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# Technical Basis for Long-Term Storage of Used Nuclear Fuel

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# Introduction and Purpose

- Termination of Yucca Mountain Project necessitates a new strategy for the safe management of nuclear wastes from the U.S. nuclear power enterprise
- The U.S. Administration established the Blue Ribbon Commission on America's Nuclear Future to examine and offer recommendations on alternative strategies for the management of nuclear wastes.
- The BRC recommendations are likely to result in a new/revised U.S. national policy for nuclear waste management
- Long-term storage of spent nuclear fuel at power plant sites and/or centralized facilities is expected to be a major component of the new/revised national policy
- The purpose of this presentation is to discuss current efforts in the U.S. to develop the technical basis to support the licensing of long-term storage facilities

# Policy → Issues → Consequences

## Policy

- New/revised U.S. national policy for nuclear waste is expected to include storage of used fuel for the foreseeable future (>120 yrs).

## Issues

- Licenses for long term dry storage of used fuel are issued for 20 years, with possible renewals up to 60 yrs. A new rule-making will allow the initial license for 40 years with one possible 40-year extension.
- Questions regarding
  - retrieval and transport of used fuel after long term storage
  - storage and transportation of high burnup fuel (>45 GWD/MTU)

## Consequences

- Technical bases need to be developed to justify licensing;
  - used fuel storage beyond 60 to 80 years
  - retrievability and transportation of used fuel after long-term storage
  - transportation of high burnup fuel

# DOE Used Fuel Disposition Program

**The Used Fuel Disposition (UFD) Campaign was established in late 2009 by the DOE Office of Nuclear Energy's Fuel Cycle Research and Development (R&D) Program. The UFD mission is to identify and conduct R&D to enable the management (i.e., storage, transportation and disposal) of used nuclear fuel and other wastes generated from both existing and future nuclear fuel cycles.**

**In the long-term, the UFD program activities are designed to provide the technical bases that will demonstrate confidence in the long-term storage, transportation and disposal of used nuclear fuel and other wastes from nuclear energy activities in the U.S.**

**In addition, the DOE Office of Nuclear Energy Advanced Modeling and Simulation (NEAMS) Campaign has initiated the development of high performance computing capabilities that can be used to evaluate various parts of existing and future nuclear fuel cycles, including waste disposal.**

**Together with the on-going BRC activities, the UFD represents the bulk of the present U.S. activities related to the management of nuclear wastes generated from civilian and some defense uses of nuclear energy. Another paper at this conference discusses in greater detail the UFD.**


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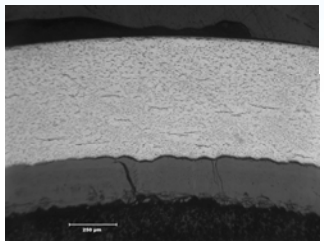
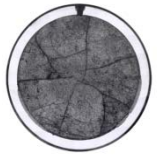
# DOE UFD Storage Program

- **R&D Opportunities**
  - Data gap analysis
  - Plan to address gaps
  - Development of technical basis
- **Security**
  - Regulatory assessment
  - Identify areas peculiar to long-term storage
  - Evaluate vulnerability analysis methodology improvements
- **Conceptual Evaluations**
  - Develop process for development of technical basis
  - Evaluate several scenarios for decision makers






**UFD Storage Implementation Plan Goals**

- **1 yr: Project Implementation Plan Framework**
- **5 yr: Project Implementation Plan & Development of Technical Basis**
- **10 yr: Field operating project**

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# DOE UFD Storage R&D Opportunities

Preliminary Moderate and High Priority R& D Needs

| System | Issue | Priority of New Research |
|---|---|---|
| Cladding | Creep | Moderate |
| | Delayed Hydride Cracking | High |
| | Embrittlement - Radiation Induced - Annealing | Moderate |
| | Embrittlement - Hydride Induced | High |
| | Oxidation | Moderate |
| Container (Welds, Bolts, Seals) | Humid Oxidation | High |
| | Marine Environment | High |
| | Wet Corrosion: General, Pitting, Crevice, Galvanic, Stress Corrosion Cracking | High |
| | Temperature Fluctuations Relax Seals and Bolts | Moderate |
| Monitoring Systems | Develop New Performance Confirmation Monitoring Systems | Moderate |

# Concept Evaluation

## Goal

- To integrate research and security needs into a comprehensive plan to provide a technical basis for licensing very long term storage and transportation (FY11) of used nuclear fuel.

## Objectives

- Early data development that could be accomplished in the next few years.
- Identify a spectrum of potential scenarios that span the range of possibilities for fielding a very long term storage demonstration facility in 10 years.
- Evaluate scenarios against an identified set of criteria to identify the best options for a demo facility.
- Select highest potential scenario for moving forward on the Implementation Plan

# DOE UFD Preliminary Concept Evaluation Framework

| DEMONSTRATION OPTIONS | | | | |
|---|---|---|---|---|
| | Monitor Existing ISFSI | Modified ISFSI | Demonstration Facility at a DOE Site | Construct a New Demonstration Facility |
| Siting and licensing | Licensed, may need NRC approval for operations | Licensed, may need NRC approval for operations | Operates under DOE orders | Licensing (or DOE permission) needed |
| Spectrum of UNF available | Limited | Full spectrum | Full spectrum | Full spectrum |
| Transportation requirements | None or very limited | Transportation of fuels needed | Transportation of fuels needed, many may be available | Transportation of fuels needed |
| Testing capabilities | Very limited | Somewhat limited – transportation needed for testing | Generally available; available in DOE complex | Either transportation will be needed or facilities must be built |
| Construction/ operating cost | Minimal | No construction cost, operating cost depends on fuels | Minimal construction cost, minimal to moderate operating cost | High cost |
| Radiological controls | Adequate controls exist | Adequate controls exist | Adequate controls exist | Must be installed |
| Waste mgmt | Needed | Needed | Probably exists | Needed |
| Security | Adequate security | Adequate security | Adequate security | Needed |

# Collaborative Efforts

**DOE/NE**

***Program Direction, Management***

**DOE/RW, EM**

***Collaboration, experience from related programs***

**Nat'l Labs**

**SNL, PNNL, ANL, INL, SRNL**

***Technical support for the 3 Work Packages***

**Nuclear Regulatory Commission**
**Supports efforts on**
**a collaborative basis**

**Industry**

**EPRI, NEI, Utilities, Suppliers**

***EPRI Extended Fuel Storage Collaboration Program***
***(Nov 18-19, 2009 Wash DC; May 3, 2010 Baltimore)***
***NEI Dry Storage Information Forum***
***(May 4-6,2010 Baltimore)***

**International**

**BAM (Germany), CRIEPI (Japan)**

***Both organizations interested in collaboration – link to EPRI program***
***IAEA Int'l Conference on Management of Spent Fuel from Power Reactors***
***(Vienna, May 31-June 4, 2010)***
***INMM Annual Meeting (Baltimore, July 11-15,2010)***
***Special session at PATRAM 2010 on Used Fuel Dry Storage (London, Oct. 3-8, 2010)***
***International High-Level Radioactive Waste Management Conference (April 10-12, 2011)***

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# Next Steps

- Develop and submit final Conceptual Evaluation Report
- Begin process to vet findings with industry and regulator
- Begin work on addressing technical gaps
- Continue process to develop demonstration alternatives

# Conclusions

- Long-term storage of used nuclear fuel may become the cornerstone of U.S. national policy for management of nuclear wastes
- A comprehensive program has been established by DOE to develop the technical basis for extension of used fuel storage for up to 300 years with subsequent transportation.
- The program is structured to take full advantage of all available means to develop the technical arguments, including:
  - comprehensive literature searches
  - experimental testing
  - analysis
  - collaboration with industry
  - collaboration with international organizations
  - collaboration with the U.S. regulator

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