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Nuclear Energy University Programs
Fiscal Year 2017
Annual Planning Webinar

Used Nuclear Fuel Disposition
FC - 4.3 Disposal

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U.S. Department of Energy

August 2016

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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

Used Fuel Disposition (UFD) Mission

- Identify alternatives and conduct scientific research and technology development to enable storage, transportation and disposal of used 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 UFD 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 UNF 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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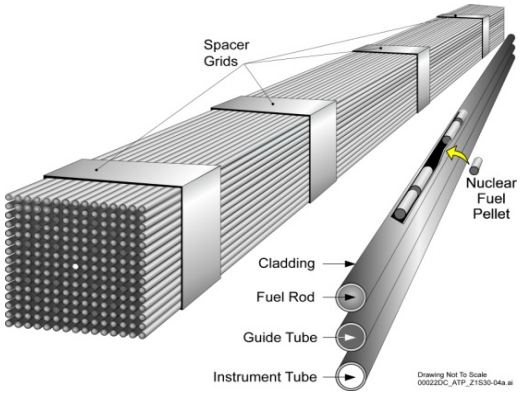
Storage System Components

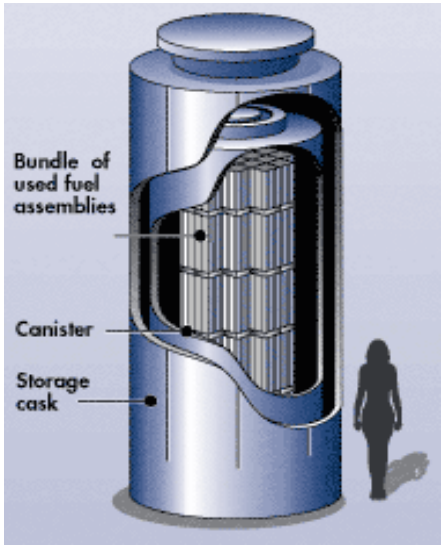
I. Fuel

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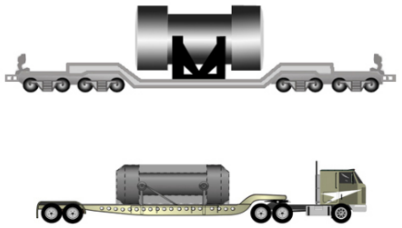
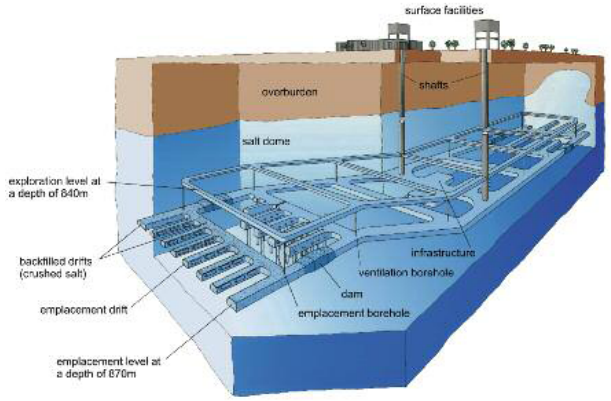
NEUP R&D Work Scope Description: Used Fuel Disposition FC-4

- **Goals:** Develop technologies for storing, transporting, and disposing of used nuclear fuel and assessing performance of waste forms in the associated storage and disposal environments





- **Focus of the research**
  - Storage (FC- 4.1)
  - Transportation (FC- 4.2)
  - Disposal (FC- 4.3)

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Used Fuel Storage (FC-4.1) and (FC-4.2) Focus Areas for University Proposals

No R&D proposals are being solicited in the FC-4.1 Storage Area at this time

No R&D proposals are being solicited in the FC-4.2 Transportation Area at this time

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Used Fuel Disposal (FC-4.3) Focus Areas for University Proposals

Key university research needs for used fuel disposal include:

- Improved understanding of degradation processes (i.e., corrosion) for heat generating waste containers/packages considering direct interactions with buffer materials in a repository reducing environment leading to the development of improved models to represent the waste container/package long term performance
- Improved understanding of the degradation processes for engineered barrier materials (i.e., waste containers/packages, buffers, seals) under evolving repository thermal conditions and radionuclide transport processes through these materials leading to and including the development of improved models to represent these processes
- Improved understanding of coupled thermal-mechanical-hydrologic-chemical processes in the near-field of relevant disposal model environments, leading to the development of improved models to represent these processes

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Used Fuel Disposal (FC-4.3) Focus Areas for University Proposals (Contd.)

Key university research needs for used fuel disposal include:

- Improved understanding of large-scale hydrologic and radionuclide transport processes in the geosphere of relevant disposal repository environments, leading to the development of improved models to represent these processes
- Development of new techniques for in-situ field characterization of hydrologic, mechanical, and chemical properties of host media and groundwater in a deep borehole or an excavated tunnel
- Development of pertinent data and relevant understanding of aqueous speciation and surface sorption at elevated temperatures and geochemical conditions (e.g., high ionic strength) relevant to the disposal environments being considered

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Used Fuel Disposal (FC-4.3) Focus Areas for University Proposals (Contd.)

Key university research needs for used fuel disposal include:

- Improved understanding of how used nuclear fuel waste forms degrade and perform in different disposal environments using theoretical approaches, models and/or experiments, with quantitative evaluations including uncertainties of how the long-term performance of used nuclear fuel waste forms can be matched to different geologic media and disposal concepts
- Experimental and modeling investigations for the effect of radiolysis on used fuel, high-level waste, and barrier material degradation at temperatures and geochemical conditions relevant to potential disposal environments