



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

Overview of the DOE-NE Used Nuclear Fuel Disposition Storage and Transportation R&D Program

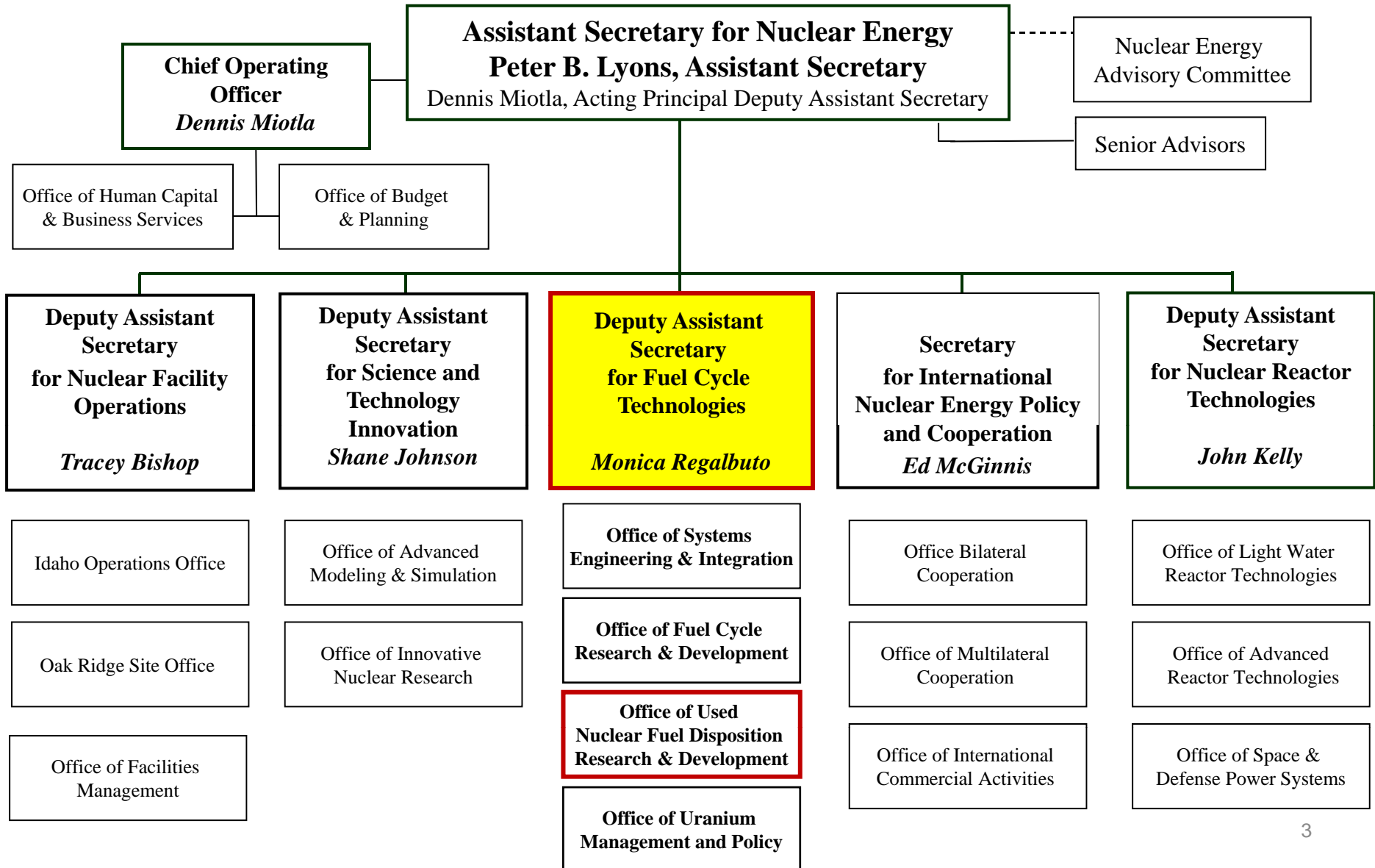
William Boyle

Director

**Office of Used Nuclear Fuel Disposition
Research & Development**

**NWTRB Winter Board Meeting
Washington, DC
November 20, 2013**

Office of Nuclear Energy Organization Overview





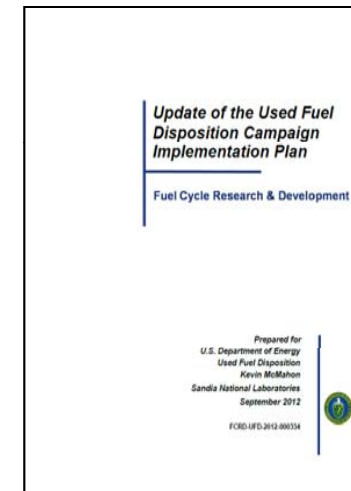
U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

Used Fuel Disposition Campaign

Campaign Mission: To identify alternatives and conduct scientific research and technology development to enable storage, transportation and disposal of used nuclear fuel and wastes generated by existing and future nuclear fuel cycles.

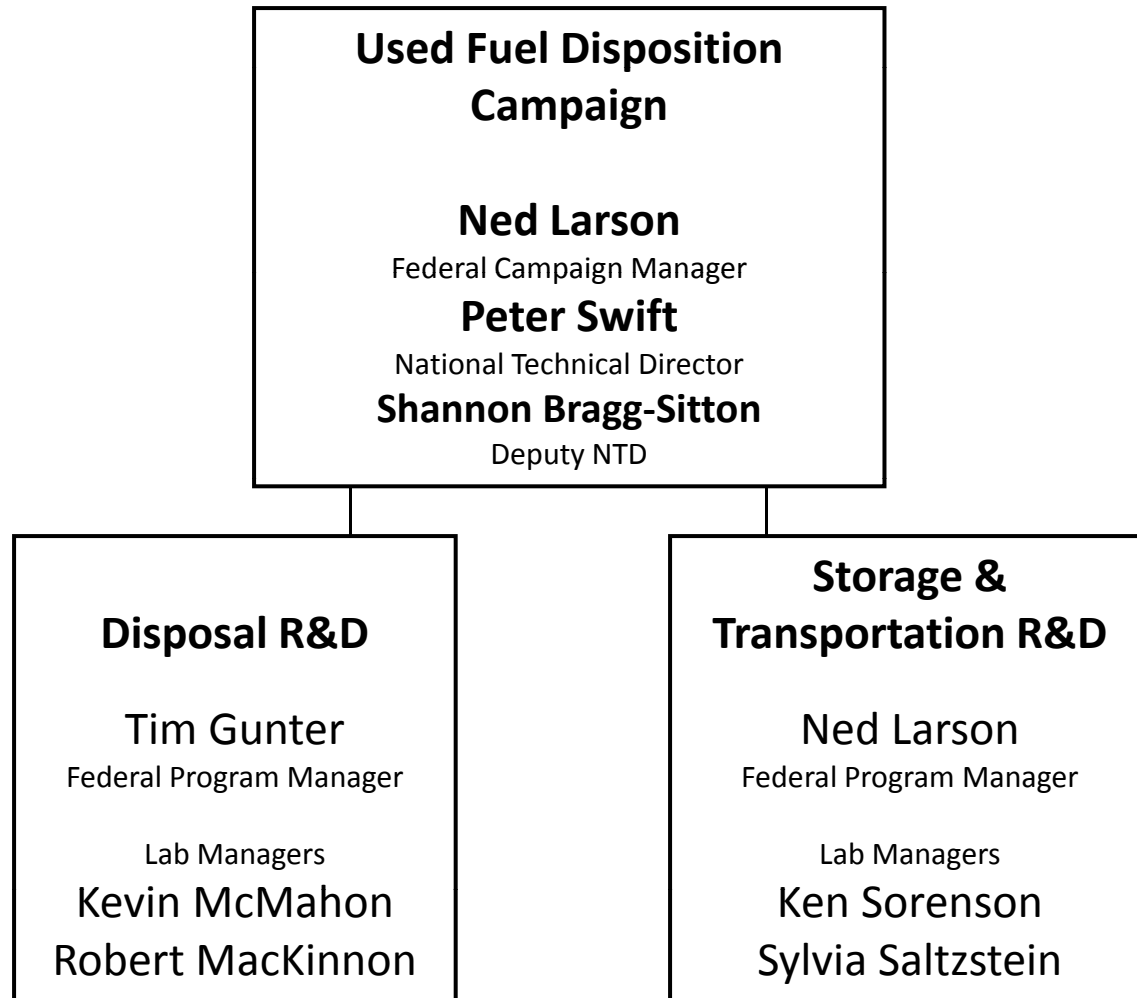
Campaign challenge: to provide a sound technical basis for implementation of a new national policy for managing the back end of the nuclear fuel cycle, including the identification and evaluation of safe and secure options for storage, transportation, and permanent disposal of radioactive wastes resulting from existing and future fuel cycles.



Update of the Used Fuel Disposition Campaign Implementation Plan
FCRD-UFD-2012-000334, September 2012



Used Fuel Disposition Campaign Organization





U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

Used Fuel Disposition Campaign FY14 Structure for Storage and Transportation R&D

Used Fuel Disposition Campaign managed through multiple control accounts :

- Campaign Management (Peter Swift)
- Storage and Transportation R&D Control Accounts (Ken Sorenson, Sylvia Saltzstein)
 1. Field Demonstration Support
 2. Experiments
 3. Analysis
 4. Transportation
 5. Security



Dry cask storage at Diablo Canyon



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

Used Nuclear Fuel Disposition Storage and Transportation R&D

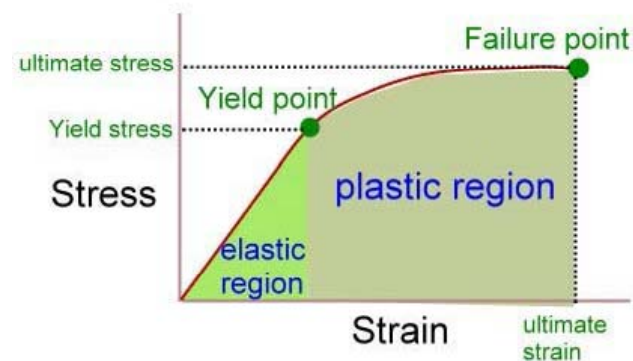
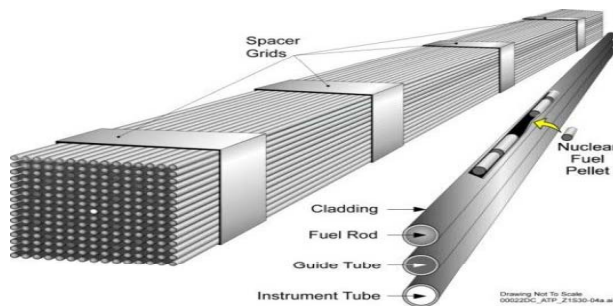
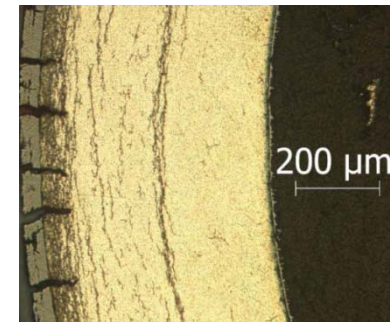


Used Fuel Disposition Storage and Transportation R&D

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

Develop the technical basis for:

- Extended storage of used nuclear fuel
- Fuel retrievability and transportation after extended storage





Used Fuel Disposition Storage and Transportation R&D (cont'd)

Objective: Better understand potential degradation mechanisms in long term dry cask storage

Develop the technical basis for:

- Complete the identification of data gaps to support extended dry storage
- Continue material testing to support modeling and simulation of used fuel aging
- Participate with industry and others on full-scale storage demonstration of high burnup used fuel



Wheeled cask transporter used to place a cask on a storage pad



Storage and Transportation Thrust Area #1: Experiments

R&D Goals: To obtain experimental data to better understand material degradation effects on cladding and canister materials during long-term storage conditions.

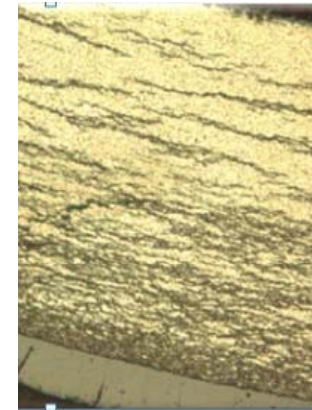
Current Work

- Conduct ring compression and ductile-to-brittle transition temperature tests on pressurized water reactor high burnup cladding
- Conduct hydrogen doping and irradiation in High Flux Isotope Reactor
- Conduct hydrogen doping/distribution tests with thermal gradients across cladding
- Conduct stainless steel canister corrosion testing

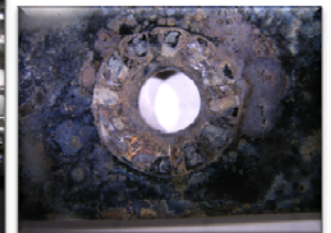
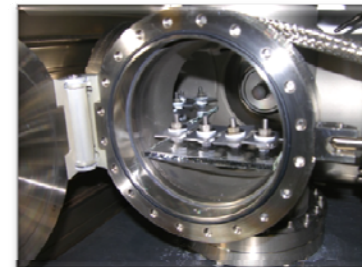
Potential Impact

These activities address priority gaps

- Hydride effects on cladding integrity
- General corrosion and stress corrosion cracking of canisters and canister welds



Ring
compression
test on
HB Zry-4
Billone, Liu;
ANL



IHLWM Conference 4/2013
Enos, Bryan; SNL

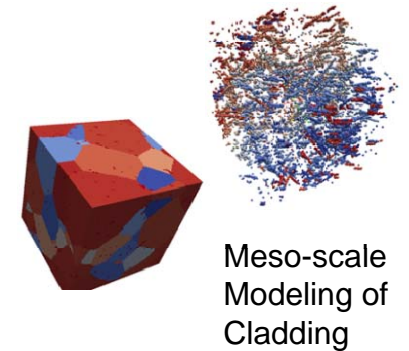


Storage and Transportation Thrust Area #2: Engineering Analysis

R&D Goals: To develop models that will predict behavior during long-term storage and transportation conditions.

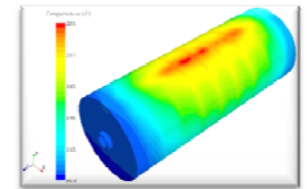
Current Work

- Develop methodology to estimate used fuel cladding hydride re-orientation during long term dry storage
- Estimate strains induced on fuel rods subject to Normal Conditions of Transport
- Conduct thermal profile analyses on dry storage canister systems



Potential Impact

- Build a computational tool to predict hydride precipitation and orientation in Zr-based clads in dry storage
- Development of thermal profiles of used fuel and used fuel storage canisters to better understand corrosion and stress corrosion cracking phenomenology



Thermal Profile of Storage Canister



Storage and Transportation Thrust Area #3: Transportation

R&D Goals: To demonstrate the transportability of high burnup used fuel.

Current Work

- Conduct shock/vibration tests on a surrogate PWR assembly for normal conditions of transport by truck
- Analyze fuel rod response to accelerometer and strain gauge data

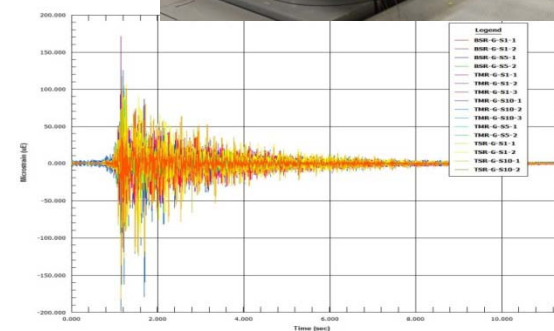
Potential Impact

- Assessment of integrity of high burnup cladding during normal transportations conditions

Instrumentation

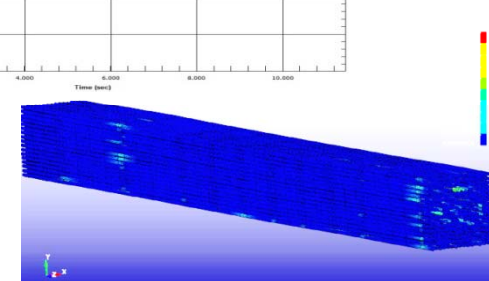


Test



Data Acquisition

Analysis





Storage and Transportation Thrust Area #4: Field Demonstration

R&D Goals: To provide a platform to store used high burnup fuel with the capability to monitor and inspect, for the purpose of confirming our understanding of material degradation processes in storage environments.

Current work

- Loading a commercial storage cask with high burn-up fuel in a utility storage pool
 - Well understood fuel
 - Cask outfitted with additional instrumentation for monitoring
- Drying of the cask contents using typical process
- Cask will be housed at the utility's dry cask storage site
 - Continuously monitored and externally inspected until the first internal inspection at ~10 years
- Site/Facility to open the cask will be determined later

Potential Impact

- Gather actual cask and cladding data





Storage and Transportation Thrust Area #5: Security

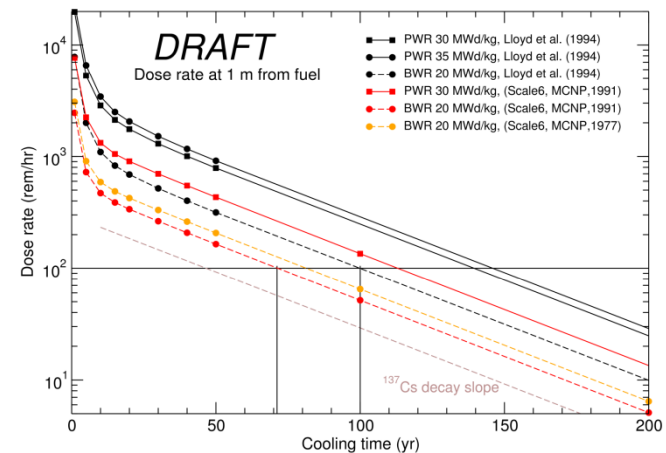
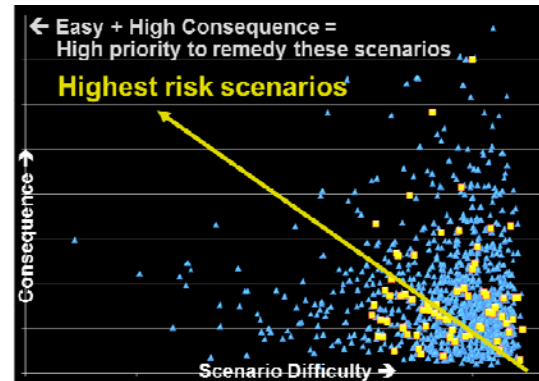
R&D Goals: Do security protection requirements and strategies change for extended times and different facility concepts?

Current Work

- Evaluating the self-protection concept for extended storage
- Analyze threat, vulnerability and consequences

Potential Impact

- Risk Informed Management for prioritizing security options





U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

Conclusion

The DOE Office of Fuel Cycle Technologies is actively developing used nuclear fuel management strategies and technologies and continues to conduct R&D on both open and closed fuel cycle technologies.

- **Used Fuel Disposition program is laying the foundation for the development of storage, transportation and disposal options**
- **Understanding the behavior of used High Burnup Fuels during storage and transportation is a key priority of our office.**

Please visit the Office of Nuclear Energy web site for further program activities and information.

<http://energy.gov/ne/office-nuclear-energy>