



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

Nuclear Energy University Programs

Fiscal Year 2021

Annual Planning Webinar

Spent Fuel and Waste Disposition

FC - 4.1 Disposal Research

FC - 4.2 Storage & Transportation

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Spent Fuel Disposition Overview

❖ DOE Office of Nuclear Energy Mission

- Advance nuclear power as a resource capable of meeting the nation's energy, environmental, and national security needs by resolving technical, cost, safety, proliferation resistance, and security barriers through research, development, and demonstration as appropriate

❖ Spent Fuel and Waste Disposition Mission

- Identify alternatives and conduct scientific research and technology development to enable storage, transportation and disposal of spent nuclear fuel and wastes generated by existing and future nuclear fuel cycles



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Spent Fuel Disposition Campaign R&D Participants





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Spent Fuel Disposition Grand Challenge

- ❖ **The *Grand Challenge* for the Spent Fuel and Waste Campaign is to provide a sound technical basis for the safety and security of long-term storage, transportation, and disposal of spent nuclear fuel and wastes from the nuclear energy enterprise**
- **Importance: Supports the establishment of SNF management and disposition pathways**



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Spent Fuel Disposition Research Needs

❖ Disposal

- Provide a sound technical basis for assurance that the US has multiple viable disposal options available when national policy is ready
- Identify and research generic sources of uncertainty that challenge the viability of disposal concepts
- Increase confidence in robustness of generic disposal concepts to reduce the impact of site-specific complexity
- Develop the science and engineering tools required to address the needs above

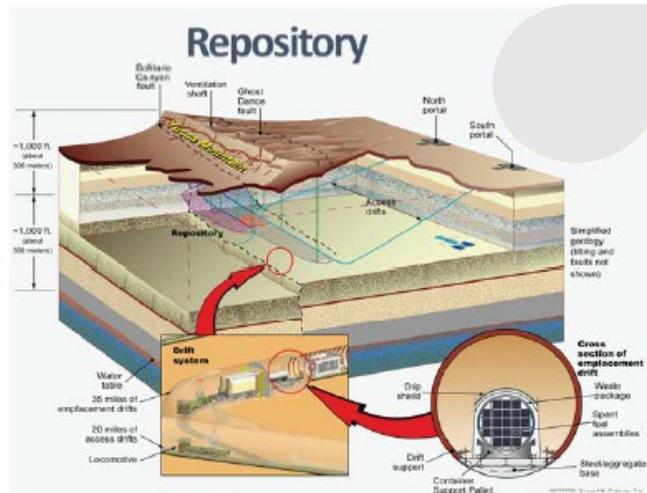
❖ Storage & Transportation

Develop the technical bases:

- To demonstrate used fuel integrity for extended storage periods
- For fuel retrievability and transportation after extended storage
- For transportation of high burnup fuel



NEUP R&D Work Scope Description: Spent Fuel Disposition FC-4.1: Disposal



Generic Geologies

- clay/shale
- salt
- crystalline rock
- tuff

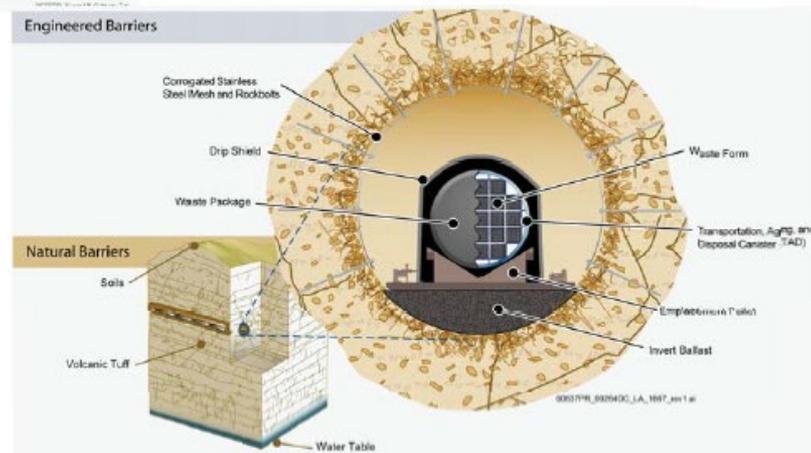
Barriers for Waste Isolation

Natural Barriers:

- Saturated or Unsaturated
- Reducing or Oxidizing

Engineered Barriers:

- Backfill
- Container, Overpack, etc.
- Waste Form (glass, ceramic)

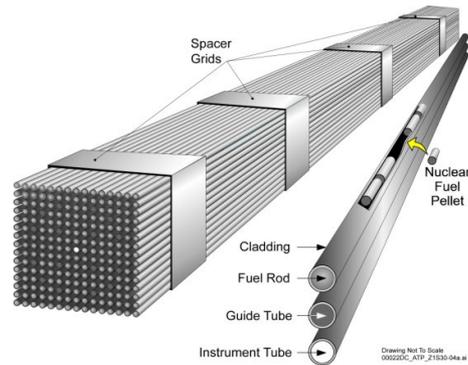




FC-4.2 Storage & Transportation Storage System Components

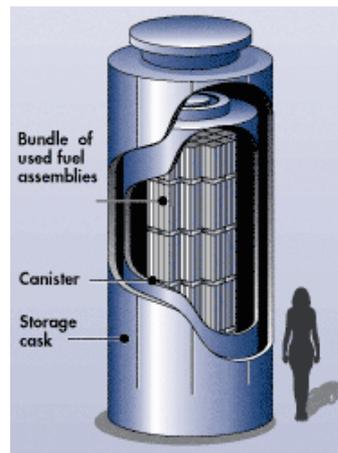
I. Fuel

- Fuel/Pellet
- Cladding
- Assembly hardware



II. Cask

- Internals (baskets, neutron poisons)
- Container (canister, welds, seals, bolts)
- Overpack/Storage module



III. ISFSI

- Pad
- Rebar
- Physical Protection

IV. Monitoring Systems

- Remote inspection
- In-package sensors
- Security



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Spent Fuel Disposition FC-4 Focus Areas for University Research Proposals

- ❖ **Program Supporting R&D proposals are being solicited in the Spent Fuel Disposition Areas:**
 - **FC-4.1 Disposal, and**
 - **FC-4.2 Storage & Transportation**
(University-led up to \$800,000 for 3 years)



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Spent Fuel Disposition FC-4.1 Disposal

Develop new and improved concepts, data, and models to demonstrate total system performance of the permanent disposal of spent nuclear fuel and high-level radioactive waste. This should apply to a variety of generic deep geologic repository concepts in clay/shale, salt, crystalline rock, and tuff. The research should include one of the following strategies:

- Barrier material development and experimenting/testing/investigating/characterizing methods advancement
- Data quality improvement and model enhancement focusing on sensitivity analysis, uncertainty quantification, reducing uncertainties

The research should address one or more of the following interest areas:

- Improved understanding of waste package failure modes
- Improved data and understanding of aqueous speciation and geochemistry of radionuclides
- Improved understanding and new concepts for engineered and natural barrier systems
- New concepts or approaches for alleviating post-closure criticality concerns



Spent Fuel Disposition

FC-4.2 Storage & Transportation

Develop novel technologies for monitoring Spent Nuclear Fuel (SNF) in Dry Storage Canisters (DSC) for the following internal conditions:

- **Canister leakage:**
 - Helium and/or helium – air mixture
 - Internal pressure
 - Internal temperature
- **Corrosion conditions and/or products:**
 - Free and/or vapor water
 - Hydrogen
- **Fuel/cladding degradation:**
 - Xe and/or Kr gas
 - Dose
- **Equipment specifications:**
 - No penetrations through the DSC wall
 - All sensors and equipment can be external to the DSC
 - Sensors can be inside, send signals through wall to equipment outside the DSC
 - Internal sensors must be radiation hardened, very small and unobtrusive, compatible with internal components, and self-powered or remotely powered



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Questions?

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