U.S. DEPARTMENT OF ENERGY | Nuclear Energy

SAND2012-4132P

UFD Mid-year Review

UFD Storage and Transportation FY12 Activities

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May 17, 2012
Las Vegas, Nevada

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- Overall Storage and Transportation Objectives
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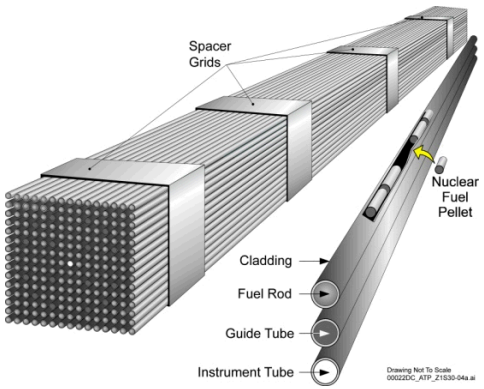
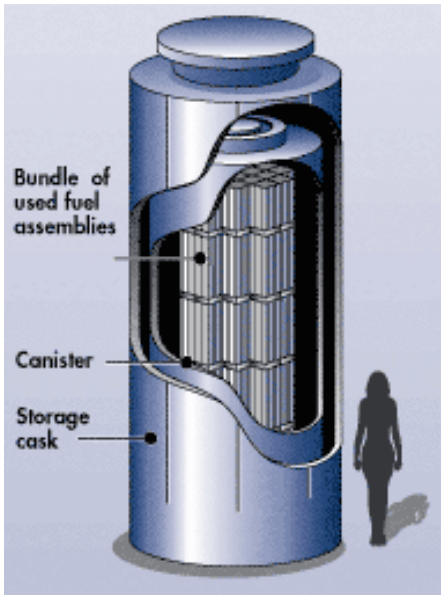


http://energy.gov/sites/prod/files/styles/



www.nrc.gov/waste/spent-fuel-storage/

www.connyankee.com/

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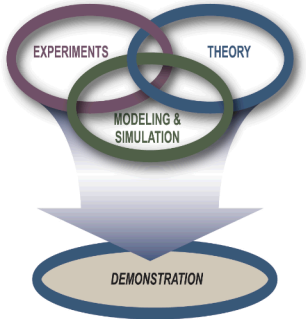
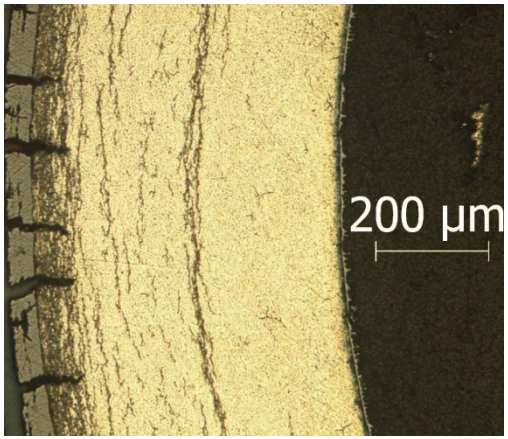
Storage and Transportation Objectives

Overall Objectives:

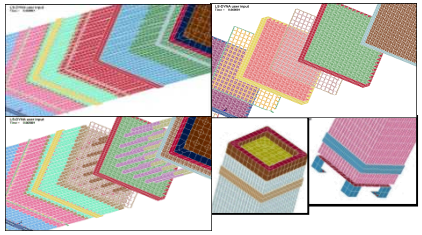
- Develop the technical bases to demonstrate used fuel integrity for extended storage periods.
- Develop technical bases for fuel retrievability and transportation after long term storage.
- Develop the technical basis for transportation of high burnup fuel.

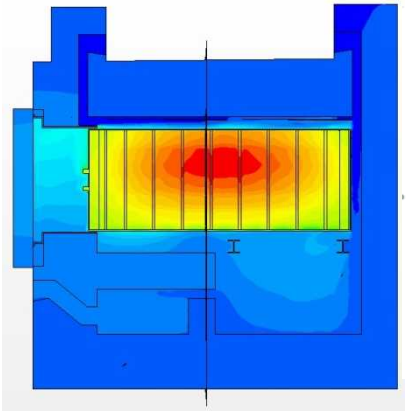


Science based, Engineering driven



UFD Telecon, April 12, 2012
Billone, Liu; Argonne





UFD Telecon, April 12, 2012
Wagner, Adkins; ORNL

'Jones 2010.ppt',
Calvert Cliffs Dry Fuel Storage and Industry Lessons Learned

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Storage and Transportation Major Control Accounts

- **Six major Control Accounts are designed to define the work to address the objectives**
  - R&D Investigations
  - Engineered Materials – Experimental
  - Engineering Analysis
  - Field Testing (ST T&E Capability Development)
  - Transportation
  - Security (transitioning to MPACT in FY13)

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R&D Investigations

Scope & Status

- Refine last year's Level 1 Technical Data Gap Rpt:
  - Submitted as a Lvl 2, April 30, 2012
- Review of identified data gaps relative to external studies: Lvl 2 due July 31, 2012
- Conduct Aging Management Plans: ANL Lvl 2 report due June 30, '12

Impact

- This prioritization informs the experimental and analysis work in the other S&T CAs

FY13

- Collapse this CA into a general Experimental CA

Gap	Likelihood of Occurrence	Consequences	Difficulty for Remediation	Importance for Licensing	Importance for Licensing
Cladding – annealing	3/2	2	3	8/7	MH/M
Cladding - H2 effects, reorientation and embrittlement	4/4	3	3	10/10	H/H
Cladding - H2 Effects, DHC	3/4	3	3	9/10	MH/H
Cladding - Oxidation	1/1	3	3	7/7	M/M
Cladding - Creep	3/3	2	3	9/9	MH/MH
Assembly Hardware – SCC of lifting hardware and spacer grids	2/2	2	3	8/8	MH/MH
Neutron Poisons - Thermal aging effects	4/4	3	3	10/10	H/H
Neutron Poisons - Creep	1/2	2	2	6/7	M/M
Neutron Poisons - Embrittlement and cracking	2/3	3	3	8/9	MH/MH
Neutron Poisons - Corrosion (blistering)	2/2	2	2	7/7	M/M
Welded Canister - Atmospheric corrosion	4/4	4	3	11/11	VH/VH
Welded Canister - Aqueous corrosion	4/4	4	3	11/11	VH/VH
Bolted casks - Thermomechanical fatigue of seals and bolts	4/4	4	2	11/11	VH/VH
Bolted casks - Atmospheric corrosion	4/4	4	2	11/11	VH/VH
Bolted casks - Aqueous corrosion	4/4	4	2	11/11	VH/VH
Concrete Overpack - Freeze–thaw	2/4	1	1	4/6	ML/M
Concrete Overpack - Corrosion of embedded steel	2/4	1	1	5/7	ML/M

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Engineered Materials - Experimental

Scope & Status

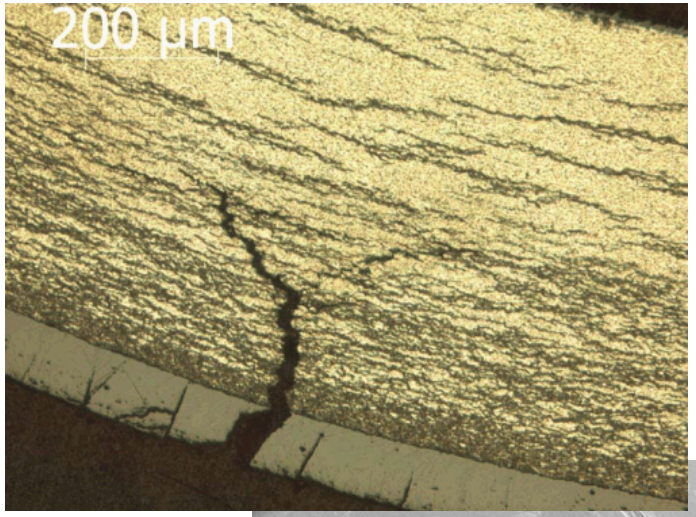
- Conduct ring compression
  Tests on used fuel cladding:
  ANL Lvl 2 report submitted
  Dec 31, '11
- HFIR cladding tests : ORNL
  Lvl 2 report submitted Mar 31, '12
- Conduct SS canister corrosion
  tests: SNL Lvl 4 Test Plan SS
  corrosion submitted Jan 31, '12

Impact

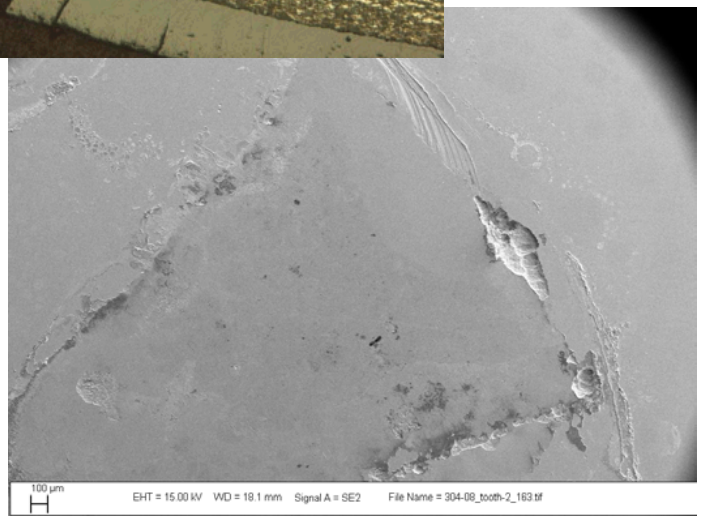
- This testing addresses high priority gaps identified for cladding and canisters

FY13

- Continue cladding and canister testing



UFD Telecon, April 12, 2012
Ring compression test on
HB Zry-4
Billone, Liu; ANL



UFD Telecon, April 12, 2012
304 SS 100µg/cm^2 corrosion test
Bryan, Enos; SNL

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Engineering Analysis

Scope & Status

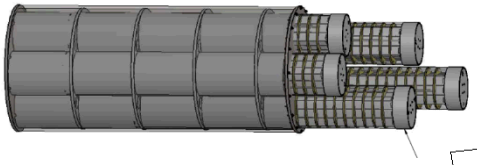
- Develop Can-in-Can concept: ORNL Lvl 4 report due Sept 28, '12
- Conduct thermal analysis on Calvert Cliffs Canister: PNNL Lvl 3 report due Sept 24, '12
- Hydride re-orientation: SNL Lvl 3 report due Sept 30, '12
- Support mechanical analysis of transport testing: New BCP for INL/PNNL

Impact

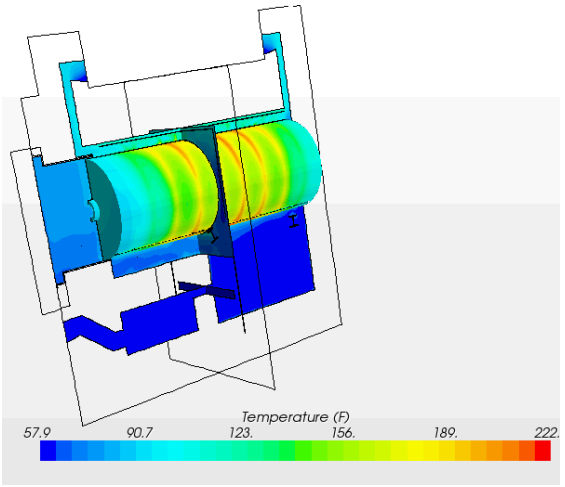
- This testing addresses identified high priority gaps
  - Thermal profiles
  - Cladding integrity

FY13

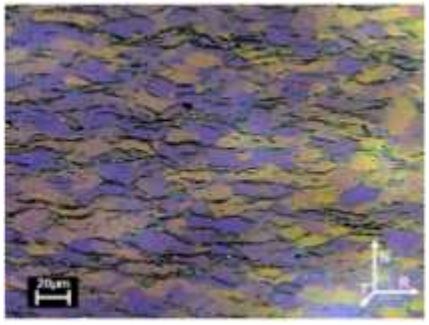
- Continue cladding and canister analysis
- Support transportation loading tests



UFD Telecon, April 12, 2012
Can-in-can analysis
Wagner, ORNL



UFD Telecon, April 12, 2012
NuHOMS thermal analysis
Adkins; PNNL



Email/Tikare to Wagner; May 10, 2012
Preliminary Hydride analysis
Tikare; SNL

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Field Testing (ST T&E Capabilities)

Scope & Status

- Write Storage/Transportation RD&D Plan; Lvl 3 report submitted Mar 31, 2012 by INL
- Revise facility functional requirements based on up-dated data gap report: SRNL Lvl 4 report due May 31, '12
- Develop collaborative test plan with EPRI to assess on-site canister corrosion: SNL, Level 2 report due June 30, '12
- Collaborate with field canister corrosion tests: INL Lvl 3 report due Aug 30, '12

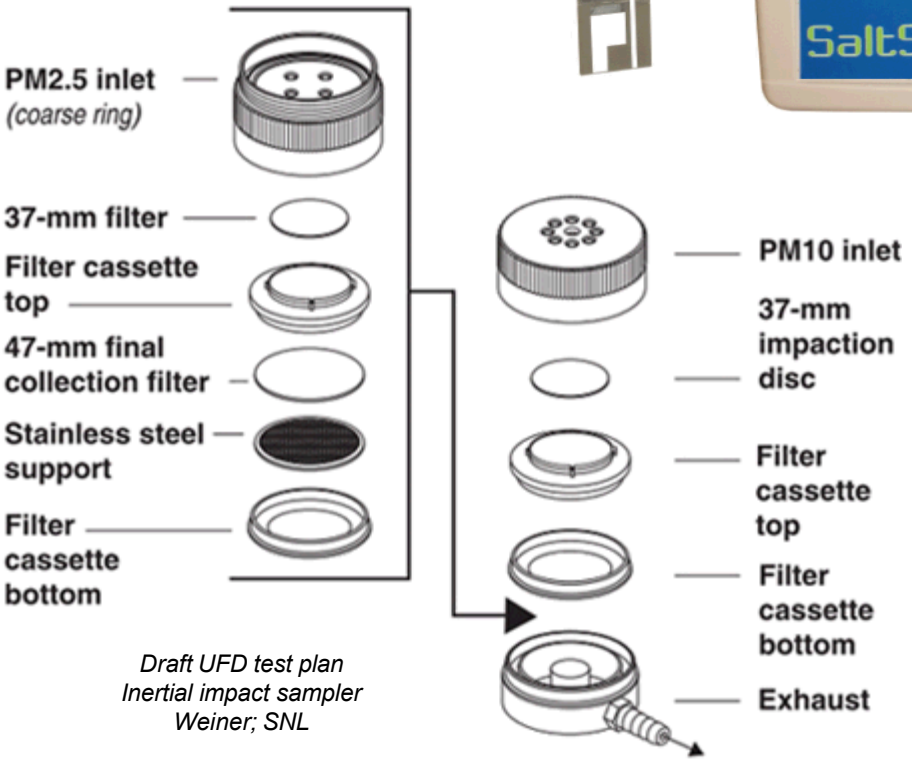
Impact

- The RD&D report supports readiness for the BRC recommendations.
- This testing addresses identified high priority gaps
  - Thermal profiles
  - Cladding integrity

FY13

- Expand canister corrosion testing to multiple sites

Draft UFD test plan
Salt content sampler
Weiner; SNL



Draft UFD test plan
Inertial impact sampler
Weiner; SNL

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Transportation

Scope & Status

- Criticality analysis: ORNL Lvl 2 report due Sept 01, '12
- Moderator exclusion: INL Lvl 3 report due Sept 28, '12
- Data base work: SRNL Lvl 3 report due Aug 15, '12
- Transportation test: SNL Lvl 3 report due Sept 30, '12

Impact

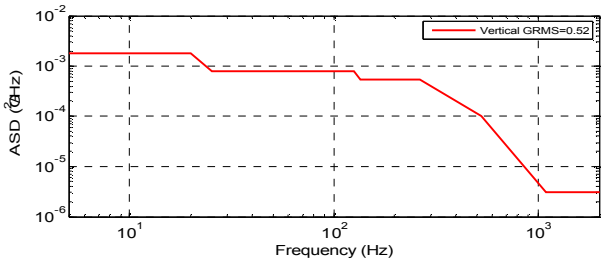
- Supports BRC recommendations to conduct transportation studies early and to de-inventory orphan sites
- Addresses alternate path to transporting used fuel without the full suite of cladding data

FY13

- Continue analyses and testing to support transport of HB used fuel
- Continue data analysis to support planning for transport of fuel

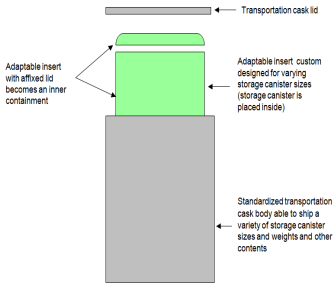
Stressor	Degradation Mechanism	Importance	
		Storage	Trans
Cladding			
Thermal	Annealing of radiation Damage	*Med*	High
	Metal Fatigue caused by temperature fluctuations	Low	Low
	Phase Change	Low	Low
Chemical	Emissivity Changes	Low	Low
	H_2 effects: embrittlement and reorientation	High	High
	H_2 effects: delayed hydride cracking	High	*Med*
	Oxidation	*Med*	*Med*
	Wet corrosion	Low	Low
Mechanical	Creep	*Med*	*Med*
Assembly Hardware			
Thermal and Mechanical	Creep	Low	Low
	Metal Fatigue caused by temperature fluctuations	Low	Low
Chemical	Corrosion and stress corrosion cracking (chemical)	*Med*	*Med*
	Hydriding effects	Low	Low
Fuel Baskets			
Thermal and Mechanical	Creep	Low	Low
	Metal Fatigue caused by temperature fluctuations	Low	Low
Chemical	Corrosion	Low	Low
Neutron Poisons			
Thermal	Thermal aging affects	*Med*	High
Thermal and radiation	Embrittlement and cracking	*Med*	Low
Thermal and	Creep	*Med*	*Med*

Transportation data gaps: PNNL



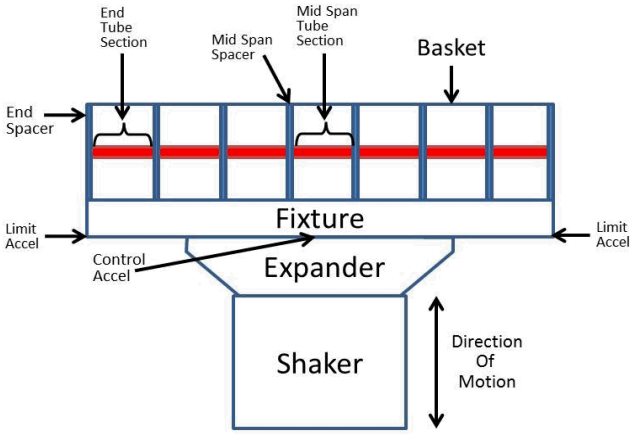
Assembly vibration analysis SNL

- Basic principle of defense-in-depth is the use of multiple barriers



- Use of an inner containment depends upon the functionality of the storage canister

Moderator exclusion concept: INL



Vibration test frame concept: SNL

Security

Scope & Status

- Transitioning to MPACT in FY13
- For UFD:
  - Continues to track regulatory movement on the spent fuel self-protection threshold and material attractiveness
  - Continues to develop the security assessment methodology
    - LLNL Lvl 4 report due on July 13, ‘12
    - SNL Lvl 3 report due on Aug 15, ‘12

Impact

- This work aligns with BRC recommendations as well as draft NE response to BRC to assess security implications of extended storage.

FY13

- All security work transitioned to MPACT