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Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste

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Nuclear Regulatory Commission
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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.**

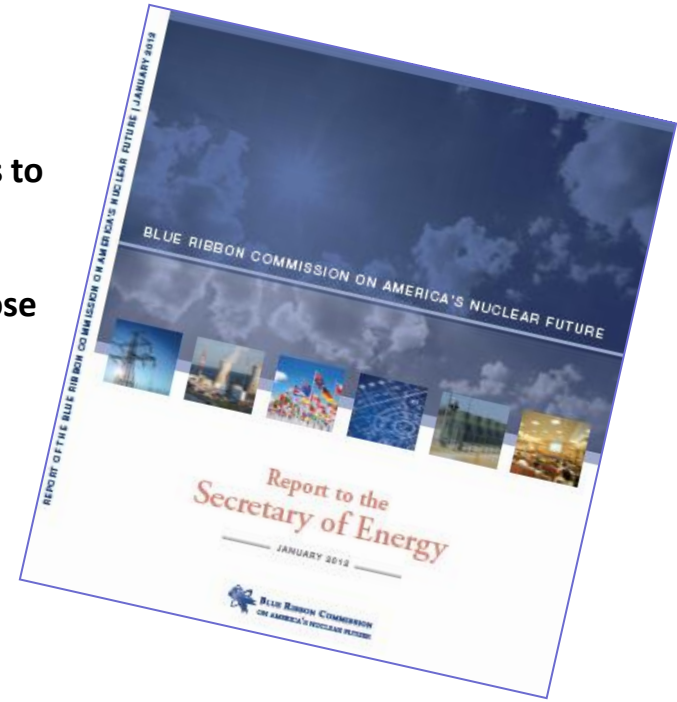
4. **Prompt efforts to develop one or more geologic disposal facilities.**

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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Summary of the Administration's UNF and HLW Strategy

- **Statement of Administration policy regarding the importance of addressing the disposition of used nuclear fuel and high-level radioactive waste, released January 2013.**
- **Response to the final report and recommendations made by the *Blue Ribbon Commission on America's Nuclear Future***
- **Initial basis for discussions among the Administration, Congress and other stakeholders**
- **10-year program of work that:**
  - Sites, designs, licenses, constructs and begins operations of a pilot interim storage facility
  - Advances toward the siting and licensing of a larger interim storage facility
  - Makes demonstrable progress on the siting and characterization of geologic repository sites

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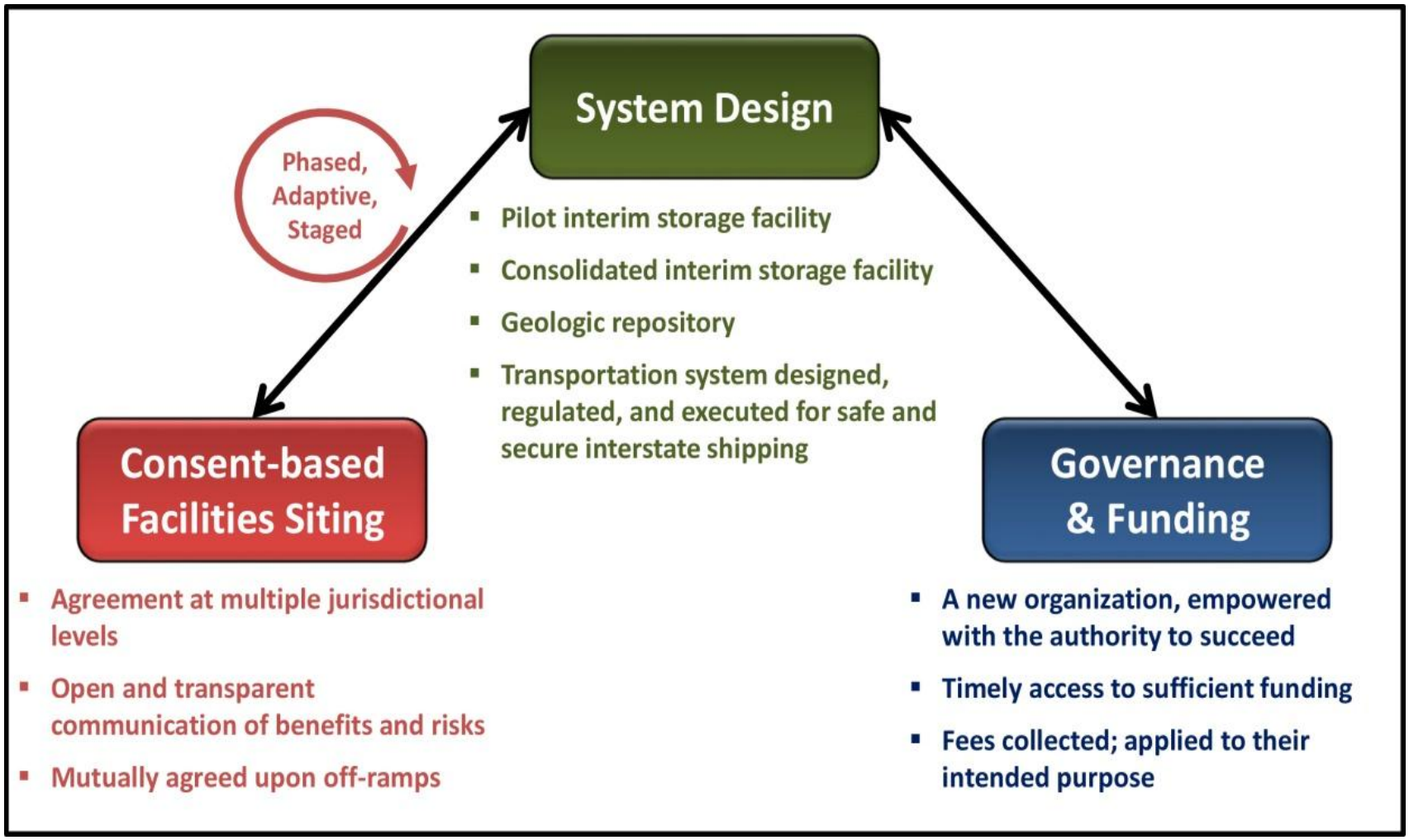
Key Strategy Elements



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Conclusion: Legislation Needed for Implementation

- Active engagement in a broad, national, consent-based process to site storage and disposal facilities
- Siting, design, licensing, and commencement of operations at a pilot-scale storage facility
- Significant progress on siting and licensing of a larger consolidated interim storage facility
- Development of transportation capabilities to begin movement of fuel from shut-down reactors
- Reformation of the funding arrangements
- Establishment of a new organization to run this program

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Backup

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Administration Focus on Disposition of Used Nuclear Fuel

- **The program is a very long term, flexible, multi-faceted approach to dispose of the nation's commercial and defense waste. The estimated programmatic cost of this effort over its first 10 years is $5.6 billion including:**
  - construction and operation of a pilot interim waste storage facility
  - progress on both full-scale interim storage and long-term permanent geologic disposal
- **Proposed funding will consist of:**
  - Ongoing discretionary appropriations of up to $200M beginning in 2014 and continue for the duration of the waste management mission
  - Mandatory appropriations from the fee collections and balance of the Nuclear Waste Fund in addition to the discretionary funding provided annually beginning in 2017 to fund the balance of the annual program costs
- **Other Strategy Elements in President's Budget**
  - funding and authority for EPA to begin the revision of generic (non-site specific) disposal standards to help guide the siting of used fuel and high-level waste facilities

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FY 2014 Budget includes $60M for Strategy Implementation Activities

- **Research and Development: $30M**
  - R&D to support extended storage of used fuel
  - R&D on alternative disposal environments (modeling, evaluation and experiments)
  - Implement field tests to advance salt repository science for disposal of heat-generating waste
  - Borehole Research: Undertake R&D as necessary to further the understanding of hydro-geochemical, physical geology, structural geology, geophysical state and engineering properties of deep crystalline rocks
  - Increase involvement with international organizations to leverage existing international knowledge
  - R&D to support transportation of extended storage fuel: field testing to assess realistic loadings during transport

- **High-Level Waste Management and Disposal System Design Activities: $30M**
  - Continue developing plans for a consent-based siting process
  - Complete an analysis for initial used fuel shipments from shutdown reactor sites
  - Continue the conceptual design for a generic storage facility and supporting transportation system
  - Conduct system architecture and operating evaluations of various used fuel management systems
  - Continue the evaluation of standardized containers for storage, transportation, and potentially disposal
  - Continue to work cooperatively with the state regional groups on transportation issues
  - Update the National Transportation Plan to address initial shipments from shutdown reactors to a generic consolidated storage facility

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Implementation: Interim Storage Facilities

- **Facilities sited using consent-based process and licensed by the Nuclear Regulatory Commission**
- **Pilot-scale interim storage facility**
  - Focused on servicing shutdown reactors
  - Operational in 2021
- **Consolidated interim storage facility**
  - Larger capacity to provide system flexibility
  - Operational in 2025
- **Facilities could service environmental cleanup and defense sites**

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Implementation: Geologic Disposal

- **Geologic Repository**
  - Sited using consent-based process by 2026
  - Designed and licensed by 2042
  - Operational in 2048
- **One of each facility for now, possible additions based on consent-based process**

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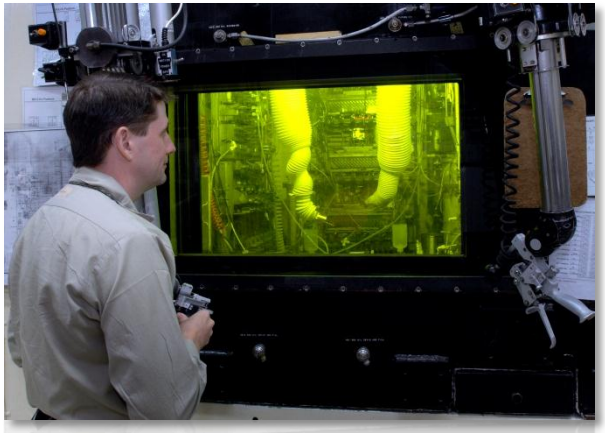
Oak Ridge National Laboratory's Technical Assessment of U.S. Used Nuclear Fuel Inventory

Based on retention needs, current UNF can be divided into 3 categories:

Disposal

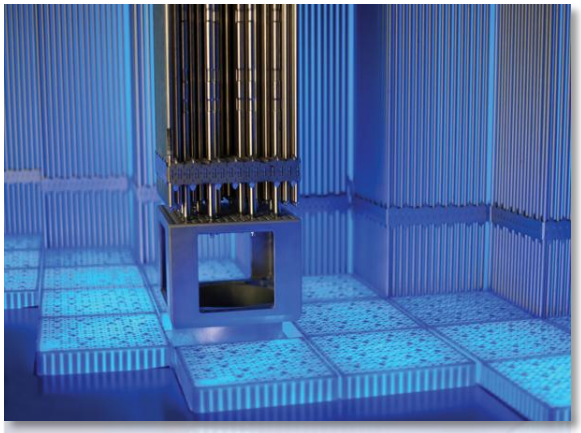
- Excess material not needed for other purposes

Research



- Material needed for R&D to support
  - UNF management
  - Advanced fuel cycle development

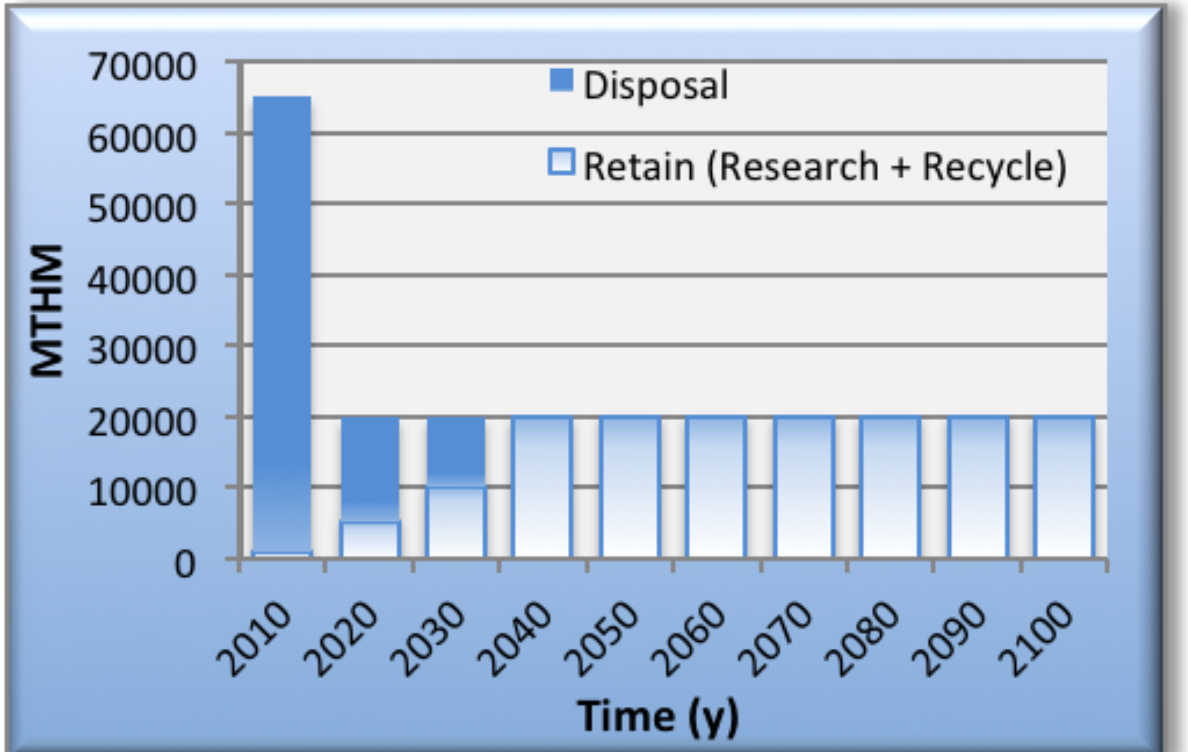
Recycle



- Material with inherent and/or strategic value

Oak Ridge National Laboratory's Technical Assessment of U.S. Used Nuclear Fuel Inventory

- **Disposal of 98% of current inventory: No adverse impact on deployment of future alternative fuel cycles**



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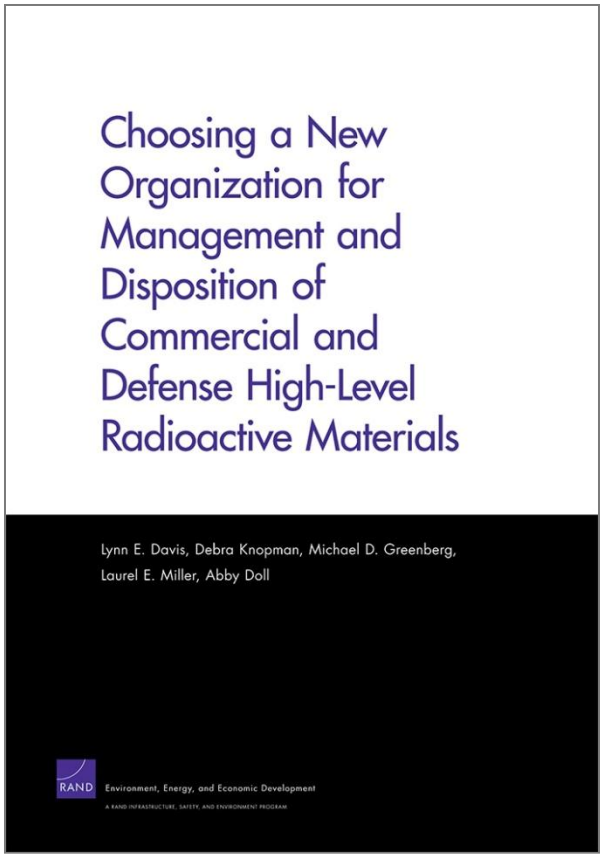
Implementation Disposal: Consent-based Process and New Organization

- **Consent-based process**
  - Host jurisdictions to be recognized as partners
  - Consent required at multiple levels
  - Public trust and confidence necessary for success
  - Defining process and terms is critical initial step
- **New Organization**
  - Multiple workable models
  - RAND study looked at independent government agency and government corporation models
  - Critical attributes: accountable, autonomous, mission-oriented, stable



Implementation: Funding

- **Ongoing appropriations**
  - Ongoing role for Appropriations Committees with funds from the General Fund
  - Could fund specific activities – e.g., management, personnel, regulatory development activities
  - Could meet obligation to fund disposal of government UNF and HLW
- **Reclassification of fee income or spending**
  - Needed to support:
    - interim storage facility development and operations
    - repository siting and licensing
  - Could move fee income to discretionary or move spending to mandatory
  - Annual amounts limited by incoming fees (~$750M/year)
- **Access to "corpus" of the Nuclear Waste Fund**
  - Needed for construction of repository
  - Could be tied to specific milestones or performance triggers

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Implementation: Transportation

- Initiate planning for a large-scale transportation program
- Evaluate operational options for consolidated storage and furthering the design of a generic consolidated storage facility
- Evaluate the inventory, transportation interface, and shipping status of used nuclear fuel at shut-down reactor sites
- Complete assessment of transportation needs, (e.g., cask, rail cars, support and security).

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Implementation: Transportation (cont'd)

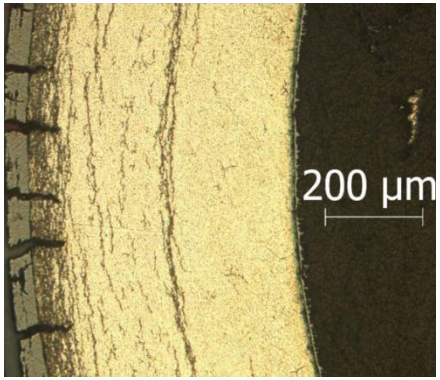
- **Engage state and regional groups and tribal representatives on transportation planning and emergency response training consistent with NWPA Section 180(c) to ensure the implementation of a staged, adaptive, consent-based transportation for SNF and HLW.**
- **BRC recommends that the development of routes from shut down reactors in the region be developed in a collaborative manner and in a similar process found in successful DOE shipping campaigns, such as WIPP.**

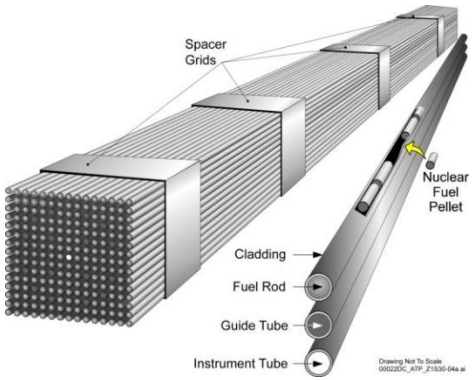
Objective

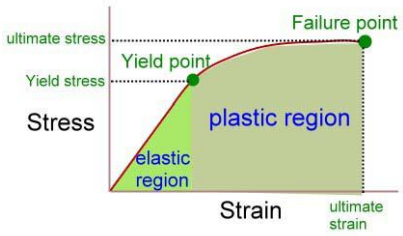
Prepare for the eventual large-scale transport of spent nuclear fuel and high level waste

Develop the technical basis for:

- **Fuel retrievability and transportation after extended storage**
- **Transportation of high burn-up used nuclear fuel**







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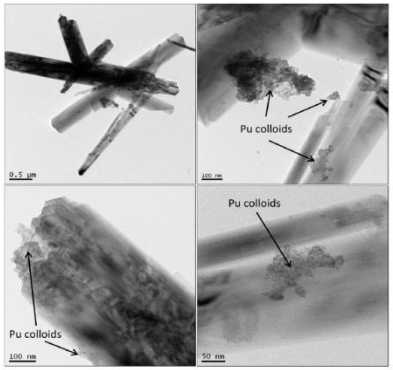
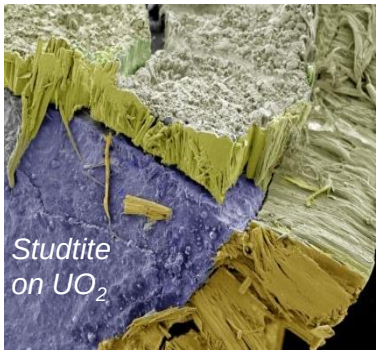
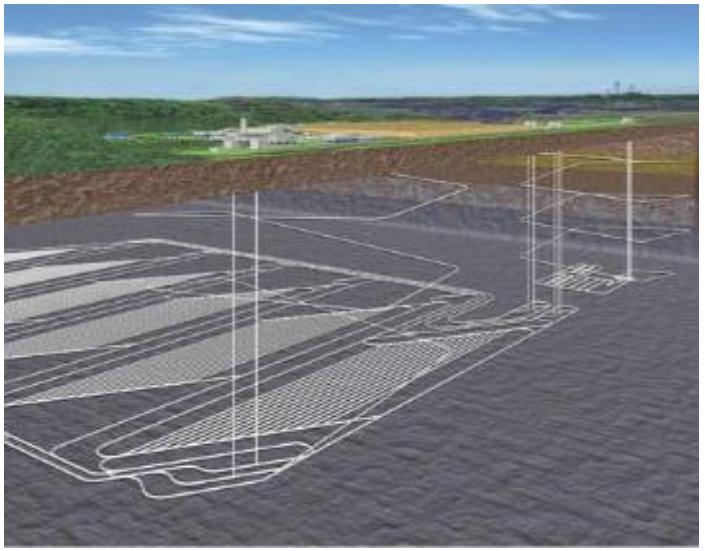
Disposal R&D: Keep repository program moving through non-site specific activities

- Increase analysis capabilities of geologic media that were not looked at since the decision to focus on Yucca Mountain.
- Goal is to determine there is a technical basis for disposal in the U.S. in these different geologic settings and will provide confidence in future decisions.

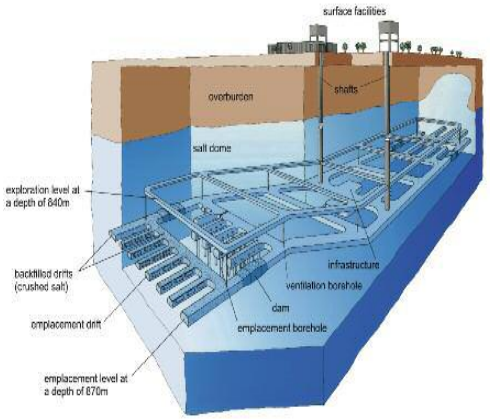


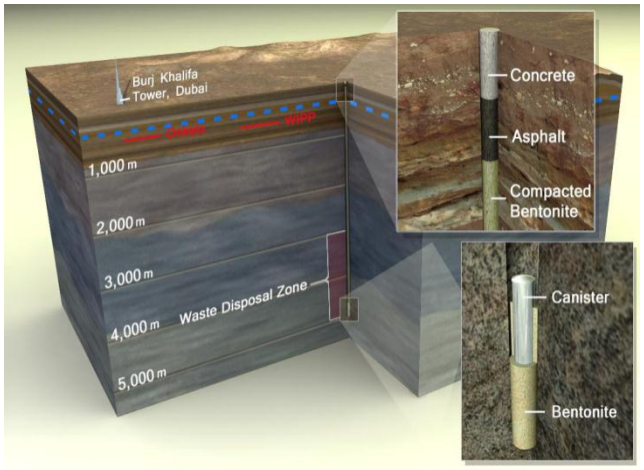


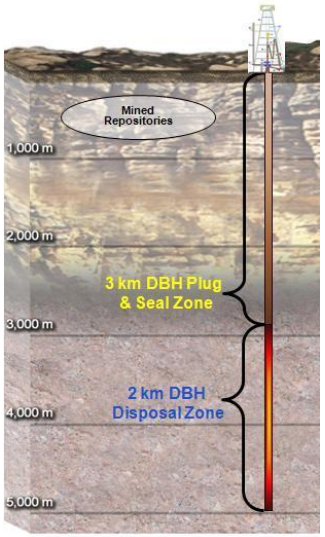


Disposal R&D (con't)

- Conduct field work at WIPP relevant to repositories in salt.
- Develop an R&D plan and roadmap for taking the borehole disposal concept to the point of a demonstration.
- Conduct R&D on the direct disposal of existing dual purpose (storage and transportation) canisters.







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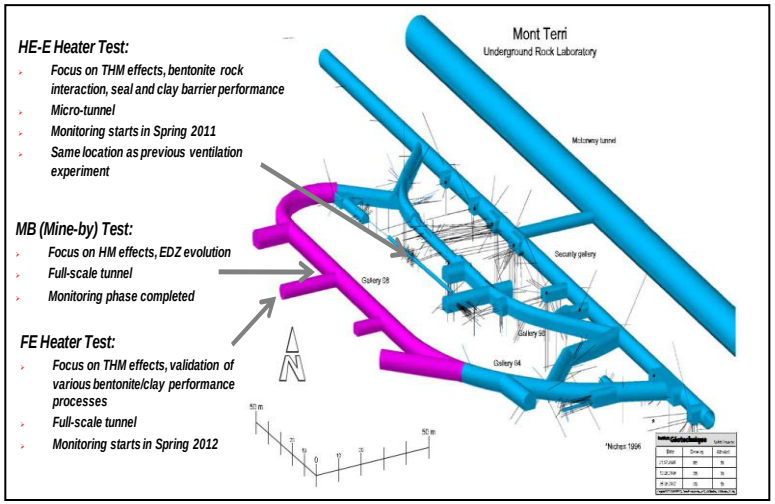
Work with International Partners who have Existing Facilities

Formal collaborative R&D arrangements with ongoing programs in Europe and Asia

Major current or soon-to-be started experiments



- Mont Terri: Underground research laboratory in clay (Switzerland)
- Grimsel: Colloid Formation and Migration Project in granite (Switzerland)
- DECOVALEX: (Development of Coupled Models and their Validation against Experiments)
- KAERI Underground Research Tunnel: Borehole Geophysics (South Korea)
- SKB: Task Forces on Groundwater Flow and Engineered Barriers at Aspo Hard Rock Laboratory (Sweden)
- BMWi: Data exchange for salt repositories at Gorleben and WIPP (Germany)
- ANDRA: Natural and Engineered Barriers in clay and shale (France)

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Fuel Cycle Research and Development

Budget Summary
$ in thousands

Program Element	FY 2012 Current	FY 2014 Request
Separations and Waste Forms	31,273	35,300
Advanced Fuels	57,154	37,100
Systems Analysis & Integration	16,527	21,500
Materials Protection, Accounting & Control Technology	5,000	7,600
Used Nuclear Fuel Disposition	57,890	60,000
Fuel Resources	3,501	3,600
Spent Nuclear Fuel Analysis	9,648	-
Total:	**180,993**	**165,100**

- **Mission**
  - Develop used nuclear fuel management strategies and technologies; conduct R&D on fuel cycle technologies and options.
- **FY 2014 Planned Accomplishments**
  - Continue activities that support the Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste
  - Develop design concepts for consolidated storage facilities
  - Explore the logistics for shipping orphan fuel to a consolidated interim storage facility
  - Identify promising candidate accident tolerant fuel cycle concepts for study
  - Advance salt repository science for disposal of heat-generating waste
  - Continue research to understand deep borehole disposal
  - Complete an analysis for initial used fuel shipments from shutdown reactor sites