U.S. DEPARTMENT OF ENERGY | Nuclear Energy

Current Issues
DOE's Nuclear Energy Programs

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Nuclear Energy Advisory Committee
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Overview

- FY15 President's Budget Request
- Assessment of Disposal Options for DOE HLW and SNF
- NEUP/NEET R&D and Infrastructure Awards
- Hybrid Energy Systems
- Continued Evaluation of NPP Economics
- Startup of Nuclear Cyber Security Activities
- Idaho National Lab-led Innovation Workshops in March 2015
- TREAT Activities
- Advanced Reactor Technology Awards
- International Updates
  - EU Acceptance of UK's Contracts of Difference
  - Anticipated ratification of CSC by Japan and Canada
  - Progress toward restart of Sendai NPP in Japan
  - Proposed IFNEC Secretariat transition to NEA

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Secretary Moniz on Nuclear Energy

"In partnership with our nuclear industry, the U.S. Government is supporting the deployment of passively safe reactors both in the United States and around the world. By incorporating passive systems into the large Gen III designs, and the new small modular reactors (SMR) being pursued today, the world has a broader set of options for safe, reliable nuclear energy.

We are also working toward a next-generation nuclear fuel that will combine higher performance with greater tolerance for extreme events, thus giving operators additional time to respond to unforeseen conditions. This year we've entered into strong partnerships with national laboratories, universities, and industry and we are very pleased with the leadership role of the OECD-Nuclear Energy Agency and the IAEA in expanding international involvement in these efforts."
2014 IAEA General Conference

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NE FY 2015 Congressional Budget Request Summary

(Dollars in Thousands)

	FY 2014 Enacted [a]	FY 2015 Request	FY 2015 House	FY 2015 SEWD
Integrated University Program	5,500	0	5,000	0
SMR Licensing Technical Support	110,000	97,000	54,500	0
Supercritical Transformational Electric Power Generation	0	27,500	27,500	27,500
Reactor Concepts RD&D	112,822	100,540	138,000	55,000
Fuel Cycle R&D	186,205	189,100	182,000	230,000
Nuclear Energy Enabling Technologies	71,109	78,246	101,000	73,500
Radiological Facilities Management	24,968	5,000	5,000	25,000
International Nuclear Energy Cooperation	2,496	3,000	3,000	3,000
Idaho Facilities Management	196,276	185,910	206,000	185,910
Idaho Safeguards and Security	94,000	104,000	104,000	104,000
Program Direction	90,000	73,090	73,000	73,090
Adjustments [b]	-5,000	0	-1,046	-1,046
Hahn Amendment	0	0	-73,309	0
Total, Nuclear Energy	888,376	863,386	824,645	775,954
Nuclear Waste Disposal [c]			150,000	

a) Reflects application of $814,100 rescission as identified within section 317 of Public Law 113-76. Does not reflect appropriation transfer to Office of Science for SBIR/STTR of $10,844K.

b) Use of Prior Year Balances (FY 2014) and rescissions (FY 2015 House and SEWD).

c) $150M for Nuclear Waste Disposal "to continue the Department of Energy's statutorily required activities for the Yucca Mountain license application." There is also $55M for the NRC "to continue adjudication of the Yucca Mountain license application." The House directs the NRC to report "not later than January 1, 2015, on its plan to complete the license application and its additional funding needs as necessary."

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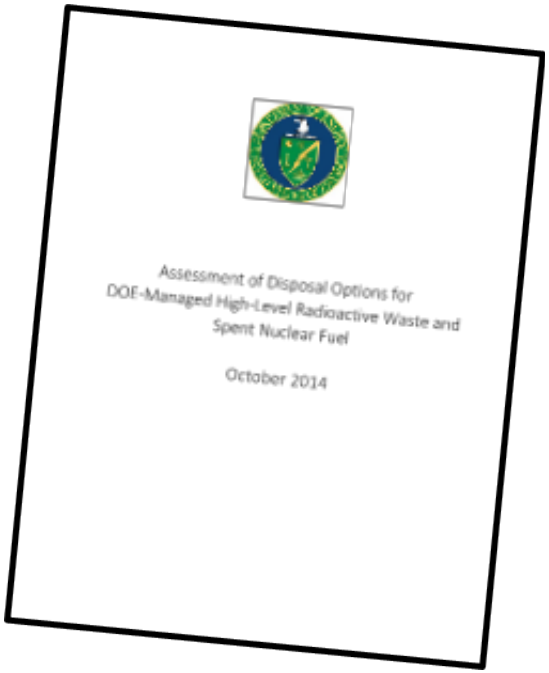
Evaluation of Technical Options for Disposal of DOE-Managed High Level Radioactive Waste and Spent Nuclear Fuel

- Over the last year, the Department has done a technical assessment of options for disposal of its inventory of DOE-managed high-level radioactive waste and spent nuclear fuel.
- This assessment considered whether DOE- managed HLW and SNF should be disposed of with commercial SNF and HLW in a one geologic repository, or whether there are advantages to developing separate geologic disposal pathways for some DOE-managed HLW and SNF.
- Disposal options analyzed --
  - Dispose of all HLW and SNF waste, regardless of origin, in a common repository
  - Disposal of some DOE-managed HLW and SNF in a separate mined repository
  - Disposal of smaller waste forms in deep boreholes



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Changed Circumstances since 1985 Decision to "Commingle" Defense and Commercial Waste

- A number of circumstances have changed since the 1985 decision to "commingle" defense and commercial waste, including the following –
  - The Cold War is over and the U.S. is no longer producing nuclear weapons materials. Thus, the inventory of defense high level waste is finite and known.
  - Defense high level waste streams are heterogeneous, existing in many different waste forms, which creates opportunities for different disposal pathways.
  - The 1985 decision assumed a repository would be available in 1998 and did not envision the legal binding agreements with the States in place today to remove DOE HLW by dates certain.

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Inventory of Commercial and DOE-Managed Radioactive Waste Requiring Geologic Disposal

- The Assessment report draws heavily on a recently completed DOE report that summarizes the inventory of both commercial and DOE-managed radioactive wastes requiring geologic disposal.

- Looking closely at the volume and characteristics of the inventory of DOE-managed HLW and SNF highlighted some opportunities for potential earlier disposal of some waste forms.

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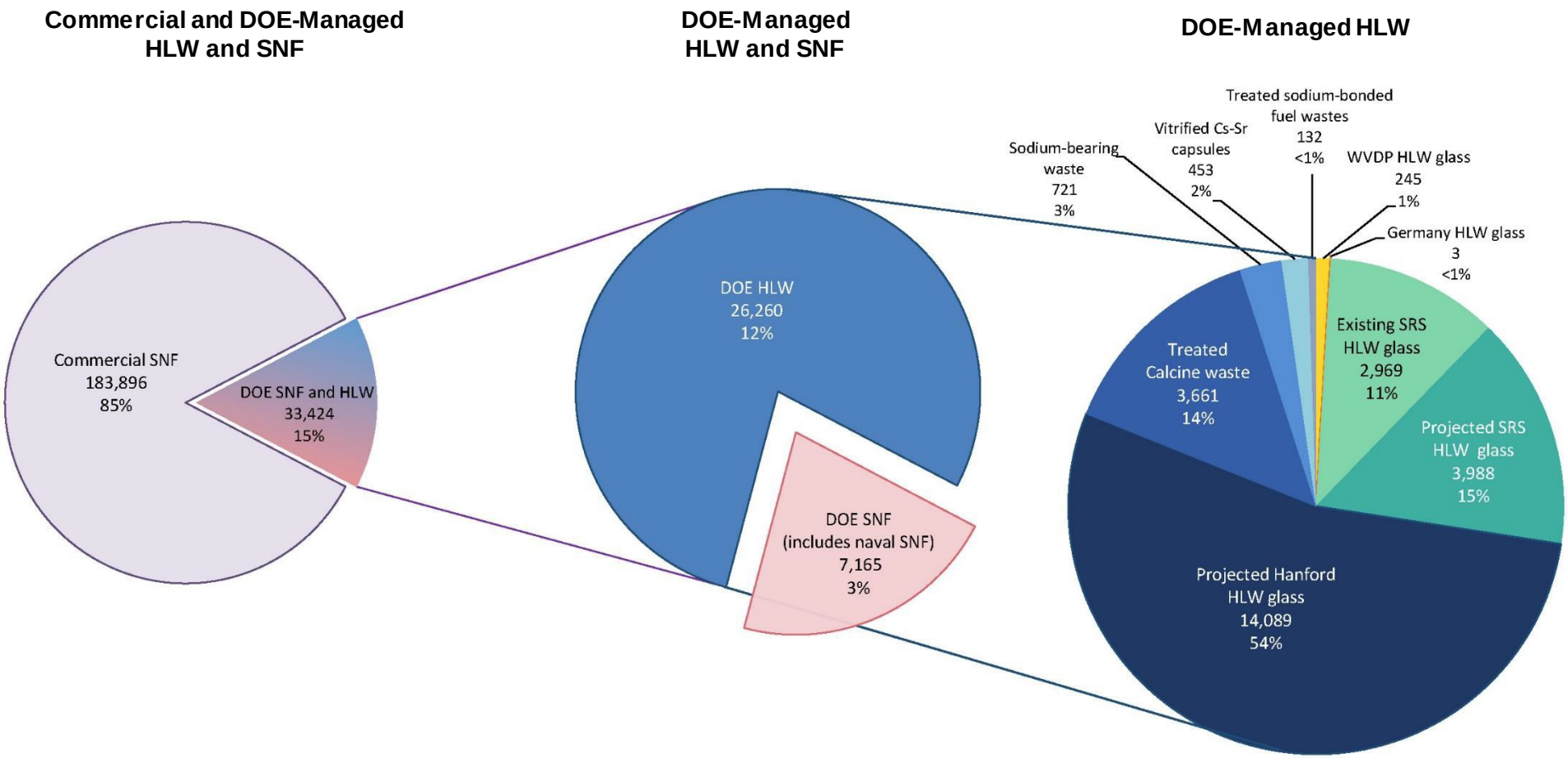
Projected Volumes (m^3) of DOE Managed HLW and Spent Nuclear Fuel



Projected volumes given in m^3

Assessment of Disposal Options for DOE-Managed High-Level Radioactive Waste and Spent Nuclear Fuel

Key Conclusions and Recommendations

- Concludes that there are multiple options for disposal of DOE-managed HLW and SNF that are technically feasible and have the potential to provide long-term isolation of this waste.
- Concludes there are potential programmatic advantages to a phased strategy that allows for flexibility in disposal pathways for some DOE-managed HLW and SNF.
- Recommends the Department begin implementation of a phased, adaptive, and consent-based strategy with development of a separate repository for some DOE-managed HLW and SNF.
- Recommends the Department retain the flexibility to consider options for disposal of some smaller DOE-managed waste forms in deep boreholes rather than in a mined geologic repository.

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FY 2014 NEUP/NEET Competitive Award Results

Nuclear Energy University Program

Research and Development

- 44 awards made to 30 universities in 24 states ($30,094,008)

Integrated Research Projects

- 5 awards made to 5 universities in 5 states ($19,999,989)

Infrastructure

- 20 awards made to 19 universities in 17 states ($4,055,891)

Integrated University Program

- 33 fellowship awards made to students at 18 universities in 17 states ($5,115,000)
- 41 scholarship awards made to students at 19 universities in 17 states ($205,000)

Nuclear Energy Enabling Technologies (NEET) Crosscutting Technology Development

Research and Development

- 12 awards made to 4 universities, 4 national laboratories, and 1 industry in 8 states ($11,363,480)

Infrastructure

- 2 awards made to 1 national laboratory ($1,228,693)

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NEUP - Integrated Research Projects

Year	Title	Lead Institution
2014	Integrated FHR Technology Development: Tritium Management, Materials Testing, Salt Chemistry Control, Thermal-Hydraulics and Neutronics with Associated Benchmarking	*Massachusetts Institute of Technology*
2014	Integrated Approach to Fluoride High Temperature Reactor (FHR) Technology and Licensing Challenges	*Georgia Institute of Technology*
2014	Multi-Sensor Inspection and Robotic Systems for Dry Storage Casks	*Pennsylvania State University*
2014	Experimental Determination and Modeling of Used Fuel Drying by Vacuum and Gas Circulation for Dry Cask Storage	*University of South Carolina*
2014	Advanced Instrumentation for Transient Reactor Testing	*University of Wisconsin, Madison*
2013	Simulation of Neutron Damage for High Dose Exposure of Advanced Reactor Materials	*University of Michigan*
2012	Inherently Safe Reactors	*Georgia Institute of Technology*
2012	Accident Tolerant Fuels	*University of Tennessee*
2012	Accident Tolerant Fuels	*University of Illinois, Urbana Champaign*
2011	Accelerated Aging of Used Nuclear Fuel in Storage	*Texas A&M University*
2011	Advanced Thermal Reactor Concepts	*Massachusetts Institute of Technology*

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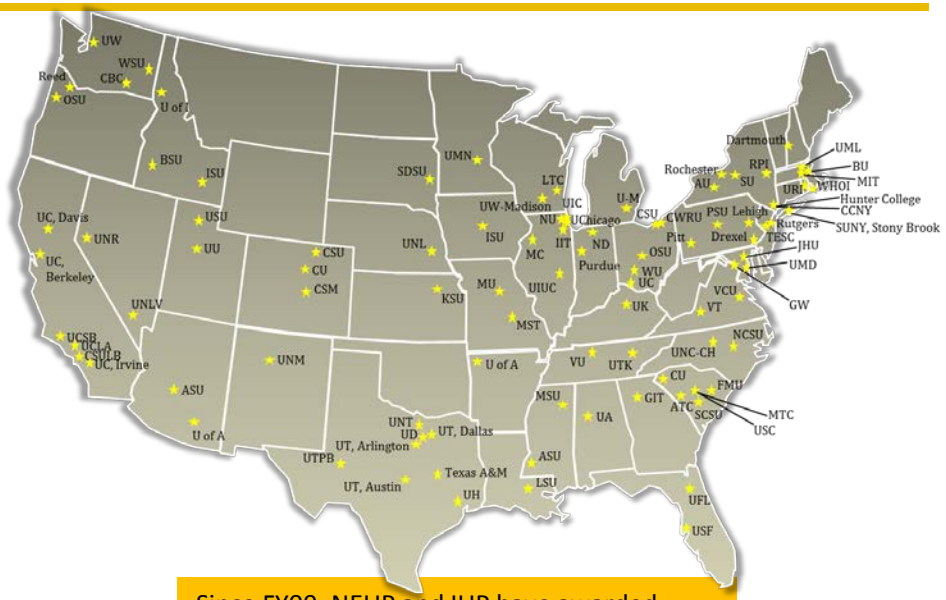
Nuclear Energy University Programs

- **The Nuclear Energy University Programs (NEUP) and the Integrated University Program (IUP) have a well established competitive process for awarding R&D, infrastructure and scholarships/fellowships.**
  - The Office of Science and Technology Innovation will continue implementing this competitive process and will expand to incorporate it into all competitive research.
  - FY14 IUP awards: 42 scholarships and 33 fellowships, totaling $5M.
  - FY14 R&D awards: 44 awards, totaling $30M
  - FY14 IRP awards: 5 awards, totaling $19.9M
  - FY14 Infrastructure awards: 20 awards, totaling $4M



Since FY09, NEUP and IUP have awarded $349.2M to 98 schools in 39 states and the District of Columbia.

- **The NE R&D Programs are the cognizant technical managers of these competitive R&D awards and therefore play an integral role in the success of each project.**
  - Universities, national laboratories, industry, and international research partners are strongly encouraged to actively engage and collaborate with the NE R&D programs.

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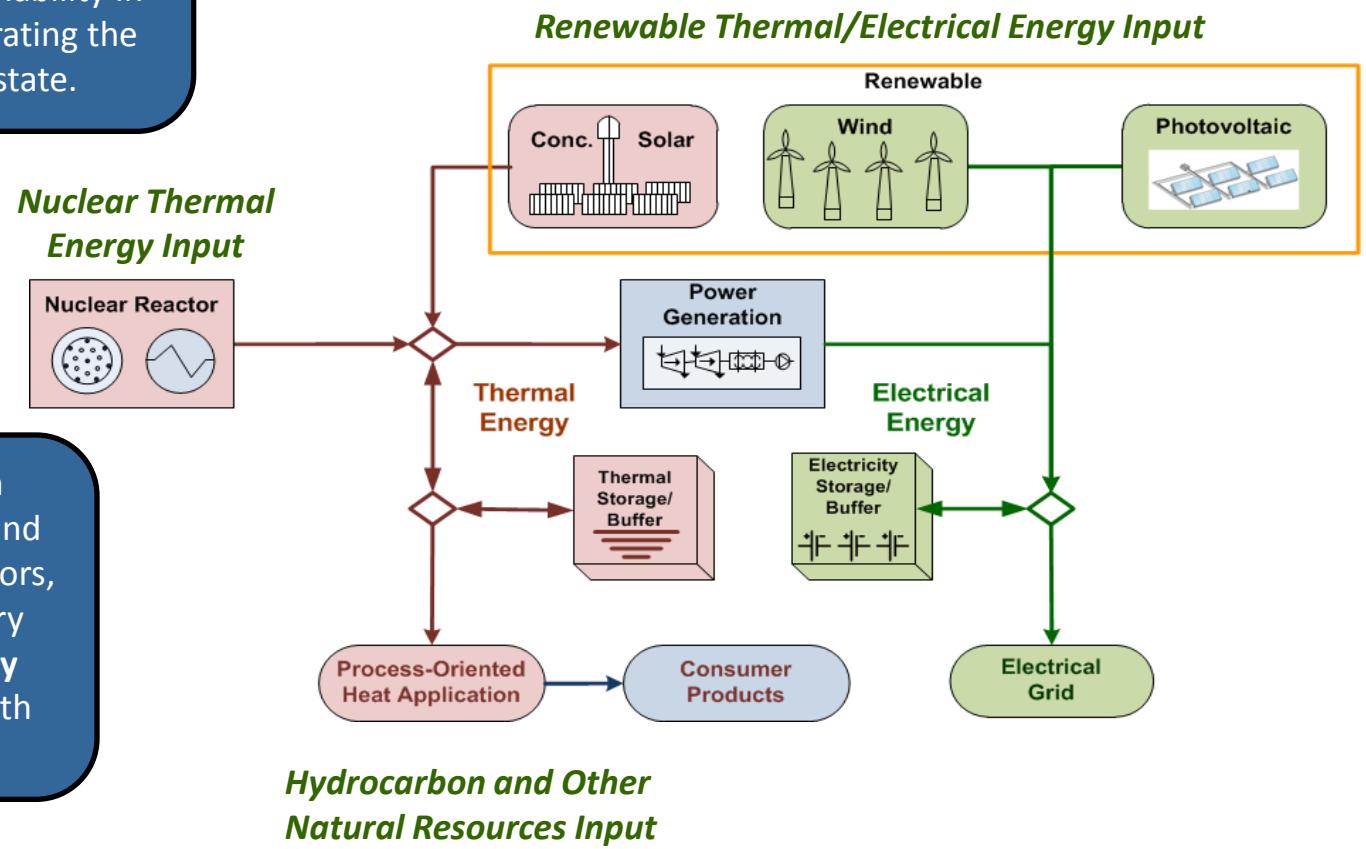
Hybrid Energy Systems: Energy Integration behind the Grid

Key take-away:
Thermal energy re-purposing and storage helps smooth large-scale variability in the system while operating the reactor at steady state.

Batteries, electric vehicles and SMART buildings help to smooth local and instantaneous variability in the system.



Integrated systems can benefit from the design and operation of nuclear reactors, energy storage / recovery buffers, and **dynamically responsive interfaces** with the electrical grid.

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Challenges for the Current Fleet

- **Four reactors permanently shutdown in 2013**
  - Vermont Yankee closure imminent
- **Increased attention on the need to maintain existing nuclear**
  - Government: DOE, EPA, FERC
  - Industry: NEI, Exelon, First Energy, Entergy, PJM
- **Exploration for mechanisms to value the attributes of nuclear**
  - Adjusting capacity markets to value firm fuel supplies (PJM)
  - State actions to maintain at-risk plants
- **Longer-term signals for maintain current fleet**
  - EPA Clean Power Plan
  - U.S.-China announcement: 2025 target of 26% - 28% U.S. GHG reduction

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Nuclear Energy Cyber Security RD&D

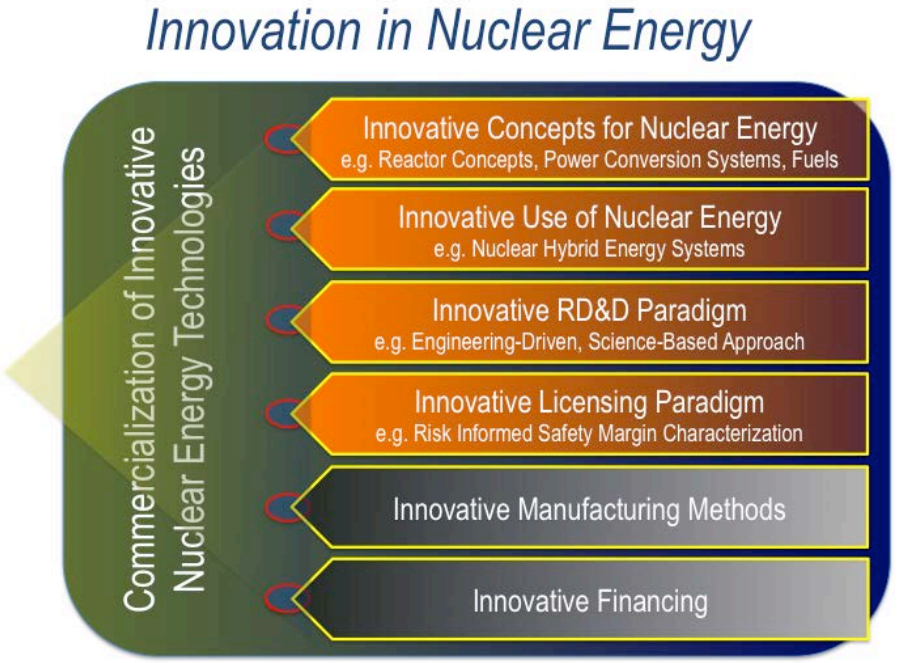
Plan for the Plan
- Stakeholder Meetings
- Identify Needs
- Catalog Assets
- Analyze Gaps

Draft R&D Plan
- Close the Gaps
- Meet the Needs
- Inform the Budget

Early Demonstration
- NEET, NEUP, SBIR
- 17 Responses so far
- 8 highly rated

Time is Now
- Cyber Threat is Real
- Consequences Unknown
- Regulatory Compliance Costly

Nuclear Innovation Workshops (2-4 March 2015)

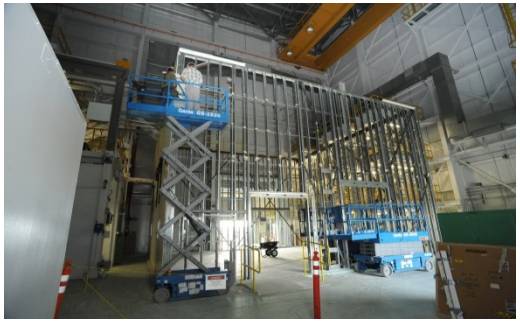


- **Six simultaneous national workshops to discuss the key theme of the Idea Summit, "How can we innovate more rapidly in the development of nuclear technology?"**
  - What areas are ripe for innovation?
  - What available tools can we bring to innovation?
  - What new tools are needed?

Resumption of Transient Testing

- **2014 Accomplishments:**
  - Initiated functional testing of the Automatic Reactor Control System
  - Removed large structure (Plasma Hearth) from reactor bay
  - Completed roof replacement on reactor building
  - Initiated development of a water loop for Accident Tolerant Fuel testing
  - Awarded an Integrated Research Project (IRP) to the University of Wisconsin for advanced instrumentation for transient testing
  - Awarded 3 Small Business Innovative Research (SBIR) Phase I projects to develop neutron radiography imaging capabilities
- **2015 Planned Accomplishments:**
  - Initiate fuel inspections of fuel both in storage and in the reactor
  - Initiate testing of reactor control system, rod drives, and reactor trip system
  - Award IRP to develop benchmark cases for validation of TREAT modeling and simulation codes
  - Award Phase II SBIR project(s) initiated in FY 2014

- **Restart effort is proceeding on schedule for a FY 2018 reactor restart**



Plasma Hearth Removal

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Investment of $13M in Cost-Shared, Industry-led, Advanced Reactor Concepts

- AREVA Federal Services partnering with TerraPower Company, Argonne National Laboratory (ANL), and Texas A&M University - Thermal Hydraulic simulations and experimental investigation for liquid metal-cooled fast reactor fuel assemblies
- GE Hitachi Nuclear Energy partnering with ANL – Development and modernization of next-generation probabilistic risk assessment methodologies
- General Atomics partnering with the University of California at San Diego and the University of South Carolina - Fabrication and testing complex Silicon Carbide structures pertinent to advanced reactor concepts
- NGNP Industry Alliance partnering with AREVA, UltraSafe Nuclear Company, Westinghouse, and Texas A&M University - High Temperature Gas Reactor (HTGR) Post-accident Heat Removal and Testing
- Westinghouse Electric Company partnering with ANL and the University of Pittsburgh-- Development of thermo-acoustic sensors for Sodium-cooled Fast Reactors (SFR)