Acceptance and Disposition of Department of Energy Spent Nuclear Fuel

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Briefing to the National Academy of Sciences
December 3, 2014
Outline

• Department of Energy/Environmental Management (DOE/EM) Organization

• Spend Nuclear Fuel (SNF) Mission/Vision

• Current Status of DOE SNF

• Partnership with Global Threat Reduction Initiative (GTRI)
  ➢ Idaho National Laboratory (INL)
  ➢ Savannah River Site (SRS)

• Ongoing/Upcoming Activities

• Summary
• Safe and secure operations in a cost-effective manner
• Protect human health and the environment
• Work with all stakeholders (including International community) and comply with legal agreements
• Achieve SNF end-state
DOE Spent Nuclear Fuel Inventory
(January 2014)

Hanford, WA
~2,130 MTHM

Idaho
~275 MTHM

Fort St Vrain, CO
~15 MTHM

Savannah River Site, SC
~30 MTHM

Other Domestic Sites
~2 MTHM

TOTAL
Spent Nuclear Fuel
(EM & NE) ~2,450 MTHM

MTHM of SNF – Metric Tons Heavy Metal
Source of SNF in DOE Inventory

- DOE production reactors (majority of inventory)
- Core debris from the Three-Mile Island Reactor
- Commercial power demonstration projects
  - Shippingport Atomic Power Station, Shippingport, Pennsylvania
  - Peach Bottom Atomic Power Station, Peach Bottom Township, Pennsylvania
  - Fort Saint Vrain Generating Station, Platteville, Colorado
- Domestic Research Reactors (DRR)
  - Includes DOE labs, Universities, and other Government agencies
- Foreign Research Reactors (FRR) – 41 countries
EM Partnership with Global Threat Reduction Initiative

• EM supports the U.S. non-proliferation and highly-enriched uranium (HEU) minimization policy
  ➢ Support GTRI efforts to secure and consolidate HEU and plutonium materials to prevent them from falling into the hands of terrorists
  ➢ Disposition of nuclear materials in a manner that renders these nuclear materials non-proliferable

• EM continues to receive, safely store, and securely manage SNF via GTRI’s FRR SNF Acceptance Program from research reactors with 41 participating countries
  ➢ Spent Fuel is of U.S.-origin

• All fuel received is consolidated at SRS & INL
  ➢ Aluminum-clad fuel is stored at SRS
  ➢ Non-aluminum-clad fuel is stored at INL

• EM also supports GTRI’s Gap Removal Program through receipt, storage and disposition of high risk, vulnerable nuclear materials of primarily non U.S.-origin; this includes
  ➢ Pu (e.g., Sweden, Belgium, Italy)
  ➢ SNF (e.g., Chile)
FRR SNF Acceptance Program

- From the start of the policy on the FRR SNF in 1996, SRS has received approximately 9,500 SNF assemblies and Idaho has received about 2,100 SNF assemblies.

- The material received accounts for:
  - ~1,200 kilograms of HEU
  - ~3,640 kilograms of low enriched uranium (LEU)

- Source of HEU and LEU received were used in foreign research reactors from countries, e.g. Australia, Brazil, Indonesia, South Africa.

- FRR Program ends in 2019
  - SNF shipments expected in the next 5 years from Canada (including liquid target residues), Switzerland, Japan, Finland, Australia, etc.
  - Exception for Austria (2025) and Japan (2029).
Idaho Cleanup Project Spent Nuclear Fuel

Facilities

NRC-Licensed Facilities

TMI - Horizontal modular dry storage

FSV - Vertical modular vault dry storage (Colorado)

CPP-2707 - Cask dry storage

CPP-603 - Shielded cave rack dry storage

CPP-749 Underground dry storage

CPP-666 - Basin water storage
SNF is stored in 6 configurations:

- CPP-2707 – Cask Storage Pad
- CPP-749 – Outdoor Fuel Storage Facility (60% full)
- CPP-603 – Irradiated Fuel Storage Facility (91% full)
- CPP-666 – Fuel Storage Area (Wet Storage, 30% full)
- CPP-1774 – TMI-2 Independent Spent fuel Storage Installation (NRC licensed)
- Ft. St. Vrain, Independent Spent fuel Storage Installation (NRC licensed), Colorado
Idaho National Laboratory, Idaho (cont)

- Treating small amount of sodium-bonded fuel using Electrometallurgical Treatment Process (Nuclear Energy)
- Continue to receive FRR (until 2019) and DRR (no end date)
  - Non-aluminum clad fuel (primarily TRIGA)
  - Currently all shipments into Idaho are suspended until treatment of remaining sodium-bearing liquid high-level waste is completed (violation of a 1995 Settlement Agreement milestone)
• L-Bundled fuel
  - Typical FRR/DRR Material Test Reactor Fuel Assemblies
  - ~90% full; 3045 bundles
  - 2013 decision to process (limited amount of fuel) eliminates the need to expand capacity

• High Flux Isotope Reactor (HFIR) Fuel Racks
  - 100% full; 120 Cores
  - 2013 decision to process eliminates need for new racks

• Isolation Cans
  - Over 400 individual isolation cans stored in 12 oversized cans
As background, H-Canyon: Only operational U.S. large-scale, shielded radiochemical separation facility capable of dispositioning surplus Al-clad SNF, uranium, plutonium, and neptunium materials.

- Completed processing potentially vulnerable fuel (Sodium Reactor Experimental fuel) in H-Canyon – August 2014
- Started processing aluminum-clad fuel in September 2014
  - Generates extra storage capacity (especially for HFIR fuel)
  - Economic benefits (converts separated HEU to LEU for commercial use to support production of electrical power)
  - Non-proliferation benefits
- Plan to add a 3rd dissolver in H-Canyon by 2016 to increase processing throughput
Forecast EBS Bundle Positions Filled by FRR/DRR Receipts with H-Canyon Processing

FY14 Completed L to H: 11 of 1000 MTR bundles

EBS Current Capacity: 3650

Assumption:
- 1176 bundles in FY15 - FY33:
  - 228 DRR
  - 307 FRR
  - 325 Japan 2020 to 2029
  - 272 NRU (3/bundle)
  - 44 NRX (3/bundle)

Inventory at the End of each Fiscal Year

Bundles In / Out

Bundles In
- FY2015: 80
- FY2016: 60
- FY2017: 20
- FY2018: 20
- FY2019: 200
- FY2020: 0
- FY2021: 0
- FY2022: 40
- FY2023: 300
- FY2024: 289
- FY2025: 0
- FY2026: 0
- FY2027: 0
- FY2028: 0
- FY2029: 0
- FY2030: 0
- FY2031: 0
- FY2032: 0
- FY2033: 0

Bundles Out

Forecast Inventory with L to H-Canyon, 1 Dissolver
- FY2015: 0
- FY2016: 0
- FY2017: 0
- FY2018: 0
- FY2019: 0
- FY2020: 0
- FY2021: 0
- FY2022: 0
- FY2023: 0
- FY2024: 0
- FY2025: 0
- FY2026: 0
- FY2027: 0
- FY2028: 0
- FY2029: 0
- FY2030: 0
- FY2031: 0
- FY2032: 0
- FY2033: 0

10-9-14
• EM in coordination with NNSA is working with our partners to develop viable disposition paths for planned and potential receipts of nuclear materials

  ➢ FRR Receipts

    ✔ Canada

    ✔ Germany

    ✔ Japan

  ➢ DRR Receipts

    ✔ Molybdenum(MO)- 99
DOE and the Atomic Energy of Canada Limited (AECL) signed a contract (March 2012) to receive HEU fuel assemblies from National Research Universal (NRU) /National Research Experimental (NRX) Reactors

- SRS modifying Shielded Transfer System at L-Basin to receive this fuel
- About a 4-year shipping campaign, projected to start in 2015

DOE and AECL signed a contract (Sept 2012) to receive Target Residual Material liquid HEU from medical isotope production

- Modifications needed at H-Canyon to receive and transfer target residues
- About a 1 to 2 year shipping campaign, projected to start in early 2016

HEU from liquid HEU will be processed in H-Canyon and downblended to LEU and shipped to Tennessee Valley Authority for fabrication into commercial fuel
Graphite Pebble Bed Reactor Research Fuel

• DOE-EM exploring possible acceptance and disposition of German pebble bed research reactor fuel containing US-origin HEU

• HEU material was provided for purposes of peaceful uses and development of nuclear energy
  
  ➢ Explored the use of coated fuel particles embedded in graphite spheres, used in pebble-bed research reactors, cooled by helium (high temperature gas-cooled reactor)

• Used in two reactors in Germany
  
  ➢ AVR Reactor (1967-1988) was the first high temperature reactor in Germany to test the technology of graphite spheres
  
  ➢ THTR-300 (1983-1989) was a demonstration reactor to prove the AVR concept design to produce electricity

• No decision regarding acceptance of this fuel has been made (environmental analysis ongoing)
DOE and Japan reached an agreement (March 2014) to reduce proliferation risks

- Japan will send their HEU and Pu to U.S. (by 2019)
- The US will assist Japan in research reactor SNF management and cooperate on upcoming R & D projects

EM working with GTRI on receipt and disposition options for Pu as well as extending receipt of FRR fuel (until 2029)

Subject to completion of appropriate environmental analysis
• The American Medical Isotopes Production Act of 2012
  
  ➢ Accelerate the establishment of reliable supplies of MO-99 without the use of highly enriched uranium

• Requires DOE to provide LEU to vendors and retain responsibility for the final disposition of SNF and radioactive waste that does not have access to commercial disposal path

• Requires completion of appropriate environmental analysis
• EM is continuing to work closely with GTRI and international partners to support non-proliferation and HEU minimization objectives
• Processing limited amount of SNF (SRS and Idaho)
• Minimal impacts to DOE on near-term SNF management
  ➢ Continue to manage safely
  ➢ Comply with site-specific agreements
  ➢ Continue to develop new and improved and cost-effective technologies
• Prolonged SNF storage must be anticipated
• DOE endorsed (Jan 2013) key principles of BRC’s recommendations – legislation needed for implementation
  ➢ Pilot-scale interim storage facility, 2021
  ➢ Consolidated interim storage facility, 2025
  ➢ Geologic repository, 2048
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Questions