Fuel Cycle Research and Development

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Mission and Program Objectives

**Mission**

Ensure America’s security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions.

Goal 3: Secure Our Nation
- Enhance nuclear security through defense, nonproliferation, and environmental efforts.

Advance nuclear power as a resource capable of making major contributions in meeting the Nation’s energy supply, environmental, and energy security needs by resolving technical, cost, safety, security and regulatory issues through research, development, and demonstration.

Develop sustainable fuel cycles and Used Fuel waste management strategies that improve resource utilization, minimize waste generation, improve safety and limit proliferation risk.

**Program Objectives**

**NE**

- Down select fuel cycle options for further development.
- Increase focus on accident tolerant fuels.
- Address BRC recommendations for Used Fuel Disposition.

**DOE**

- Conduct science based, engineering driven research for selected fuel cycle options.
- Complete implementation plan for developing a Test and Validation Complex for extended storage of used nuclear fuel.
- Evaluate benefits of various geologic media for disposal.

**FCRD**

- Demonstrate the selected fuel cycle options at engineering scale.
- Execute Test and Validation Complex for extended storage of Used Fuel.
- Conduct engineering analysis of disposal site(s) for selected geologic media.
Strategic Linkages

Nuclear Energy

- Sustainable Fuel Cycles
- FCRD
  - Used fuel management
  - Accident tolerant fuels
  - Advanced Reactor Fuels
  - Fuel resources
  - Spent fuel separation/conditioning processes
  - Secondary waste form development
  - Special nuclear materials protection, accounting and control
- Enable New Reactors
- Minimize Proliferation and Terrorist Risk
- Extend Life of Current Reactors
Working Toward an Integrated Fuel Cycle Approach

### Front End

- **Uranium Resources**
  - Conventional production
  - Innovative approaches

- **Fuel Fabrication**
  - Safety enhanced LWR fuel
  - Higher performance

- **Reactors**
- **Interim Storage**
  - Evaluating extended time frames
  - Transportation after storage

### Back End

- **Recycle**
  - Separations
  - Recycled fuel
  - Secondary waste treatment

- **Disposal**
  - Alternative geologies
  - Alternative waste forms

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Optimize Through Systems Analysis and Engineering
## Fuel Cycle Technical Focus Areas

### Nuclear Energy

#### Fuel Resources
- Conventional production - support uranium enrichment operations.
- Innovative approaches - developing alternative technologies that can provide significant quantities of fuel resources at an economically-viable cost.

#### Advanced Fuels
- Developing next generation light water reactor fuels for improved operating margins, accident tolerance, and high burnup.
- Developing transmutation metal fuel with a high degree of tolerance to accident conditions that represent advances in resource utilization and reduced waste.

#### Separations and Waste Forms
- Developing next generation separations and waste management technologies that enable a sustainable fuel cycle.
- Developing fuel disposal conditioning technologies.
- Developing recycling technologies with minimal processing, waste generation, and potential for material diversion.

#### Materials Protection, Accounting, and Control Technology
- Developing instrumentation capable of real-time measurement of group transuranics in advanced fuel systems.
- Developing proliferation risk analyses applied to advanced fuel cycles.

#### Used Nuclear Fuel Disposition
- Developing technologies for storing, transporting, and disposing of used nuclear fuel.
- Assessing performance of high-level waste forms in the associated storage and disposal environments.

### Systems Analysis and Integration
- Providing a systematic and objective process to prioritize research and development activities and inform programmatic decisions.
Key Challenges to Success & Out Year Considerations

Blue Ribbon Commission
- Recommendations could lead to near term program shifts and a major restructuring in the longer term.
- Potential to consider interim storage and associated transport to centralized storage location.

Fukushima Event
- May lead to shifting program priorities while also dealing with reduced overall program funding.
- Severe accident tolerant fuel.
## FY 2011-12 Budget Summary

### Nuclear Energy

*Dollars in thousands*

<table>
<thead>
<tr>
<th>Activity/Sub-Activity</th>
<th>FY 2011 Current</th>
<th>FY 2012 (a) Request</th>
<th>FY 2012 (a) Appropriation</th>
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<tr>
<td>Separations and Waste Forms</td>
<td>37,133</td>
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<td>Advanced Fuels</td>
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<td><strong>Total</strong></td>
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<td><strong>150,670</strong></td>
<td><strong>187,351</strong></td>
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a. Does not include SBIR/STTR contribution.
b. Assess issues related to the aging and safety of storing spent nuclear fuel in fuel pools and dry storage casks.
c. $10M for development and licensing of standardized casks, $3M for developing models for potential partnerships to manage waste, $7M for characterizing potential geologic repository media.
Integration within NE and Other Offices

**Within NE**
- Coordinates with Reactor Technologies in crosscutting areas:
  - NEAMS
  - LWRS
  - Nuclear data
  - Proliferation risk assessment
- Facilities Management funds crosscutting facilities required by FCR&D: ATR, advanced PIE capability, and transient testing capability.

**NNSA**
- Safeguards - close coordination with large NNSA programs:
  - NA-24’s Next Generation Safeguards Initiative: Technology and Concepts
  - NA-22’s Nonproliferation R&D: Global Safeguards

**EM**
- Coordinated R&D is conducted in:
  - Disposal technologies
  - Waste forms

**SC**
- Coordinated R&D is conducted in:
  - Modeling and simulation
  - Materials
  - Nuclear physics
  - Separations

NE lead separations workshop aimed at identifying the crosscutting needs of DOE for separations technologies and to speed development, examining opportunities to leverage R&D across DOE.
Evaluation and screening process:

- Provides a systematic and objective process to prioritize R&D activities
- Informs programmatic decisions