Horizontal Dry Cask Simulator Progress
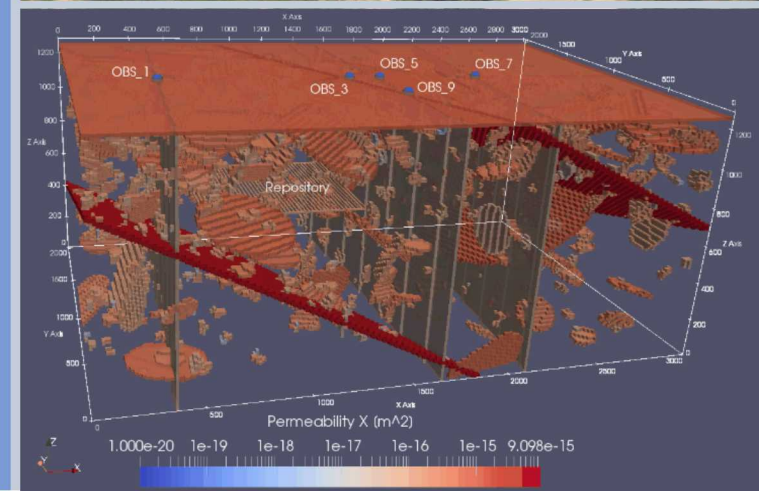
Sam Durbin, Ramon Pulido, and Eric Lindgren

Sandia National Laboratories

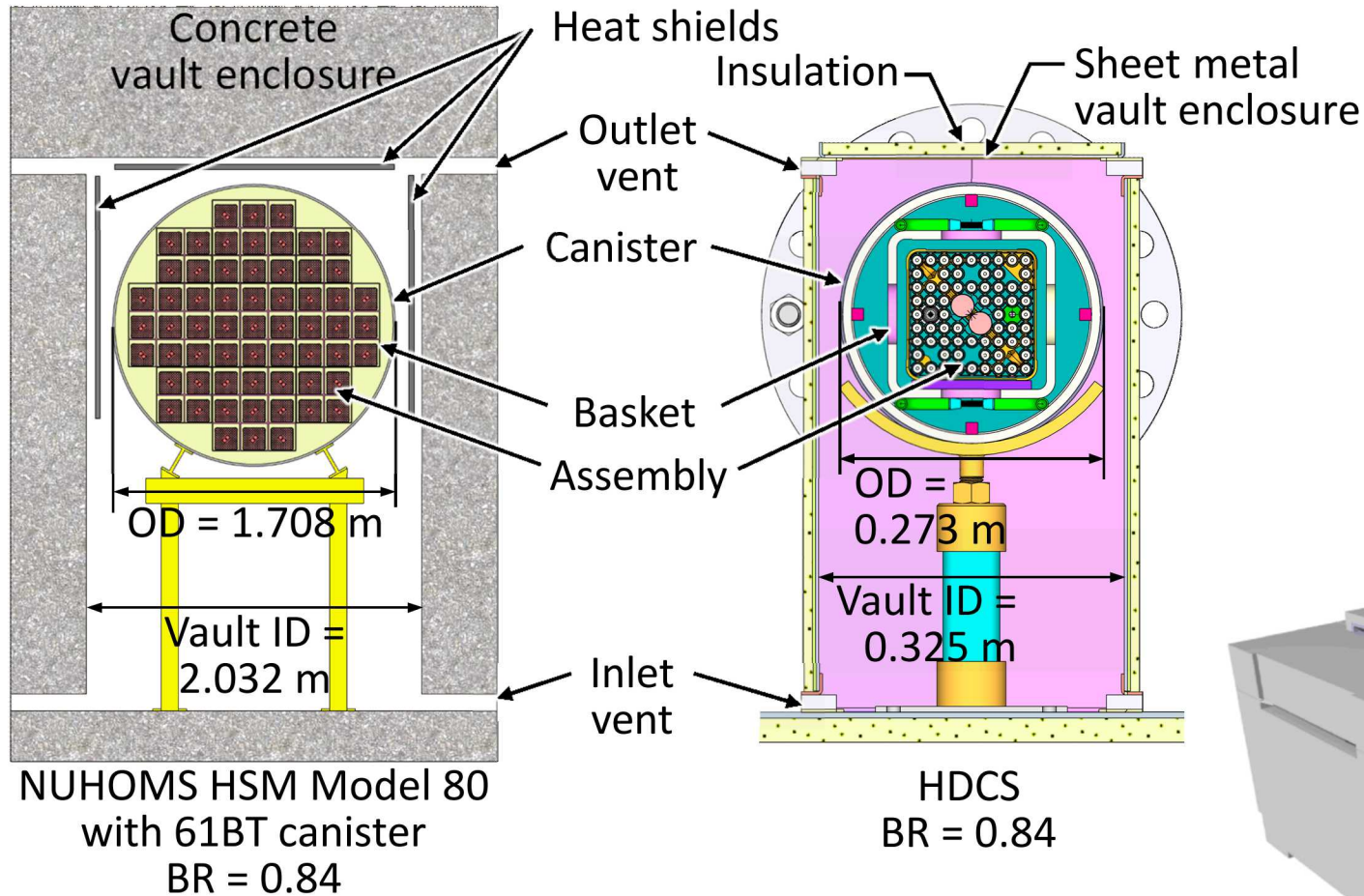**SFWD**

SPENT FUEL & WASTE DISPOSITION

Annual Working Group Meeting
UNLV-SEB – Las Vegas, Nevada
May 21-23, 2019

Overview of Horizontal Dry Cask Simulator (HDCS) Testing

Concrete vault enclosure

Heat shields

Insulation

Sheet metal vault enclosure

Outlet vent

Canister

Basket

Assembly

OD = 1.708 m

OD = 0.273 m

Vault ID = 2.032 m

Vault ID = 0.325 m

Inlet vent

NUHOMS HSM Model 80
with 61BT canister
BR = 0.84
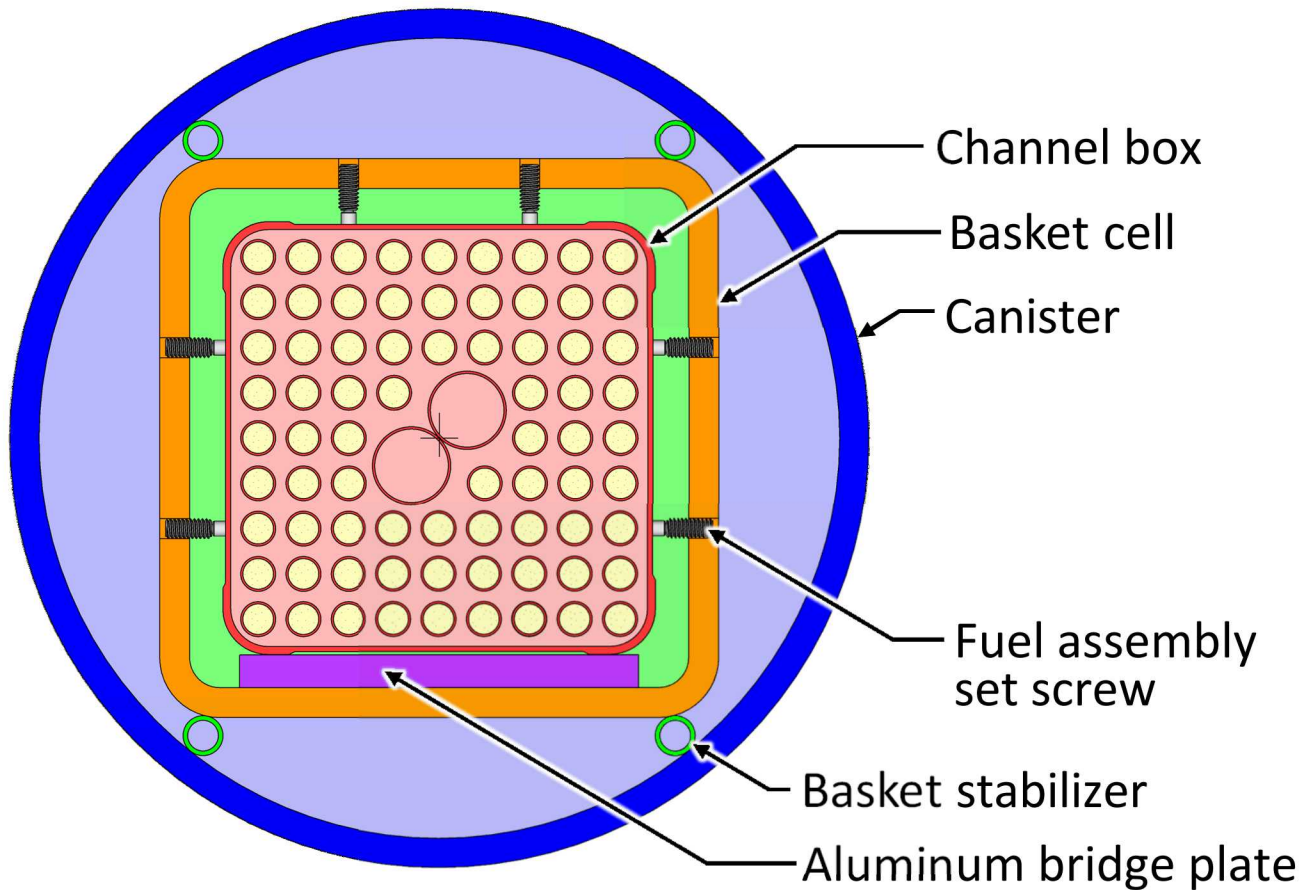
HDCS
BR = 0.84

- Repeat testing for horizontal storage configuration
  - Wide range of test parameters
    - Decay heats, gas backfills, and internal pressures
  - Collect validation data
    - Temperatures and air flow rates

Depictions of horizontal storage modules

Source: http://us.areva.com/home/liblocal/docs/Catalog/AREVA-TN/ANP_U_299_V5_17_ENG_NUHOMS_HSM.pdf

Assembly Modifications

Channel box

Basket cell

Canister

Fuel assembly set screw
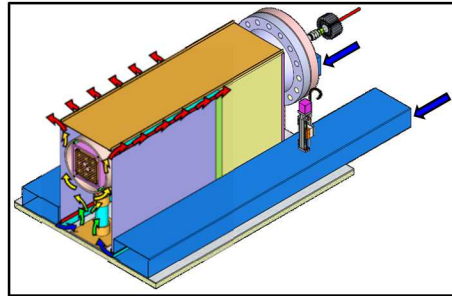
Basket stabilizer

Aluminum bridge plate

- DCS presently converted to horizontal configuration
  - Outer shell and inner shells removed
  - Pressure vessel opened
  - Basket removed
- Maintain concentricity and enhance heat conduction
  - Add stabilizers
    - Between channel box and basket
    - Between basket and canister wall
      - Full length to limit convective cells
  - Keep from damaging existing TC's

Facility Transition
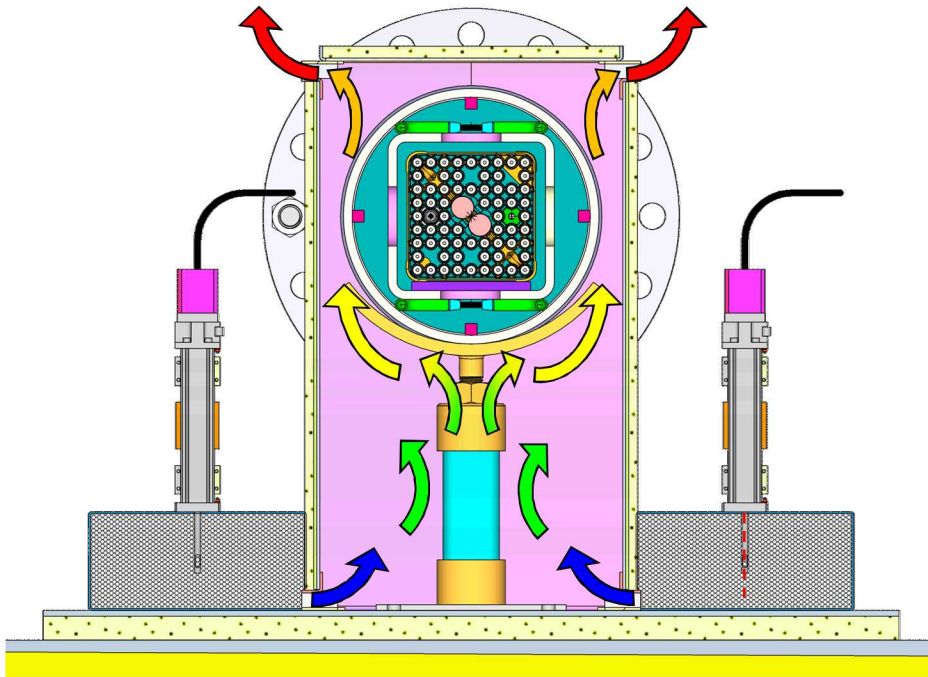

March 26, 2019

April 22, 2019

May 2, 2019

- After performing in-vessel modifications
  - HDCS moved from inside vessel to the 3rd floor
  - GENTLY rotated assembly to horizontal configuration
- Construct "vault" enclosure
  - Inlet and outlets
- Install additional instrumentation
- Reconnect to DAQ
  - Power control
  - Instrumentation
- Conduct testing

Dimensional Analyses

- Internal scaling within fuel maintained by matching prototypic geometry
  - Known scaling distortions
    - Power: Higher surface-area-to-volume
    - Internal heat transfer: Reduced conductivity between structures
- External dimensionless groups may appear dissimilar at first inspection, but…
  - Reynolds: Irregular regime for $270 < Re_D < 5{,}000$
  - Modified Rayleigh: 3-D wake separation (turbulence) for $Ra_D^* > 3.5 \times 10^9$

Parameter	Horizontal		
	HDCS Low Power	HDCS High Power	Cask
Power (kW)	0.5	5.0	24
Re_D	280	730	2,000
Ra_D^*	1.3E+09	1.3E+10	1.4E+13
Nu_{DH}	30	50	170

Summary

- Horizontal dry cask simulator (HDCS) progress
  - Fuel assembly and pressure vessel reoriented to horizontal configuration
  - Vault construction nearly complete
    - Inlets and outlets attached
  - Thermocouples reconnected (internal) and installed on surrounding structures
  - Hot wire anemometers to be installed in inlet air ducts
  - Power control reestablished
    - Assembly still intact and functioning after move
- Testing during summer of 2019
  - 28 tests scheduled
    - 3 gas backfills (Helium, air, argon)
    - 4 different decay heats (0.5, 1.0, 2.5, 5.0 kW)
    - 3 pressures (100, 200, 800 kPa)

QUESTIONS?

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