

DOE/NE USED FUEL DISPOSITION STORAGE AND TRANSPORTATION PROGRAM

INMM 27th Spent Fuel Management Seminar

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Team Members

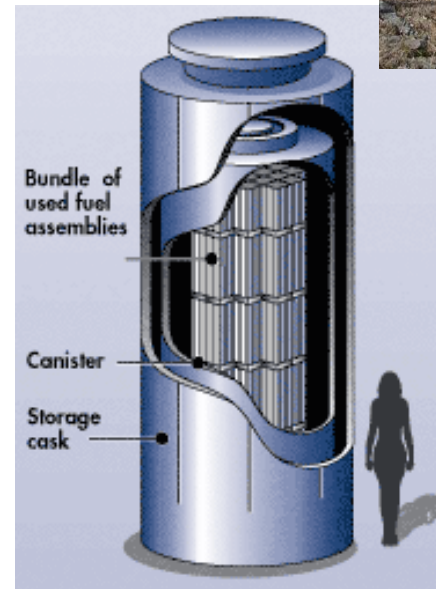
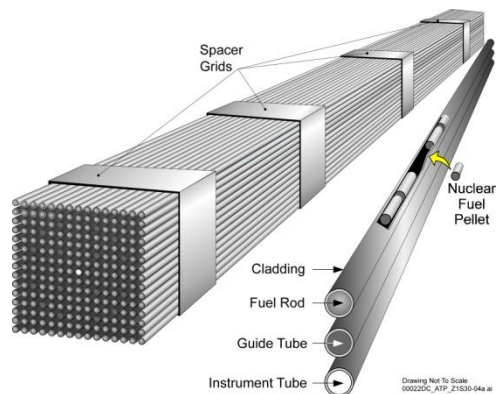
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Oak Ridge National Laboratory
Pacific Northwest National Laboratory
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Storage and Transportation Objectives

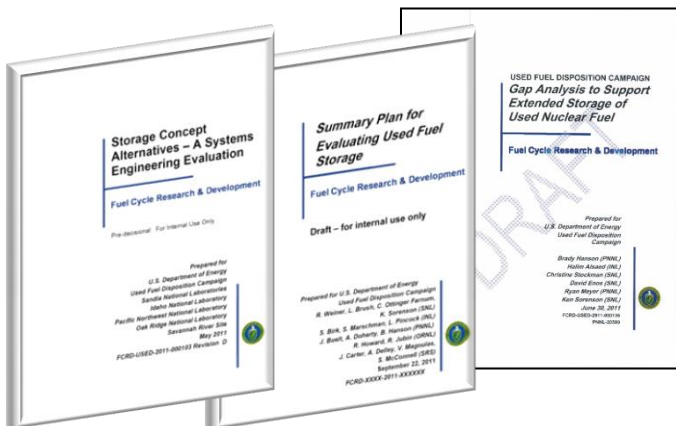
Objectives:

- Develop the technical bases to demonstrate storage system component integrity for extended periods of storage.
- Develop technical bases for fuel retrievability and transportation after long term storage.
- Develop the technical basis for transportation of high burnup fuel.

Focus of this presentation

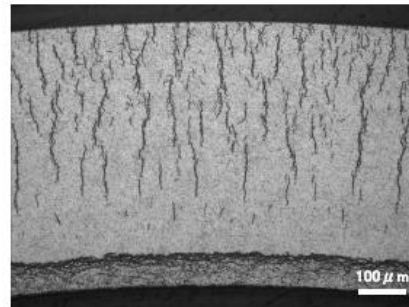
2010

- **UFD Program Stood Up**



2015

- **Project Implementation Plan**
- **Development of technical basis**
 - **Near-term experiments and analyses**



2020

- **Operational long-term storage “demo” project**
 - **Longer-term validation**



Work Packages: Approach to Meeting Objectives

A deliberate process has been developed, followed, and continually assessed in order to achieve success in meeting our objectives

1. Documentation of objectives

- UFD Campaign Implementation Plan: March 2010
- NE Roadmap (R&D Objective 3): April 2010

2. Implement Systems Engineering Approach

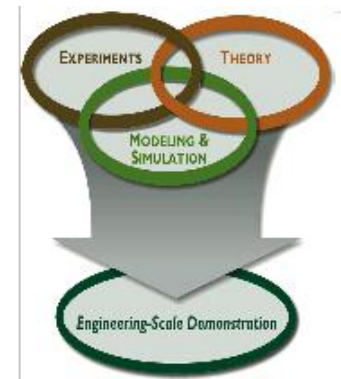
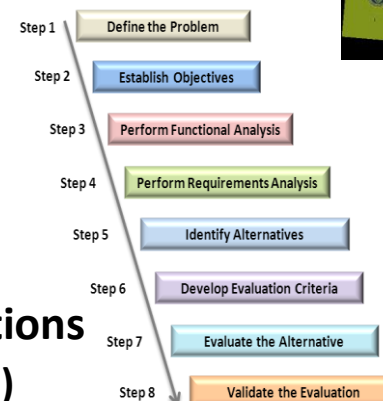
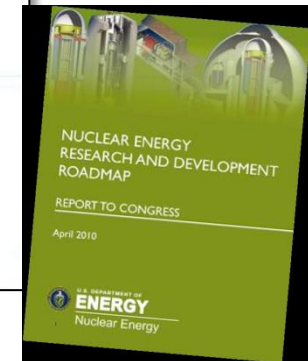
- Process identification and implementation
- Technical implementation
- Independent reviews

3. Conduct Independent Reviews

- NEAC: April 2011
- NWTRB: September 2011

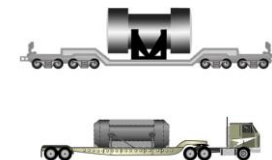
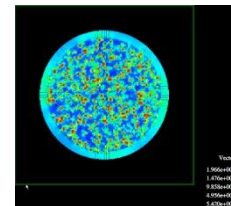
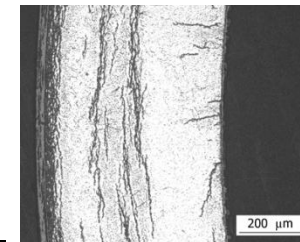
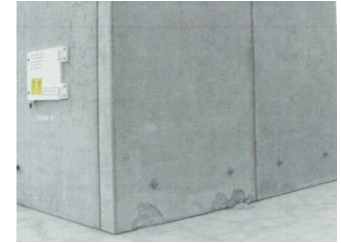
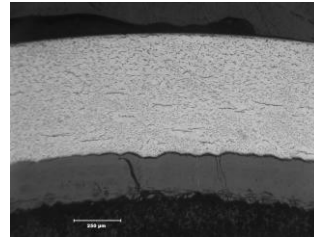
4. Assess alignment with BRC recommendations (consistent with NE Roadmap R&D Objective 3)

- Draft report from Storage and Transportation Subcommittee: May 2011
- Draft report from Main Committee: July 2011
- Final report: January 26, 2012



Work Packages : Scope, Tasks, Deliverables

- **Based on this process, six separate Control Accounts conduct the work to meet the stated objectives.**
 - **Storage R&D Investigations**
 - Identifies R&D needs
 - Informs work for the other Work Packages
 - **Field Testing**
 - Systems level tests
 - Near-term focus on industry collaborations
 - **Engineered Materials Experimental**
 - Conducts separate effect tests
 - Focus on lab scale testing
 - **Engineering Analysis**
 - Modeling and simulation to augment experimental data collection
 - **Security**
 - Spent fuel threshold
 - **Transportation**
 - Focus on retrievability and transportation subsequent to extended storage



Work Packages: R&D Investigations

- **FY 11 Major Accomplishment: Level 1 Report**

- Gap Analysis to Support Extended Storage of Used Nuclear Fuel

- *Independent Technical Review, INL*
- *Draft submitted June 30, 2011*
- *Independent Industry Review, EPRI/NEI*
- *Submittal of final report; pending*

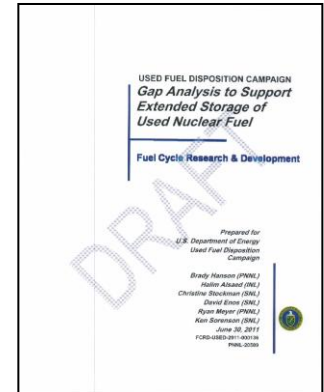
- Report was developed by a multi-lab team, headed by Brady Hanson, PNNL

- *There was significant interactions with external groups during the development of the report*
 - Industry
 - NRC
 - NWTRB
 - International Organizations

We are confident that we have identified the major issues that need to be addressed

- Report resulted in identification and preliminary prioritization of data needs that need to be addressed to successfully meet program objectives.

- Work in FY12 will be to focus on further prioritizing of relatively large list of “High” and “Medium” priority issues and to compare list with other independent studies being conducted at NRC and NWTRB.



Work Packages: R&D Investigations

Storage system component “High” and “Medium” priorities

System Component	Issue	Importance of R&D
Cladding	Annealing of Radiation Effects	Medium
	Oxidation	Medium
	H ₂ effects: Embrittlement	High
	H ₂ effects: Delayed Hydride Cracking	High
	Creep	Medium
Assembly Hardware	Stress corrosion cracking	Medium
Neutron Poisons	Thermal aging effects	Medium
	Embrittlement and cracking	Medium
	Creep	Medium
	Corrosion (blistering)	Medium
Canister	Atmospheric corrosion (marine environment)	High
	Aqueous corrosion	High

Work Packages: R&D Investigations

Storage system component “High” and “Medium” priorities

System Component	Issue	Importance of R&D
Bolted Direct Load Casks	Thermo-mechanical fatigue of bolts/seals	Medium
	Atmospheric corrosion (marine environment)	High
	Aqueous corrosion	High
Overpack and Pad (Concrete)	Freeze/Thaw	Medium
	Corrosion of steel rebar	Medium

Cross-cutting or General Gaps

- *Temperature profiles for fuel*
- *Drying issues*
- *Monitoring*
- *Subcriticality*
- *Fuel transfer options*
- *Re-examine INL dry cask storage*

*High
High
High
High
High
High*



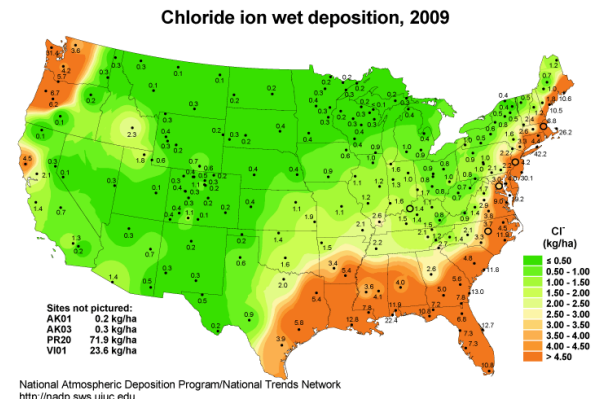
Identification of these data gaps are used to inform new initiatives for FY12



Work Packages: Field Testing

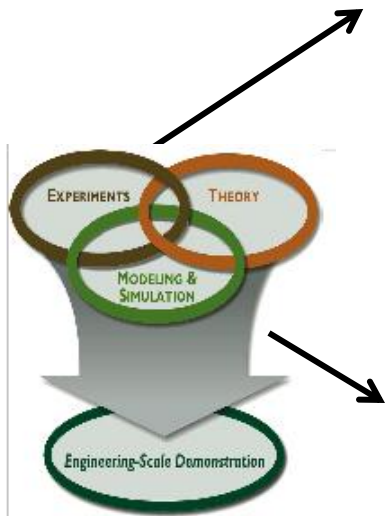
This is a re-directed Control Account to focus on near-term potential collaborations with industry

- From the technical data gap report, a high priority gap is SS canister performance in-service at ISFSIs located at or near coastal sites
 - atmospheric data collection at and near to the canister
 - indication of canister corrosion
 - assessment of canister corrosion rates



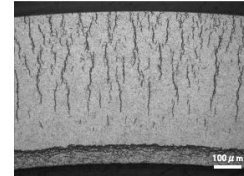
New S&T Initiatives for FY12

Based on the work to date, two new Control Accounts have been added to the S&T program:



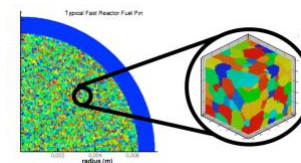
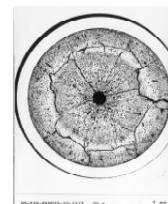
1. Engineered Materials – Experimental

- ANL has been tasked to conduct ring compression tests on irradiated fuel cladding (from data gap report – high priority gap associated with hydride effects on clad)
- ORNL has been tasked to conduct hydride effects tests on unirradiated clad (understand hydride effects between irradiated clad [ANL tests] and unirradiated clad [ORNL tests])
- SNL/LANL are collaborating on corrosion testing for SS canisters



2. Engineering Analysis

- Working with the R&D Investigations team, conduct modeling and analysis on data gap problems that can be addressed analytically using existing codes



New S&T Initiatives for FY12

The S&T program is collaborating with NEUP



- **Technical advisor to four NEUP university contracts: Texas A&M, Michigan, Penn State, and MIT**

The S&T program engages with the A&AS industry teams as requested

- **Current contracts involve assessment of feasibility of fielding and operating a demonstration project.**

Collaboration with Industry and Regulators

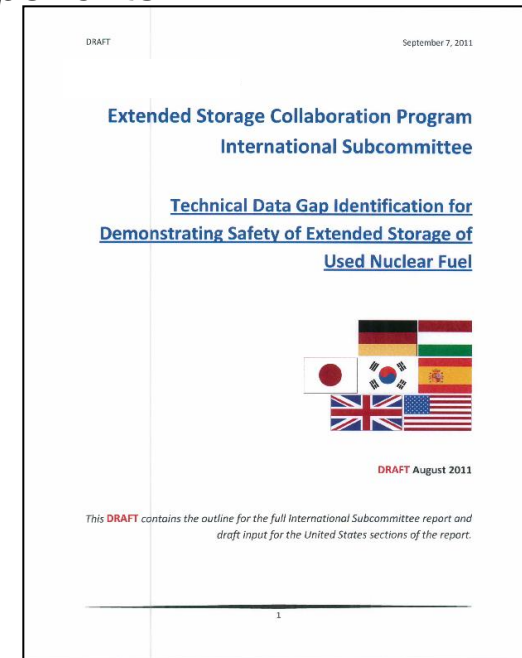
The DOE program is closely integrated with industry and regulators to ensure that all applicable aspects of the storage system components are identified and considered.

The primary interface for this work is the Electric Power Research Institute (EPRI) Extended Storage Collaboration Program (ESCP). This committee is a working group made up of representatives from:

- ***Industry (EPRI, utilities, fuel vendors, cask vendors)***
- ***Regulator (NRC)***
- ***DOE Laboratories***
- ***International organizations***

Objectives:

- ***Share information on work being conducted by individual organizations that is relevant to all ESCP members***
- ***Coordinate efforts associated with identification and prioritization of data gaps***
- ***Share data/information related to on-going work associated with addressing data gaps***



Collaborations: Relation to Other Work

The DOE program is making full use of all work going on in this area.

U.S.



The NRC is conducting its own technical data gap analysis.

- *Consistent with DOE data gap analysis with some differences in priorities*



The Nuclear Waste Technical Review Board has developed a similar technical data gap analysis.

- *Consistent with DOE and NRC gap analysis*
- *Addition of emphasis on modeling*

Industry is collaborating through ESCP in several areas.

- *Providing fuels data that relates to technical data gaps*
- *Providing operational data/experience related to storage system performance*
- *Identifying fuel that may be available for test program*

EPRI

Relation to Other Work (cont)

International



Bundesanstalt für Materialforschung und –Prüfung (BAM/Germany)

- *Long term behavior of metal and elastomer seals*
- *Long term behavior of polymers used for neutron shielding*
- *Optimization of corrosion protection measures*
- *Transportation after long term storage*
- *Requirements for periodic safety inspection and aging management*



Public Agency for Radioactive Waste Management (PURAM/Hungary)

- *Fuel material property degradation*
- *Concrete structures material degradation*
- *Ability to transfer fuel for transportation*



Central Research Institute of Electric Power Industry (CRIEPI/Japan)

- *Stress corrosion cracking of canister*
- *Degradation of MOX fuel*
- *Long term storage studies*



International Atomic Energy Agency (IAEA, Vienna)

- *Consultancy on Dual Purpose Casks*
- *Consultancy on Long Term Storage*

Conclusions

DOE/NE is supporting development of the technical basis for certification of very long term storage of used fuel and subsequent transportation. Programmatically, this includes:

- development of a plan to support experimental data gathering to address gaps in the existing data base,***
- conducting experiments to gather needed data,***
- working with the NRC to properly integrate data needs perceived by both the regulator and industry,***
- working closely with industry,***
- working closely with our international partners, and***
- development of the technical basis documents.***

This work remains aligned to the original Campaign Implementation Plan as well as the NE Roadmap. It is also consistent with recommendations published by the BRC.