



U.S. DEPARTMENT OF  
**ENERGY**

**Nuclear Energy**

**Nuclear Energy University Programs  
Fiscal Year 2019  
Annual Planning Webinar**

**Spent Fuel and Waste Disposition  
FC - 4.1 Disposal  
FC - 4.2 Storage & Transportation**

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NEUP Federal Point of Contact

Spent Fuel and Waste Disposition

Office of Nuclear Energy

U.S. Department of Energy

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## Used 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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## Used Fuel Disposition Campaign R&D Participants





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## 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 used nuclear fuel and wastes from the nuclear energy enterprise**
- **Importance: Supports the establishment of SNF management and disposition pathways**



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# Used Fuel Disposition Research Needs

## ❖ 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

## ❖ 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



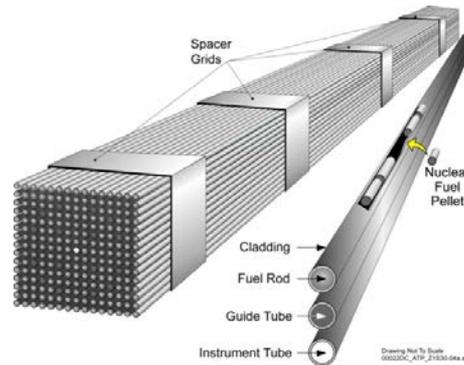
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# Storage System Components

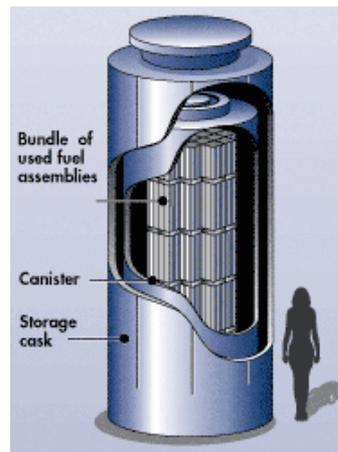
## I. Fuel

- I. Fuel/Pellet
- II. Cladding
- III. Assembly hardware



## II. Cask

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



## III. ISFSI

- I. Pad
- II. Rebar
- III. Physical Protection

## IV. Monitoring Systems

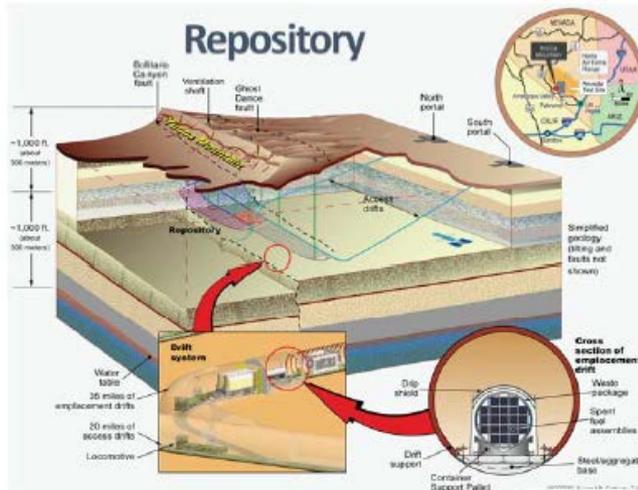
- I. Remote inspection
- II. In-package sensors
- III. Security



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# NEUP R&D Work Scope Description: Used Fuel Disposition FC-4

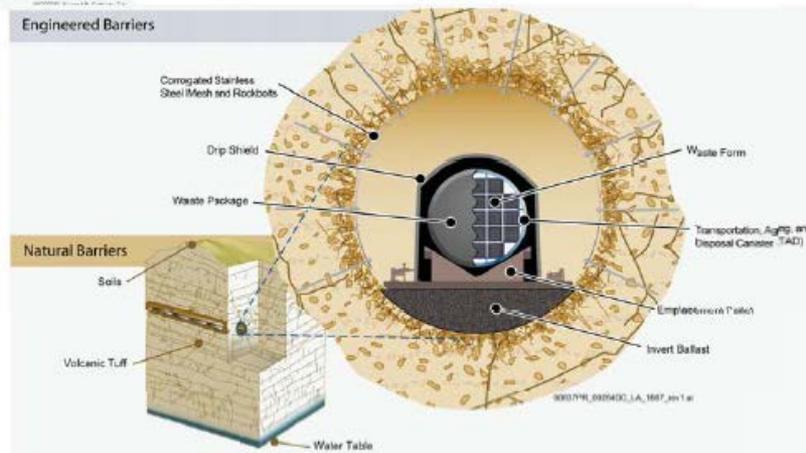


## Candidate Geologies

- clay/shale
- salt
- crystalline rock
- tuff

## Barriers for Waste Isolation

- Unsaturated Zone
- Waste Form
  - **Glass or hard ceramic**
- Engineered Barrier System





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## Used Fuel Disposition FC-4.1 Focus Areas for University Proposals

- ❖ **One IRP proposal is being solicited in the Used Fuel Disposition Area, FC-4 (University-led up to \$5,000,000 over 3 years)**
- ❖ **Two Program Supporting R&D proposals are being solicited in the Used Fuel Disposition Area, FC-4.1 and FC-4.2 (University-led up to \$800,000 over 3 years)**



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## Used Fuel Disposition IRP FC-4 Proposals

### ❖ Quantification of Residual Water after Drying a Spent Nuclear Fuel Storage Canister:

- Extensive work in this area has been performed by a recently completed IRP at the University of South Carolina. This IRP is intended to build and expand upon, not duplicate, the USC work.
- The objective of this IRP is to experimentally quantify the amount of unbound liquid water and the amount of water vapor remaining in a spent nuclear fuel dry storage canister following drying performed according to typical industry practices after the spent fuel is loaded into a dry storage canister from the spent fuel pool.
- This work would involve using spent nuclear fuel, assembly, and dry storage canister mockups to simulate industry drying practices for a variety of typical storage canister designs.
- It is expected that the mockups would be able to mimic the temperature and pressure conditions experienced so that realistic estimates of residual liquid and vapor water can be quantified.



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## Used Fuel Disposition FC-4.1 and FC-4.2 R&D Proposals

### ❖ FC-4.1 Disposal

Develop new technologies, models, and validation techniques to support the permanent disposal of spent nuclear fuel and high-level radioactive waste for a variety of generic mined repository concepts in various rock media, including:

- total system performance of generic mined repository concepts
- waste package failure modes and material degradation processes
- large-scale hydrologic and radionuclide transport processes
- new techniques for in-situ field characterization of hydrologic, mechanical, and chemical properties
- aqueous speciation, multiphase barrier interactions, and surface sorption
- repository closure and long-term waste isolation and performance
- novel buffer materials, engineered/natural system component properties and failure modes

### ❖ FC-4.2 Storage and Transportation

- Modeling, simulating, and empirically validating the initiation and growth of Chlorine Induced Stress Corrosion Pits and Cracks, and their repair or mitigation in SNF Storage Canisters