Current Issues
DOE's Nuclear Energy Programs

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Office of Nuclear Energy
U.S. Department of Energy

National Conference of State Legislators
June 5th, 2014
President Obama’s 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

“Today, I'm announcing a new national climate action plan, and I'm here to enlist your generation’s help in keeping the United States of America a leader -- a global leader -- in the fight against climate change.”

June 25, 2013, Georgetown University

“...the debate is settled. Climate change is a fact. And when our children's children look us in the eye and ask if we did all we could to leave them a safer, more stable world, with new sources of energy, I want us to be able to say yes, we did.”

President Obama’s 2014 State of the Union Address
“The Energy Department is committed to strengthening nuclear energy’s continuing important role in America’s low carbon future, and new technologies like small modular reactors will help ensure our continued leadership in the safe, secure and efficient use of nuclear power worldwide.”

*New Investment in Innovative Small Modular Reactor, December 12, 2013*

“All-of-the-above is not merely a slogan, but a clear-cut pathway to creating jobs and at the same time reducing carbon emissions, which recently stood at their lowest level in 20 years... President Obama has made clear that he sees nuclear energy as part of America’s low carbon energy portfolio. And nuclear power is already an important part of the clean energy solution here in the United States.”

*The National Press Club, February 19, 2014*
Highlights of the Nuclear Energy FY 2015 Request

- **Small Modular Reactors ($97M)**—Continues technical support for licensing two SMRs.
- **Reactor Concepts ($101M)**—Expands light water reactor sustainability efforts to maintain carbon free generation of the current fleet and supports development of non-water cooled reactor systems.
- **Nuclear Energy Enabling Technologies ($78M)**—Continues Energy Innovation Hub for Modeling and Simulation for second 5-year period; advanced modeling and simulation for NE R&D programs.
- **Fuel Cycle R&D ($189M)**—Expands effort to develop commercial used nuclear fuel disposal solutions; maintain schedule for 2016 selection of accident tolerant fuel candidates for further development and testing.
- **Supercritical CO2 demonstration ($28M)**—Initiates multi-program effort to accelerate commercialization of sCO2 Brayton cycle energy conversion technologies with a 10MW demonstration project.
- **Idaho National Laboratory ($290M)**—Modernization of facilities and security capabilities.

<table>
<thead>
<tr>
<th>FY 2014 Enacted</th>
<th>FY 2015 Request</th>
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<tr>
<td>$888M</td>
<td>$863M</td>
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# NE FY 2015 Congressional Budget Request Summary

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<tr>
<th>Area</th>
<th>FY 2014 Request</th>
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<td>Integrated University Program</td>
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<td>SMR Licensing Technical Support</td>
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<td>Supercritical Transformational Electric Power Generation</td>
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<td>Adjustments b</td>
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<td><strong>Total, Nuclear Energy</strong></td>
<td>735,460</td>
<td>888,376</td>
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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.
Secretary Moniz Announces $6.5 Billion Vogtle Loan Guarantee

“The construction of new nuclear power facilities like this one - which will provide carbon-free electricity to well over a million American energy consumers - is not only a major milestone in the Administration’s commitment to jumpstart the U.S. nuclear power industry, it is also an important part of our all-of-the-above approach to American energy as we move toward a low-carbon energy future...

The innovative technology used in this project represents a new generation of nuclear power with advanced safety features and demonstrates renewed leadership from the U.S. nuclear energy industry.”
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
- DOE is working with B&W to establish a path forward for the mPower project

NuScale Power

- Selection of NuScale announced on December 12, 2013
- Cooperative Agreement signed May 27, 2014
- DOE to fund up to $217 M for NuScale SMR development
- DCA submittal currently planned for 2nd half of 2016
Light Water Reactor Sustainability Program

LWRS Program Goal
- Develop fundamental scientific basis to allow continued long-term safe operation of existing LWRs (beyond 60 years) and their long-term economic viability

LWRS program is developing technologies and other solutions to
- Enable long term operation of the existing nuclear power plants
- Improve reliability
- Sustain safety

LWRS focus areas
- Materials Aging and Degradation
- Advanced Instrumentation and Controls
- Risk-Informed Safety Margin Characterization
- Systems Analysis and Emerging Issues (includes research to support post-Fukushima lessons learned)
Accident Tolerant Fuels Became a Major Focus Area after Fukushima

Goal: By 2022, develop and test, in an existing LWR, an advanced fuel rod which tolerates loss of active cooling in the core for considerably longer time period than existing fuel.

Objectives:

- Significantly reduce or eliminate hydrogen generation
- Reduce spent fuel volume through increased burnup
- Reduce Fuel Pin Failures & Increased reliability
- Improve Economics & Permit Power Upgrades

Congressional Direction:

The Fukushima (March 2011) accident led the U.S. Congress to direct the DOE to focus efforts on development of fuels with enhanced accident tolerance.
INL Facilities

Resumption of Transient Testing

- Environmental Assessment and Finding of No Significant Impact (FONSI) was issued in February 2014 which identified TREAT at INL as the preferred alternative.

- Goal is to resume transient testing operations by FY 2018 which supports the future testing needs of the Accident Tolerant Fuels program.

- Preliminary assessments of the reactor fuel, the filtration/cooling system (HEPA), and the electrical distribution system have all come back positive.

- Current efforts are focused on updating safety documentation and procedures to allow for fuel handling and movement of the control rod drives.
On March 27, 2014, DOE exercised an option in BEA’s original 10-year contract to operate INL for an additional 5 years.

The basis for exercising the option to extend is BEA’s consistently strong annual performance and success in managing INL.

The contract to create INL was awarded to BEA in November 2004 and began on Feb 1, 2005. BEA will now operate INL through September 30, 2019, contingent on continued high-performance.
The Offices of Nuclear Energy and Energy Efficiency and Renewable Energy have agreed to sponsor a study of Hybrid Energy Systems. The study will examine optimizing clean energy sources (intermittent and baseload) to produce clean energy products.

Kickoff workshop will occur July 8 through July 10 at Idaho National Laboratory. Academia, industry, and international participants are invited.
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 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 foreign research partners are strongly encouraged to actively engage and collaborate with the NE R&D programs.

Since FY09, NEUP and IUP have awarded $290M to 89 schools in 35 States and the District of Columbia.
Coordinated U.S. Efforts to Support Nuclear Power

White House Director for Nuclear Energy Policy
- Coordinate U.S. government policy and activities
- Enhance interaction with foreign decision makers

Types of Efforts:
- Industry Analysis
- Commercial Liaisons
- Advocacy
- Dual-Use Licensing

Other Efforts:
- Financing Policy
- Export Credit Financing

- Financing for:
  - Feasibility Studies
  - Reverse trade missions

- Standards
  - Licensing
  - Bilateral cooperation

- RD&D
  - Infrastructure
  - Fuel Cycle
  - Licensing
  - Nonproliferation
  - International Cooperation

- Foreign Policy
  - Nonproliferation
  - 123 Agreements
  - Infrastructure

Industry Advisory Committee (CINTAC)
Impact of Early Retirements on Clean Energy Goals

- **Consider Dramatic Retirement Scenario**
  - One-third of the reactor fleet, ~26 GW, 200 TWh/yr
  - Replacement power estimated to add 125 MT per year

- **Near-term Target: Reduce Emissions 17% by 2020**
  - 2005 emissions from power sector: 2,417 MT
  - Reduction target of 411 MT climbs to 536 MT (30% increase)

- **Long-term Target: 80% Clean Electricity by 2035**
  - Need 2,900 TWh non-emitting power; EIA: 800 TWh of nuclear, 700 TWh of renewable
  - 1,400 TWh shortfall grows to 1,600 TWh with retirements

Meeting energy goals will be challenging. Retiring nuclear plants early makes the challenge more daunting.
Declining Electricity Demand Forecasts

Nuclear Energy

EIA, Annual Energy Outlook

June 5, 2014
Presentation to NCSL
Current (2012) capacity by initial year of operation and fuel type
gigawatts

- Coal
- Natural Gas
- Nuclear
- Petroleum
- Hydro
- Other
- Wind

EIA
Natural Gas Price in U.S.

Natural Gas Price for Electric Power Production

Dollars per thousand cubic feet


EIA
The range around these averages can be significant

- +/- ~40% from first to fourth quartile
- Greater variation for single- vs. multi-unit plants, older vs. younger units
Carbon Implications of Retirements

Estimated Annual CO₂ Emissions from Power Sector

- Announced Closures Only
- 5% Fleet Closure
- 30% Fleet Closure

Retired nuclear plants are replaced almost entirely with natural gas-fired generation.
Global Demand for Nuclear Energy Continues

Sanmen – April 2014
Source: SNPTC

Vogtle – May 2014
Source: Georgia Power Co.

Haiyang – December 2013
Source: State Nuclear Power Engineering Feng Qingyi Wang Jinjie.

Summer – June 2014
Source: SCE&G