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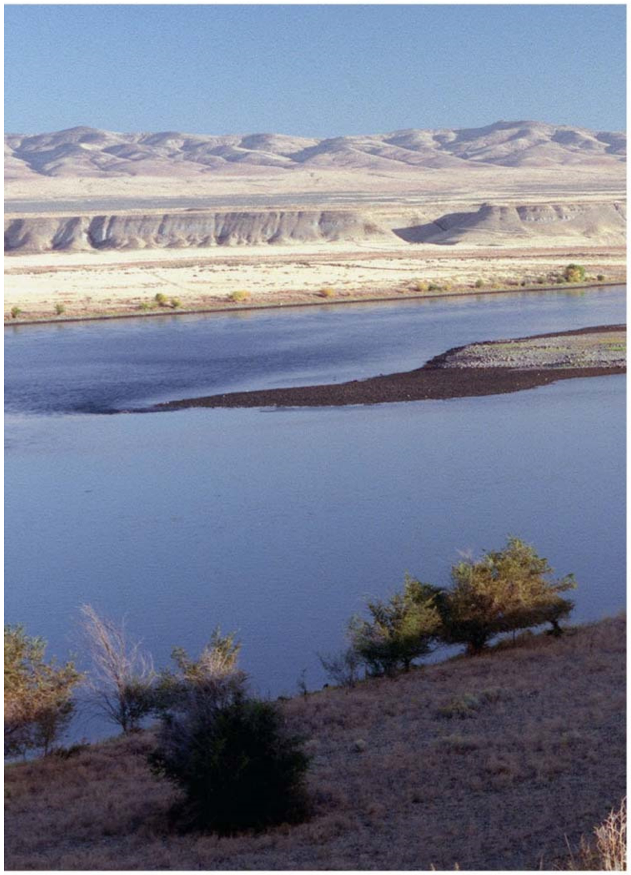

Hanford Multi-Canister Overpack Drying

Presented to: Nuclear Waste Technical Review Board

Presented by: Roger McCormack

One Team. One Culture.

CHPRC-02286, Rev. 0

Hanford Multi-Canister Overpack Drying

- Fuel Condition
- Development of Drying Process
  - Proof of Dryness Test
- Drying Process
- Multi-Canister Overpack (MCO) Internal Gas Composition and Pressure
- MCO Monitoring During Storage

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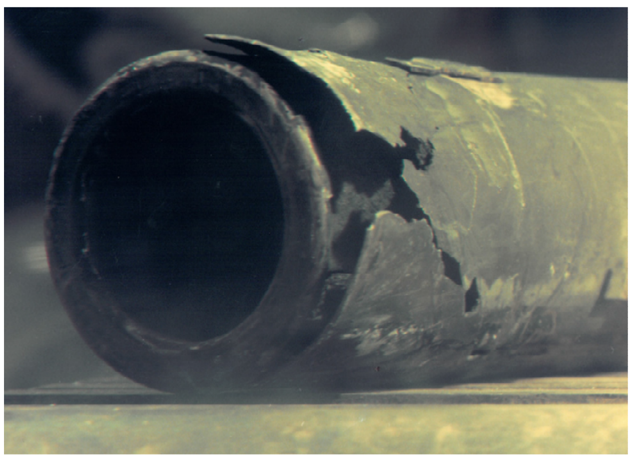
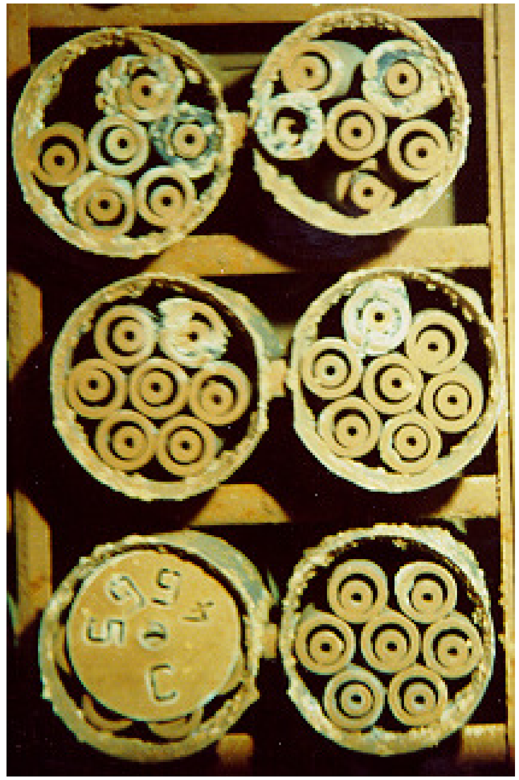
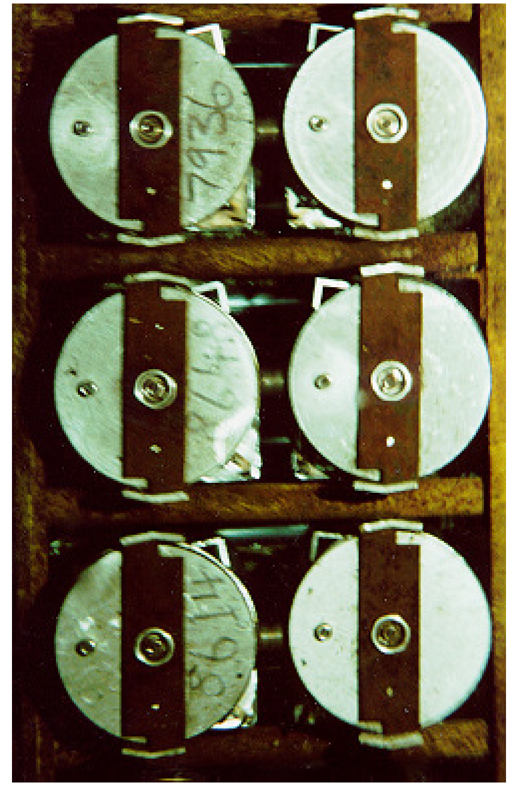
Fuel Condition







Top Left: Damaged N Reactor Fuel Element.

Bottom Left: N Reactor Fuel Outer Element with Damaged Cladding.

Center: KE Basin Fuel Storage.

Right: KW Basin Fuel Storage.

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Development of Drying Process

- Process required to ensure <200 grams free water remains in each Multi-Canister Overpack (MCO) prior to shipment to interim storage
  - Free water contributes to generation of heat, oxygen, hydrogen, and uranium oxides in MCO during storage
- Fuel cleaning required prior to MCO loading to limit amount of hydrated oxides (hydroxides) of primarily Uranium, Iron and Aluminum
- Development /demonstration of process included:
  - Fuel Characterization
  - GOTH SNF model
  - First article testing
  - Whole element furnace test

Proof of Dryness Test

- Proof of Dryness Test used to establish that <200 grams free water remains in MCO
  - Particulate-laden cracks assumed to completely fill with water after MCOs drained and prior to drying
  - Model established that gives diminishing rate of water release during drying as water in cracks recedes
  - Maximum rate to ensure <200 grams free water for each MCO is established based on minimum fuel temperature following thermal reset, MCO void volume, # of scrap baskets, and scrap basket loading
- Effects of Helium impeding diffusion were added later

Drying Process

- Water in MCO cask heated to drying process temperature and bulk water drained from MCO
- Vacuum drying commenced; helium slowly added to purge hydrogen and improve heat transfer
- When pressure drops below 12 Torr, Helium can be shut off; vacuum pump works to establish 0.5 Torr*
- Pressure rebound pre-test performed for ten minutes*
- Final thermal reset and initial pressure rebound test performed for 30 minutes*
- One hour proof mode performed; vacuum adjusted to 0.5 Torr, MCO isolated, and final pressure rebound performed

*Steps repeated and thermal resets used, as necessary, until successful completion prior to proceeding with next step

MCO Bound Water Content Values

Source of Bound Water	Bound Water Content in Maximum MCO	Bound Water Content in Average MCO
Adhering Particulate	0.30 kg	0.33 kg
Aluminum Hydroxide Cladding Film	3.73 kg	0.41 kg
U Cladding Film	0.00 kg	0.04 kg
Exposed Fuel Oxide Film	0.02 kg	0.02 kg
Canister Particulate	0.16 kg	0.16 kg
Stray Particulate	0.00 kg	0.00 kg
Generated Particulate	0.03 kg	0.03 kg
Total Bound Water	4.23 kg	0.99 kg

Note: Maximum Theoretical Bound Water in an MCO is 4.64 kg
Maximum Free Water in an MCO is 200 g

MCO Internal Gas Composition and Pressure

- Affected by radiolysis and thermal decomposition of free and bound water in MCO
- Internal gas composition and pressure modelled for interim storage
  - Ensure oxygen content remains below lower limit for flammability
  - Ensure pressure remains within MCO limits
- GOTH SNF MCO Model for Repository Receipt/Handling
  - Based on interim storage end point
  - Considers non-mechanistic breaches
  - Defense-in-depth

MCO Monitoring During Storage

- **Limited Monitoring**
  - Includes pressure, temperature, and gas sampling for a limited number of MCOs (15 of 394 from K Basins)
  - Provides data on large loads of actual fuel, in full-scale configuration, over long time periods
  - Most sampled four months, one year and two years after arrival at the Canister Storage Building (CSB) and once every ten years thereafter
- **Long-Term Monitoring**
  - Includes only approximate high-pressure indication capability