U.S. DEPARTMENT OF ENERGY | Nuclear Energy

Storage and Transportation Wrap-up

2015 UFD Workshop

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Sandia National Laboratories

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Overall Comments

- **We continue to follow our Gap Prioritization Report**
  - This aligns well with NRC research needs.
  - The DOE Industry Committee recently affirmed the our research priorities.
- **Great quality of presentations this year**
- **Lots of integration**
- **Lots of very relevant and impactful work**
  - I will mention a few of the highlights

IRPs

- **Texas A&M**
  - Boise State Barnacle has great potential for determining when an area or cask should be inspected for CISCC.
- **UNLV**
  - Temperatures at drying
- **University of Utah**
  - Interesting seismic analysis which integrates well with PNNL's work.
- **Penn State**
  - Great start on NDE with deployability

Thanks to the IRP leads for attending and collaborating with the UFD Community. We all benefit from the increased communication.

Experiments

- **ORNL, ANL: Integrated cladding program (CIRFT, Ring Compression, etc.)**
  - Cladding is stronger than we thought 3 years ago
  - Still need to test on other cladding types, lower burn-up sections, and at lower temperatures.
  - *NRC's questions are largely addressed.*
- **SNL: Stress Corrosion Cracking**
  - Evaluating deliquescence properties and brine stabilities as a function of composition.
  - Looking forward to residual stress data from the full-scale mock-up.
  - *This is a top priority for NRC, EPRI, NEI, and Industry*

Analysis

- **ORNL: Rod Internal Pressure Modeling**
  - Results have exciting impacts on hydride formation, creep, and hoop stress.
    - *At 50 Gwd/MTU, Rod Internal Pressure would be between 7.5 to 9.2 MPa.*
    - *At 400C, 62.5 GWd/MTU, would have 72-84 MPa hoop stress*
  - If true, we may not need to worry about going below DBTT.
  - Importance of PCI/PPI is less critical
- **SNL: UQ Effort on Stress Corrosion Cracking Probabilistic Performance Model**
  - Identifying the most important parameters to focus future efforts
    - *Crack growth rate (determined by temperature, absolute humidity, and salt composition)*
    - *Limiting relative humidity for corrosion*

Analysis

PNNL: Structural Uncertainty Model

- Will answer important questions such as:
  - *What is the smallest stress corrosion crack size that could cause failure of the containment boundary?*
  - *How much thinning is needed to fail the cladding under postulated load?*

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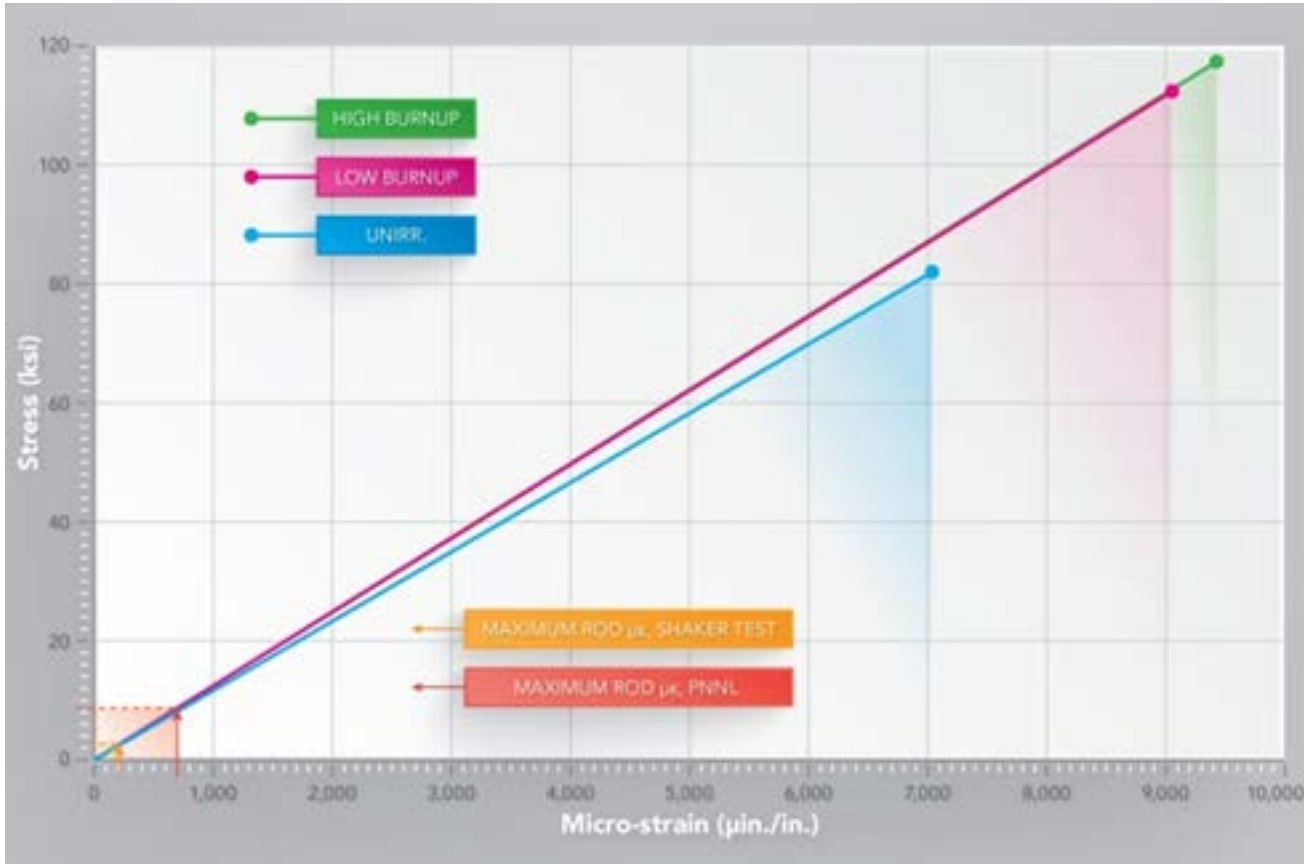
Transportation

- **Rail Shaker Table Data aligned with Truck Shaker Table and Road data**
- **Mo pellets did not behave differently than Pb pellets or rope. (Pb rope appears most conservative)**
- **Obtained important data <3.5 Hz**



Field Demonstration

- **25 Sister Rods pulled successfully**
  - 9 M5, 12 Zirlo, 2 low-tin Zirc-4, 2 Zirc-4
- **Gas Sampling Frequency Strategy Developed**
  - After loading, one year, three years later, ten years later
  - Sample gas from the top of the canister
  - More frequent sampling will be considerer for conditions such as:
    - *High clad temperature,*
    - *presence of gasses, and*
    - *temp below DBTT*
  - *There are NPP operational challenges that must be considered.*

Field Demonstration

- ***Surrogate 9x9 BWR Dry Cask Simulator*** ***(NRC and DOE Joint FY15-16 Funding)***
  - Purpose: Validate assumptions and calculations used to determine steady-state cladding temperatures in dry casks in above and below-ground storage configurations.
    - *Each rod will be uniformly electrically heated*
    - *Thermocouples will be attached directly to the cladding.*
  - Field Demo Thermocouple will be most likely used to understand the difference between cladding surface temperature and the thermocouple lance.

Security

- **Transportation is the time of highest security risk.**
  - Someone might want to create a PR nightmare and mess.
  - Lessons learned from the Nuclear Weapons program
- **NRC is considering changing from a DBT to a consequence model.**
  - *More access delay may be possible but will have to go through licensing.*
  - *Force on Force modeling exercises are being done*
  - *Next steps may be to study economic impacts of DBT releases*

Lessons Learned

- **Let us know what worked for you.**
  - NEUP sessions in plenary?
  - Single S&T session?
  - Anything else?

- **Reiterate Brady's reminder**
  - ALWAYS PUT OUR DATA AND RESULTS IN CONTEXT SO WE KNOW THE ASSUMPTIONS AND LIMITATIONS OF OUR DATA RESULTS.
    - *M2s must go through the campaign review process to ensure all data is placed in context. All data should be published, but context needs to be documented.*