

*Department of Energy
Spent Nuclear Fuel - Update*

*Edgard Espinosa
Office of Environmental Management*

*Briefing to the Institute for Nuclear Materials Management
January 13, 2015*

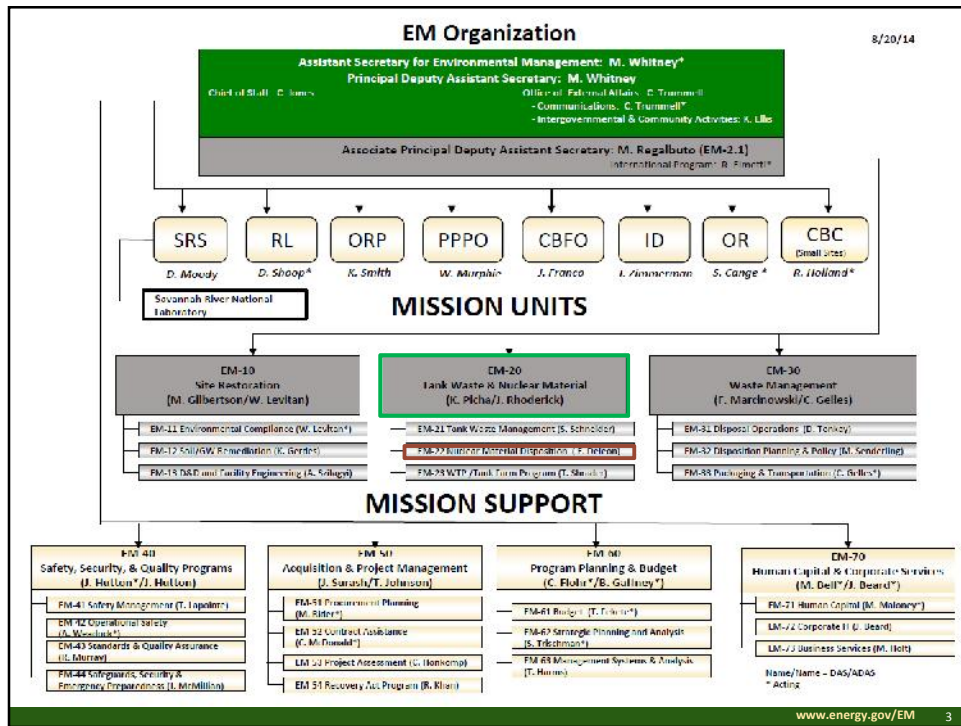
www.energy.gov/EM 1



Outline

- Department of Energy/Environmental Management (DOE/EM) Organization
- Spent 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 Receipts
- Summary

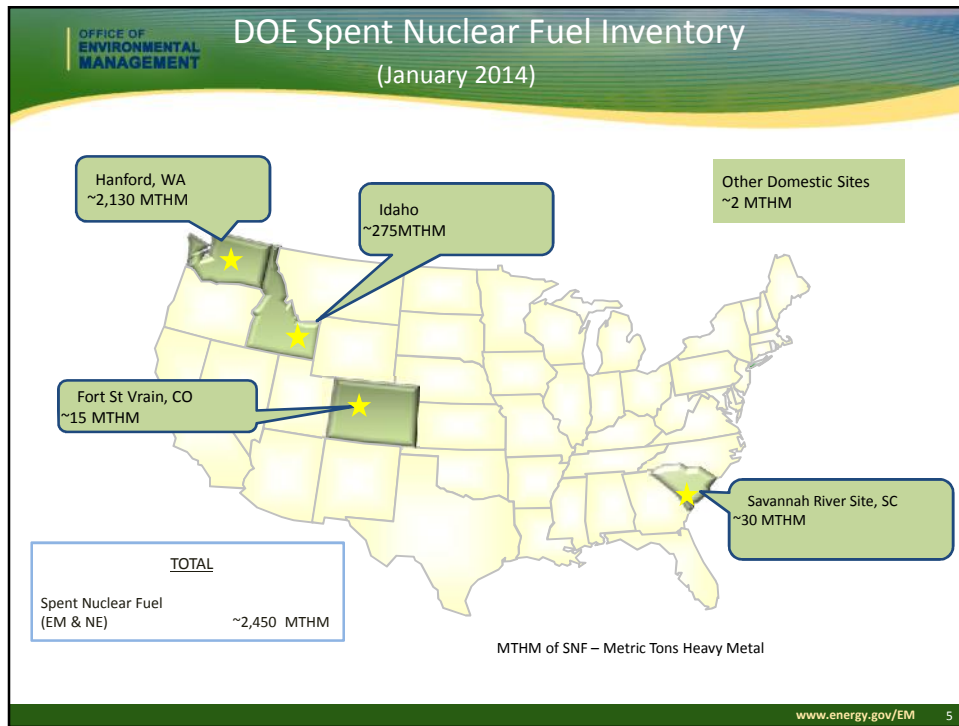
www.energy.gov/EM 2



OFFICE OF ENVIRONMENTAL MANAGEMENT
SNF Mission/Vision

- 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

www.energy.gov/EM 4



- ### Source of SNF in DOE Inventory
- OFFICE OF ENVIRONMENTAL MANAGEMENT
- DOE production reactors (majority of inventory)
 - Core debris from the Three-Mile Island (TMI) 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
- www.energy.gov/EM 6

OFFICE OF ENVIRONMENTAL MANAGEMENT

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)

www.energy.gov/EM 7

OFFICE OF ENVIRONMENTAL MANAGEMENT

FRR SNF Acceptance Program



Wet Storage in L-Basin at SRS



CPP 603, Irradiated Fuel Storage Facility, INL

- 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)

www.energy.gov/EM 8



OFFICE OF ENVIRONMENTAL MANAGEMENT

SNF Storage Facilities, Idaho

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

www.energy.gov/EM 10

OFFICE OF ENVIRONMENTAL MANAGEMENT

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)



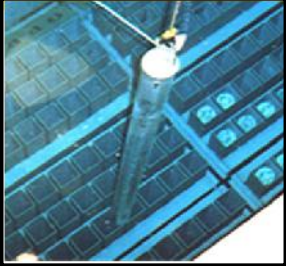


Cask Pad

www.energy.gov/EM 11

OFFICE OF ENVIRONMENTAL MANAGEMENT

L-Basin Stored Fuels and Capacities, SRS

- 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






www.energy.gov/EM 12

OFFICE OF ENVIRONMENTAL MANAGEMENT

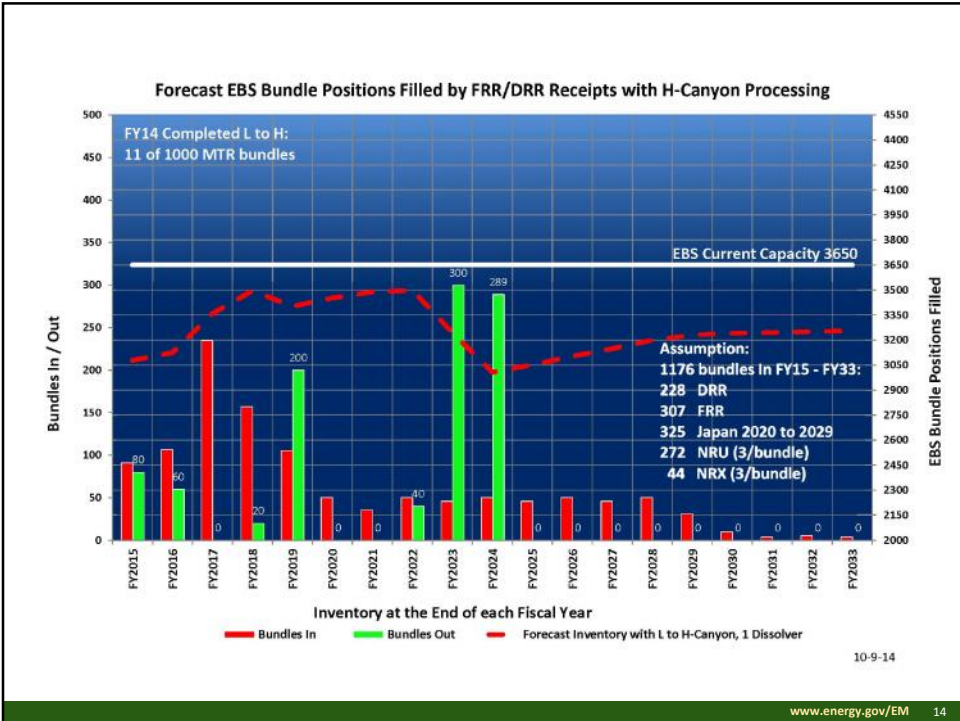
Savannah River Site, South Carolina

- 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



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.

www.energy.gov/EM 13



OFFICE OF ENVIRONMENTAL MANAGEMENT

Ongoing/Upcoming Receipts

- 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

www.energy.gov/EM 15

OFFICE OF ENVIRONMENTAL MANAGEMENT

Atomic Energy of Canada Limited

NRU Reactor
Chalk River Laboratories

NRU is a 135MW thermal research reactor at AECL


- 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

www.energy.gov/EM 16


OFFICE OF ENVIRONMENTAL MANAGEMENT

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)



AVR Research Reactor, 15MW(e), Jülich



THTR-300, Demonstration Reactor, 300 MW(e), Hamm-Uentrop

www.energy.gov/EM 17

OFFICE OF ENVIRONMENTAL MANAGEMENT

Statement of Intent with Japan

- 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

www.energy.gov/EM 18

OFFICE OF ENVIRONMENTAL MANAGEMENT

Molybdenum (Mo) 99

- 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

www.energy.gov/EM 19

OFFICE OF ENVIRONMENTAL MANAGEMENT

Summary

- 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**
 - **Continue to work closely with GTRI and international partners to support non-proliferation and HEU minimization objectives**
- Processing limited amount of SNF (SRS and Idaho)
- **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**
- **Separate repository for defense HLW and SNF**
- **Establishing SNF working group**

www.energy.gov/EM 20

OFFICE OF ENVIRONMENTAL MANAGEMENT

For More Information Please Contact

Edgard Espinosa
Office of Environmental Management (EM-22)
US Department of Energy
1000 Independence Ave., SW
Washington, DC 20585
Edgard.Espinosa@hq.doe.gov
301-903-3201

www.energy.gov/EM 21

OFFICE OF ENVIRONMENTAL MANAGEMENT

Questions

www.energy.gov/EM 22

OFFICE OF ENVIRONMENTAL MANAGEMENT

Background

www.energy.gov/EM 23

OFFICE OF ENVIRONMENTAL MANAGEMENT

Defense SNF & HLW

- *Assessment of Disposal Options for DOE-Managed High-Level Radioactive Waste and Spent Nuclear Fuel, October 2014*
 - Consistent with Administration's January 2013 *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste*
 - Report is based on technical and programmatic considerations (and does not include an evaluation of relevant regulatory and legal considerations)
 - Assessment analyzed three options
 - ✓ Disposal of all HLW & SNF regardless of origin in one repository
 - ✓ Disposal of some DOE-managed HLW & SNF in a separate mined repository
 - ✓ Disposal of smaller waste forms in deep boreholes

www.energy.gov/EM 24

OFFICE OF ENVIRONMENTAL MANAGEMENT

Defense SNF & HLW - Conclusions

- DOE pursue separate disposal options for some DOE-managed HLW and SNF
 - Technologies available today to dispose of DOE-managed SNF and HLW
 - Benefits from beginning a stepwise approach
 - Would build confidence that SNF and HLW can be safely disposed
- Include a research, development and demonstration program addressing technologies relevant to deep borehole disposal of smaller DOE-managed waste forms and large DOE-managed waste packages with high thermal loads in mined repositories

www.energy.gov/EM 25

OFFICE OF ENVIRONMENTAL MANAGEMENT

SNF Working Group

- DOE complex-wide coordination of SNF issues by establishing an internal DOE working group in 2014
 - Led by Office of Environmental Management, other participants include:
 - ✓ Office of Science, Nuclear Energy, Naval Reactors, and Global Threat Reduction
 - ✓ DOE field sites that manage DOE SNF
- SNF working group goals are to
 - Promote integration and issue resolution across the DOE complex
 - Strategic planning and policy development
 - Cost-effective implementation of decisions
 - Consistency across the DOE complex
 - Efficient knowledge exchange

www.energy.gov/EM 26

OFFICE OF ENVIRONMENTAL MANAGEMENT

SNF Working Group- Objectives

- SNF working group objectives include:
 - Develop complex-wide strategies for storage, retrieval, packaging, transportation, technology development, processing, and/or disposal
 - Integrate and leverage DOE SNF management and disposition activities across the complex
 - Work to develop waste acceptance criteria for a future repository
 - Support non-proliferation goals
 - Reestablish National SNF Program and oversee complex-wide database of DOE's SNF

www.energy.gov/EM 27

OFFICE OF ENVIRONMENTAL MANAGEMENT

SNF Working Group (Cont.)

- Initial meeting held in November 2014, in Idaho Falls
 - Identified collaborative efforts that would benefit the SNF complex
 - ✓ Evaluate DOE security and safeguards strategy
 - ✓ Feasibility of fuel exchange between Idaho and SRS
 - Promoted SNF activities as "one DOE"
 - Discussed working relationships with other cross-cutting organizations, such as Tank Waste Corporate Board

www.energy.gov/EM 28