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Long Term Storage of Used Nuclear Fuel in the U.S.

PATRAM 2010

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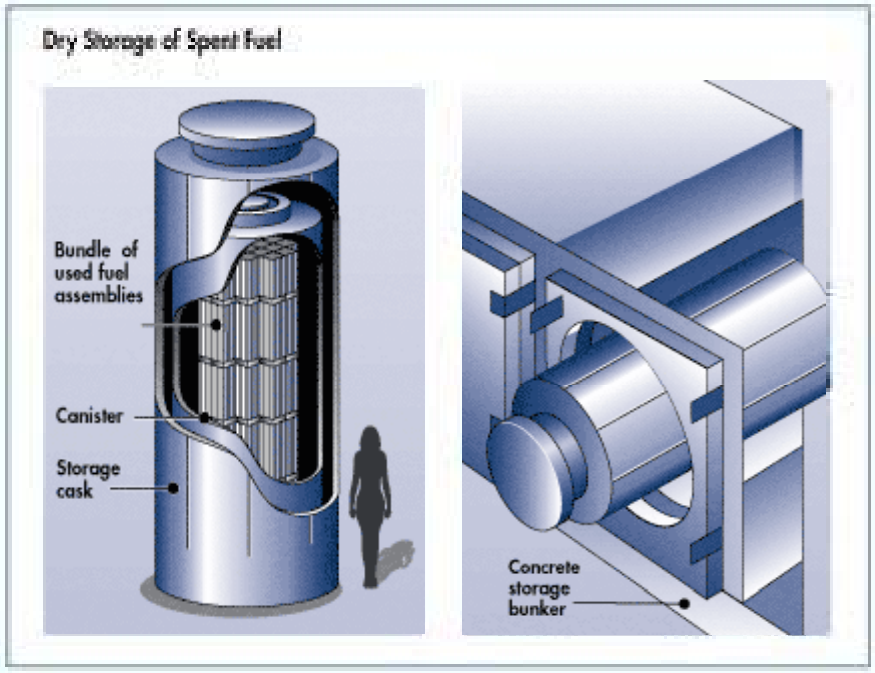


Source: Nuclear Regulatory Commission http://www.nrc.gov/waste/spent-fuel-storage/diagram-typical-dry-cask-system.html

Source: Connecticut Yankee http://connyankee.com/html/fuel_storage.html

Background

Policy → Issues → Consequences

Policy

- The Administration's decision to cancel Yucca Mountain means that the U.S. will need to store used fuel for the foreseeable future (>120 yrs)

Issues

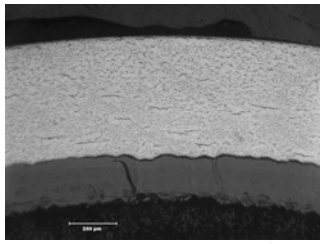
- Licenses for long term storage of used fuel are issued for 20 years, with possible renewals up to 60 years. A new rule-making will allow the initial license for 40 years with one possible 40-year extension.
- Questions regarding:
  - extended storage beyond 60 to 80 years
  - retrieval and transport of used fuel after long term storage
  - storage and transportation of high burnup fuel (>45 GWD/MTU)

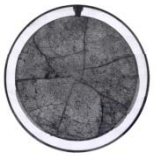
Consequences

- Technical bases need to be developed to justify licensing:
  - used fuel storage beyond 60 to 80 years (up to 300 yrs)
  - retrievability and transportation of sued fuel after long term storage
  - storage and transportation of high burnup fuel

Department of Energy Program

- R&D Opportunities
  - Data gap analysis
  - Plan to address gaps
  - Development of technical basis
- Security
  - Regulatory assessment
  - Identify issues peculiar to long-term storage
  - Evaluate vulnerability analysis methodology improvements
- Conceptual Evaluation
  - Design process for development of technical basis
  - Evaluate several scenarios for accomplishing development of technical basis
  - Develop a systems framework for decision-making
- Transportation
  - Data gap analysis
  - Plan to address gaps
  - Development of technical bases





CSNF Waste Form Degradation: Summary Abstraction, ANL-EBS-MD-000015 REV01C, Authored by J. Cunnane.

Source: Connecticut Yankee
http://connyankee.com/html/fuel_storage.html

Storage Implementation Plan Goals

- **1 yr: Project Implementation Plan Framework**
- **5 yr: Project Implementation Plan & Development of Technical Basis**
- **10 yr: Field operating project**

Department of Energy Program

Preliminary R&D Technical Issues

SSC	Mechanism	Influenced by Longer Times?	Influenced by Higher Burn-up?	Other Data Needs?	Priority of New Research
Cladding	Embrittlement - Radiation Induced - Annealing	Maybe	Maybe	Yes	Moderate
Cladding	Embrittlement - Hydride Induced	Maybe	Yes	Yes	High
Cladding	Creep	Maybe	Maybe	Yes	Low
Cladding	Delayed Hydride Cracking	Maybe	Yes	Yes	High
Cladding	Phase change	Maybe	Maybe	No: not likely to happen	Very low
Neutron shield	Loss of shielding	Maybe	Maybe	No: no significant consequence	Very low
Container	Stress Corrosion Cracking of Closure Welds	Yes	No	Yes	High
Container	Degradation of Seals	Maybe	No	Yes	High
Concrete overpack	Degradation of concrete	Yes	No	Yes	Very low: potential for aging mgt program
Pad	Degradation	Yes	No	Yes	Very low: potential for aging mgt program

Department of Energy Program

Preliminary Concept Evaluation Framework

DEMONSTRATION OPTIONS				
	Monitor Existing ISFSI.	Modified ISFSI	Demonstration Facility at a DOE Site	Construct a New Demonstration Facility
Siting and licensing	Licensed, may need NRC approval for operations	Licensed, may need NRC approval for operations	Operates under DOE orders	Licensing (or DOE permission) needed
Spectrum of UNF available	Limited	Full spectrum	Full spectrum	Full spectrum
Transportation requirements	None or very limited	Transportation of fuels needed	Transportation of fuels needed, many may be available	Transportation of fuels needed
Testing requirements	Very limited	Somewhat limited – transportation needed for testing	Generally available; available in DOE complex	Either transportation will be needed or facilities must be built
Construction/ operating cost	Minimal	Minimal	Moderate	High
Radiological controls	Controls may need modification	Adequate controls exist	Adequate controls exist	Needed
Waste mgmt	Needed	Needed	Needed	Needed
Security	Adequate	Adequate	Adequate	Needed

Collaborations

Nuclear Regulatory Commission
Supports efforts on a collaborative basis

DOE/NE

Program Direction, Management

DOE/RW, EM

Collaboration, experience from related programs

Nat'l Labs

SNL, PNNL, ANL, INL, SRNL

Technical support for the 3 Work Packages

Industry

EPRI, NEI, Utilities, Suppliers

EPRI Extended Fuel Storage Collaboration Program

(Nov 18-19, 2009 Wash DC; May 3, 2010 Baltimore)

NEI Dry Storage Information Forum

(May 4-6,2010 Baltimore)

International

BAM (Germany), CRIEPI (Japan), United Kingdom

IAEA Int'l Conference on Management of Spent Fuel from Power Reactors

(Vienna, May 31-June 4, 2010)

INMM Annual Meeting (Baltimore, July 11-15,2010)

Special session at PATRAM 2010 on Used Fuel Dry Storage (London, Oct. 3-8, 2010)

International High-Level Radioactive Waste Management Conference (April 10-12, 2011)

Conclusion

A comprehensive program has been established in the U.S. to develop the technical bases for extension of used fuel storage for up to 300 years with subsequent transportation. This program is structured to take full advantage of all available means to develop the technical arguments, including:

- **comprehensive literature searches**
- **experimental testing**
- **analysis**
- **collaboration with industry**
- **collaboration with international organizations**
- **collaboration with the U.S. regulator**