

High Burnup Research Cask Project Update

Technical Meeting on the Behaviour of Spent Fuel and Cladding During
Storage and the Performance of Spent Fuel Storage Systems
Seoul, South Korea



Keith Waldrop
Principal Technical Leader

June 23, 2025

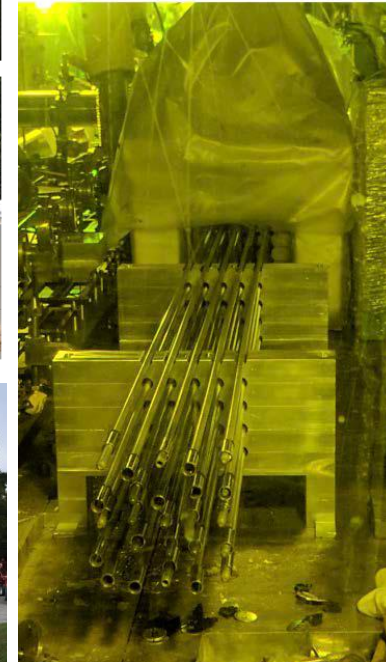


HBU Research Cask Background

HBU Research Cask – High Level Plan

Conduct a cask demonstration to confirm the technical basis for high burnup fuel

- Provide data to support HBU license renewals
- Load cask with high burnup fuel
 - Determine initial condition of the fuel through sister rods
 - Collect temperature and gas composition data
- Store cask at least 10 years
- Determine post-storage condition of the fuel
 - Ship cask to examination facility
 - Open cask without rewetting and inspect fuel
- Option to reclose and continue storage and measurements

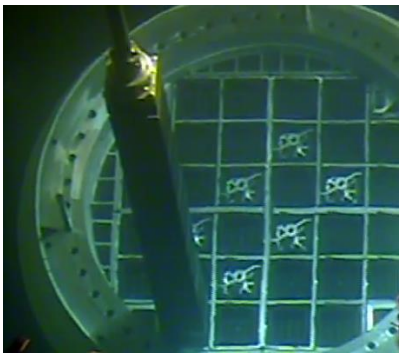




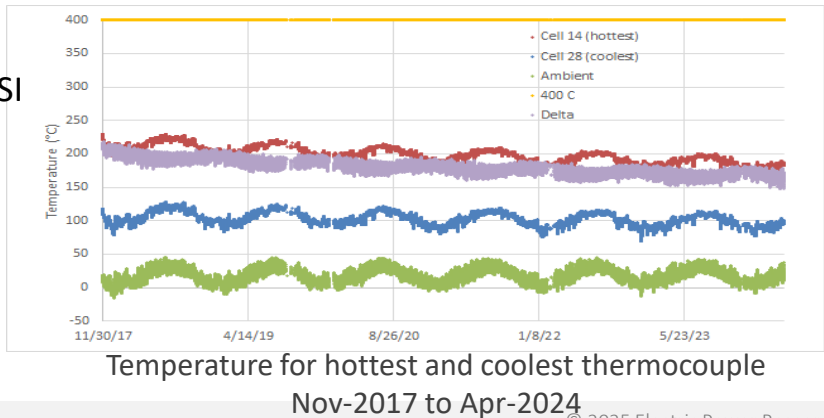
HBU Research Cask Data Collection

HBU Demo – Data Collection

- Cask loaded Nov 2017
 - Data collected
 - 3 gas samples (after He backfill, 1 week and 2 weeks)
 - No Kr - All radionuclides zero - No fuel failure
 - Essentially no hydrogen or oxygen (below detection limit)
 - Moisture content proved difficult to determine
 - ~100 ml after 2 weeks
 - Temperature data – 63 internal thermocouples
 - Continue collecting internal temperature data

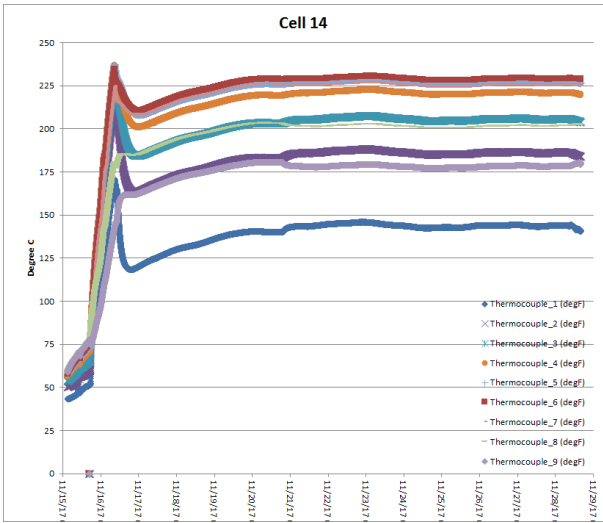


Temperature vs time at ISFSI
Nov 2017 – Apr 2024
Highest temperature
Lowest temperature
Ambient temperature
Delta (highest-ambient)



First 5 years:
~6 ½ °C drop per year
Dependent on:

- cooling time
- location



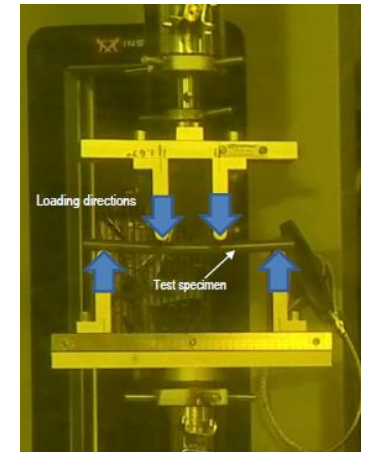
Temperature vs time
Loading through 2 weeks storage
9 axial locations in cask center

HBU Demo – Sister Rods

- Sister rods
 - 25 sister rods shipped to ORNL Jan 2016
 - Determine initial condition of the fuel
 - Perform separate effects tests for closing data gaps
 - Phase 1 of sister rod testing complete and results published
 - Nondestructive: ORNL/SPR-2017/484 Rev. 1
 - Destructive:
 - ORNL/SPR-2022/2678
 - PNNL-33781
 - Summary report: SAND2024-16441R
 - Phase 2 final test plan published 9/15/23 (SAND2023-09981R)
 - Phase 2 testing not likely to occur
 - EPRI and industry have provided support for Phase 2 testing
 - Current DOE leadership focused on other priorities



Courtesy NAC International



Load frame for 4-point bend test
ORNL/SPR-2022/2678



HBU Research Cask Transportation Planning

HBU Research Cask Shipment

- Completion of HBU Research Cask project requires:
 - Shipping cask to fuel examination facility
 - Opening dry and inspecting fuel
- Plan to ship HBU Research Cask cask in 2027
 - North Anna has window to ship in 2027
 - Top priority to DOE to ship in 2027
 - 2027 shipment supports upcoming 2028 licensing need



Table A1.8-1, High Burnup Fuel AMP Toll Gate Assessments

Toll Gate	Year*	Assessment
1	2028	Evaluate information obtained from the HDRP loading and initial period of storage along with other available sources of information. If the HDRP NDE (i.e., cask gas sampling, temperature data) has not been obtained at this point and no other information is available then Calvert Cliffs has to provide evidence to the NRC that no more than 1% of the high burnup fuel has failed.

Licensing Commitment from
Calvert Cliffs High Burnup Aging Management Program

HBU Research Cask – Transport License & Components

- Transport license issued 7/2/24
 - Minor revisions needed to address:
 - Operational logistics for transload onto railcar
 - Clarification of intact fuel
- Fabricate transportation components
 - Impact limiter fabrication Mar 2025 – Aug 2026
 - Other transportation components Jul 2025 – Jun 2026

U.S. NUCLEAR REGULATORY COMMISSION			
CERTIFICATE OF COMPLIANCE FOR RADIOACTIVE MATERIAL PACKAGES			
1. CERTIFICATE NUMBER	2. LICENSE NUMBER	3. LICENSEE NAME	4. DATE OF ISSUE
9377	0	71-9377	USA5377B(UF-96)

5. PRELIMINARY

6. THIS CERTIFICATE IS ISSUED TO SATISFY THE REQUIREMENTS OF 10 CFR PART 171, AS APPLICABLE, AND THE PROVISIONS SPECIFIED BELOW.

7. THIS CERTIFICATE DOES NOT RELIEVE THE LICENSEE FROM COMPLIANCE WITH ANY REQUIREMENTS OF THE REGULATIONS OF THE U.S. DEPARTMENT OF TRANSPORTATION OR OTHER APPLICABLE REGULATORY AGENCIES, INCLUDING THE GOVERNMENT OF ANY COUNTRY THROUGH ITS AUTHORITY TO SHIP OR TRANSPORT.

8. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION.

9. ISSUED TO: NAME AND ADDRESS

10. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

11. THE AMERICAN LLC
7185 Riverwood Drive, Suite 200
Columbia, MD 21046

12. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

13. TNA-32 Transportation Cask Safety Analysis Report, dated June 2024.

14. CONDITIONS

15. This certificate is conditional upon fulfilling the requirements of 10 CFR Part 171, as applicable, and the provisions specified below.

16. (a) Packaging

(1) Model No. TNA-32B.

(2) Description:

The TNA-32B packaging consists of a spent fuel basket assembly, a containment vessel, a forged steel shell body, a radial neutron shielding, and impact limiters.

Basket

The spent fuel basket consists of a honeycomb-like structure of stainless steel cells, housing 32 fuel assemblies, separated by aluminum end plates and a sandwich panel. The aluminum plates provide heat conduction paths from the spent fuel assemblies to the cask cavity wall. The poison material provides the necessary criticality control. The opening of the cells is 0.7 in. x 0.7 in., leaving a minimum of 10 in. clearance around the fuel assemblies. The overall basket length (150.0 in.) is less than the cask cavity length to allow for thermal expansion and fuel assembly handling.

Containment Vessel

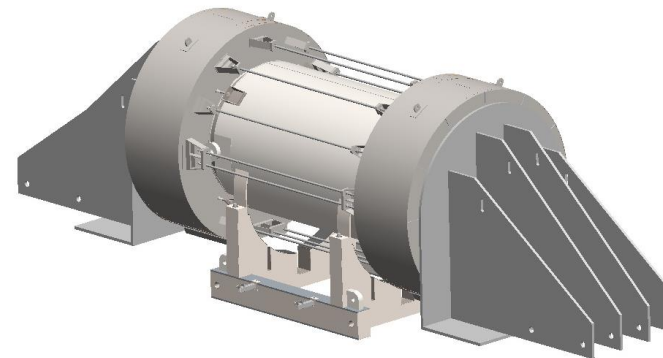
The containment vessel consists of the inner shell and bottom inner plate, shell flange, closure lid outer plate, closure lid bolts, penetration cover plates and bolts, thermocouple sensor assemblies and their seals, inner metallic seals of the lid, vent and drain seals. The containment vessel, which maintains an inert atmosphere (helium) in the cask cavity, is 171 inches long, with a wall thickness of 1.5 inch. The

CoC 71-9377

NRC ADAMS Accession #: ML24180A132



Wood material for impact limiters



Cask in shipping frame with impact limiters

HBU Research Cask – North Anna Site Assessment

- Integrated team conducted site assessment May 2024
 - Evaluated infrastructure
 - Interviews for past experience in shipping
 - Local leaders
 - Inspect potential off-site transload locations
 - Conclusion:
 - 2 options exist, but each require significant effort
 - Transload on-site (preferred)
 - Heavy haul to alternate site for transload
 - Transload on-site option selected
 - North Anna already refurbished rail for another project
 - Need to address deviations in analyzed haul path



INL Announced as Destination for HBU Research Cask

Idaho and Trump Administration sign agreement to support US nuclear energy future

April 29, 2025

By Idaho National Laboratory

Paving the way for advanced nuclear research

State of Idaho, U.S. Department of Energy announce waiver to 1995 Settlement Agreement

(IDAHO FALLS, Idaho) — The State of Idaho and the U.S. Department of Energy have agreed to a targeted waiver of the 1995 Settlement Agreement. The agreement established milestones to remove legacy waste at the Idaho National Laboratory site while allowing nuclear energy research and development at the lab.

The waiver will enable critical research on a high burnup nuclear fuel cask from a commercial nuclear power plant. This research will provide data to support licensing for the extended storage of spent fuel at 54 nuclear power plants in 28 states.

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HBU Research Cask – Shipment Planning

- Assembled integrated team with DOE/labs/EPRI/Orano
 - Develop and execute shipment planning activities
- Planning dry runs – North Anna, destination, route
 - Use empty unused TN-32B cask
 - Perform fit-ups
 - Use of ATLAS railcar



TN-32B cask at EPRI
Available for dry run



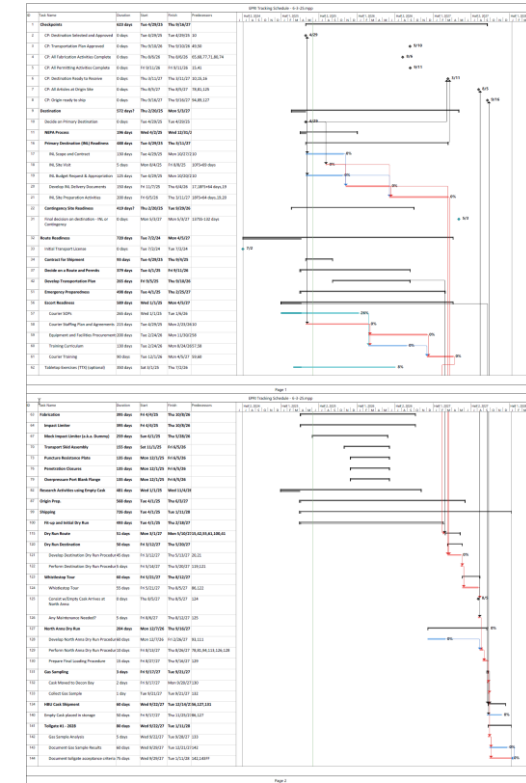
Atlas railcar



Example transload operation

HBU Research Cask Project Schedule

- EPRI developed a high-level tracking schedule
 - Coordinated schedule including DOE, National lab, and EPRI team activities with logic ties
- Schedule supports September 2027 shipment
- DOE has all critical path activities until turnover to North Anna for prep and loading
- Continue working with DOE and updating schedule
- Contingency if shipment does not occur in 2027
 - Several CNO letters to DOE supporting 2027 shipment
 - Developing plans to revise HBU AMP

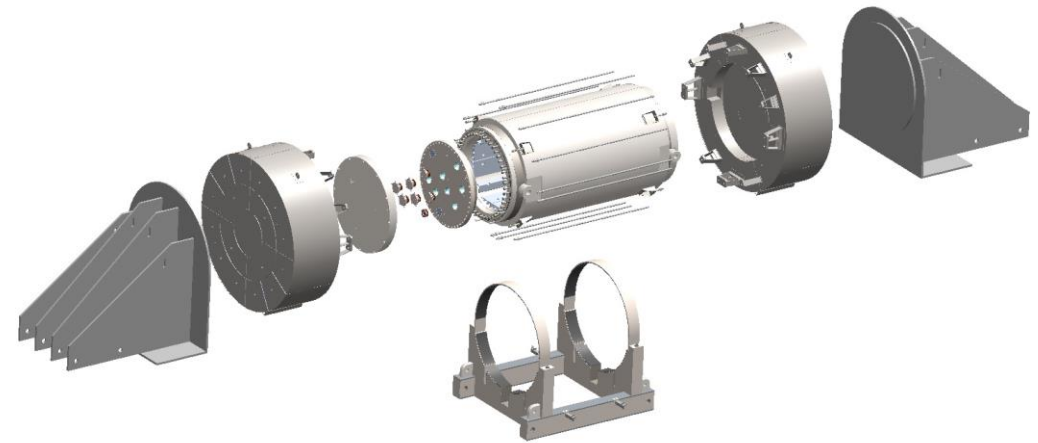
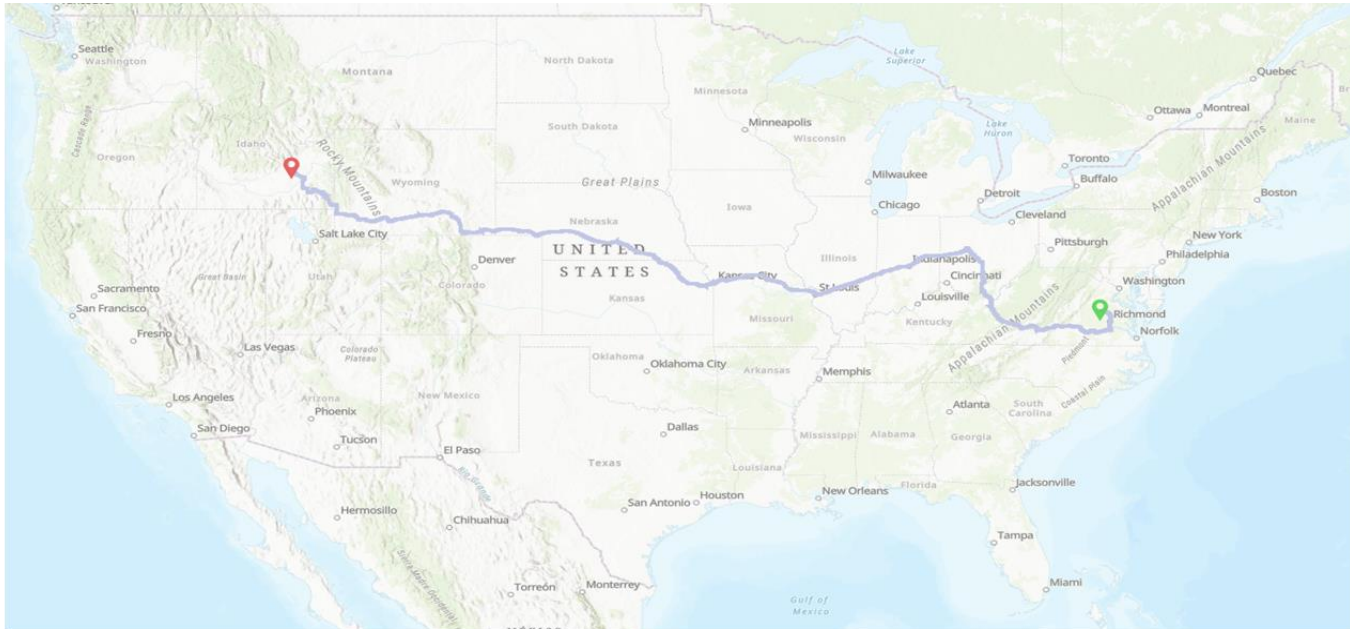


HBU Research Cask – Activities for 2025-2027

Task	Date
DOE identify destination	Apr-2025
Begin transportation component fabrication	Mar-2025
Finalize method to load on railcar	Apr-2025
Determine transportation route	Sep-2025
Submit transport CoC revision	Oct-2025
Transport CoC revision approved	May-2026
Complete transportation component fabrication	Aug-2026
Complete fit up test of impact limiters	Mar-2027
Begin dry runs	Apr-2027
Complete dry runs	Aug-2027
Take gas sample	Sep-2027
Ship HBU Research Cask cask	Sep-2027
Tollgate 1 due	Apr-2028

Summary

- HBU Demo making good progress
 - INL identified as destination
 - Activities ongoing to support shipment in 2027
 - Contingency plans being developed





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