



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

OFFICE OF NUCLEAR ENERGY UPDATE

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

Nuclear Energy Advisory Committee
Washington, DC
December 6, 2012



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President Obama's Nuclear Energy Goals

"We can build the next-generation nuclear reactors that are smaller and safer and cleaner and cheaper."

Ohio State University-March 22, 2012

"With rising oil prices and a warming climate, nuclear energy will only become more important. That's why, in the United States, we've restarted our nuclear industry as part of a comprehensive strategy to develop every energy source."

Seoul, Korea - March 26, 2012





FY 2012-2013 Budget Summary

Nuclear Energy

Program	FY 2012 Adjusted	FY 2013 Request	FY 2013 House Appropriations Committee	FY 2013 Senate Appropriations Committee
Integrated University Program	5,000	0	5,000	0
SMR Licensing Technical Support	67,000	65,000	114,000	65,000
Reactor Concepts RD&D	114,871	73,674	126,660	73,674
Fuel Cycle R&D	186,260	175,438	138,716	193,138
Nuclear Energy Enabling Technologies	74,670	65,318	75,000	65,318
Radiological Facilities Management	69,510	51,000	51,000	66,000
Idaho Facilities Management				
<i>O&M</i>	154,097	144,220	154,220	144,220
<i>13-D-905, RHLLW</i>		6,280	6,280	6,280
<i>13-E-200, APIE</i>		1,500	1,500	1,500
Idaho Facilities Management	154,097	152,000	162,000	152,000
Idaho Sitewide Safeguards and Security	93,350	95,000	93,350	93,000
International Nuclear Energy Cooperation	2,983	3,000	3,000	3,000
Program Direction	91,000	90,015	90,015	92,015
Nuclear Waste Disposal			25,000	
Use of Prior Year Balances/Reprogramming				(17,700)
Total, Office of Nuclear Energy	858,741	770,445	883,741	785,445

Other Defense Activities
Prior Year Nuclear Waste Fund
Nuclear Waste Disposal (New)



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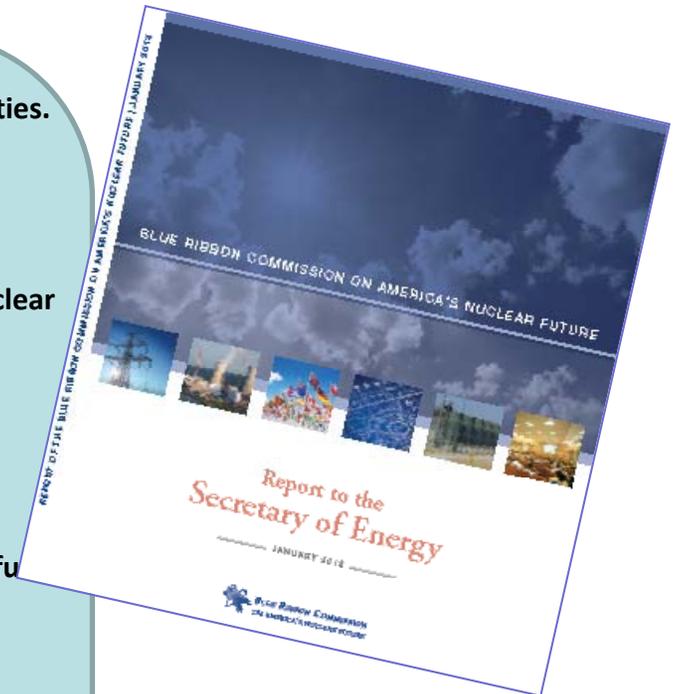
Recent Key Events

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- **Blue Ribbon Commission on America's Nuclear Future- Final Report Issued January 26, 2012**
 - **Mars Science Laboratory Landed**
 - **New Integrated Research Projects Awards Announced**
 - **Small Modular Reactor Selection Announced**
 - **Office of Nuclear Energy Reorganization Approved**
 - **Key Awards**



Blue Ribbon Commission Recommendations

1. A new, consent-based approach to siting future nuclear waste management facilities.
2. A new organization dedicated solely to implementing the waste management program and empowered with the authority and resources to succeed.
3. Access to the funds nuclear utility ratepayers are providing for the purpose of nuclear waste management.
4. Prompt efforts to develop one or more geologic disposal facilities.
5. Prompt efforts to develop one or more consolidated storage facilities.
6. Prompt efforts to prepare for the eventual large-scale transport of spent nuclear fuel and high-level waste to consolidated storage and disposal facilities when such facilities become available.
7. Support for continued U.S. innovation in nuclear energy technology and for workforce development.
8. Active U.S. leadership in international efforts to address safety, waste management, non-proliferation, and security concerns.

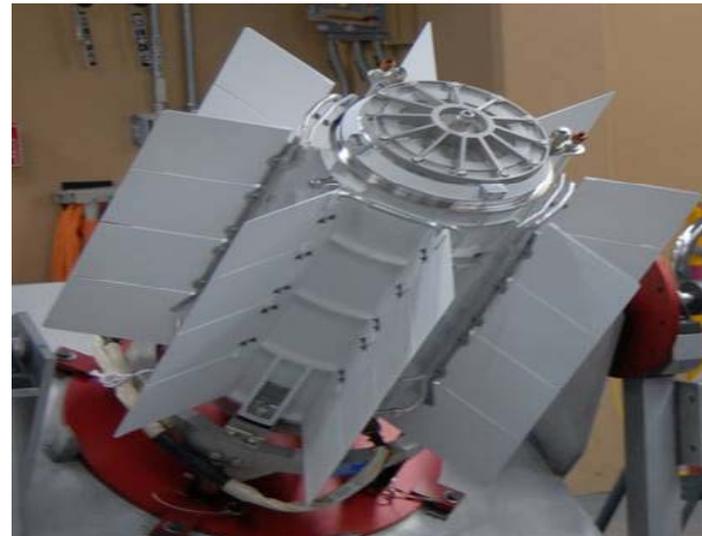




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Mars Science Laboratory Landed August 6





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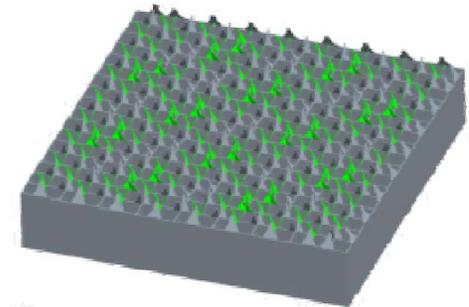
IRP: Accident Tolerant Fuels

University of Illinois, Urbana Champaign

*Engineered Zircaloy Cladding Modifications for Improved
Accident Tolerance of LWR Nuclear Fuel*

Budget: \$3,499,945

PI: Brent Heuser



Collaborators: University of Florida, University of Michigan

**Foreign Involvement: University of Manchester (\$1.5M to be provided
by RCUK)**

Industrial Participation: ATI Wah Chang (\$180k)

National Laboratory Participation: INL (\$450k)



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IRP: Accident Tolerant Fuels

University of Tennessee

*Advanced Accident-Tolerant Ceramic Coatings for Zr-Alloy
Cladding*

Budget: \$3,510,000

PI: Kurt Sikafus

**Collaborators: Pennsylvania State University, University of Colorado-
Boulder, University of Michigan**

**Foreign Involvement: Oxford, U Manchester, U Huddersfield, U
Sheffield, (\$2.24 M combined), ANSTO (Australian Nuclear Science and
Technology Organization)**

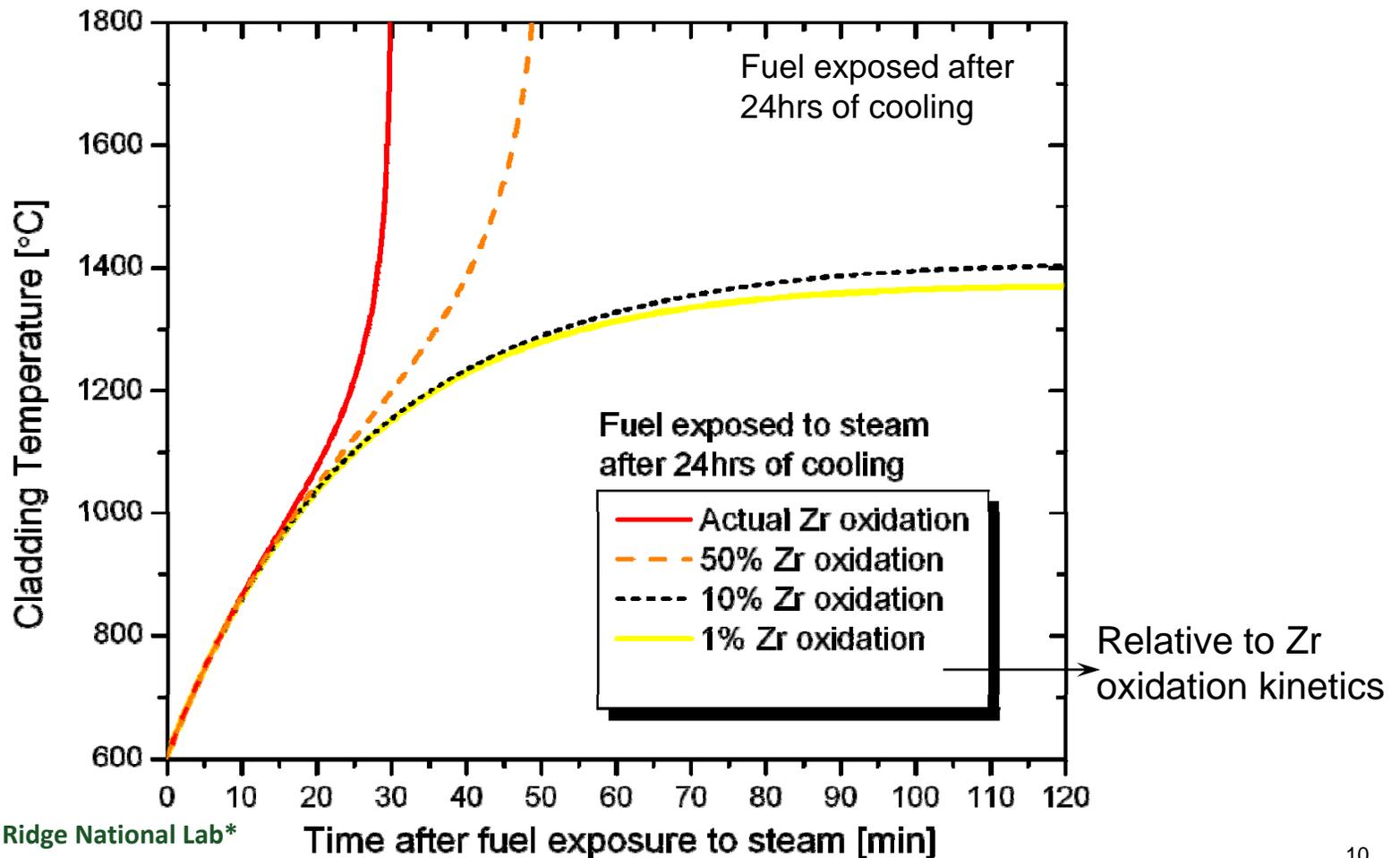
Industrial Participation: Westinghouse Electric (\$210,050)

National Laboratory Participation: LANL (\$390,000)



Materials With Slower Oxidation Kinetics Offer Larger Margins of Safety

- **Materials with slower oxidation kinetics in steam (~ 2 orders of magnitude or less) delay rapid cladding degradation**



Slide provided by Oak Ridge National Lab



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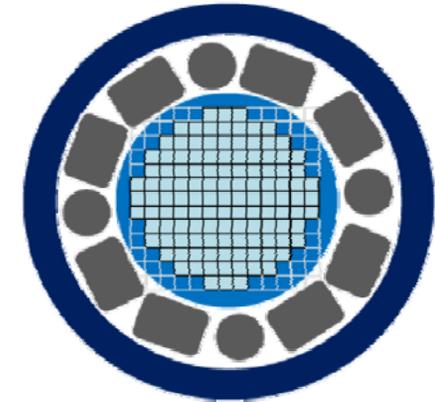
IRP: Inherently Safe Reactors

Georgia Institute of Technology

Integral Inherently Safe Light Water Reactor

Requested Budget: \$5,999,784

PI: Bojan Petrovic



Collaborators: University of Michigan, Virginia Tech, University of Tennessee, University of Idaho, Morehouse College

Foreign Involvement: Polytechnic University of Milan, University of Cambridge (\$450K to be provided by RCUK)

Industrial Participation: Westinghouse Electric (\$600k), Southern Nuclear (\$135k)

National Laboratory Participation: INL (\$300k)



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SMR Licensing Technical Support Program

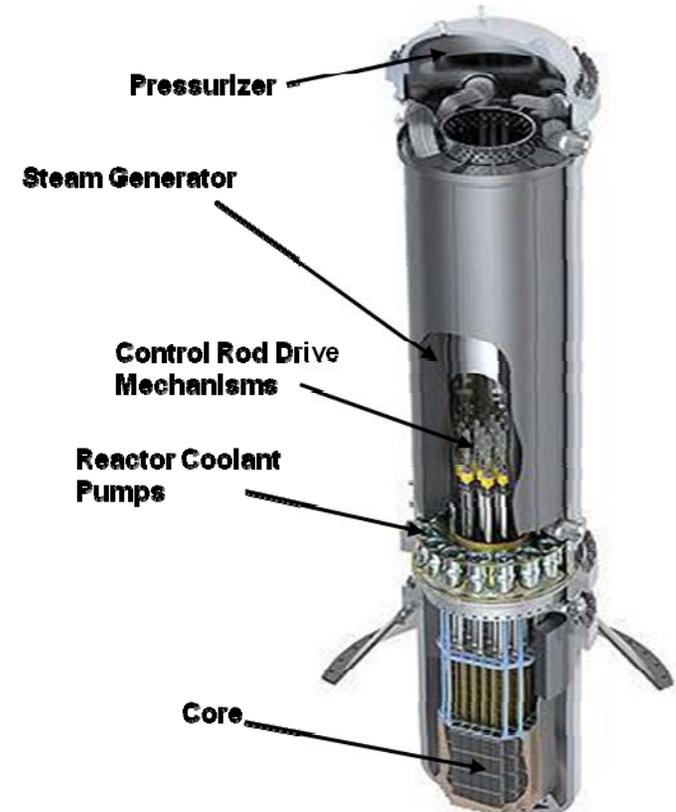
- **Supports first phase for deployment**
- **Facilitates and accelerates commercial development and deployment of near term U.S. SMR designs at domestic locations**
- **\$452 M in cost-share program over 5 years**
 - FY12 funding is \$67M and FY13 request is \$65M
- **DOE selected one award under the first SMR funding opportunity announcement (FOA)**
 - Babcock and Wilcox- mPower Design selected)
- **DOE is developing a second FOA that places more emphasis on innovation in improved safety attributes and reduces regulatory risk for some of the SMR technologies through:**
 - lower core damage frequencies
 - longer post-accident coping periods
 - enhanced resistance to natural phenomena
 - potentially smaller emergency preparedness zones
 - smaller workforce requirements

**** Both the 1st and 2nd funding opportunities will be funded out of the \$452m program****



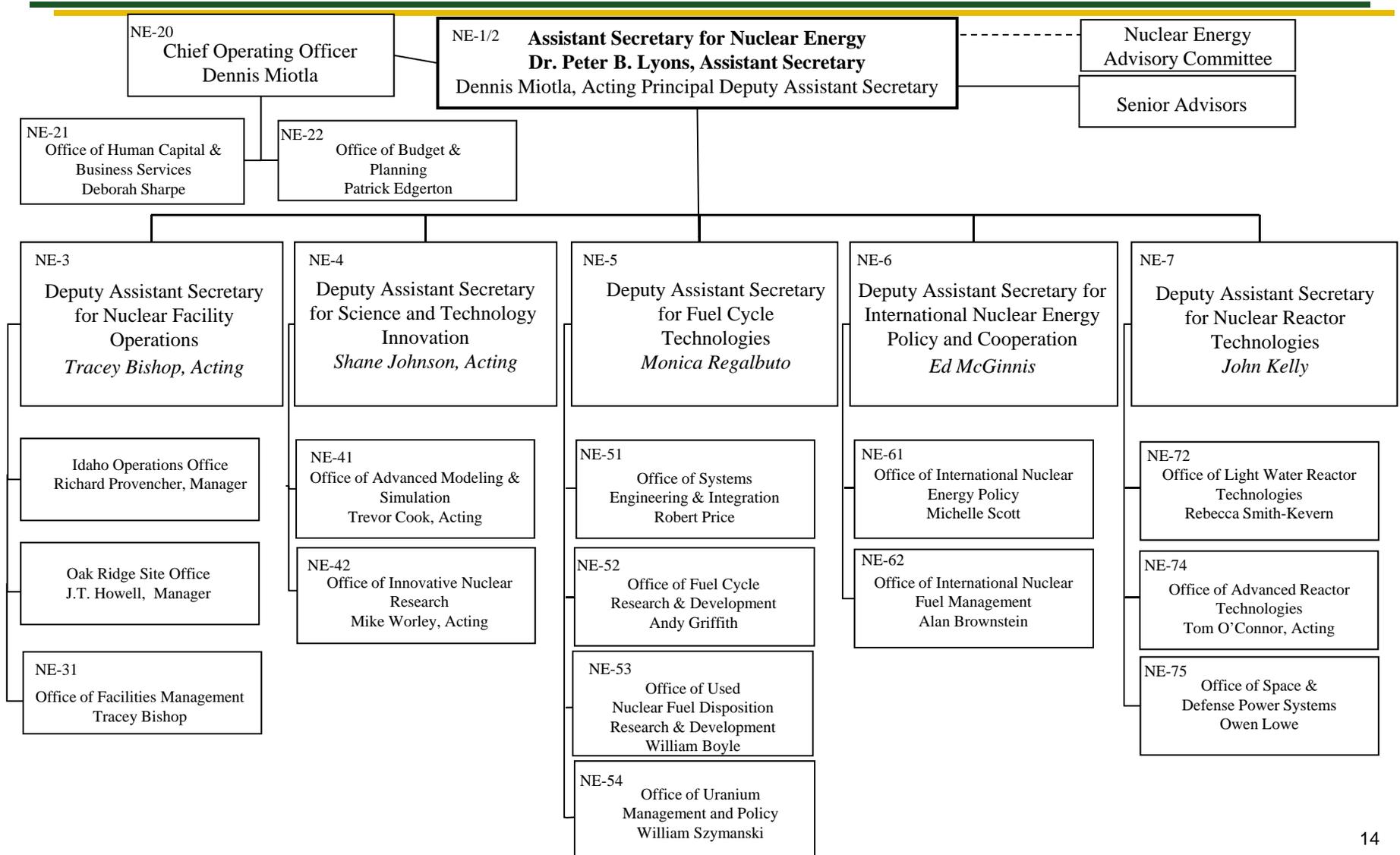
Babcock and Wilcox (B&W) Selected for First SMR Award

- The Department has selected Babcock & Wilcox (B&W), in partnership with the Tennessee Valley Authority (TVA) and Bechtel, to receive the first award under the Small Modular Reactor (SMR) Licensing Technical Support Program.
- The mPower SMR design is technically well-conceived with a viable path to certification and licensing that has been worked aggressively with the Nuclear Regulatory Commission over several years leading to this selection.
 - ~180 MWe
 - Utilizes standard UO₂ LWR fuel
 - Up to 4 year refueling interval
 - Provides air-cooled condenser option





NE Reorganization Approved

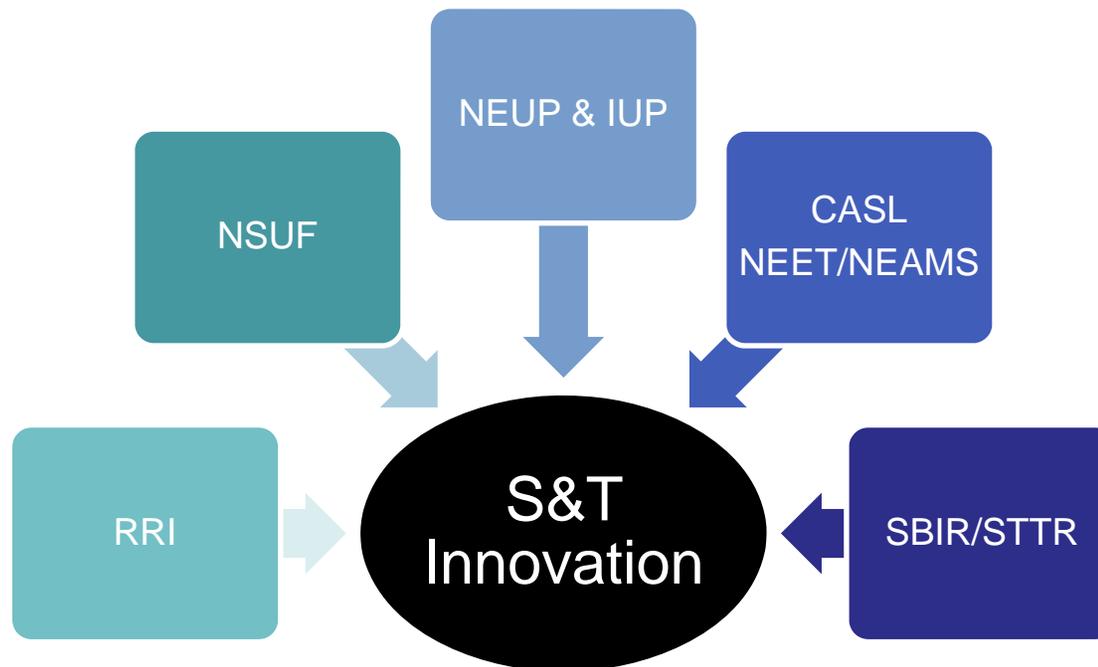




Science and Technology Innovation

■ Vision

- Coordinate Office of Nuclear Energy (NE) competitive research
- Work with NE R&D Programs to integrate all research and foster a balanced portfolio





Uranium Extraction from Seawater

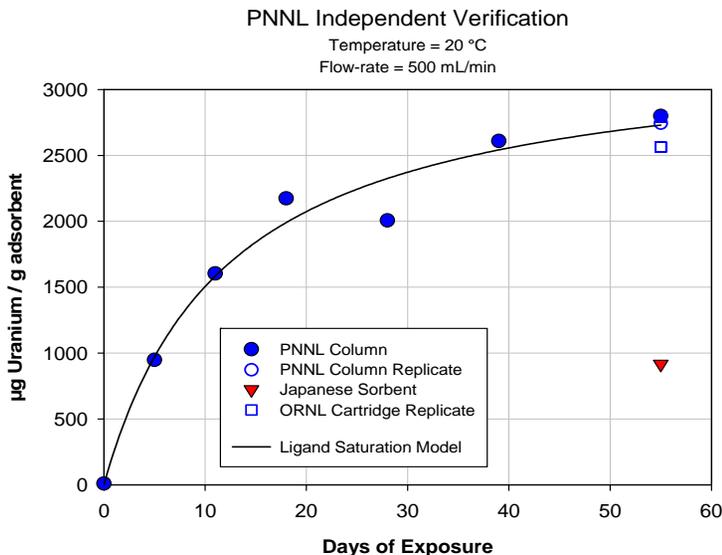
Winner of R&D100 Award in 2012



Courtesy: M. Tamada

Vast potential resource in seawater: ~4.5 billion tonnes U
Challenge is low concentration: ~3.3 ppb in seawater

- provide a price cap and ensure centuries of U supply even with aggressive world-wide growth in nuclear energy applications



Seawater Uranium Sorption Capacity

U.S. sample	2.75	(g U/kg Adsorbent @20°C)
Japanese sample	0.92	

ORNL adsorbents showed 3 times higher U capacity than the Japanese adsorbent

U.S. Investment Strategies-

Develop novel adsorbent materials:

Increase surface area via reduce fiber size and change fiber shape; Increase functional group density and grafting efficiency via tailored nanostructure design, nano-manufacturing and irradiation techniques; Enhanced ligand design via computational modeling and computer-aided screening

Understand coordination modes, sorption mechanism, kinetics, and thermodynamics

Enhance adsorbent durability

Increase the number of recycles/reuse;
Improve U stripping methodology

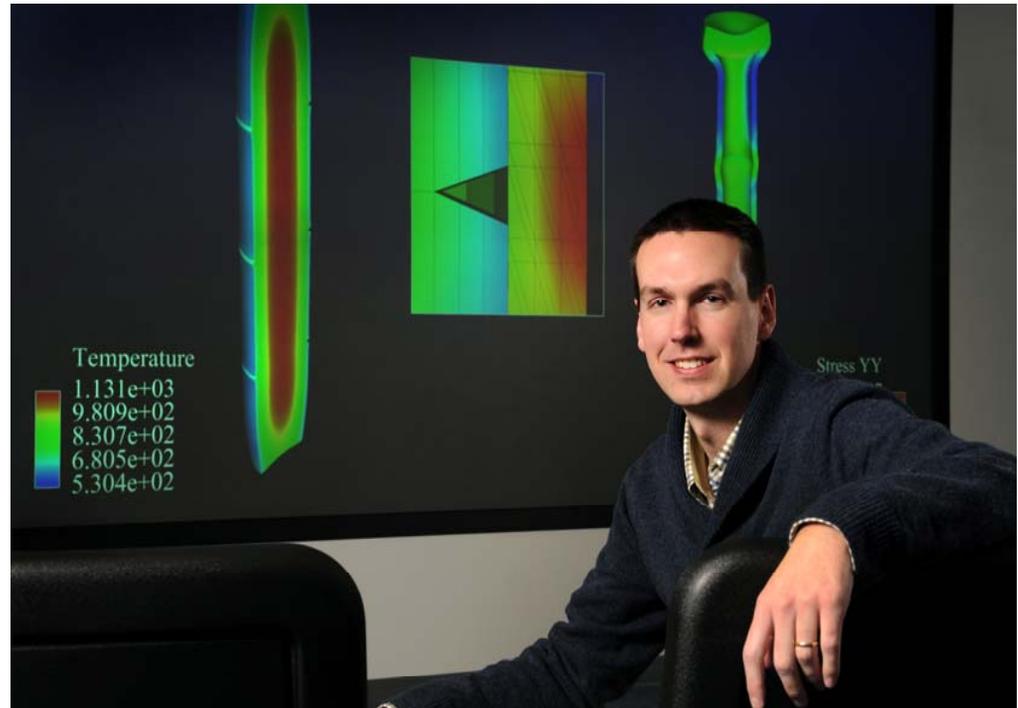


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The Presidential Early Career Awards for Scientists and Engineers (PECASE)

- The Office of Nuclear Energy had its first ever PECASE recipient, Mr. Derek Gaston from Idaho National Lab.
- Derek was nominated for the development of MOOSE- a multi-physics simulation framework that enables the rapid creation of fast engineering simulation tools, for the application of this framework to the understanding of accident-tolerant and novel nuclear fuels, and for his service to the scientific community.



For more information on Derek's research, please visit: <http://www.inl.gov/research/moose>.



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Global Demand for Nuclear Energy Continues



Sanmen- January 2012



Summer - May 2012



Vogtle – August 2012

■ Key Drivers:

- Long-term energy supply/energy security
- Clean, base-load source of energy
- Significant source of jobs and economic benefit