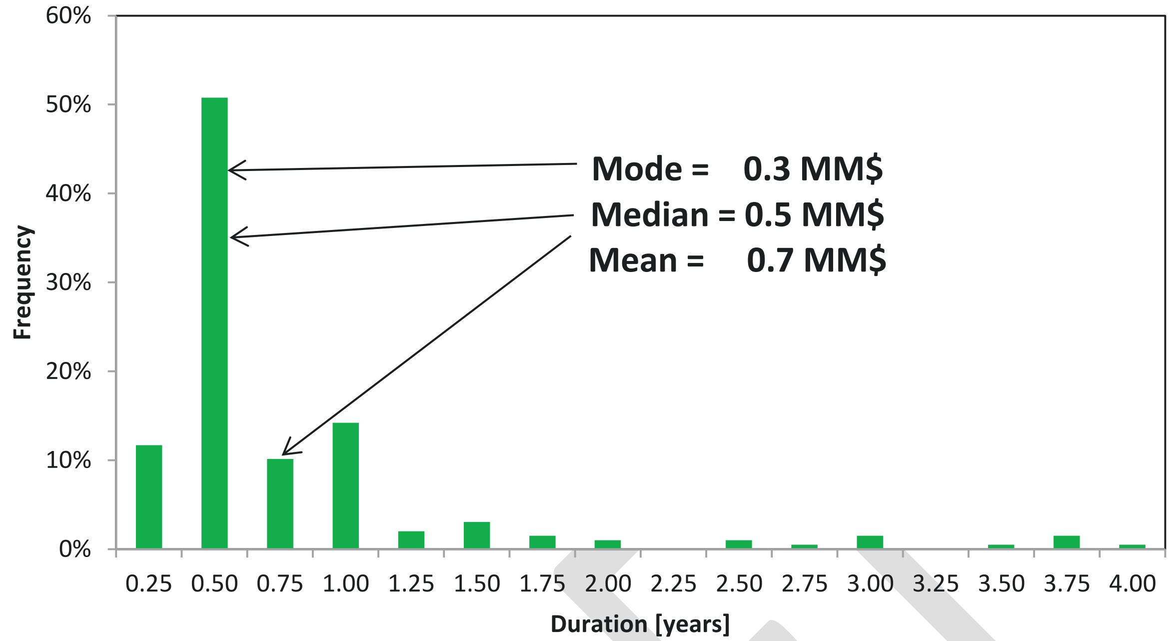

Figure 14: Cost/Year Distribution

Integrated Research Project Proposed Work Scopes

Five integrated research project work scopes were proposed:

1. Validation of Multi-physics/Multiscale Simulations - Experimental and analytical techniques for the characterization of tightly coupled phenomena to quantify and justify confidence in high fidelity simulations, the Idaho National Laboratory (3 years, 6.0MM$)

2. Assessing Unit Resilience Impacts in the Optimal Control of Hybrid Systems, The Ohio State University (3 years, 4.5MM$)

3. Modeling the Transport of Radionuclides in Arid Environments, AREVA-NP (3 years, 3.0MM$)

4. Development of a Process For Tritium Separation and Capture from Aqueous Streams Containing Dilute Quantities of Tritium, AREVA-NP (3 years, 3.0MM$)

5. Development of an Open-Source Virtual Reactor Road Map for Use in Research and Education, AREVA-NP (3 years, 3.0MM$)

Qualitative Comments on the CINR Process

Two proposers submitted qualitative statements concerning the administration of the Office of Nuclear Energy competitive funding programs. These statements are included here in their entirety with only editorial changes made for clarity.

Fuel Cycle Research and Development

There is significant work scope in many different areas, so, fewer topics that rotate so that awards can be funded at a higher level, e.g. ~3 topics per year would be more beneficial. If the work scope is very specific to one or two issues, it results in more centered and relevant proposals.

NEET

Offer fewer topics with more dollars to maintain collaborations. The number of NEET subject areas has increased significantly from three to six. This reduces the number of proposals that can be funded in each area. If six or more areas are going to stay constant, the funding for NEET needs to be increase by a factor of two. If the funding is to stay the same for the same six subject areas, I would suggest that proposals be solicited for three subject areas the first year and the other three the second year.

Also, the original idea was to have each proposal include collaborators in industry, national laboratories, and universities. If that is expected, the funding needs to be increased to be similar to the amount of funding for IRPs at ~1MM$ per year for three years. With funding so low, it is very difficult to have more than three collaborators without significantly reducing the scope that can be accomplished.

Needed capabilities supporting research, training and technology demonstration

The capabilities needed to support research, training, and technology demonstration are state of the art characterization equipment that is maintained in working order.

- In addition, to be used for training, this equipment needs to be accessible for students.
- The capabilities must be able to handle low-level radioactive samples.

Capabilities that are needed include:

- Focused Ion Beam Microscopes (FIB)
- Transmission Electron Microscopes, both high-resolution and analytical (TEM)
- Scanning Electron Microscopes (SEM)
- Electron Backscatter Diffraction (EBSD)
- Optical microscopy
- Mechanical Testing equipment
- Other specialized equipment such as Atom Probe Tomography (APT)

Because these capabilities are in high demand for performing research, these are needed at national laboratories as well as universities.

Additional Comments on DOE NEUP

The funding of nuclear research by DOE NEUP is greatly appreciated and it has caused a sea change in the outlook of nuclear engineering departments across the country. The comments below should be taken in the context of this deep appreciation, while wanting to make the program even better, of higher quality and more useful to DOE.

Relevance Assessment

The system for assessing the relevance of research proposals in the DOE system is deeply flawed. The relevance reviewers appear to have little knowledge of the research currently being done in the DOE NEUP, so they reject proposals that they believe are being addressed when in fact they are not and recommend funding proposals that are repeats of others. Further, the review relevancy process is very opaque, as the PIs receive only a cryptic message of this work is being done elsewhere. This makes the DOE lose credibility with researchers.

- **It is recommended** that technical people be involved in both the real review and the relevancy evaluation as it is not possible to evaluate relevancy when the reviewers have little technical knowledge of the field.

Accountability of research projects

It is necessary to require greater accountability of the results in the research projects funded, especially on the IRP projects. This is because these projects often do not deliver on their promises. Currently there is little incentive in the DOE proposal process for being accurate on what is promised in the research proposal. If one promises more than can be reasonably delivered, but adjusts the milestones to something that can be fulfilled, little other checking appears to occur. In speaking to other researchers, the feeling is that there is little use of the reports we send in, the TPOC being busy with their own work and having little incentive to follow up.

This process is made worse in the initial evaluation process by the fact that the reviews are semi-blind, and it is not possible to take an applicant's track record into account while making the evaluation of whether the objectives of a research project is likely to be completed. NSF asks for a report on prior support; this should at least be evaluated by DOE.

- **It is recommended** that DOE NEUP consider
  (i) No longer using the semi blind process of evaluations (find other means of awarding research funding to young investigators which is very a laudable

goal - e.g. reserve a part of the budget for investigators less than X years out). This would allow reviewers to take the PI's track record into account in evaluating the proposal.

(ii) Ask for an account of prior support to be submitted with the proposal;

(iii) Require that IRPs have an Advisory Board approved by the TPOC who monitors the research projects and reports independently to DOE; this would allow in course corrections,

(iv) Change the reward system so that TPOC's have an incentive to engage in and monitor the research.

Appendix 1: Summary data table for all proposals

Tracking ID	Institution	Description	Institution Type	Infra Area (Q6)	Infra Area (Q6)	Infra Area (Q6)	NE Mission Area (Q7)	NE Mission Area (Q7)	NE R&D Area (Q8)	NE R&D Area (Q8)	NE R&D Program	NE R&D Program	NEAMS Tie-In?	Cost [MM$]	Immediate or Future Needs	Multiple Partners?	Schedule [YEARS]	Cost/Year	IRP?
RFI-RD--9609	EPRI	improved NDE capabilities to characterize materials aging	Industry	MatEx			1		STM		RC		N	NE	I	NE	NE		
RFI-RD--9610	Massachusetts Institute of Technology	Offshore Floating Nuclear Plant (OFNP) concept with the potential for attractive economics and unprecedented levels of safety	University	RX			2		NSY		RC		N	2	F	Y	2	1.00	
RFI-RD--9613	University of Houston	degradation of concrete structures (radiation and high-temperature effects) experiments and simulation tools	University	MatEx	CON		1		RSK	CON	RC		Y	2	I	Y	3	0.67	
RFI-RD--9615	Virginia Polytechnic Institute and State University	C-SiOC-SiC Coated Particle Fuels and C-SiOC-SiC Encapsulated Pellet Fuels for Nuclear Reactors (ion irradiation, structural evaluation & simulation)	University	FDF	MatEx	IGBF	3		NFL		FC		Y	0.8	F	N	3	0.27	
RFI-RD--9616	University of Utah	Development of Technology to Enable Thorium Fueled Molten Salt Reactors	University	RX	FDF		2	3	NSY	NFL	FC		N	8	F	Y	10	0.80	
RFI-RD--9619	Brookhaven National Laboratory	Synergistic, Length Scale-Bridging Characterization Schemes in Assessing Irradiation Damage Effects and Evolution of Advanced Reactor Materials under Extremes. The conceptualization, optimization and conduct of unique but relevant experiments at different scales.	National Laboratory	RX	IGBF	MatEx	2		STM	RSK	NEAMS		Y	2.4	F	Y	5	0.48	
RFI-RD--9620	North Carolina State University	Integrated Research Program on multiscale experimentation, modeling and validation of multicomponent flows. By combining novel high fidelity experimental, computational and data analysis methods.	University	THF	HPC		2	1	NSY	RSK	RC		Y	3.75	F	Y	3	1.25	
RFI-RD--9621	Purdue University	Development for Field Implementation of a Transformational Gamma--Beta Blind Neutron--Alpha--Fission Spectrometer for Cross--Cutting Needs: -- The overall objective of this project is to develop prototype advanced sensors and instrumentation to monitor in near real-time for fission, fission fragments, neutrons and alpha spectra based on the TMFD technology	University	AIN			3	4	SST	NSY	NEET-CTD		N	1.5	F	Y	3	0.50	
RFI-RD--9622-1	GE Hitachi	TWO PHASE FLOW COMPUTATIONAL FLUID DYNAMICS METHODS	Industry	HPC	THF		1	2	NSY	RSK	RC		Y	5-20	I	Y	3.5		
RFI-RD--9622-2	GE Hitachi	ADVANCED MATERIAL FOR APPLICATION IN PYROTECHNIC-OPERATED VALVES (VALVE BODIES - CERAMET)	Industry	MatEx	RCL		2	1	STM		NEET-CTD		N	1.7-3.1	I	N	1.25		
RFI-RD--9622-3	GE Hitachi	AN INTEGRATED GENERATION RISK ASSESSMENT AND PROBABILISTIC RISK ASSESSMENT MODEL FOR GENERATION III+ PLANTS	Industry	HPC			2	1	RSK	NSY	NEET-CTD		N	4-6	I	Y	3		
RFI-RD--9622-4	GE Hitachi	EVALUATION AND OPTIMIZATION OF ADDITIVELY MANUFACTURED NICKEL BASED ALLOYS FOR NUCLEAR APPLICATIONS (600 & 718)	Industry	AM	IGBF	MatEx	1	2	AM	STM	NEET-CTD		N	0.8	I	Y	2	0.40	
RFI-RD--9622-5	GE Hitachi	ADVANCED HIGH STRENGTH NICKEL ALLOYS WITH IMPROVED RESISTANCE TO ENVIRONMENTAL DEGRADATION (725 & Hicorov-11)	Industry	MatEx	IGBF	RCL	2	1	STM		NEET-CTD		N	1	I	Y	2	0.50	
RFI-RD--9622-6	GE Hitachi	EVALUATION AND OPTIMIZATION OF HIGH CHROMIUM STRUCTURAL ALLOYS AND WELD METALS FOR BWR APPLICATIONS (310, 800, 690)	Industry	MatEx	RCL		2	1	STM		NEET-CTD		N	1	I	Y	2	0.50	
RFI-RD--9622-7	GE Hitachi	CONTINUOUS ONLINE ELECTROCATALYTIC INJECTION TECHNOLOGY MECHANISM AND DEVELOPMENT	Industry	RCL			1	2	STM	RSK	NEET-CTD	RC	N	1	I	Y	2	0.50	
RFI-RD--9622-8	GE Hitachi	ALTERNATIVE NOBLE METAL DELIVERY METHOD FOR BWR APPLICATIONS	Industry	RCL			1		STM	RSK	NEET-CTD	RC	N	1	I	Y	2	0.50	
RFI-RD--9622-9	GE Hitachi	ENVIRONMENTAL DEGRADATION RESISTANCE OF STAINLESS STEEL CANISTERS AND MECHANICAL & CHEMICAL BEHAVIOR OF USED FUEL UNDER DRY CASK LONG TERM STORAGE	Industry	CSK	RCL		3		UNF	NFL	FC		N	2	I	Y	2	1.00	
RFI-RD--9622-10A	GE Hitachi	SODIUM-REACTOR ANALYSIS TOOLS/MODELING FOR LICENSING – PRIORITY 1 (modern code suite for LMR: TRANSIENT ANALYSIS)	Industry	RX			2		NFL	RSK	RC	NEET-CTD	N	8-12	F	Y	2-5	1.00	
RFI-RD--9622-10B	GE Hitachi	SODIUM-REACTOR ANALYSIS TOOLS/MODELING FOR LICENSING – PRIORITY 1 (modern code suite for LMR: SS TH)	Industry	THF			2		NSY	RSK	RC	NEET-CTD	N	1-5	F	Y	2-5	1.00	
RFI-RD--9622-10C	GE Hitachi	SODIUM-REACTOR ANALYSIS TOOLS/MODELING FOR LICENSING – PRIORITY 1 (modern code suite for LMR: 3D FLUX SOLUTION)	Industry	HPC			2		NSY	RSK	RC	NEET-CTD	N	2-6	F	Y	2-5	1.00	

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RFI-RD–9622-10D	GE Hitachi	SODIUM-REACTOR ANALYSIS TOOLS/MODELING FOR LICENSING – PRIORITY 1 (modern code suite for LMR: CROSS-SECTION GENERATION)	Industry	HPC			2		NSY	RSK	RC	NEET-CTD	N	1-5	F	Y	2-5	1.00	
RFI-RD–9622-10E	GE Hitachi	SODIUM-REACTOR ANALYSIS TOOLS/MODELING FOR LICENSING – PRIORITY 1 (modern code suite for LMR: DYNAMIC COEFFICIENT GENERATION)	Industry	HPC			2		NSY	RSK	RC	NEET-CTD	N	1-5	F	Y	2-5	1.00	
RFI-RD–9622-10F	GE Hitachi	SODIUM-REACTOR ANALYSIS TOOLS/MODELING FOR LICENSING – PRIORITY 1 (modern code suite for LMR)	Industry	HPC			2		NFL	RSK	RC	NEET-CTD	N	2-7	F	Y	2-5	1.00	
RFI-RD–9622-11	GE Hitachi	SODIUM REACTOR CIVIL/STRUCTURAL ANALYSIS – PRIORITY 2 (ITEM A) (SEISMIC + AIRCRAFT)	Industry	MatEx	CON		2		RSK	CON	RC	NEET-CTD	N	9-18	I	Y	3-5	1.00	
RFI-RD–9622-12	GE Hitachi	SODIUM REACTOR DIGITAL INSTRUMENTATION AND CONTROL – PRIORITY 2 (ITEM B)	Industry	AIN			2		INC	NSY	RC	NEET-CTD	N	7-14	I	Y	3-5	1.00	
RFI-RD–9622-13A	GE Hitachi	SODIUM REACTOR MATERIALS VALIDATION – PRIORITY 2 (ITEM C: FUEL AND CLADDING)	Industry	MatEx			2		NFL		FC	RC	N	5-12	F	Y	3		
RFI-RD–9622-13B	GE Hitachi	SODIUM REACTOR MATERIALS VALIDATION – PRIORITY 2 (ITEM C: HEAT TRANSFER SYSTEMS)	Industry	THF	RCL		2		NSY		RC	NEET-CTD	N	6-16	F	Y	3		
RFI-RD–9622-13C	GE Hitachi	SODIUM REACTOR MATERIALS VALIDATION – PRIORITY 2 (ITEM C: STRUCTURAL MATERIALS)	Industry	MatEx			2		STM		RC	NEET-CTD	N	5-10	F	Y	3		
RFI-RD–9625	University at Buffalo	Deploying Stainless Steel in Modular SC Construction for Nuclear Energy Facilities	University	MatEx			2		STM		NEET-CTD		N	0.8	I	Y	NE		
RFI-RD–9629	Rensselaer Polytechnic Institute	Atomic-scale to Meso-scale Simulation Studies to Moose Simulation Environment of Thermal Ageing and Irradiation Effects in Fe-Cr Alloys and Other Nuclear Materials	University	MatEx	HPC		1	2	STM		NEET-CTD		Y	2-3	I	Y	3		
RFI-RD–9632	University of Florida	SiC Triplex Clad with doped pellets and a Liquid Metal Bond for greatly improved Accident Tolerant Fuel	University	FDF	THF		3		NFL		FC		N	NE	I	NE	NE		
RFI-RD–9634	University of Houston	3D Printed Concrete for Modular Construction	University	AM	MatEx	CON	2		CON	AM	NEET-CTD		N	1.6	I	Y	3	0.53	
RFI-RD–9643-1	University of Michigan	Improve both fuel cycle economics and resource utilization through the investigation of high power density fuels and hard neutron spectra. (Fully Passive Resource Renewable/TRU Burning LWR)	University	HPC			3	2	NSY	NFL	FC	RC	N	0.8	F	Y	3	0.27	
RFI-RD–9643-2	University of Michigan	Improve both fuel cycle economics and resource utilization through the investigation of high power density fuels and hard neutron spectra. (High Density Fuels to Improve Fuel Cycle Performance)	University	HPC			3	2	NFL		FC	RC	N	0.8	F	Y	3	0.27	
RFI-RD–9643-3	University of Michigan	Improve both fuel cycle economics and resource utilization through the investigation of high power density fuels and hard neutron spectra. (Effect of fast flux and fluence on Zircaloy and advanced claddings)	University	RX	IGBF	MatEx	3		NSY		RC	NEET-CTD	Y	0.8	F	N	3	0.27	
RFI-RD–9643-4	University of Michigan	Improve both fuel cycle economics and resource utilization through the investigation of high power density fuels and hard neutron spectra. (Void fraction prediction in small hydraulic diameters)	University	THF	HPC		3		NSY		RC	NEET-CTD	Y	0.8	F	N	3	0.27	
RFI-RD–9643-5	University of Michigan	Improve both fuel cycle economics and resource utilization through the investigation of high power density fuels and hard neutron spectra. (CHF of axially non-uniform heated rod at high qualities)	University	THF	HPC		2		NSY	RSK	RC		Y	0.8	F	N	3	0.27	
RFI-RD–9643-6	University of Michigan	Improve both fuel cycle economics and resource utilization through the investigation of high power density fuels and hard neutron spectra. (MOX fuel thermo-physical properties at high burnup)	University	RX	AIN	HPC	2		NFL		RC		Y	0.8	F	N	3	0.27	
RFI-RD–9643-7	University of Michigan	Improve both fuel cycle economics and resource utilization through the investigation of high power density fuels and hard neutron spectra. (Reactor Physics in intermediate Spectrum)	University	RX			2	3	NFL	RSK	RC	FC	Y	0.8	F	N	3	0.27	
RFI-RD–9646	University of Michigan	Analysis of Tritium Production/Migration/Release in Enhanced Accident Tolerant Fuel (EATF) Fuel Systems	University	HPC			3		NFL	RSK	FC		Y	0.8	I	Y	3	0.27	
RFI-RD–9647	Massachusetts Institute of Technology	Uncertainty quantification of nuclear data in high fidelity reactor simulations	University	HPC			3		SYS		NEET-CTD		Y	0.8	I	Y	3	0.27	
RFI-RD–9648	Oak Ridge National Laboratory	Techniques for Data Communication through Thick Concrete Structures without Physical Penetrations	National Laboratory	AIN	INC		1	2	INC	SST	NEET-CTD		N	2	I	Y	3	0.67	

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RFI-RD–9656	Brookhaven National Laboratory	Develop **cyber attack** scenarios for a nuclear power plant, determine their impacts on the plant, and include them in the PRA of the plant to determine the risk significance of cyber attacks.	National Laboratory	INC	AIN		1	2	INC	SYS	NEET-CTD		N	NE	I	Y	NE		
RFI-RD–9658A	Los Alamos National Laboratory	Embed Safeguards and Security By Design (SSBD) concepts in the design of automated fuel handling to more fully integrate with safety (so called 3S approach). (Jim Sprinkle)	National Laboratory				3		NFL	RSK	NEET-CTD		N	NE	I	NE	NE		
RFI-RD–9658B	Los Alamos National Laboratory	Accident Tolerant Fuel (ATF) qualification and licensing. (Cetin Unal)	National Laboratory	HPC			3		NFL	RSK	FC		Y	NE	I	NE	NE		
RFI-RD–9659	Brookhaven National Laboratory	Specify an approach for conducting a hazard analysis to satisfy the requirements for safety-critical digital systems	National Laboratory	INC			1	2	INC	RSK	NEET-CTD		N	1	I	Y	3	0.33	
RFI-RD–9660	Brookhaven National Laboratory	Development of a Statistical Testing Approach for Quantifying Software Reliability of a FPGA Based Digital System	National Laboratory	INC	AIN		1	2	INC	RSK	NEET-CTD		N	NE	I	Y	NE		
RFI-RD–9661	Brookhaven National Laboratory	Development of V&V Guidelines for a FPGA Based Digital System	National Laboratory	INC	AIN		1	2	INC	RSK	NEET-CTD		N	0.8	I	Y	2.5	0.32	
RFI-RD–9674	Virginia Polytechnic Institute and State University	A Heat Pipe Assisted Thermoelectric Generator for Local Powering In Nuclear Power Plant	University	THF			1	2	INC		NEET-CTD		N	NE	I	N	NE		
RFI-RD–9676-1	University of Notre Dame	Radiation chemical effects in fuel cycle research and development (fuel separation systems, solvents and ligands)	University	RCL			3		UNF		FC		N	1-3	I	Y	3		
RFI-RD–9676-2	University of Notre Dame	Radiation chemical effects in fuel cycle research and development (Short and long-term container materials)	University	RCL	CSK		3		UNF		FC		N	0.6-2	I	Y	3		
RFI-RD–9678	Montana Tech of The University of Montana	Small Mobile Modular Rotary Nuclear Reactor (SMMRNR) concept	University	THF	HPC		2		NSY		RC		N	0.1	F	N	1	0.10	
RFI-RD–9680	Louisiana State University	Broaden NE's competitive R&D Scope of Work to include **health physics** in a substantial way	University				4		RSK		NEET-CTD		N	1.5	I	Y	3	0.50	
RFI-RD–9682	Massachusetts Institute of Technology	Long Term Preservation of Nuclear Assets: Analysis Tools for Decision Making	University				1		SYS		RC		N	NE	I	N	NE		
RFI-RD–9683	Los Alamos National Laboratory	Phase transition and crystallization from simple (model) to multiphase glass ceramic (evaluate multi-phase borosilicate-based glass ceramic (GC) as potential high-level waste (HLW) forms)	National Laboratory	FDF	RCL	MatEx	3		WST		FC		N	0.75	I	Y	3	0.25	
RFI-RD–9685	University of Kentucky	Imaging of Reactor Fuels	University	FDF			3		UNF	SST	FC	NEET-CTD	N	0.6	I	N	4	0.15	
RFI-RD–9686	Idaho National Laboratory	Validation of Multiphysics/Multiscale Simulations - Experimental and analytical techniques for the characterization of tightly coupled phenomena to quantify and justify confidence in high fidelity simulations **(IRP)**	National Laboratory	RX			1	2	STM		NEAMS	RC	Y	5-7	I	Y	3-4	1.00	IRP
RFI-RD–9688	Idaho National Laboratory	SUPPORTING OPERATOR PERFORMANCE IN HIGHLY AUTOMATED NUCLEAR POWER PLANTS (demonstrate ways to enable optimal situation awareness for human operators in complex safety critical systems)	National Laboratory	INC	AIN		1	2	INC	RSK	NEET-CTD		N	1.25	I	Y	3	0.42	
RFI-RD–9689	Clemson University	Xenon Diffusivity in UO2: Numerical Model Development and Experimental Validation for MARMOT Simulation	University	MatEx			3		NFL		NEAMS	FC	Y	0.8	I	Y	3	0.27	
RFI-RD–9690-1	AREVA Federal Services	Development of a Process for Extracting Useful Isotopes from Recycling/Reprocessing Waste Streams: Separations, Waste Minimization/Optimization, and Tradeoff Studies	Industry	FDF			3		UNF	WST	FC		N	1	F	N	3	0.33	
RFI-RD–9690-2	AREVA Federal Services	Big Data Analysis - an Assessment of Current Capabilities, Resources, and Opportunities for Plant Performance Optimization	Industry	HPC			1	3	NSY	RSK	NEET-CTD		N	1	I	N	3	0.33	
RFI-RD–9690-3	AREVA Federal Services	Effect on Fuel for Load Following in U.S. Power Reactors	Industry	INC			1		NSY	RSK	RC	FC	N	1	F	N	3	0.33	
RFI-RD–9690-4	AREVA Federal Services	Integration of Nuclear Energy into Hybrid Energy Systems	Industry	THF	INC		2		NSY	PRO	RC		N	1	F	N	3	0.33	

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RFI-RD–9690-5	AREVA Federal Services	Integration of Cybersecurity in Main Control Room Operations and Technologies	Industry	INC			1	2	INC	RSK	RC		N	1	I	N	3	0.33	
RFI-RD–9690-6	AREVA Federal Services	Long Term Fuel Storage Concept Designs for for Storage, Transport and Disposal, including Deep Borehole	Industry	FDF			3		UNF	WST	FC		N	1	F	N	3	0.33	
RFI-RD–9690-7	AREVA Federal Services	Modeling and Optimization of Dry Cask Transport and Storage in the U.S.	Industry				3		UNF		FC		N	1	I	N	3	0.33	
RFI-RD–9690-8	AREVA Federal Services	Performance Improvement Technologies for Outage Control Centers	Industry				1		SYS		RC		N	1	I	N	3	0.33	
RFI-RD–9690-9	AREVA Federal Services	Assessment of New Technologies for Hydrogen Release from Waste Areas	Industry	RCL			3		UNF	WST	FC		N	1	I	N	3	0.33	
RFI-RD–9690-10	AREVA Federal Services	Development of a Method for Establishing Burnup Credit Uncertainty	Industry	FDF			3		NFL	RSK	FC		N	1	I	N	3	0.33	
RFI-RD–9690-11	AREVA Federal Services	Spectrum Investigation for Gas-Cooled and Molten Salt-Cooled Reactors	Industry	RX			2	3	NSY	NFL	RC		Y	1	F	N	3	0.33	
RFI-RD–9690-12	AREVA Federal Services	Fuel Forms for Gas-Cooled and Molten Salt-Cooled Reactors	Industry	RX			3	2	NFL	NSY	FC	RC	N	1	F	N	3	0.33	
RFI-RD–9690-13	AREVA Federal Services	Canister MSR for Gas-Cooled and Molten Salt-Cooled Reactors	Industry	RX	FDF		3	2	NFL	WST	FC		N	1	F	N	3	0.33	
RFI-RD–9690-14	AREVA Federal Services	Supercritical Fluid Power Conversion Cycles	Industry	THF			2		PRO	NSY	RC		N	1	F	N	3	0.33	
RFI-RD–9690-IRP-1	AREVA Federal Services	Modeling the Transport of Radionuclides in Arid Environments **(IRP)**	Industry	RCL			3		UNF		FC		N	3	F	Y	3	1.00	IRP
RFI-RD–9690-IRP-2	AREVA Federal Services	Development of a Process For Tritium Separation and Capture from Aqueous Streams Containing Dilute Quantities of Tritium **(IRP)**	Industry	RCL			3		UNF	WST	FC		N	3	I	Y	3	1.00	IRP
RFI-RD–9690-IRP-3	AREVA Federal Services	Development of an Open-Source Virtual Reactor Road Map for Use in Research and Education **(IRP)**	Industry	RX			2	1	STM	NFL	RC		Y	3	F	Y	3	1.00	IRP
RFI-RD–9691-1	Westinghouse Electric Company LLC	Potential Application of ARG-US (RFID-RAMM) Technology (multi-sensor battery-powered RFID tags for SNM & remote-monitoring for nuclear facilities)	Industry	AIN	FDF		3		SST	INC	NEET-CTD		N	1.75-2.25	I	Y	3		
RFI-RD–9691-2	Westinghouse Electric Company LLC	Potential Application of Bayesian Analysis to Human Reliability Analysis	Industry	INC			1		RSK	INC	NEET-CTD		N	0.8-1	I	Y	1.5-2		
RFI-RD–9691-3	Westinghouse Electric Company LLC	Evaluation and Experimentatal Investigation of Micro-channel Heat Exchangers for Integral LWR Applications	Industry	THF			2		NSY		RC		N	4	F	Y	4	1.00	
RFI-RD–9691-4	Westinghouse Electric Company LLC	Support systems for fusion power plants	Industry				2		NSY		RC		N	2.1	F	N	3	0.70	
RFI-RD–9691-5	Westinghouse Electric Company LLC	Use of in-core instrumentation to remove core operation uncertainties	Industry	INC	AIN		1	2	INC	SYS	RC		N	7.2	I	Y	3	2.40	
RFI-RD–9691-6	Westinghouse Electric Company LLC	Assessment and Development of Radiation-tolerant Wireless Sensor Technology	Industry	INC	AIN		1	2	INC	RSK	RC		N	0.75-1	I	Y	1.5-2		
RFI-RD–9692	Louisiana State University	Deep Borehole Disposal	University	FDF			3		UNF		FC		N	0.76	F	Y	1	0.76	
RFI-RD–9693	Ceramic Tubular Products	Recycle of North American Used Nuclear Fuel - A Feasibility Study of a Bilateral US and Canadian Program that Converts a Portion of Each Countries Used Nuclear Fuel into Reusable Nuclear Fuel and Stable Waste Forms for Permanent Disposal	Industry	FDF			3		NFL	UNF	FC		N	2	F	Y	2	1.00	
RFI-RD–9694	Ceramic Tubular Products	Silicon Carbide Clad Binary Fuel for Accident Tolerant Behavior in Light Water Reactors, Combining the Accident Tolerant Features of TRIPLEX SiC Cladding, With the Superior Behavior of Spark Plasma Sintered (SPS) Annular UO2 Fuel having a Central Core of Thorium Dioxide	Industry	FDF	RX		3		NFL		FC		N	3.3	F	Y	4	0.83	
RFI-RD–9696	PT INDUSTRI NUKLIR INDONESIA (INUKI)	Innovative design for providing a modular molten salt reactor with enhanced fuel burnup characteristics and a more sustainable fuel cycle with special enhancements in the areas of cost, safety and reliability. (Prototype reactor design, component testing, fuel characterization and testing, site selection, design finalization)	Industry	THF	INC	FDF	2		NSY	NFL	RC	FC	N	25	F	Y	7	3.57	
RFI-RD–9697	University of Pittsburgh	Plugging Methods and Materials for Deep Borehole Disposal of High-Level Nuclear Waste	University				3		UNF	WST	FC		N	0.8	F	Y	3	0.27	

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RFI-RD--9699	Brookhaven National Laboratory	Alternative Carrier Fluids for Homogeneous Reactor Systems	National Laboratory	FDF			3		NFL	WST	FC		N	NE	F	Y	NE	#VALUE!	
RFI-RD--9700	Brookhaven National Laboratory	Understanding and Predicting Performance of Potential Nuclear Hybrid Energy Systems	National Laboratory	THF			2		NSY	PRO	RC		N	1	F	Y	3	0.33	
RFI-RD--9701-1	NuScale Power	Innovative fuel pin/assembly designs to enhance natural circulation flow	Industry	THF			3		NSY	RSK	FC		N	NE	F	Y	NE		
RFI-RD--9701-2	NuScale Power	Development of interface technologies to facilitate coupling of SMRs to hybrid energy systems	Industry	THF			2		PRO	NSY	RC		N	NE	F	Y	NE		
RFI-RD--9701-3	NuScale Power	Small, mobile nuclear energy systems	Industry				2		NSY	PCS	RC		N	NE	F	Y	NE		
RFI-RD--9701-4	NuScale Power	Benchmarked modeling and simulation of the coupled neutronics and thermal-hydraulics under natural circulation	Industry	THF			2		NSY	RSK	NEAMS		Y	NE	F	Y	NE		
RFI-RD--9701-5	NuScale Power	Development of multi-objective, multi-parameter optimization methods and user tools	Industry				2		NSY	SYS	NEAMS		Y	NE	F	Y	NE		
RFI-RD--9701-6	NuScale Power	Advancing integrated dynamic PRA for LWRs and next generation advanced nuclear systems	Industry				2		RSK		NEAMS		Y	NE	F	Y	NE		
RFI-RD--9701-7	NuScale Power	Demonstration of defined hard and soft wireless technology solutions for LWRs and advanced reactor systems	Industry	AIN	INC		1	2	INC		NEET-CTD		N	NE	I	Y	NE		
RFI-RD--9701-8	NuScale Power	Extension of dynamic modeling and simulation to nuclear supply chain modeling	Industry				1	2	SYS		NEET-CTD		N	NE	I	Y	NE		
RFI-RD--9701-9	NuScale Power	Advanced factory-based manufacturing technologies	Industry	AM			2		AM		NEET-CTD		N	NE	F	Y	NE		
RFI-RD--9701-10	NuScale Power	Novel approaches to seismic isolation	Industry	MatEx	CON		2		RSK	CON	NEET-CTD		N	NE	F	Y	NE		
RFI-RD--9701-11	NuScale Power	New technologies supporting SMR fleet management	Industry	AIN	AM		2		AM		NEET-CTD		N	NE	F	Y	NE		
RFI-RD--9703-1	Pacific Northwest National Laboratory	Integrated Research on Fuel Cladding Failure in Simulated LWR Coolant Loop T. S. Byun, M. B. Toloczko	National Laboratory	THF			3		NFL		FC		N	7	I	Y	10	0.70	
RFI-RD--9703-2	Pacific Northwest National Laboratory	Digging Deep and Overcoming Challenges with Nuclear Waste Disposal - M. Asmussen, J. Neeway, G. Last and N. Qafoku	National Laboratory	THF	RCL		3		UNF	WST	FC		N	1.5	F	Y	3	0.50	
RFI-RD--9703-3	Pacific Northwest National Laboratory	Integrated Characterization and Modeling of Reactor Materials Degradation - P. Ramuhalli and R. Devanathan	National Laboratory	MatEx			1	2	STM		RC		N	3	I	Y	3	1.00	
RFI-RD--9703-4	Pacific Northwest National Laboratory	Modeling and non-destructive evaluation of concrete degradation for reactor life extension - R. Devanathan	National Laboratory	MatEx	CON		1		CON	RSK	RC		Y	1.5	I	Y	3	0.50	
RFI-RD--9703-5	Pacific Northwest National Laboratory	Radiation-tolerant sensors and telerobotics for harsh environments - P. Ramuhalli and W. Glass	National Laboratory	AIN	INC		2		INC		RC		N	4.5	F	Y	3	1.50	
RFI-RD--9703-6	Pacific Northwest National Laboratory	Signature Discovery and Analysis from Non-Destructive Evaluation (NDE) Data - W. Glass	National Laboratory	AIN	INC		1	2	INC		RC		N	3	F	Y	3	1.00	
RFI-RD--9703-7	Pacific Northwest National Laboratory	Multiphysics Modeling of Spent Nuclear Fuel Canister Degradation - P. J. Jensen, S. B. Ross and R. Devanathan	National Laboratory	CSK			3		UNF		NEAMS		Y	3	I	Y	3	1.00	
RFI-RD--9703-8	Pacific Northwest National Laboratory	Mesoscale Simulation of Nuclear Fuel Cladding Behavior with Atomistic Input - R. Devanathan	National Laboratory	MatEx			3		NFL		NEAMS		Y	2.4	I	Y	3	0.80	
RFI-RD--9703-9	Pacific Northwest National Laboratory	Development and Characterization of Nanostructured Ferritic-Austenitic Duplex Alloy for Reactor Core Applications - T. S. Byun and R. Devanathan	National Laboratory	AM	MatEx		2		STM		NEET-CTD		N	1.5	F	Y	3	0.50	

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RFI-RD–9703-10	Pacific Northwest National Laboratory	Innovative Tools for Nuclear Power Operations and Risk Management - P. Ramuhalli	National Laboratory				1	2	RSK	SYS	NEET-CTD		N	2.1	F	Y	3	0.70	
RFI-RD–9703-11	Pacific Northwest National Laboratory	The Use of Neutron Irradiation Preconditioning Followed by Self-Ion Irradiation to Assess High Dose Performance of Fast Reactor Clad and Duct Materials M.B. Toloczko	National Laboratory	IGBF	MatEx	RX	3	2	STM	RSK	NEET-CTD		N	1.5	I	Y	3	0.50	
RFI-RD–9703-12	Pacific Northwest National Laboratory	Development of State-of-the-Art Methods for Determining SCC Crack Susceptibility of Spent Nuclear Fuel Dry Storage Containers - M.B. Toloczko	National Laboratory	MatEx	CSK		1	3	UNF		NEET-CTD		N	1.05	F	N	3	0.35	
RFI-RD–9703-13	Pacific Northwest National Laboratory	Micro-Magnetic Materials Characterization and Modeling for Advanced Diagnostic NDE of Irradiated Metals - P. Ramuhalli, B. R. Johnson, J. McCloy	National Laboratory	MatEx	AIN		1	2	STM		NEET-CTD		N	2	F	Y	3	0.67	
RFI-RD–9704	Terrestrial Energy USA Ltd.	First-of-a-Kind Heat Exchanger for Advanced Small Modular Reactors Cooled by Molten Salt	Industry	THF			2		NSY	PRO	RC	NEET-CTD	N	3.75	F	Y	2	1.88	
RFI-RD–9705	University of Tennessee at Knoxville	Enhanced Solvent Extraction for Nuclear Fuel Recycle Via Encapsulation of Ligands into or on Nano Particles	University	RCL	THF		3		UNF	WST	FC		N	0.375	F	N	3	0.13	
RFI-RD–9707-1	Argonne National Laboratory	Additive Manufacturing for Nuclear Energy Applications (Manufacturing advanced fuel materials)	National Laboratory	AM	MatEx		3		AM	NFL	NEET-CTD	FC	N	1.6375	I	Y	3	0.55	
RFI-RD–9707-2	Argonne National Laboratory	Additive Manufacturing for Nuclear Energy Applications (Manufacturing Advanced Nuclear Structural Materials)	National Laboratory	AM	MatEx		2		AM	STM	NEET-CTD	RC	N	1.6375	I	Y	3	0.55	
RFI-RD–9707-3	Argonne National Laboratory	Additive Manufacturing for Nuclear Energy Applications (Manufacturing Zircaloy based Advanced Cladding Materials)	National Laboratory	AM	MatEx		3		AM	NFL	NEET-CTD	FC	N	1.6375	I	Y	3	0.55	
RFI-RD–9707-4	Argonne National Laboratory	Additive Manufacturing for Nuclear Energy Applications (3D Printing of Advanced Heat Exchanger for Nuclear Systems)	National Laboratory	AM	THF		2		AM	PRO	NEET-CTD	RC	N	1.6375	F	Y	3	0.55	
RFI-RD–9707-5	Argonne National Laboratory	Additive Manufacturing for Nuclear Energy Applications (Manufacturing for the Back End of the Fuel Cycle)	National Laboratory	AM	RCL		3		AM	WST	NEET-CTD	FC	N	1.6375	F	Y	3	0.55	
RFI-RD–9708	Argonne National Laboratory	Application of Penetrating Heavy Ions to Nuclear Materials Development	National Laboratory	IGBF	MatEx		3	2	NFL	STM	NEET-CTD		N	1.2	I	Y	3	0.40	
RFI-RD–9709	Argonne National Laboratory	Wireless Power and Data Transfer for Post-Accident Standoff Monitoring of a Nuclear Power Plant (microwave technology)	National Laboratory	AIN	INC		1		INC		NEET-CTD		N	1.5	I	Y	3	0.50	
RFI-RD–9710	Argonne National Laboratory	Harvesting Power from Spent Nuclear Fuel for Enhanced Safety and Economics	National Laboratory	CSK	THF		3		PCS	UNF	NEET-CTD		N	1	I	Y	2	0.50	
RFI-RD–9711	Argonne National Laboratory	Virtual Simulation of Mechanical Operations in Nuclear Applications	National Laboratory	INC	AIN		4		INC	AM	NEET-CTD		N	1.5	I	Y	3	0.50	
RFI-RD–9712	Argonne National Laboratory	Wearable Mobile Display for Nuclear Power Plant Workers	National Laboratory	INC	AIN		4		INC		NEET-CTD		N	1.5	I	Y	3	0.50	
RFI-RD–9713	Argonne National Laboratory	Investigation of the Effect of Suspended Nanoparticles on Chemical Reactivity of Liquid Sodium	National Laboratory	RCL			3		PRO	RSK	FC		N	2	F	Y	3	0.67	
RFI-RD–9714	Argonne National Laboratory	The Role of Nuclear Power and Energy Storage in Future Carbon-Constrained Power Systems	National Laboratory				2	1	SYS		NEET-CTD	RC	N	1	I	Y	2	0.50	
RFI-RD–9715	Argonne National Laboratory	Radial Core Expansion as a Fast Reactor Reactivity Feedback	National Laboratory	THF			2		NFL	RSK	RC	NEAMS	Y	1	F	Y	3	0.33	
RFI-RD–9716-1	Argonne National Laboratory	Development of Sodium-Cooled Fast Reactors and Lead-Cooled Fast Reactors (Evolution of LFR Conceptual Designs)	National Laboratory	THF			2		NSY		RC		N	1.5	F	Y	3	0.50	
RFI-RD–9716-2	Argonne National Laboratory	Development of Sodium-Cooled Fast Reactors and Lead-Cooled Fast Reactors (Lead Coolant Corrosion Control and Coolant Chemistry Control for a Pool-Type LFR)	National Laboratory	RCL			2		NFL		RC		N	1.5	F	Y	3	0.50	

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RFI-RD--9716-3	Argonne National Laboratory	Development of Sodium-Cooled Fast Reactors and Lead-Cooled Fast Reactors (Testing of HLMC Heat Exchangers)	National Laboratory	THF			2		PRO		RC		N	1.5	F	Y	3	0.50	
RFI-RD--9716-4	Argonne National Laboratory	Development of Sodium-Cooled Fast Reactors and Lead-Cooled Fast Reactors (Development and Testing of HLMC Mechanical Pumps)	National Laboratory	THF			2		PRO		RC		N	1.5	F	Y	3	0.50	
RFI-RD--9716-5	Argonne National Laboratory	Development of Sodium-Cooled Fast Reactors and Lead-Cooled Fast Reactors (Removal of Polonium-210 from Heavy Liquid Metal Coolant)	National Laboratory	RCL			2		REC	WST	RC		N	1.5	F	Y	3	0.50	
RFI-RD--9716-6	Argonne National Laboratory	Development of Sodium-Cooled Fast Reactors and Lead-Cooled Fast Reactors (Startup of a Natural Circulation LFR)	National Laboratory	THF			2		NSY		RC		N	1.5	F	Y	3	0.50	
RFI-RD--9716-7	Argonne National Laboratory	Development of Sodium-Cooled Fast Reactors and Lead-Cooled Fast Reactors (Freezing and Melting Behavior of HLMC)	National Laboratory	THF			2		NSY		RC		N	1.5	F	Y	3	0.50	
RFI-RD--9716-8	Argonne National Laboratory	Development of Sodium-Cooled Fast Reactors and Lead-Cooled Fast Reactors (Qualification of Particulate-Based Metallic Fuel)	National Laboratory	RX	MatEx		2		NFL		RC		N	1.5	F	Y	3	0.50	
RFI-RD--9717	Argonne National Laboratory	Acoustic Surveillance Methods and Instrumentation for Sodium-cooled Advanced Fast Reactors	National Laboratory	THF	AIN	INC	2		NSY	RSK	RC		N	2.8	F	Y	4	0.70	
RFI-RD--9718	Argonne National Laboratory	Leak Detection Systems for Steam Generators of Sodium-cooled Fast Reactors (chemical and acoustic)	National Laboratory	THF	AIN	INC	2		NSY	RSK	RC		N	3	F	Y	5	0.60	
RFI-RD--9719	Argonne National Laboratory	Behavior of Nuclear Materials under Extreme Conditions	National Laboratory	MatEx	IGBF		3		NFL		FC		N	2	I	Y	5	0.40	
RFI-RD--9725	North Carolina State University	Assessment of Seismically Induced Leakage Fragilities due to Aging in Piping Systems	University	MatEx	CON		1		CON		RC		Y	0.75	I	Y	3	0.25	
RFI-RD--9726	North Carolina State University	Vulnerability beyond Design Bases for Multiple Hazards	University				1		RSK		NEET-CTD		N	0.45	I	Y	3	0.15	
RFI-RD--9727	North Carolina State University	Performance Limit States of Flood Defense Structures Protecting Nuclear Power Plants in Coastal Regions	University				1		RSK		NEET-CTD		Y	0.9	F	Y	3	0.30	
RFI-RD--9728	Rensselaer Polytechnic Institute	Advanced Fabrication of UO2-UB2 Composite Fuels by Field Assisted Sintering Technology	University	FDF	AM	MatEx	3		NFL	AM	FC		N	0.8	I	Y	3	0.27	
RFI-RD--9729	United States Advanced Ceramics Association (USACA)	SiC ceramic fuel cladding as Accident Tolerant Fuel (ATF) cladding, program changes	Industry	RX	RCL	MatEx	3		NFL		FC		N	NE	I	Y	6		
RFI-RD--9730	Rensselaer Polytechnic Institute	Fabrication and Microstructure Control of U3Si2 Fuels: Experimental Validation of MARMOT Models and Implementation into the BISON Fuel Performance Code	University	FDF	MatEx		3	4	NFL		NEAMS	FC	Y	0.8	I	Y	3	0.27	
RFI-RD--9731	Rensselaer Polytechnic Institute	Xe Migration in Nuclear Fuel Systems: Characterization by EMPA, RBS, SIMS and SAXS and Validation of Fission Gas Model of NEAMS Tool MARMOT	University	FDF	MatEx		3	4	NFL		NEAMS	FC	Y	0.8	I	Y	3	0.27	
RFI-RD--9732	North Carolina State University	Coupling Computation with Experiment for Characterizing Reactor Coolant Chemistry	University	RCL	THF		1		SYS		FC	NEAMS	Y	0.6-0.8	I	N	4		
RFI-RD--9735	Louisiana State University	Simulation of thermal conductivity of oxide fuel at reactor conditions from first principles – Mechanism, effect of impurity, defect, and microstructure	University	FDF	MatEx		3		NFL		NEAMS		Y	0.7-0.8	I	Y	3		
RFI-RD--9737	Idaho National Laboratory	NEUP Research Project on Incremental Advanced in Complex Code/Model Validation	National Laboratory	AIN	RX	MatEx	4		STM	NFL	NEAMS		Y	0.5-0.8	I	Y	3		
RFI-RD--9738	University of South Carolina	Uncertainty Quantification (UQ) driven Failure Prediction of SiC/SiC CMC Nuclear Claddings using Nondestructive Tomography	University	MatEx			3		NFL	RSK	NEET-CTD		N	0.8	I	Y	3	0.27	
RFI-RD--9740	North Carolina State University	Development & Validation of Comprehensive Error Estimators for Neutron Transport Deterministic Methods & Codes	University				4		SYS		NEAMS		Y	NE	I	NE	NE		
RFI-RD--9742	University of Tennessee at Knoxville	Innovative Architectures for Safety—Related Nuclear Power Plant Instrumentation and Control Systems	University	INC	AIN		1	2	INC	RSK	NEET-CTD	RC	N	1-1.5	I	Y	3		
RFI-RD--9743-1	Kansas State University	Advanced physics models for fuel-cycle simulation	University	FDF			3		NFL	UNF	FC		N	0.8	F	N	3	0.27	
RFI-RD--9743-2	Kansas State University	Detectors for long-term, in-core, 3-D flux monitoring	University	AIN	AM	INC	1	2	AM	INC	RC		N	0.8	F	N	3		

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RFI-RD–9744-1	University of California, Berkeley	Improve both fuel cycle economics and resource utilization through the investigation of high power density fuels and hard neutron spectra. (Fully Passive Resource Renewable/TRU Burning LWR)	University	HPC			3	2	NSY	NFL	FC	RC	N	0.8	F	Y	3	0.27	
RFI-RD–9744-2	University of California, Berkeley	Improve both fuel cycle economics and resource utilization through the investigation of high power density fuels and hard neutron spectra. (High Density Fuels to Improve Fuel Cycle Performance)	University	HPC			3	2	NFL		FC	RC	N	0.8	F	Y	3	0.27	
RFI-RD–9744-3	University of California, Berkeley	Improve both fuel cycle economics and resource utilization through the investigation of high power density fuels and hard neutron spectra. (Effect of fast flux and fluence on Zircaloy and advanced claddings)	University	RX	IGBF	MatEx	3		NSY		RC	NEET-CTD	Y	0.8	F	N	3	0.27	
RFI-RD–9744-4	University of California, Berkeley	Improve both fuel cycle economics and resource utilization through the investigation of high power density fuels and hard neutron spectra. (Void fraction prediction in small hydraulic diameters)	University	THF	HPC		3		NSY		RC	NEET-CTD	Y	0.8	F	N	3	0.27	
RFI-RD–9744-5	University of California, Berkeley	Improve both fuel cycle economics and resource utilization through the investigation of high power density fuels and hard neutron spectra. (CHF of axially non-uniform heated rod at high qualities)	University	THF	HPC		2		NSY	RSK	RC		Y	0.8	F	N	3	0.27	
RFI-RD–9744-6	University of California, Berkeley	Improve both fuel cycle economics and resource utilization through the investigation of high power density fuels and hard neutron spectra. (MOX fuel thermo-physical properties at high burnup)	University	RX	AIN	HPC	2		NFL		RC		Y	0.8	F	N	3	0.27	
RFI-RD–9744-7	University of California, Berkeley	Improve both fuel cycle economics and resource utilization through the investigation of high power density fuels and hard neutron spectra. (Reactor Physics in intermediate Spectrum)	University	RX			2	3	NFL	RSK	RC	FC	Y	0.8	F	N	3	0.27	
RFI-RD–9745	University of Missouri	Measurements of particle-surface adhesion forces and models for particle resuspension rate	University	MatEx	RCL		4		RSK	NFL	NEET-CTD		N	0.8	F	N	3	0.27	
RFI-RD–9747	Vanderbilt University	Assessment of Stakeholders and Attributes to Support Nuclear Fuel Cycle Research, Development and Deployment Decision-Making	University				3		NFL	SYS	FC		N	0.8	F	Y	3	0.27	
RFI-RD–9748	Vanderbilt University	Developing a User-Focused Environment for Continued Enhancement of Nuclear Fuel Cycle Simulators	University				3		NFL	SYS	FC		N	0.8	F	Y	3	0.27	
RFI-RD–9750	Alfred University	GYROMELTER FOR RAPID PROCESSING OF NUCLEAR WASTES	University	FDF	MatEx		3		UNF	WST	FC		N	3	F	Y	3	1.00	
RFI-RD–9751	University of Wisconsin, Madison	FUEL ELEMENT DEVELOPMENT FOR Fluoride Salt-Cooled High-Temperature Reactors (FHR)	University	FDF	MatEx	RX	3		NFL		FC		N	1	F	N	4	0.25	
RFI-RD–9752	University of Missouri	Support and Enhancement of Research and Training Capabilities for Engineers Trained in Probabilistic Risk Assessment	University				4		RSK		NEET-CTD		N	0.4	I	N	NE		
RFI-RD–9753	Rensselaer Polytechnic Institute	Novel Multiphase Waste Forms for Complex Waste Streams: Synthesis and Performance Evaluation	University	FDF	RCL	MatEx	3		WST	UNF	FC		N	0.8	F	Y	3	0.27	
RFI-RD–9754	Pennsylvania State University	Safety assessment of nuclear reactors using Monte Carlo reactor simulation tools (TH feedback optimization, dynamic MC calculations and parallel scalability)	University	HPC			4		RSK	SYS	NEAMS		Y	0.4	I	N	3	0.13	
RFI-RD–9755	North Carolina State University	Hierarchical Models for High Temperature Diffusion Assisted Crack Growth Mechanisms in Crystalline Alloys	University	MatEx			4		STM		NEAMS	NEET-CTD	Y	0.6-0.8	I	N	4		
RFI-RD–9757	University of Pittsburgh	Emerging Digital I&C Technology	University	INC			1	2	INC	RSK	NEET-CTD		N	0.8-1	I	Y	4		
RFI-RD–9758	University of Missouri	Aerosol and Fission Product Transport in Nuclear Decontamination Devices	University	RCL	HPC		4		RSK		NEET-CTD		N	0.8	F	N	3	0.27	
RFI-RD–9760	Illinois Institute of Technology	SUSTAINABLE CONDITION ASSESSMENT AND PROGNOSTIC HEALTH MONITORING FOR ADVSMR COMPONENTS WITH SENSOR FUSION	University	INC	AIN		4	1	INC	RSK	NEET-CTD	RC	N	0.45	F	Y	3	0.15	
RFI-RD–9761	Virginia Polytechnic Institute and State University	Beta-voltaic batteries for low-power space and defence power systems applications.	University	FDF	AM		2		SDP	AM	RC		N	0.5	I	Y	3	0.17	

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RFI-RD–9762	University of Pittsburgh	Advanced I&C for Real-Time Risk-Based Decision Making	University	INC			1	2	INC	RSK	NEET-CTD		N	0.8-1	I	Y	3		
RFI-RD–9764	Texas A&M University	Pool Mixing Validation for Enhanced Safety of Current and Future Water-cooled Reactors	University	THF			1		RSK	NSY	RC		N	0.5	I	Y	3	0.17	
RFI-RD–9765	Texas A&M University	Resolving geometric complexities in reactor models – An isogeometric approach	University				4		RSK	NSY	NEAMS		Y	0.8	I	Y	3	0.27	
RFI-RD–9766-1	Oak Ridge National Laboratory	Cross-Cut Nuclear Physics Working Group (NPWG) to Identify and Address Nuclear Data Needs for Advanced Fuel Cycle Applications	National Laboratory				3	4	NFL	RSK	FC	NEET-CTD	N	12	I	Y	3	4.00	
RFI-RD–9766-2	Oak Ridge National Laboratory	A Benchmark Experiment to Investigate Reactor Fuel Bundle Fluid and Thermal Behavior Under 2-Phase Conditions	National Laboratory	THF			1		NSY	RSK	NEET-CTD	RC	N	5	I	N	5	1.00	
RFI-RD–9766-3	Oak Ridge National Laboratory	High-Temperature Thermometry Based on Thermographic Phosphors	National Laboratory	AIN			2		INC		NEET-CTD		N	1.5	I	Y	3	0.50	
RFI-RD–9766-4	Oak Ridge National Laboratory	High-Temperature Flow Meter Concept Based on Acoustics	National Laboratory	THF	AIN		2		INC	PRO	NEET-CTD		N	1.8	I	Y	3	0.60	
RFI-RD–9766-5	Oak Ridge National Laboratory	Critical Instrumentation Improvements Needed For BWR Mark 1 Severe Accident Management	National Laboratory	INC	AIN		1		INC	RSK	NEET-CTD		N	3	I	Y	3	1.00	
RFI-RD–9766-6	Oak Ridge National Laboratory	Mini-Scale Processing Capability Developing Advanced Processing Techniques for Used Nuclear Fuel	National Laboratory	FDF	RCL		3		WST	UNF	FC		N	5.1	I	Y	4	1.28	
RFI-RD–9766-7	Oak Ridge National Laboratory	Criticality Excursion Modeling & Simulation Capability For Repository Evaluations	National Laboratory	THF			3		RSK	NSY	FC	NEAMS	Y	5	I	Y	3	1.67	
RFI-RD–9766-8	Oak Ridge National Laboratory	Expanded Use Of The Modified Direct De-Nitration (MDD) Process For Advanced Fuel Cycle Applications	National Laboratory	FDF	RCL		3		WST	UNF	FC		N	2.5	I	N	4	0.63	
RFI-RD–9766-9	Oak Ridge National Laboratory	Improving LWR Plant Margin through Development of a Higher-Fidelity Core Protection Calculator System	National Laboratory	INC	AIN		4		RSK	INC	NEET-CTD		N	1.25	F	N	3	0.42	
RFI-RD–9766-10	Oak Ridge National Laboratory	Preconceptual Design of Portable Small Modular Reactor	National Laboratory				2		NSY	PRO	RC		N	2.4	F	Y	2	1.20	
RFI-RD–9766-11	Oak Ridge National Laboratory	Advanced Engineered Cementitious Composites for Next Generation of Nuclear Power Plants	National Laboratory	CON	MatEx		4		CON	RSK	NEET-CTD		N	3	F	Y	3-4	0.00	
RFI-RD–9767-1	University of Illinois, Urbana Champaign	Advanced modeling and simulation of nuclear energy systems (**Validation of two-phase flow conditions: boiling HT, spacer grid effects, natural circulation and scaling experiments workscopes**)	University	THF			4		NSY	RSK	NEAMS		Y	4	F	Y	3	1.33	
RFI-RD–9767-2	University of Illinois, Urbana Champaign	Advanced modeling and simulation of nuclear energy systems (**Participation in multi-physics verification and validation OECD/NEA programs**)	University				4		NSY	RSK	NEAMS		Y	1.5	I	Y	3	0.50	
RFI-RD–9767-3	University of Illinois, Urbana Champaign	Advanced modeling and simulation of nuclear energy systems (**Education and workforce training in V&V**)	University				4		NSY	RSK	NEAMS		Y	NE	I	Y	NE		
RFI-RD–9767-4	University of Illinois, Urbana Champaign	Fuel cycle research and development for used fuel storage and disposal (**Pool to repository systems analysis for LWR used fuel**)	University	CSK			3		UNF	SYS	FC		N	3	I	Y	3	1.00	
RFI-RD–9767-5	University of Illinois, Urbana Champaign	Fuel cycle research and development for used fuel storage and disposal (**Deep borehole disposal of nuclear waste**)	University	CSK			3		UNF	SYS	FC		N	3	I	Y	3	1.00	
RFI-RD–9767-6	University of Illinois, Urbana Champaign	Fuel cycle research and development for used fuel storage and disposal (**Used nuclear fuel storage: development of robust radiation resistant ceramics**)	University	AM	MatEx		3		UNF	WST	FC		N	NE	F	Y	NE		
RFI-RD–9767-7	University of Illinois, Urbana Champaign	Digital and cyber capabilities for reliability, resilience, and reducing risks of nuclear power plants	University	INC			4	2	INC	RSK	NEET-CTD		N	4	I	Y	3	1.33	

Tracking ID	Institution	Description	Institution Type	Infra Area (Q6)	Infra Area (Q6)	Infra Area (Q6)	NE Mission Area (Q7)	NE Mission Area (Q7)	NE R&D Area (Q8)	NE R&D Area (Q8)	NE R&D Program	NE R&D Program	NEAMS Tie-In?	Cost [MM$]	Immediate or Future Needs	Multiple Partners?	Schedule [YEARS]	Cost/Year	IRP?
RFI-RD--9768	Purdue University	High Temperature Interface properties to Predict Effect of Particles on Creep Fatigue Failure of Metallic Alloys such as IN_617 and Hastealloy	University	MatEx			2		STM		NEET-CTD		N	NE	F	N	NE		
RFI-RD--9769	Purdue University	Interface Effects on Fracture in Nuclear Structures	University	MatEx			2		STM		NEET-CTD		Y	NE	F	N	NE		
RFI-RD--9770	Purdue University	Effect of Corrosion, High Temperature, and Irradiation on Cladding Material Interface Thermal and Mechanical Properties	University	MatEx	RCL		2		STM		NEET-CTD		Y	NE	F	N	NE		
RFI-RD--9771	Purdue University	A COMBINED ELECTROCHEMICAL NANOINDENTATION AND NANOMECHANICAL RAMAN SPECTROSCOPY BASED APPROACH TO CHARACTERIZE MICROSTRUCTURE DEPENDENT MECHANICAL PROPERTIES OF NUCLEAR MATERIALS IN ELECTROCHEMICAL ENVIRONMENTS	University	MatEx	RCL		2		STM		RC		Y	NE	F	N	NE		
RFI-RD--9772	Idaho National Laboratory	Single Fuel Pellet Ultrasonic Three-Dimensional Computed Tomography	National Laboratory	RX	AIN	MatEx	3		NFL	INC	NEET-CTD	NEAMS	Y	3	I	Y	3	1.00	
RFI-RD--9773	Idaho National Laboratory	Advanced Image Analysis for Nuclear Energy Applications	National Laboratory	AIN			4		INC		NEET-CTD		N	3	I	Y	3	1.00	
RFI-RD--9774	Idaho National Laboratory	Innovative Verification and Validation Technologies for NEAMS	National Laboratory	MatEx	AIN	RX	4		SYS		NEAMS		Y	15	I	Y	5	3.00	
RFI-RD--9775	Pennsylvania State University	A new funding area called "Nuclear Energy Enabling Science (NEES)." This area would specifically fund research that aims to increase our understanding of the basic mechanisms that drive fission and fusion reactor behavior, but does not directly aim for short-term improvements to current reactor technology	University	RX			4		SYS		NEET-CTD		N	0.8	F	Y	3	0.27	
RFI-RD--9776	Idaho National Laboratory	Micro/Nano-Sensor Development	National Laboratory	AIN	INC		4		INC	RSK	NEET-CTD	NEAMS	Y	3	I	Y	3	1.00	
RFI-RD--9777	Pennsylvania State University	Nexus for Fundamental Science of Nuclear Systems	University	MatEx			4		NFL	STM	NEET-CTD		N	0.9	F	Y	3	0.30	
RFI-RD--9778	University of California, Berkeley	Fuel Cycle Options Analysis: nuclear fuel cycle systems analyses evaluating, at the engineering technology level, variations on the four promising fuel cycles	University				3		NFL	UNF	FC		N	0.6	I	Y	3	0.20	
RFI-RD--9779	Texas A&M University	Robust 3D Sensor System for Dry Cask Storage Facility Functional Integrity Monitoring	University	CSK	AIN		3		UNF	RSK	FC		N	1	I	N	3	0.33	
RFI-RD--9781	University of California, Berkeley	Software Development to Enable Next-Generation Computational Neutronics Capability (GPU abd/or MIC architectures)	University	HPC			4		NSY	SYS	NEET-CTD		N	NE	I	Y	3		
RFI-RD--9782-1	Idaho National Laboratory	NEUP Topics to Support Electrochemical Recycling (Release Fraction and Particle Size for Declad High Burnup Commercial Fuel)	National Laboratory	MatEx	FDF		3		NFL	RSK	FC		N	0.45	I	N	2	0.23	
RFI-RD--9782-2	Idaho National Laboratory	NEUP Topics to Support Electrochemical Recycling (Investigation of Nature and Mitigation of Particles in Electrorefining Systems)	National Laboratory	MatEx	FDF		3		NFL		FC		N	0.6	F	Y	3	0.20	
RFI-RD--9782-3	Idaho National Laboratory	NEUP Topics to Support Electrochemical Recycling (Morphology Control of Uranium Deposition in Electrorefining Systems)	National Laboratory	MatEx	FDF		3		NFL		FC		N	0.75	F	Y	3	0.25	
RFI-RD--9782-4	Idaho National Laboratory	NEUP Topics to Support Electrochemical Recycling (Direct Lanthanide Removal from Electrorefining Electrolyte)	National Laboratory	MatEx	FDF		3		NFL		FC		N	0.9	F	Y	3	0.30	
RFI-RD--9783	Kansas State University	Lattice Boltzmann methods: New methods can be developed which can solve neutron or radiation transport and thermo-fluid transport at meso-scale to evaluate the micro-to-macroscopic effects of fuel irradiation, localized reaction rates, bubble formation in the fuel and high fidelity models for fuel gaps and pellet-clad interactions.	University				4		NFL		NEAMS		Y	NE	F	N	NE		
RFI-RD--9784	University of California, Berkeley	Neutronics Aspects of Boiling Water Reactors	University				4		NSY	SYS	NEAMS		Y	NE	I	Y	3		
RFI-RD--9786	Rensselaer Polytechnic Institute	Effects of Defects and High Burn-up Structure on the Thermal Conductivity of Sintered Fuels: Validation of MARMOT Thermal Transport Model	University	FDF	IGBF	MatEx	4	3	NFL		NEAMS		Y	0.8		Y	3	0.27	

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RFI-RD--9787	Kansas State University	Advanced instrumentation and data learning tools for monitoring severe accidents and stored nuclear waste	University	AIN	INC		4		INC	RSK	NEET-CTD		N	NE	I	N	NE		
RFI-RD--9788	Kansas State University	Advanced Nuclear fuel for load following Nuclear Power Plants	University	FDF	RX	MatEx	3		NFL		FC		Y	NE	I	N	NE		
RFI-RD--9790	University of California, Berkeley	Reactor Module Library for Fuel Cycle Analysis	University				3		SYS	NFL	FC		N	0.8	I	Y	3	0.27	
RFI-RD--9791	Ohio State University	Development and Experimental Validation of an Integrated System for Software Dependability Assessment and Prediction	University	INC			4		INC	RSK	NEET-CTD		N	1	I	Y	3	0.33	
RFI-RD--9794	University of California, Berkeley	Reprocessing Facility Library for Fuel Cycle Analysis	University				3		SYS	NFL	FC		N	0.4	I	Y	3	0.13	
RFI-RD--9795-1	Pennsylvania State University	Multiphysics experiments and modeling of coupled thermal-hydraulics, reactor physics, chemistry, mechanics and materials to develop a unified understanding of in-reactor materials degradation phenomena.	University	MatEx			4		NFL	STM	NEET-CTD		Y	NE	I	Y	NE		
RFI-RD--9795-2	Pennsylvania State University	Behavior of nuclear fuel cladding at high burnup: Materials Behavior at High Doses	University	IGBF	MatEx		3		NFL		FC		N	NE	I	Y	NE		
RFI-RD--9795-3	Pennsylvania State University	Behavior of nuclear fuel cladding at high burnup: Corrosion of light water reactor fuel and the associated hydrogen pickup	University	RCL	MatEx		3		NFL		FC		N	NE	I	Y	NE		
RFI-RD--9795-4	Pennsylvania State University	Behavior of nuclear fuel cladding at high burnup: Effect of hydrides on the mechanical behavior of zirconium alloy	University	RCL	MatEx		3		NFL		FC		N	NE	I	Y	NE		
RFI-RD--9795-5	Pennsylvania State University	Behavior of nuclear fuel cladding at high burnup: RIA behavior at high burnup	University	RX	MatEx		3		NFL		FC		N	NE	I	Y	NE		
RFI-RD--9795-6	Pennsylvania State University	Fundamental Materials Research	University	RX	IGBF	MatEx	4		NFL	STM	NEET-CTD		N	NE	I	Y	NE		
RFI-RD--9796	Texas A&M University	Nuclear Power Sustainability Analysis and Economics of Energy Sources	University				4		SYS		FC	RC	N	0.8	I	Y	3	0.27	
RFI-RD--9797-1	General Atomics	Investigation of advanced fuel compositions for high burn-up and long life	Industry	FDF	IGBF	MatEx	3	4	NFL		FC	NEAMS	Y	3.5	F	Y	3	1.17	
RFI-RD--9797-2	General Atomics	Testing of Advanced Cladding Materials in Advanced Reactor and Simulated Accident Conditions	Industry	FDF	MatEx		3		NFL	RSK	FC		N	2	F	Y	2		
RFI-RD--9798	Missouri University of Science and Technology	Experimental investigation CHF under natural circulation	University	THF			4		NSY		NEET-CTD		N	1.5	I	Y	3	0.50	
RFI-RD--9799	Louisiana State University	Development of in situ experimental techniques to examine phase transformation process for nuclear materials	University	AM	IGBF	MatEx	3		NFL	WST	FC		N	0.7-0.8	I	Y	3		
RFI-RD--9800	Louisiana State University	Long term performance of iodine nuclear waste forms -- Leaching and dissolution mechanism under accelerated and environmental conditions	University	RCL	MatEx		3		NFL	WST	FC		N	0.7-0.8	I	Y	3		
RFI-RD--9801	Texas A&M University	Analysis of Fuel Processing, Disposal and System Decommissioning Issues Related to Advanced Burner Reactor (ABR) Systems	University				3	2	NSY	SYS	FC	RC	N	0.8	F	N	3	0.27	
RFI-RD--9802-1	University of Pittsburgh	Advanced Sensor Instrumentation and Its Manufacturing Method (**Sensor Fused Additive Manufacturing**)	University	AIN	AM		4		AM	INC	NEET-CTD		N	0.8-1	F	Y	3		
RFI-RD--9802-2	University of Pittsburgh	Advanced Sensor Instrumentation and Its Manufacturing Method (**Photonic Instruments Via 3D Printing**)	University	AIN	AM		4		AM	INC	NEET-CTD		N	0.8-1	F	Y	3		
RFI-RD--9803	Texas A&M University	Fast Spectrum Material's Testing Reactor with variable energy spectra to support Advanced Reactors Program and Light Water Reactor Sustainability Program R&D	University	RX	FDF		4		NSY		NEET-CTD		N	0.8	F	Y	3	0.27	
RFI-RD--9804	Ohio State University	ASSESSING UNIT RESILIENCE IMPACTS IN THE OPTIMAL CONTROL OF HYBRID SYSTEMS	University				4		NSY		NEET-CTD		N	4.5	F	Y	3	1.50	IRP
RFI-RD--9805	University of Illinois, Urbana Champaign	CHF under natural circulation	University	THF			4		NSY		NEET-CTD		N	1.5	I	Y	3	0.50	

Appendix 2: Request for Information DE-SOL-0008246

U.S. DEPARTMENT OF ENERGY

REQUEST FOR INFORMATION

DE-SOL-0008246

University, National Laboratory, Industry, and International Entities Input to the Office of Nuclear Energy's Competitive Research and Development Work Scope Development

April 13, 2015

Office of Nuclear Energy

Office of Innovative Nuclear Research

Table of Contents

1 Introduction

The primary mission of the Office of Nuclear Energy is to advance nuclear power as a resource capable of meeting the Nation's energy, environmental, and national security needs by resolving technical, cost, safety, proliferation resistance, and security barriers through research, development, and demonstration as appropriate.

NE's program is guided by the four research objectives detailed in its Nuclear Energy Research and Development Roadmap:

- Develop technologies and other solutions that can improve the reliability, sustain the safety, and extend the life of current reactors.
- Develop improvements in the affordability of new reactors to enable nuclear energy to help meet the Administration's energy security and climate change goals.
- Develop sustainable fuel cycles.
- Understand and minimize the risks of nuclear proliferation and terrorism.

NE strives to promote integrated and collaborative research conducted by national laboratory, university, industry, and international partners under the direction of NE's programs. NE funds research activities through both competitive and direct mechanisms, as required to best meet the needs of NE. This approach ensures a balanced R&D portfolio and encourages new nuclear power deployment with creative solutions to the universe of nuclear energy challenges. The competitive portion of NE's R&D portfolio is executed through the Nuclear Energy University Program (NEUP) and Nuclear Energy Enabling Technologies Crosscutting Technology Development (NEET CTD). NEUP utilizes up to 20 percent of funds appropriated to NE's R&D program for university-based infrastructure support and R&D in key NE program-related areas: Fuel Cycle Research and Development (FCR&D), Reactor Concepts Research, Development and Demonstration (RCRD&D), and Nuclear Energy Advanced Modeling and Simulation (NEAMS). NEET CTD supports national laboratory, university and industry led crosscutting research.

2 Requested Information

1) DOE is seeking ideas in the areas of research, information, comments, feedback, and recommendations from interested parties for future work scopes for the major NE-funded research programs. This input may lead to a more robust R&D program that reflects the communities' ideas and could identify new work scopes. Although the focus of this Request For Information (RFI) is to obtain input to and identify potential new work scopes for future Funding Opportunity Announcements in the areas listed below, DOE also seeks input on creative, innovative and transformative work that aligns with NE's mission.

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. Additionally, it is desired that 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 United States.

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 materials recovery technologies, 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), Advanced (Non-Light Water) Reactor Concepts (ARC) and Advanced Small Modular Reactors (Adv SMRs). 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 codes and methods that give the user state-of-the-art physics models that can take advantage of 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 an advanced mechanistic toolkit that is applicable to a wide range of reactor designs for use by industry, academia, and the national laboratories. The NEAMS Toolkit will help engineers and scientists form new insights into the safety and economics of current and next generation 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 toolset 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.

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.

Nuclear Energy Enabling Technologies (NEET) Crosscutting Technology Development (CTD). NEET CTD competitively awards high-priority R&D to universities, national laboratories, and industry, leading to the development of innovative solutions to unique and crosscutting nuclear energy challenges. The subprogram works in close coordination with NE's other R&D programs to ensure that developed technologies and capabilities address critical technology gaps as part of an integrated solution offering the potential of revolutionary improvement in safety, performance, reliability, economics, and proliferation risk reduction. Additionally, NEET CTD strategically invests in competitive, nuclear energy-related infrastructure enhancement at national laboratories; ensuring researchers have access to state-of-the-art R&D capabilities. The capabilities developed through NEET CTD advance the state of nuclear technology, improving its competitiveness, and promoting continued contribution to meeting our Nation's energy and environmental challenges.

Replies to this request should follow the general organization of Section 2 of this RFI and information should be as succinct as possible. Respondents are encouraged to provide input on any areas of interest of this RFI.

2.1 Cover Page

Responses shall include a cover page containing the following information:

- RFI title
- Names, phone numbers, and e-mail addresses for the principal points of contact
- Company or affiliate name and address
- Date of submittal

2.2 NE Work Scope Recommendations

Clearly define your proposed work scope, and how it relates to any part of NE's mission described in this RFI. Describe any defined goals in achieving the desired outcomes, along with appropriate metrics to assess how well those goals have been achieved.

2) What would be the estimated cost of the work scope?

3) Would the work scope be more focused on immediate NE program needs, or more creative, innovative and transformative?

4) Would the work scope require multiple partners?

5) What would be a reasonable schedule duration and key milestones?

2.3 Other Information

Provide any other relevant information you feel is important not otherwise already covered including comments or suggestions.

3 Participant Eligibility to Respond to RFI

Information is being sought from educational institutions, National Laboratories, utilities, private industry, international entities, and any other interested party.

4 Program Guidelines

This market research request is done under the Federal Acquisition Regulation (FAR), Parts 10 – Market Research and FAR subpart 15.201(e) – Requests for Information.

5 Intellectual Property Rights

Participants are advised that their RFI response package should be submitted without any restrictive markings. However, if restrictions are required in order to fully explain a response, the participant is responsible to mark the cover page and any and all submittal documents appropriately. Respondents are strongly discouraged from placing any restrictive markings on submissions as they may limit DOE's ability to use the submitted information.

6 Communications Protocol

Responses must be submitted through www.NEUP.gov to be considered. You must create an account to access the submission site. Submit electronic submissions through the "Applications" function at www.NEUP.gov. If you have problems completing the registration process or submitting your response, call 208-526-1507 or send an email to NEUP@inl.gov.

Participants are advised that any indication of interest, in the affirmative, is not meant to imply nor in any way impart an obligation on the part of the Government that an award will be forthcoming for the offered work or project.

7 Schedule

7.1 Submission Time and Date

The DOE will continually accept packages in response to this RFI No. DE-SOL-0008246. However to be considered for the 2016 grant opportunities a response will be required no later than **8:00 p.m. ET, June 19, 2015.**

This announcement does not impose any obligation on the Government nor does it signify any intent for a contract or other form of award.

8 Disclaimers

a. DOE does not plan to send individual acknowledgements or replies to respondents to the RFI. However, DOE may conduct one-on-one meetings with entities that respond to this request if clarification or additional information is required to improve the DOE's understanding of the comments provided. If DOE decides to hold one-on-one meetings, applicable interested parties will be contacted. The decision to meet with a company one-on-one has no bearing on the worthiness of its RFI submittal or on any future offerings.

b. This is a request for information only. It has no direct relation to other DOE Funding Opportunity Announcements or solicitations. DOE does not presently intend to solicit or award any kind of contract or financial assistance award; this RFI is issued only with the intent of obtaining information.

c. Any response to this RFI is voluntary and does not commit to Government to any expense or obligation. This request does not impose any obligation on the Government or signify a firm intention to enter into a contract. No costs associated with responding to this RFI or participating in any subsequent meetings will be borne by the Government.

d. DOE does not intend to publish the results of the responses to this RFI.