

DOE Spent Nuclear Fuel Storage, Transportation, and Plans for Disposal

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U.S. DEPARTMENT OF
ENERGY

OFFICE OF
ENVIRONMENTAL
MANAGEMENT

Outline

- Spent Nuclear Fuel (SNF) Definition and Terminology
- EM Spent Nuclear Fuel Mission
- Regulatory Framework
- Management of DOE SNF
- SNF Working Group
- SNF Constraints
- SNF Challenges & Potential Solutions



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SNF Definition & Terminology

- Spent Nuclear Fuel (SNF) is defined by statute (Nuclear Waste Policy Act and the Atomic Energy Act of 1954)
 - SNF is “fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing”
 - Following irradiation in a reactor, assemblies also contain “byproduct material”
 - Byproduct material is any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material.

EM SNF Mission

The U.S. Department of Energy Office of Environmental Management's mission is to address the nation's Cold War environmental legacy resulting from many decades of nuclear weapons production and government-sponsored nuclear energy research.

The Office of Nuclear Materials is responsible for safely managing nuclear materials remaining on sites around the country, including a diverse, complex inventory of spent nuclear fuel.

SNF Regulatory Framework

Atomic Energy Act

- Key statute that defines key terms, lays out U.S. government policies, gives the Secretary authorities to utilize nuclear materials and manage radioactive waste
- AEA and Energy Reorganization Act of 1974 also established NRC's regulatory authority over commercial SNF and certain DOE facilities.

National Environmental Policy Act

- Promotes better decision making
- Ensures full and meaningful public engagement
- Fundamental principles of informed and science-based decision making

Nuclear Waste Policy Act

- National policy on safe disposal of SNF
- Established the Federal responsibility to provide for the disposal of SNF
- Requires generators and owners of SNF to enter into contracts and agreements with DOE to obtain disposal services.

Applicable Regulations and Directives

- Through the AEA, DOE and NRC establish requirements which can be applicable to SNF. These include requirements for material control, safeguards, protection, etc.

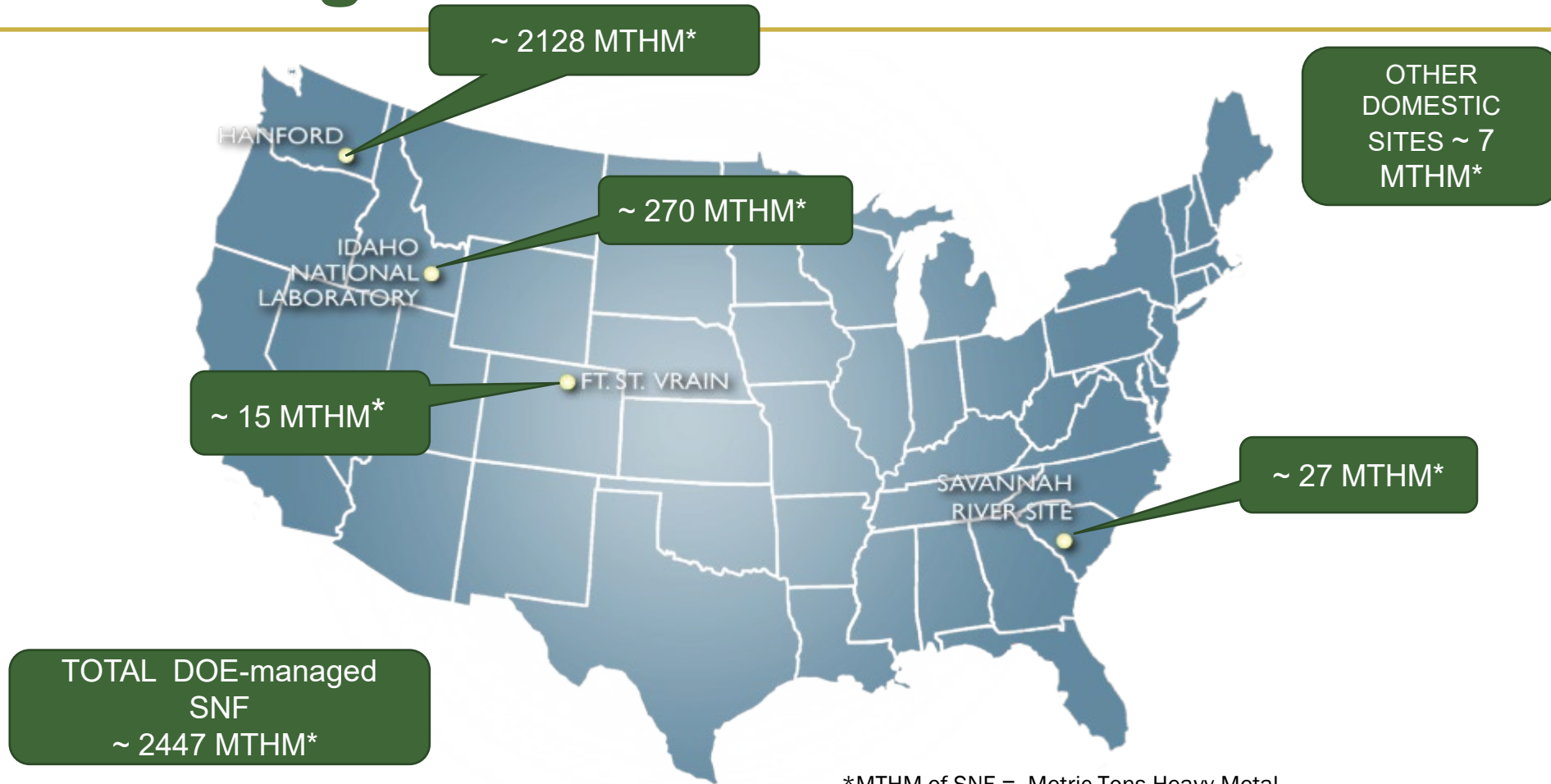
Idaho Settlement Agreement

- Establishes site-wide clean up milestones
 - SNF out of ID by 1/1/2035
 - State imposed sanctions (SNF shipments)
 - Limiting SNF shipments into Idaho

SNF Inventory

- Sources of DOE-managed SNF in DOE Inventory
 - DOE production reactors (majority of inventory)
 - Some commercial-origin SNF
 - Core debris from the Three-mile Island Reactor
 - Commercial power demonstration projects
 - Foreign Research Reactors
 - Domestic Research Reactors
 - Includes DOE labs, Universities, and other Government agencies
 - DOE–managed SNF is SNF that is stored or processed in DOE facilities and for which the office of EM has some responsibility, excludes majority of commercial SNF

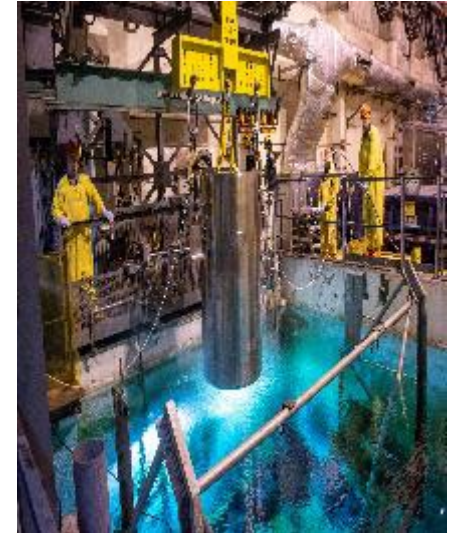
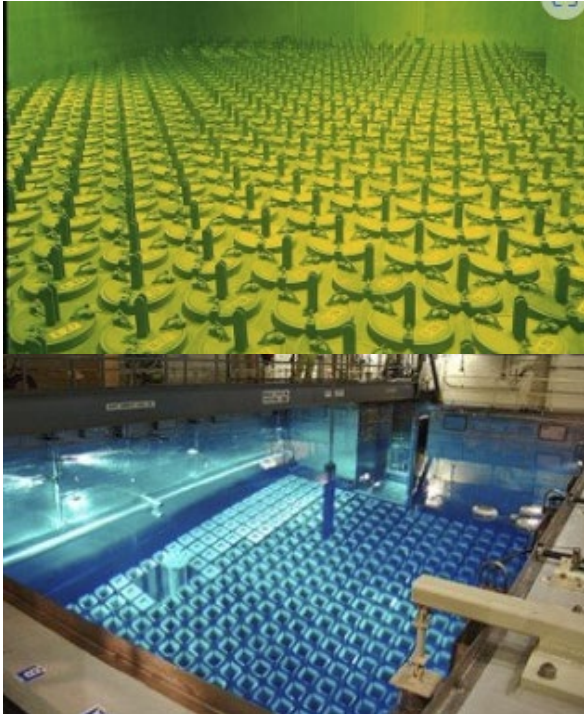
SNF Storage Locations



*MTHM of SNF =- Metric Tons Heavy Metal

Where is DOE SNF Currently Stored?

- DOE-managed SNF is stored in various configurations at four primary sites
 - Savannah River Site stores its SNF in the L-Basin pool
 - Hanford stores its SNF in the Canister Storage Building and an adjacent Interim Storage Area in the 200 Area
 - Idaho National Laboratory has 9 storage facilities to store a wide variety of SNF generated by EM, NNPP, and NE
 - DOE-ID is also responsible for storage of SNF from the Ft. St. Vrain nuclear power station in Colorado



Savannah River's L-Basin



Various Storage Facilities at INL



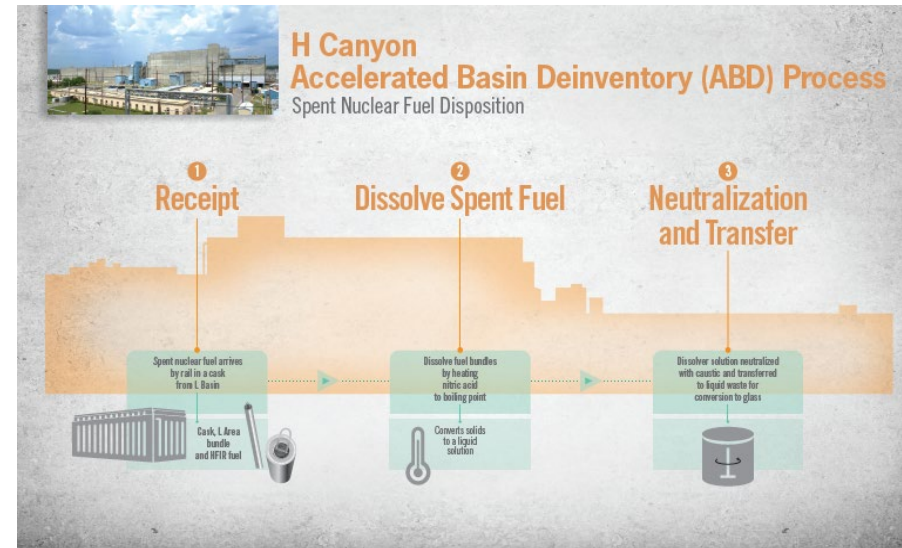
Canister Storage Building and Interim Storage Area at Hanford's 200 Area



Ft. St. Vrain (CO) SNF Storage

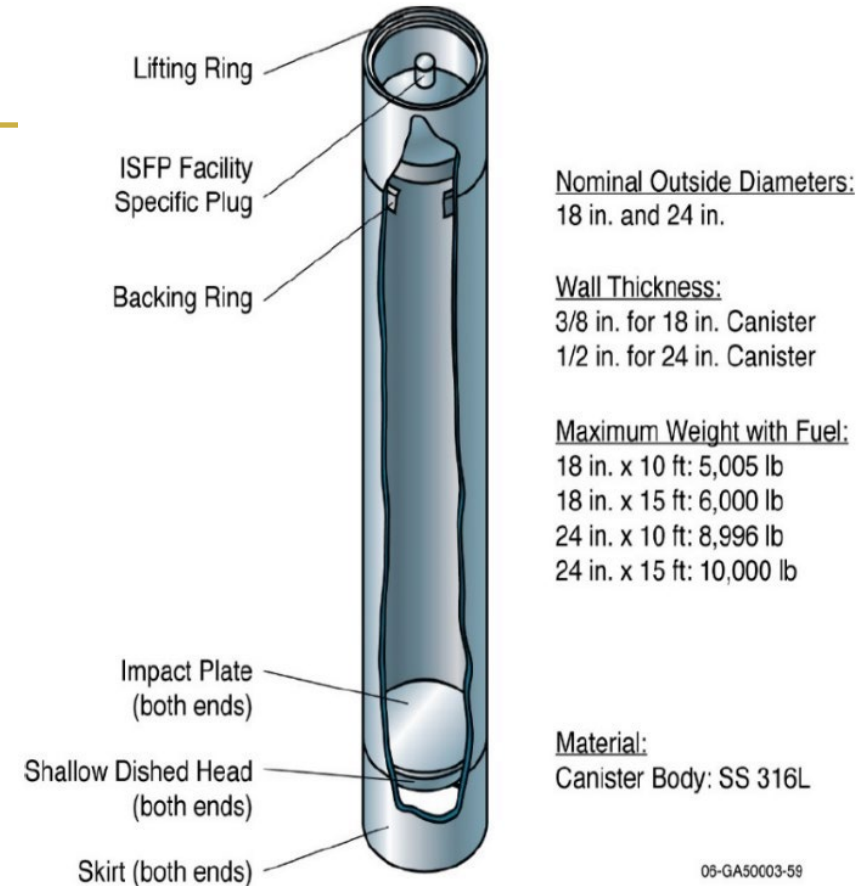
Processing

- H-Canyon
 - Only large-scale nuclear chemical processing facility in the U.S.
- Implementing the Accelerated Basin De-inventory (ABD) Mission
 - Approved April 2022
 - Process the SNF in the L-Basin at SRS through H-Canyon without recovering of uranium.



Transportation/Disposal

- Office of Nuclear Energy is evaluating options for transportation and disposal
- Approximate inventory thru 2055*
 - Hanford: ~575 MCO/DOESC
 - Idaho: ~2000 DOESC's - includes Ft. St. Vrain
 - SRS: ~800 DOESC's



DOE Standard Canister (DOESC)
Multi canister Overpack (MCO)

SNF Working Group

- Chartered by DOE in 2014
- Provides forum for the entire DOE complex to
 - Cooperatively develop and implement an effective SNF management strategy
 - Advise DOE management on actions to address wide range of SNF management issues
- Member Organizations
 - Co-Chaired by EM and NE
 - Idaho Operations Office (EM and NE members)
 - National Nuclear Security Administration
 - Office of Naval Reactors
 - Richland Operations Office
 - Savannah River Operations Office
 - Office of Science

SNF Working Group Accomplishments

- Developed internal DOE SNF strategic plan: *Strategic Framework for DOE-Managed Spent Nuclear Fuel* (2021)
- Completed Report on AI-clad SNF (ASNF) Knowledge Gaps (2015)
- Completed an internal Exploratory Disposition Roadmap Report (2019)
- Completed internal RRDS Report (2021)
- Conducted a formal Analysis of Alternatives (AoA) for SRS SNF disposition (2019)
- Conducted a formal AoA for SNF at the Idaho site (2021)
- Developed a draft, internal definition of nuclear fuel (2020)
- Evaluated the NWTRB 2017 Report, *Management and Disposal of U.S. Department of Energy Spent Nuclear Fuel*, for any implications with respect to managing our technology development (TD) program or on our SNF strategy (2022)

SNF Constraints

Safely and effectively manage the DOE inventory of SNF throughout storage, processing, transportation to the point of ultimate disposition.

- Legislative basis
- State agreement, milestones, and other constraints
 - Idaho Settlement Agreement (ISA)– covers all waste management activities in Idaho
 - ISA and Colorado milestones to have all SNF out of state by 2035
 - No available repository or interim storage facility or other identified disposition path to meet milestone

SNF Challenges/ Potential Solutions

1. Remaining SNF inventory in L-Basin post-ABD (including challenging non-aluminum SNF) and future receipts
 - ✓ *Identify and select alternatives (e.g., small-scale modular nuclear material processing capability)*
2. Long-term storage sustainability
 - ✓ *Implementing an integrated SNF management plan for the Idaho Site,*
 - ✓ *Pursuing Technology Development activities on safely managing SNF*
3. Drying and Packaging for Road-ready configuration (that would allow for long-term storage and/or transportation for disposal)
 - ✓ *Continue to prepare to package SNF in Road Ready Dry Storage configuration combined with aging management program*

SNF Challenges/ Potential Solutions (cont.)

4. Aging Facilities

✓ *SNF Working Group is initiating complex-wide infrastructure planning*

5. NEPA

✓ *Ensuring that NEPA coverage is adequate for future activities, such as those to be contemplated in infrastructure planning*

6. Adequate Resources

✓ *Seeking additional resources from Congress/Other DOE Programs while reducing expenses (i.e., ABD mission)*

Additional Information



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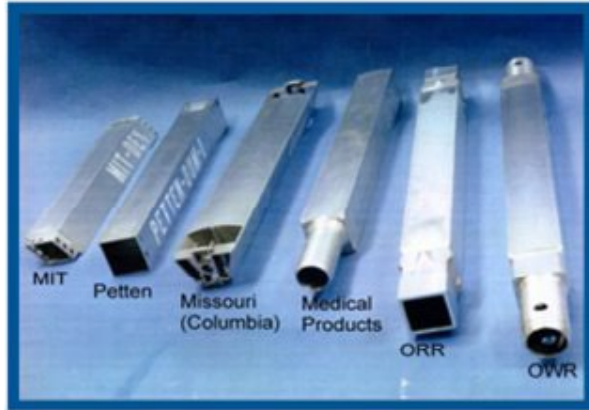
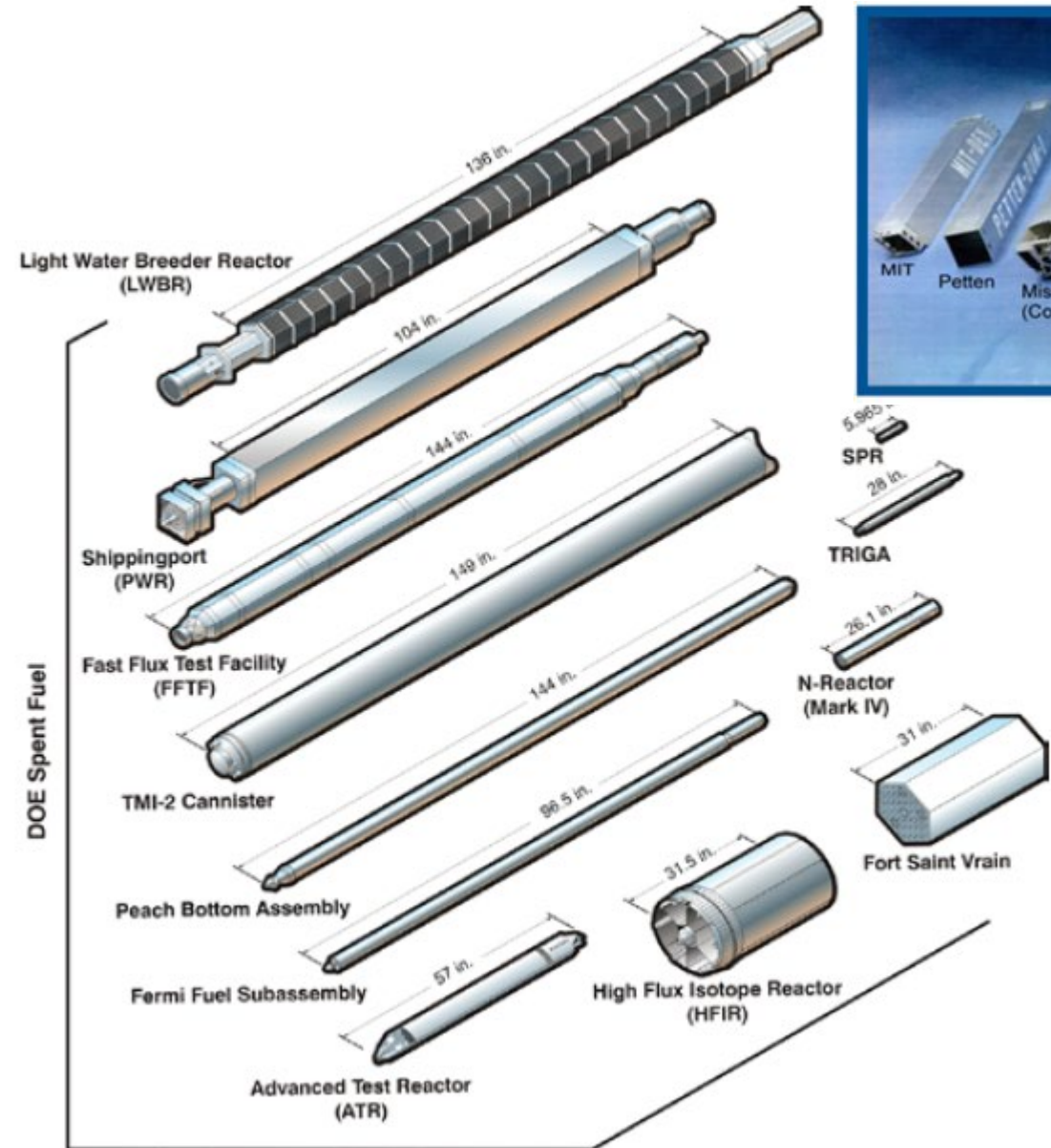
Acronyms

- ABD – Accelerated Basin De-inventory
- AoA- Analysis of Alternatives
- DOE – Department of Energy
- EM – Office of Environmental Management
- ID – DOE Idaho Operations Office
- ISA- Idaho Settlement Agreement
- NE – Office of Nuclear Energy
- NEPA- National Environmental Policy Act
- NNPP – Naval Nuclear Propulsion Program
- NRC – Nuclear Regulatory Commission
- NWTRB – Nuclear Waste Technical Review Board
- RRDS- Road-Ready Dry Storage
- SRS - Savannah River Site
- TD – Technology Development

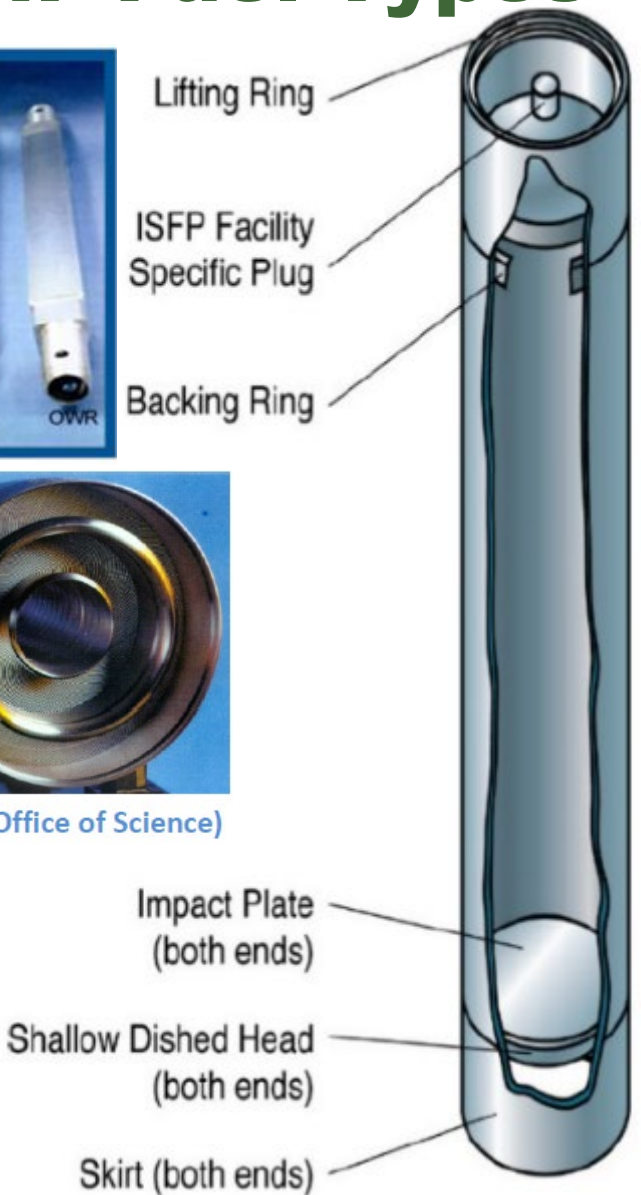
References

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- DOE 2017 *Aluminum-Clad Spent Nuclear Fuel—Technical Considerations and Challenges for Extended Dry Storage_Report_NOT PUBLIC.pdf*
- SNFWG 2021 *Exploratory Disposition Roadmap FINAL Report NOT PUBLIC.docx*
- SNFWG 2021 *Road Ready Dry Storage FINAL Report NOT PUBLIC.docx*
- SNFWG 2021 *Road Ready Dry Storage Vol 1_FINAL_Report_NOT PUBLIC.docx*
- SNFWG 2021 *Road Ready Dry Storage Vol 2_FINAL_Report_NOT PUBLIC.docx*
- Future of H-Canyon Operations and Management Options for Spent Nuclear Fuel and Nuclear Material at the Savannah River Site Analysis of Alternatives Integrated Project Team Final Report – August 2019 NOT PUBLIC
- Management Options for Spent Nuclear Fuel at the Idaho National Laboratory Site Integrated Project Team Analysis of Alternatives Final Report - January 2021 NOT PUBLIC

Examples of DOE Managed SNF Fuel Types



HFIR Fuel (Office of Science)



Nominal Outside Diameters:
18 in. and 24 in.

Wall Thickness:
3/8 in. for 18 in. Canister
1/2 in. for 24 in. Canister

Maximum Weight with Fuel:
18 in. x 10 ft: 5,005 lb
18 in. x 15 ft: 6,000 lb
24 in. x 10 ft: 8,996 lb
24 in. x 15 ft: 10,000 lb

Material:
Canister Body: SS 316L