



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

Current Issues

DOE's Nuclear Energy Programs

Dr. Peter Lyons
Assistant Secretary for Nuclear Energy
U.S. Department of Energy

Nuclear Energy Advisory Committee
December 19, 2013



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President Obama's Nuclear Energy Goals

"We have an obligation to leave our children a planet that's not polluted or damaged, and by taking steady, responsible steps to cut carbon pollution and an all-of-the-above approach to develop homegrown energy ...

Thanks to the ingenuity of our businesses, we're starting to produce much more of our own energy. We're building the first nuclear power plants in more than three decades in Georgia and South Carolina."

- Georgetown University June 26th, 2013





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Secretary Moniz on Nuclear Energy

“The United States is strongly committed to ensuring the safe, secure, and peaceful uses of nuclear energy while steadfastly preventing the proliferation of nuclear weapons...

As we look collectively at the challenge of working to reduce carbon emissions while facilitating global development, nuclear energy clearly has a role to play. In that regard, I suggest that we should begin looking beyond the era of “Atoms for Peace” toward a model of “Atoms for Prosperity.”



*2013 IAEA General Conference
September 16, 2013*



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Role of U.S. Department of Energy for Sustainable and Innovative Nuclear Energy

Conduct Research, Development, and Demonstration to:

- Reduce regulatory risk
- Reduce technical risk
- Reduce financial risk and improve economics
- Manage nuclear waste
- Minimize the risks of nuclear proliferation and terrorism
- Foster international and industry collaboration



Vogtle – October 2013

Source: Southern Co.



Office of Nuclear Energy FY 2014 Request

(Dollars in Thousands)

	FY 2014 Congressional	House Mark	Senate Energy & Water Mark
Integrated University Program	0	5,500	0
SMR Licensing Technical Support	70,000	110,000	70,000
Reactor Concepts RD&D	72,500	86,500	62,500
Fuel Cycle R&D	165,100	91,081	175,100
Yucca Mountain	--	25,000	0
Nuclear Energy Enabling Technologies	62,300	66,748	62,300
Radiological Facilities Management ^a	5,000	5,000	20,000
International Nuclear Energy Cooperation	2,500	2,500	2,500
Idaho Facilities Management	181,560	181,560	166,560
Idaho Safeguards and Security ^b	94,000	94,000	94,000
Program Direction	87,500	87,500	87,500
Adjustments	-5,000	-5,000	-5,000
Total, Nuclear Energy	735,460	750,389	735,460

a) Space & Defense Infrastructure included in NASA budget request starting in FY 2014.

b) Requested within Nuclear Energy in FY 2014 and FY 2015 (retains Defense function)



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Recent Events

-
- **Megatons to Megawatts**
 - **USEC RDD Program**
 - **Commingling Report**
 - **Inventory Analysis**
 - **Used Fuel and Waste Management**
 - **Small Modular Reactors**
 - **Nuclear Energy University Programs (NEUP)**
 - **Changes in NEAC and Subcommittees**
 - **Market conditions on nuclear power**
 - **SEAB review of Hubs**



Completion of Centrifuge Test Program

- **Cooperative Agreement between DOE, USEC and American Centrifuge Demonstration, LLC**
- **Cost: \$321M cost-shared between DOE (\$257M) and USEC/ACD (\$64M)**
- **Joint project will be completed on January 15, 2014**
- **The project will have demonstrated the technical reliability and robustness of the American Centrifuge Technology by:**
 - Conducting extensive testing on the centrifuge components and systems
 - Manufacturing 154 centrifuges, reaching a peak production rate of 12 centrifuges per month
 - Operating the demonstration cascade for over two months (20 machine-years) to confirm expected SWU production





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Commingling

- **“The Commission therefore urges the Administration to launch an immediate review of the implications of leaving responsibility for disposal of defense waste and other DOE-owned waste with DOE versus moving it to a new waste management organization”** *Blue Ribbon Commission*
- **“As supported in the Administration’s Strategy and recommended by the BRC, DOE has initiated an analysis of the pros and cons of commingling civilian and defense waste.”** *Secretary Moniz, U.S. Senate Energy and Natural Committee, July 30th, 2013*



What Has Changed Since 1985?

	Legislative Framework	Waste Inventory	DOE's Mission	Technical Basis for Disposal	Programmatic Considerations
1985	Multiple repository sites being evaluated under NWPA	<ul style="list-style-type: none"> Essentially all DOE SNF would be reprocessed All DOE HLW would be vitrified 	Support for defense program	<ul style="list-style-type: none"> No operating repositories world-wide Limited site-specific information 	<ul style="list-style-type: none"> Commercial repository projected in 1998 Only repository options were full commingling of DOE and commercial waste or full segregation into separate repositories
2013	1987 Nuclear Waste Policy Amendments Act leaves no alternative path under the NWPA for a repository other than Yucca Mountain	<ul style="list-style-type: none"> Essentially all DOE SNF will be disposed of as-is Vitrified HLW is still largest component, but HLW exists in other forms (e.g., calcine) Inventory now includes DOE-managed non-defense wastes (e.g., West Valley HLW, Three Mile Island & Ft. St. Vrain SNF) 	<ul style="list-style-type: none"> Environmental cleanup NNSA fuel take-back program 	<ul style="list-style-type: none"> 28 years of additional repository R&D in US and other nations 14 years of operating experience at WIPP 	<ul style="list-style-type: none"> Commercial repository projected in 2048 DOE/State agreements mandate DOE SNF removal by 2035 Multiple repository concepts are possible for different DOE wastes

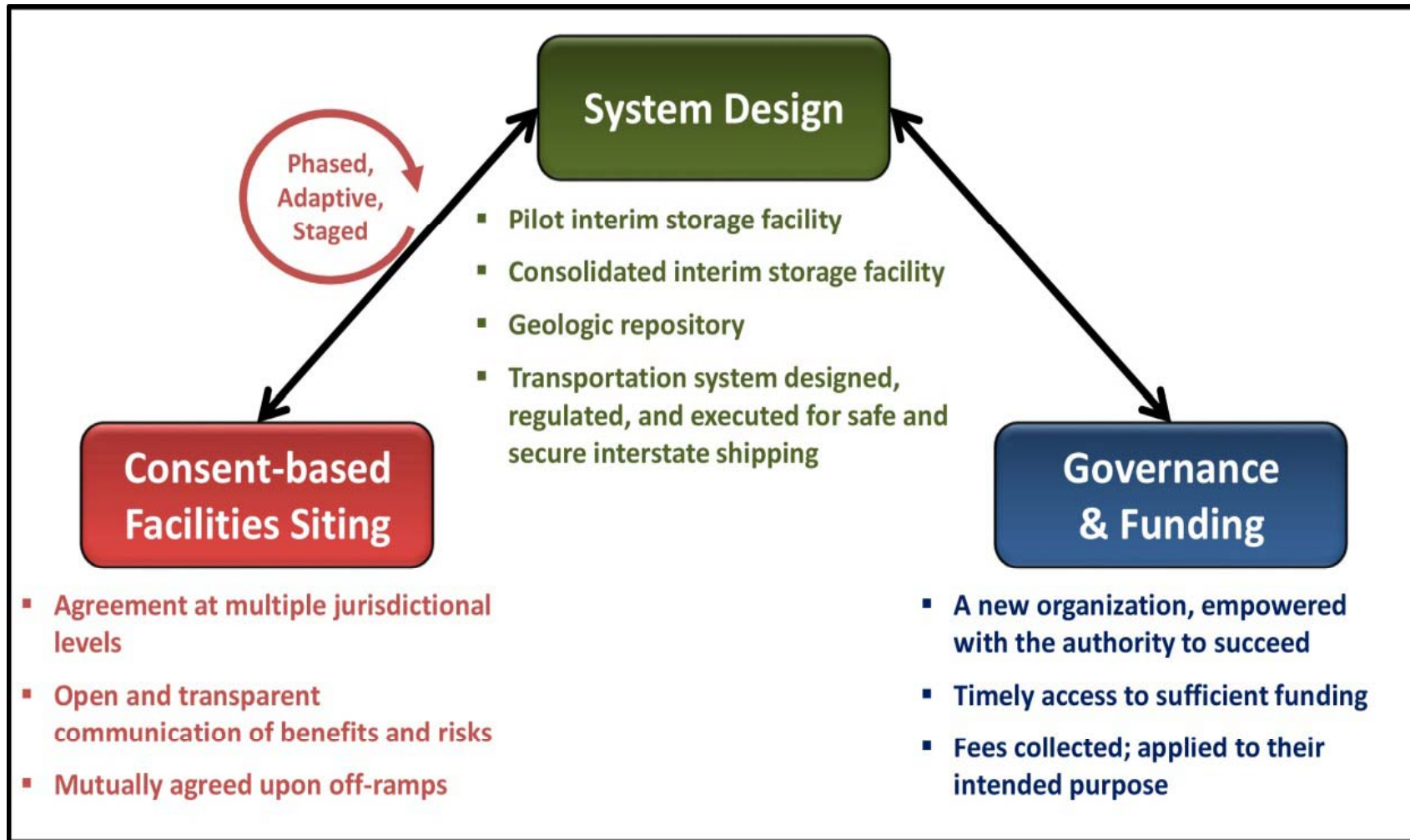


Preliminary Conclusions from the *Waste Form Disposal Options Report*

- **All wastes could go to one mined repository**
- **No wastes require a specific disposal concept**
 - Information is incomplete for sodium-bonded fuels, which may require treatment before disposal
- **The evaluation did not provide a compelling basis for choosing one medium over others: All media considered in the study are viable for all wastes**
 - Salt and clay/shale scored comparably
 - Evaluation for mined crystalline repositories suggests greater R&D needs
- **Deep borehole disposal scores well for some small and low-volume waste types**
 - Placing large volumes of waste in deep boreholes would likely require significant modifications to waste forms, e.g., rod consolidation for pressurized water reactor fuel, redesign of canister sizes for HLW



Key Strategy Elements





Congressional Activity

- **Senators Wyden, Murkowski, Feinstein, and Alexander introduced comprehensive nuclear waste legislation – Nuclear Waste Administration Act of 2013 (S. 1240)**
 - Establishes a siting process for storage and repository facilities that relies on consent agreements and Congressional ratification
 - Establishes a new organization – Nuclear Waste Administration – run by a single Administrator and overseen by an Oversight Board
 - Addresses funding reform by creating a new Working Capital Fund in which fees are deposited and are available as needed
- **Path to passage is difficult to predict**
 - Court cases still pending
 - Some factions in Congress ready to “move on” from Yucca Mountain, while others not



Status of SMR Licensing Technical Support Program

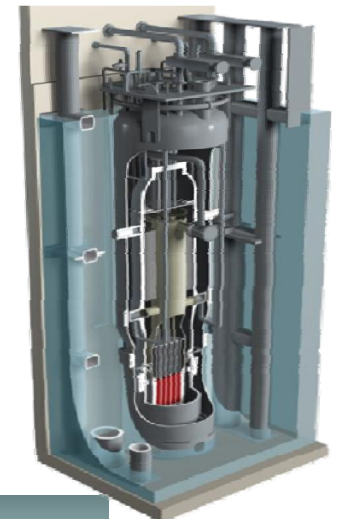
B&W mPower America

- Cooperative Agreement established with team consisting of B&W, Bechtel, and TVA in April 2013
- Initial DOE commitment of \$101 M through March 2014
- Design Certification Application (DCA) submittal in late 2014;
Construction Permit in mid-2015
- mPower is meeting the DOE goals established in the agreement



NuScale Power

- Award with NuScale announced on December 12, 2013
- Negotiations on cooperative agreement terms will begin immediately
- DCA submittal planned for late 2015



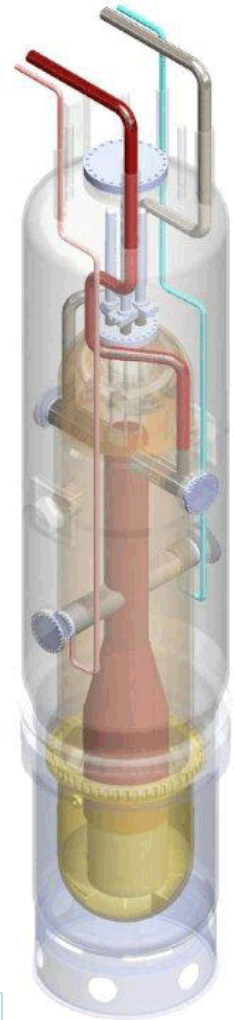
The program is currently a 6-year \$452 M program – DOE is examining options to optimize the funding split between the industry partners



NuScale Power SMR Features

- 45 MWe per unit (150 MWt) – up to 12 units/plant
- Standard UO₂ LWR fuel (4.95% enriched)
- 2.5 year refueling interval
- Utilizes passive circulation cooling under normal operating conditions
- SMR containment vessels submerged in reactor pool for improved safety
- Core Damage Frequency for internal events calculated at 2.9×10^{-9}
- Ongoing proactive pre-application engagement with NRC
- Design Certification application submittal to NRC estimated Q3 2015
- Supports DOE goal for SMR deployment in the 2025 timeframe

Innovative emergency core cooling system design requires no operator intervention, no AC or DC power, and no additional cooling water to maintain safe condition for an indefinite period

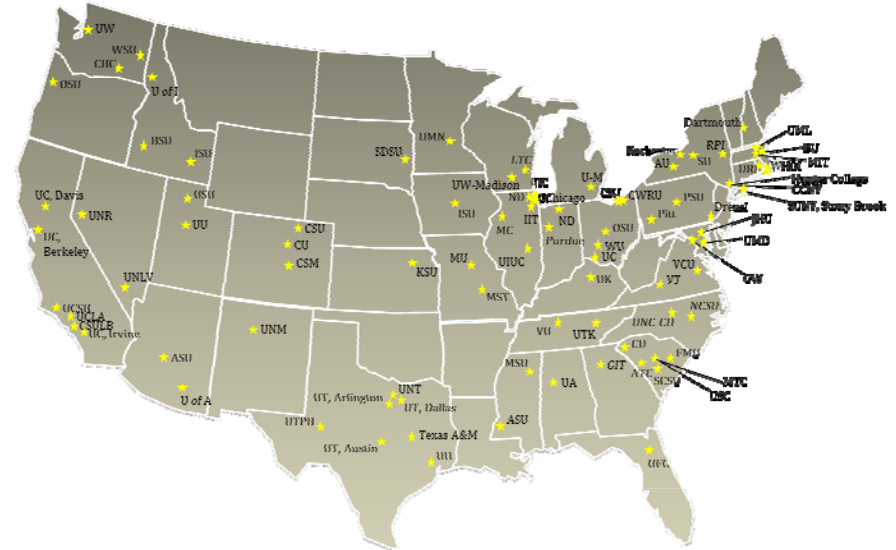




Nuclear Energy University Programs

■ 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.



Since FY09, NEUP and IUP have awarded \$290M to 89 schools in 35 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 in integral role in the success of each project.

- Universities, national laboratories, industry, and foreign research partners are strongly encouraged to actively engage and collaborate with the NE R&D programs.



High Fidelity Ion Beam Simulation of High Dose Neutron Irradiation

Lead: Gary Was, University of Michigan

Collaborators: University of Tennessee, Pennsylvania State University, University of Wisconsin, Madison, University of South Carolina, University of California, Berkeley, University of California, Santa Barbara, University of Manchester, Oxford University, Queens University, CEA Saclay Center, Tour AREVA, TerraPower, LLC, EPRI, ORNL, LLNL, ANL, LANL, INL

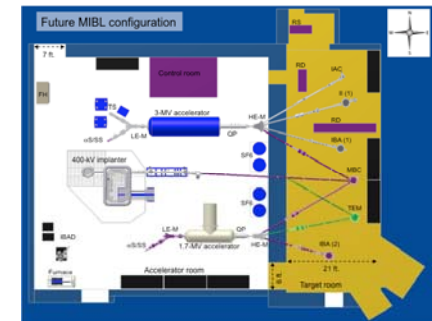
DOE Funding: \$5M

Collaborator Contributions: \$4M

Total Project Budget: \$9M

Upgrade and utilize ion beam irradiation capabilities to:

- Simulate advanced (e.g. fast) reactor neutron irradiations
- Predict microstructural evolution and other properties of structural materials in-reactor and at high doses





Transition of FY 2011 NEUP IRPs

- **Transition options were evaluated for FY 2011 IRPs. Process is being formalized, structured, and applied to all competitively-awarded research. Linked to PICS:NE program execution management system**
- **Evaluation Results for FY 2011 IRPs**
 - *High-Temperature Salt-Cooled Reactor for Power and Process Heat* . MIT. \$7.5 million (RCRD).
 - This research is transitioning to a new IRP in FY 2014: *Integrated Approach to Fluoride High Temperature Reactor (FHR) Technology and Design Challenges*. Up to \$5 million and 3 years (RCRD)
 - *Fuel-Aging in Storage and Transportation (FAST): Accelerated Characterization and Performance Assessment of the Used Nuclear Fuel Storage System*. TAMU. \$4.5 million (FCRD)
 - This research is on track to provide desired result so no specific transition needed. UFD program will build on results as appropriate. University researchers may propose follow-on efforts via NEUP call



NEAC Membership List Going Forward

- Reappointed all 18 members with two rotating out December 31, 2014
- Appointed two new members to begin January 1, 2014

Outgoing NEAC Members - December 31, 2014

1. William Martin
2. Michael Corradini

New Members

January 1, 2014

1. Warren F. "Pete" Miller
2. Joy Rempe

Notes:

- In 2014 Regis Matzie will chair the International subcommittee.
- In 2014 Mujid Kazimi will chair the Reactor Technology subcommittee.
- Total number of NEAC members is 20 in 2014 and it will decline to 18 on December 31, 2014
- Rotation will maintain a broad range of perspectives and opinions and retain diverse backgrounds that range from national laboratory, U.S. government, and industry, and of course, strong scientific and technological credentials.



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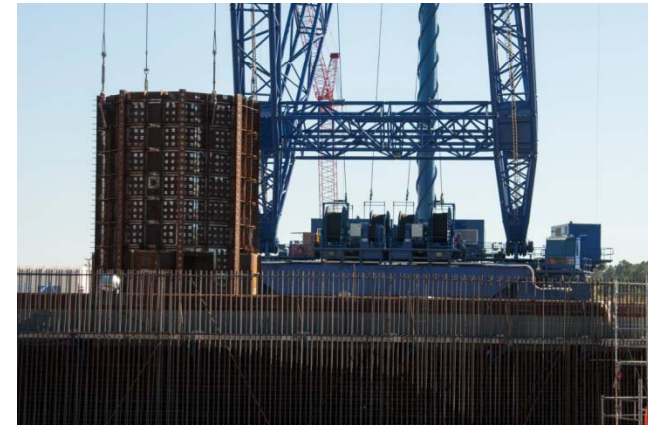
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Global Demand for Nuclear Energy Continues



Sanmen – September 2013

Source: SNPTC



Summer – September 2013

Source: SCE&G



Vogtle – November 2013

Source: Georgia Power Co.



Haiyang – June 2013

Source: State Nuclear Power Engineering Feng Qingyi
Wang Jinjie.

Global Energy Distribution

