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Overview of DOE Program Supporting the Very Long Term Storage and Transportation of Used Nuclear Fuel

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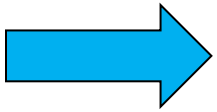
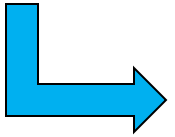
Overview of DOE/NE Fuel Cycle Technologies (FCT) Program

The Department of Energy/Office of Nuclear Energy supports the development of innovative and transformational options to the nuclear fuel cycle that will lead to research, development, and demonstration of the best options. This approach focuses on science-based R&D that integrates theory, experiments, and high-performance modeling and simulation.

- The Office of Used Nuclear Fuel Disposition Research and Development (UFD) supports the overall FCT program in the areas of Storage, Transportation, and Disposition of wastes generated from current and any future nuclear fuel cycles.
  - To support the development of the technical basis for extended storage of used fuel with subsequent transportation, the UFD program manages four separate Work Packages.
    - R&D Investigations
    - Security
    - Transportation
    - Concept Evaluations

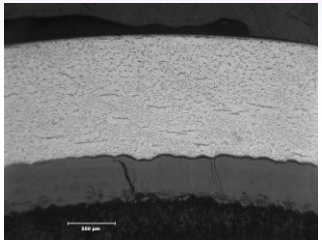


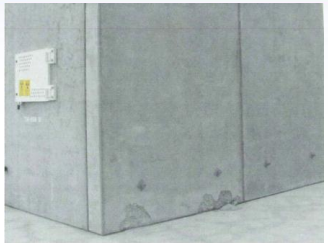
These four Work Packages encompass the DOE work associated with developing the technical arguments for extended long term storage and subsequent transportation



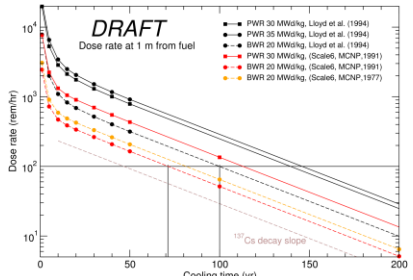
Storage and Transportation Work Packages

- **Storage R&D Investigations**
  - Data gap analyses
  - Plan to address gaps
  - Development of technical basis

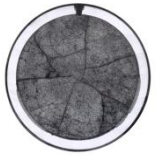


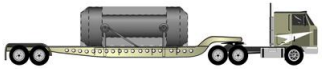


- **Security**
  - Regulatory assessment
  - Identify issues for long-term storage and subsequent transportation
  - Evaluate methods for security assessment over long-term storage



- **Transportation**
  - High burnup fuels
  - Transportation of all fuels after storage





- **Conceptual Evaluation**
  - Evaluate scenarios for accomplishing development of technical basis
  - Develop a systems framework for decision-making

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Collaboration with Industry and Regulators

The DOE program is closely integrated with industry and regulators to ensure that all applicable aspects of the storage system components are identified and considered.

The primary interface for this work is the Electric Power Research Institute (EPRI) Extended Storage Collaboration Program (ESCP). This committee is a working group made up of representatives from:

- **Industry (EPRI, utilities, fuel vendors, cask vendors)**
- **Regulator (NRC)**
- **DOE Laboratories**
- **International organizations**

Objectives:

- **Share information on work being conducted by individual organizations that is relevant to all ESCP members**
- **Coordinate efforts associated with identification and prioritization of data gaps**
- **Share data/information related to on-going work associated with addressing data gaps**

Collaboration with Industry and Regulators (cont)

ESCP Structure:

Steering Committee

- **Provide overall direction**

Two Sub-committees

- **Experimental Sub-committee**
  - **technical data gap analyses and prioritization**
  - **sharing of data/information from existing and on-going efforts**
- **International Sub-committee**
  - **technical data gap analyses and prioritization**
  - **sharing of data/information from existing and on-going efforts**

Committees strive to meet two times per year, supplementing meetings with conference calls, as necessary.

Collaboration with Industry and Regulators (cont)

Provisional Technical Gaps Based on Storage System Component

	Fuel	Internals/ Canister	Overpack/ISFSI	Transportation
Germany	• See "Transportation" cell	• Corrosion of containment boundary components • Polymer neutron poison degradation	• Degradation of metal and elastomer seals	• Retrievability and subsequent transport of fuel after VLTS
Japan	• Degradation performance of MOX fuel	• Degradation data for normal SS under a realistic salty air environment with/without reduced residual stress	• Degradation on loss of water content in shielding overpack	• Evaluation method on containment performance of aged metal
Hungary	• Corrosion • Creep		• Concrete structure degradation	• Retrievability to transfer into transport cask
U.S.	• Hydride embrittlement • Delayed hydride cracking • Annealing of radiation effects • Oxidation • Creep	• SCC on canister welds • de-watering effectiveness • neutron poison degradation	• Concrete degradation (marine environments) • Closure lids, seals, bolts	• Fuel retrievability • Clad integrity of high burnup fuel after storage • Kinetic energy transfer to fuel from normal condition loadings

Relation to Other Work

The DOE program is making full use of all work going on in this area.

U.S.

The NRC is conducting its own technical data gap analysis.

- Consistent with DOE data gap analysis with some differences in priorities

The Nuclear Waste Technical Review Board has developed a similar technical data gap analysis.

- Consistent with DOE and NRC gap analysis
- Addition of emphasis on modeling

EPRI

Industry is collaborating through ESCP in several areas.

- Providing fuels data that relates to technical data gaps
- Providing operational data/experience related to storage system performance
- Identifying fuel that may be available for test program

Relation to Other Work (cont)

International

Bundesanstalt fur Materialforschung und –Prufung (BAM/Germany)

- Long term behavior of metal and elastomer seals
- Long term behavior of polymers used for neutron shielding
- Optimization of corrosion protection measures
- Transportation after long term storage
- Requirements for periodic safety inspection and aging management

Public Agency for Radioactive Waste Management (PURAM/Hungary)

- Fuel material property degradation
- Concrete structures material degradation
- Ability to transfer fuel for transportation

Central Research Institute of Electric Power Industry (CRIEPI/Japan)

- Stress corrosion cracking of canister
- Degradation of MOX fuel
- Long term storage studies

International Atomic Energy Agency (IAEA, Vienna)

- Consultancy on Dual Purpose Casks
- Consultancy on Long Term Storage

Conclusions

DOE/NE is supporting development of the technical basis for certification of very long term storage of used fuel and subsequent transportation. Programmatically, this includes;

- **development of a plan to support experimental data gathering to address gaps in the existing data base,**
- **conducting experiments to gather needed data,**
- **working with the NRC to properly integrate data needs perceived by both the regulator and industry,**
- **working closely with industry,**
- **working closely with our international partners, and**
- **development of the technical basis documents.**