

Used Fuel Disposition Campaign

High Burnup Used Fuel Demonstration Workshop

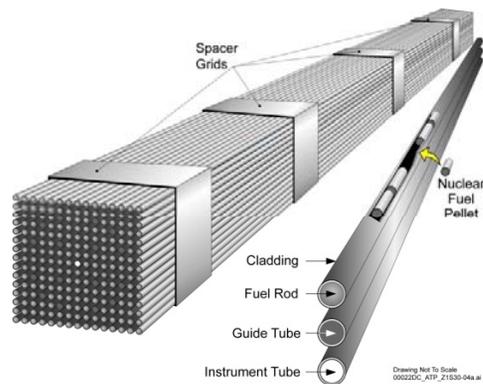
UFD Storage and Transportation Up-date

**Ken Sorenson: UFD S&T Control Account Manager
Sandia National Laboratories**

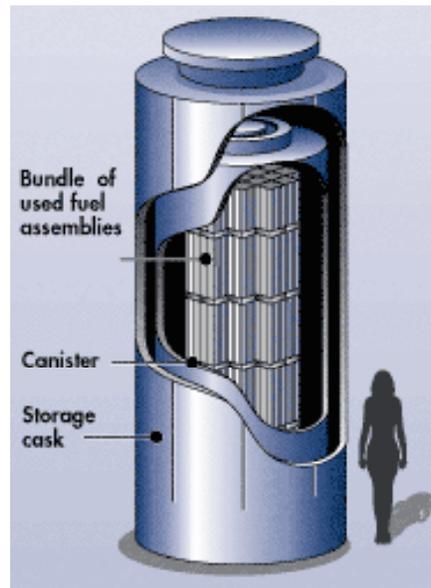
**August 22, 2012
Idaho Falls, Idaho**

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- Overall Storage and Transportation Objectives
- Control Account Status and Major Activities
- FY12/FY13 Transitions



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



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



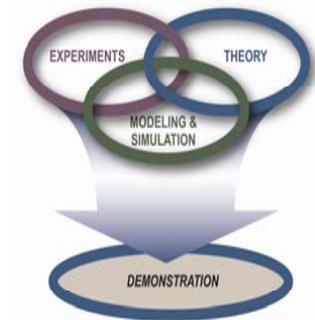
www.connyankee.com/

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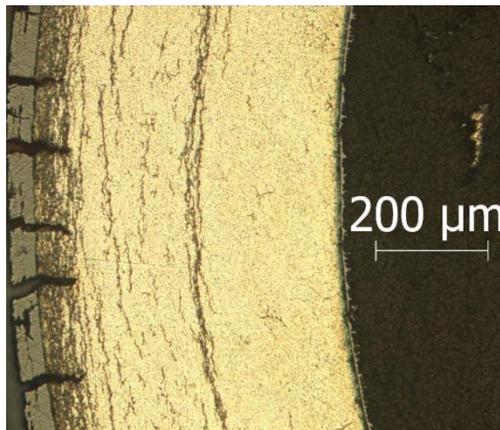
Storage and Transportation Objectives

Overall Objectives:

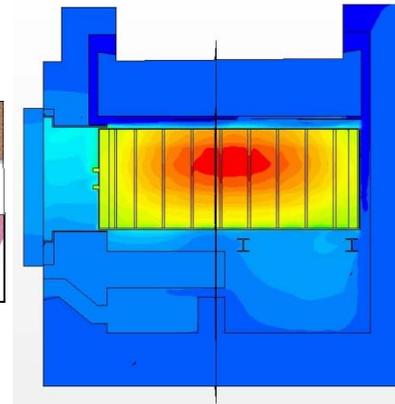
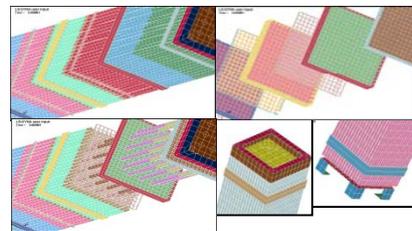
- Develop the technical bases to demonstrate used fuel integrity for extended storage periods.
- Develop technical bases for fuel retrievability and transportation after long term storage.
- Develop the technical basis for transportation of high burnup fuel.



*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

**Used
Fuel
Disposition**

Storage and Transportation Major Control Accounts: FY12

■ **Six major Control Accounts are designed to define the work to address the objectives**

- R&D Investigations
- Engineered Materials – Experimental
- Engineering Analysis
- Field Testing
- Transportation
- Security

Used Fuel Disposition

R&D Investigations

Scope & Status

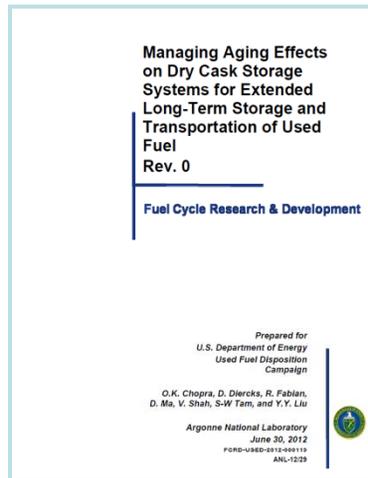
- Refine last year's Level 1 Technical Data Gap Rpt: PNNL
- Review of identified data gaps relative to external studies: PNNL
- Conduct Aging Management Plans: ANL

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

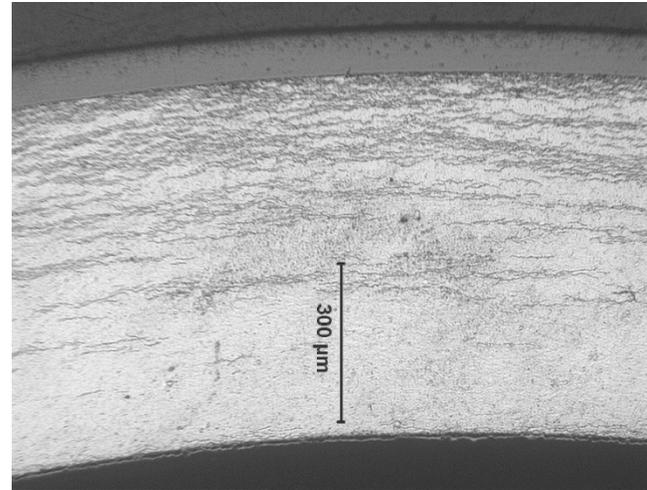
- Conduct ring compression tests on used fuel cladding: ANL
- HFIR cladding tests : ORNL
- Conduct SS canister corrosion tests: SNL

Impact

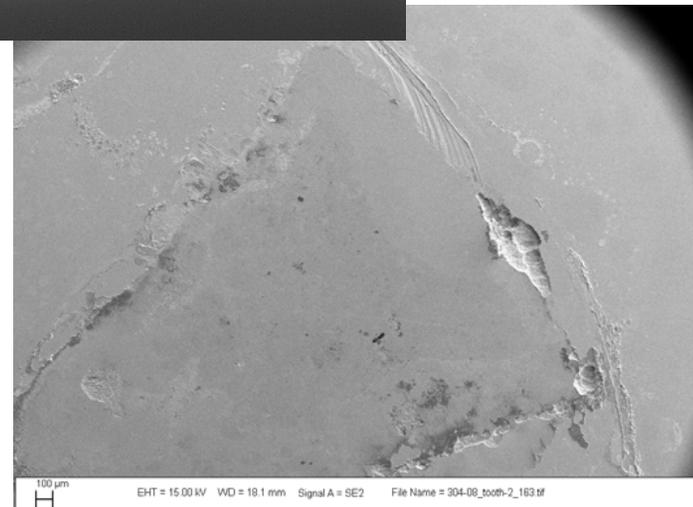
- This testing addresses high priority gaps identified for cladding and canisters

FY13

- Continue cladding and canister testing
- Compare lab-scale corrosion behavior to on-site environmental conditions



FCRD-USED-2012-000039,
Dec 31, 2011
HB Zry-4 cladding
64 GWd/MTU – 550 wppm H
Billone, Liu; ANL



UFD Telecon, April 12, 2012
304 SS 100µg/cm² corrosion test
Bryan, Enos; SNL

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Engineering Analysis

Scope & Status

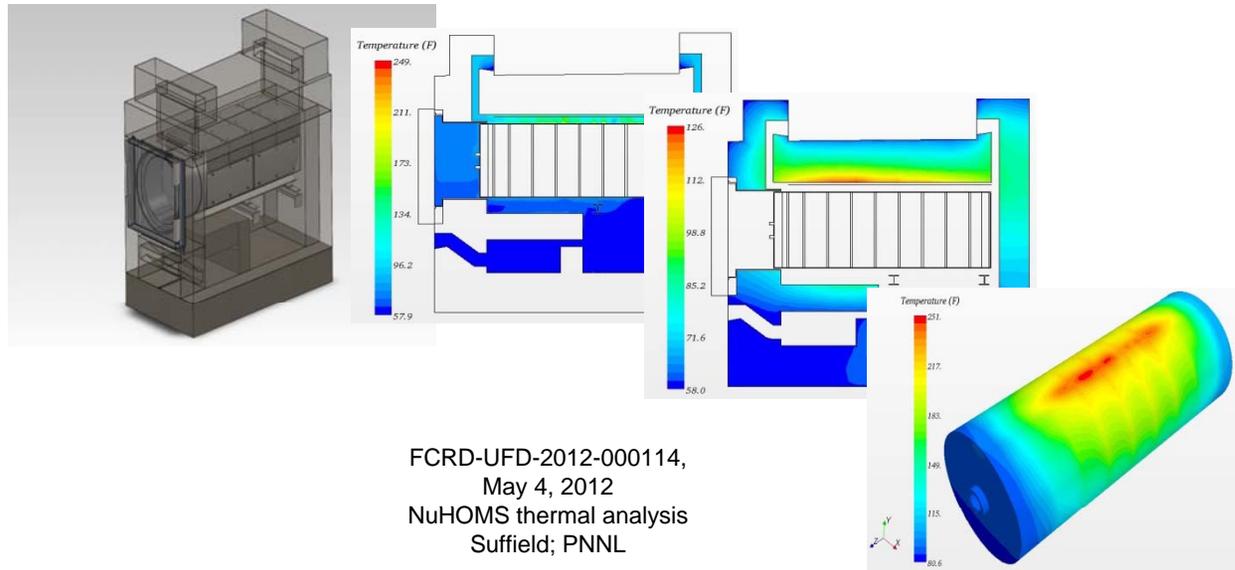
- Thermal analysis of Calvert Cliffs Canister: PNNL
- Hydride re-orientation: SNL

Impact

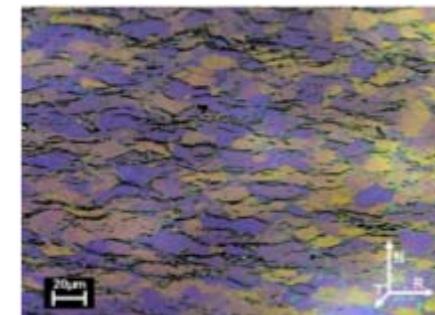
- This work addresses identified high priority gaps
 - Thermal profiles
 - Cladding integrity

FY13

- Continue cladding and canister analyses
- Support transportation loading tests on a fuel assembly



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



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Field Testing

Scope & Status

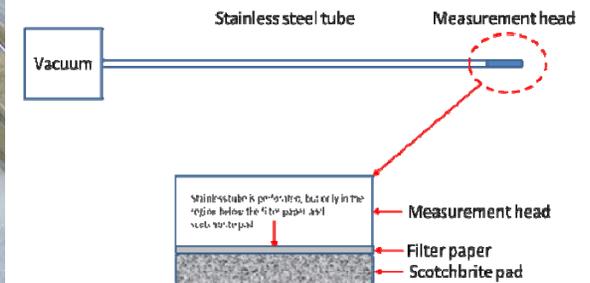
- Storage/Transportation RD&D Plan; INL, PNNL, SNL, SRNS, ANL
- Develop collaborative test plan with EPRI to assess on-site canister corrosion: INL, SNL
- Collaborate with field canister inspections: INL, SNL, PNNL

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



Calvert Cliffs NuHOMS canister inspection report,
July 26, 2012
Enos; SNL

Used Fuel Disposition

Transportation

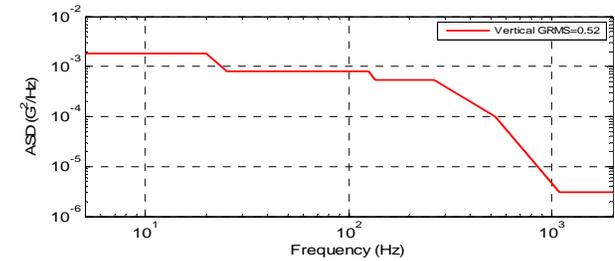
Scope & Status

- Criticality analysis: ORNL
- Moderator exclusion: INL
- Data base work: SRNL
- Transportation test: SNL

CASK VENDOR	CANISTER Type	NUMBER OF CANISTERS (12/2011)	TRANSPORT CASK(S)	NUMBER OF FABRICATED TRANSPORT CASKS
FUEL SOLUTIONS	W150	8	TS-125	0
	VSC-24	58	None-Storage Only	-
IN (NUHOMS)	24PT1, 24PT4	68	MP-187/MP-197HB	1 / 0
	24PT	7P, 12T, 24P	None-Storage Only	-
	24PHB ¹ , 32P ¹ , 52B	258	None-Storage Only	-
	24PTH, 32PT, 32PTH	263	MP-197/MP-197HB	0 / 0
NAC	61BT, 61BTH	59	NAC-STC	2 ²
	MPC-26, MPC-36	59	NAC-STC	2 ²
	UMS-24	204	NAC-UMS	0
HOLTEC	TSC-37	0	NAC-MAGNATRAN	0
	MPC-24 ¹ , MPC-32 MPC-68, MPC-80	439	HISTAR 100	12

¹ Still being ordered as of 12/2011. All others "Storage Only" canisters have not been ordered in at least the last five years.
² Fabricated Canisters for Offshore Use Only.
 Includes Trian 286P

UFD Mid-yr, May 17: SRNL



Assembly vibration analysis SNL

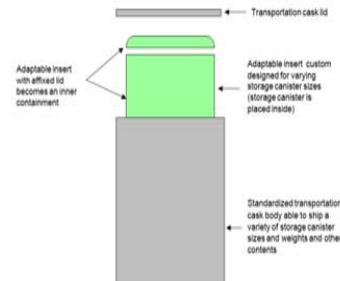
Impact

- 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

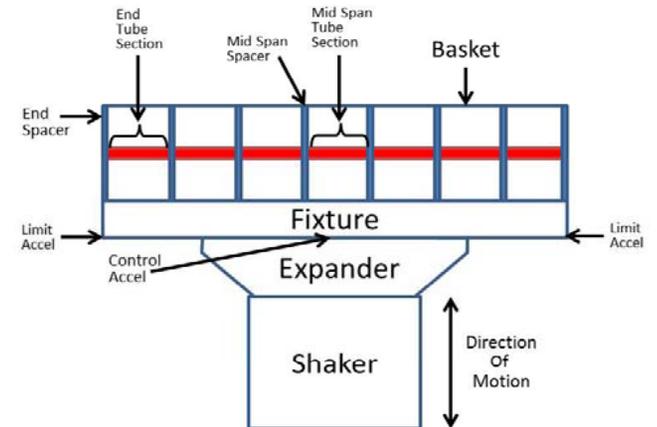
- Continue analyses and testing to support transport of HB used fuel
- Continue data analysis to support planning for transport of fuel

• 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

Scope & Status

- Track regulatory movement on the spent fuel self-protection threshold and material attractiveness: SNL, LLNL
- Develop security assessment methodology: SNL, LLNL

Impact

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

FY13

- Continue to track regulatory developments
- Support any planning for transport of used fuel from orphaned sites to a consolidated interim storage site (BRC recommendation)

Used Fuel Disposition

FY12/FY13 Transitions

- We have done due diligence to identify and prioritize the technical gaps that need to be addressed to meet our program objectives
- We have vetted these identified gaps against similar external studies
- We have confirmed alignment of our progress and path forward plans to the BRC recommendations

Therefore, FY13 work activities will focus on:

- Experimental
 - Near term separate effects tests on high burnup fuel cladding
 - Continued focus on canister corrosion mechanisms/stress corrosion cracking
 - Continued collaboration with industry on canister corrosion/SCC
- Field Demonstration
 - Collaborate with industry on fielding a storage demonstration
- Analysis
 - Fuel/canister thermal profiles
 - Hydride behavior in high cladding
- Transportation
 - Conduct fuel assembly load testing
 - Perform logistical/operational studies for preparing transport of used fuel from orphan sites