U.S. DEPARTMENT OF ENERGY | OFFICE OF ENVIRONMENTAL MANAGEMENT

THE SIGNIFICANCE OF NUCLEAR MATERIALS DISPOSITION PATHWAYS TO ACHIEVE INTERNATIONAL NONPROLIFERATION OBJECTIVES

Jay Rhoderick
Associate Deputy Assistant Secretary
for
Tank Waste and Nuclear Materials
Office of Environmental Management

Eighth Annual RadWaste Summit
Summerlin, Nevada
September 4, 2014

Outline

- The Office of Environmental Management Mission and Partnership with Global Threat Reduction Initiative
- Overview of Nuclear Materials Disposition Process
- Ongoing International Activities
- Summary

Environmental Management Mission

The mission of the DOE's Office of Environmental Management (EM) is to complete the safe cleanup of the environmental legacy brought about from five decades of nuclear weapons development and government-sponsored nuclear energy research.

James V. Forrestal Building, Washington, D.C.

EM Partnership with Global Threat Reduction Initiative

- EM supports the U.S. non-proliferation and highly-enriched uranium (HEU) minimization policy
  - Support Global Threat Reduction Initiative (GTRI) to secure and consolidate spent nuclear fuel (SNF) and Gap Nuclear Materials
  - Disposition of nuclear materials for reuse and/or disposition in a manner that these nuclear materials could no longer be used as a nuclear weapon or an improvised nuclear device
- EM continues to receive, store, safely and securely manage SNF via the Foreign Research Reactor Spent Nuclear Fuel Acceptance Program from research reactors within 41 participating countries
  - Spent Fuel is of U.S.-origin
- All fuel received is consolidated at Savannah River Site (SRS) and Idaho National Laboratory (Idaho)
  - Aluminum clad fuel is stored in SRS
  - Non-aluminum clad fuel is stored in Idaho
- EM 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)

Global Partnership Under the GTRI

Received Spent Nuclear Fuel Assemblies via the Policy Concerning Foreign & Domestic Research Reactors

Wet Storage in L-Basin at SRS

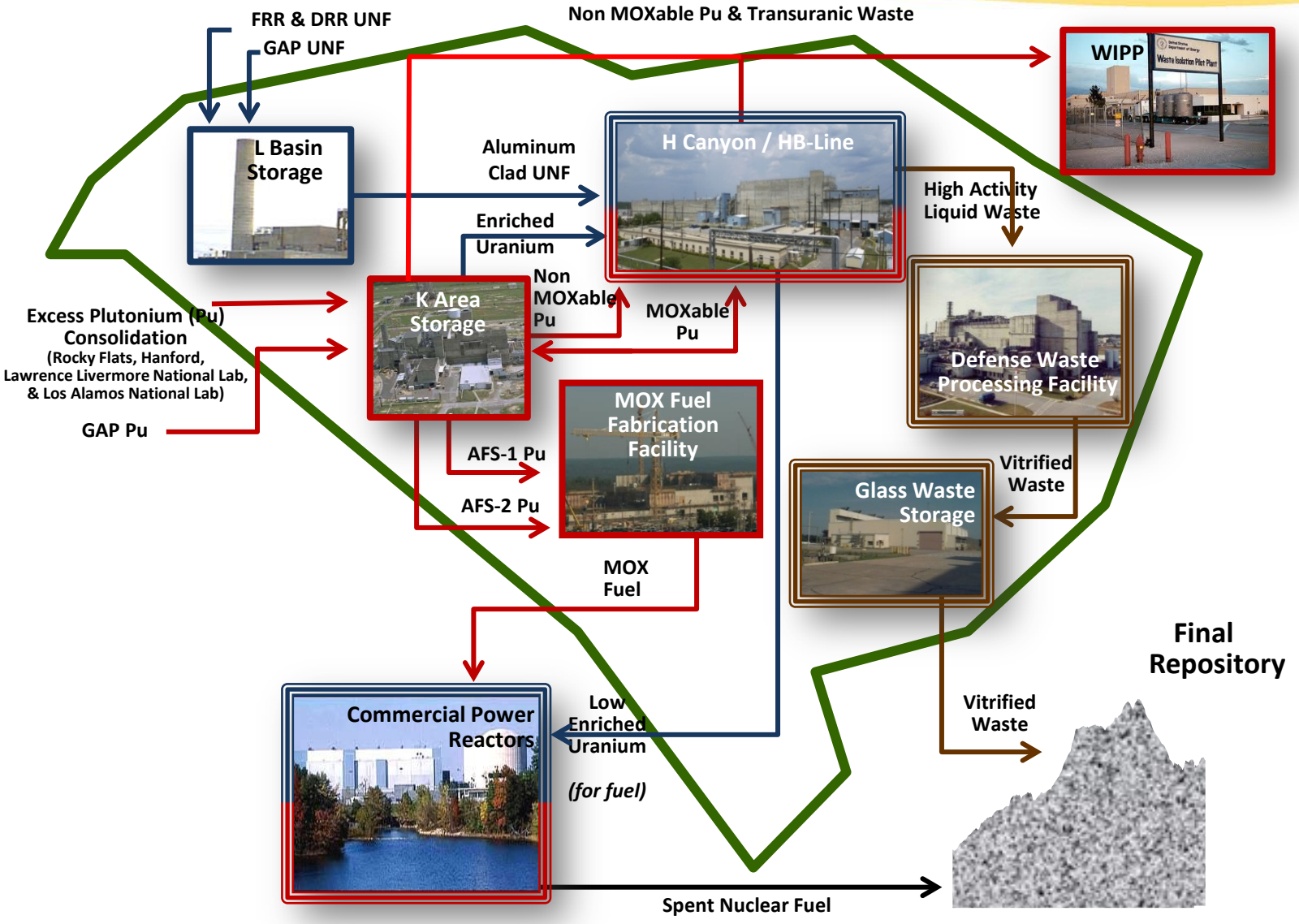
High Flux Isotope Reactor core

- From the start of the policy on the Foreign Research Reactors Spent Nuclear Fuel in 1994, SRS has taken for disposition approximately 9,500 SNF assemblies (MTR); Idaho has received about 2,100 SNF assemblies (TRIGA)
- The material received accounts for:
  - ~1,200 kilograms of HEU
  - ~3,640 kilograms of LEU
- Source of HEU and LEU received were used in foreign research reactors from countries, *e.g.* Australia, Brazil, Indonesia, South Africa, etc.
- Fuel also received from domestic research reactors, *e.g.* Missouri University Research Reactor, MIT, High Flux Isotope Reactor in Oak Ridge

Foreign Research Reactor and Domestic Research Reactor Projected Receipts - SRS

				FY																		
Type	Reactor	Location	Data	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	Grand Total
DRR	HFIR	Tennessee	Assemblies	4	12	12	12	12	12	12	12	12	10	10	10	7	8	7	7	7			166
	HFIR		Casks	4	12	12	12	12	12	12	12	12	10	10	10	7	8	7	7	7			166
	MIT	Massachusetts	Assemblies	8	8	8	8	8	16	8	16	8	16	8	16	8	16	8	16				176
	MIT		Casks	1	1	1	1	1	2	1	2	1	2	1	2	1	2	1	2				22
	MURR	Missouri	Assemblies	24	40	40	40	16	24	16	24	16	24	16	24	16	24	16	24	16	24	16	440
	MURR		Casks	3	5	5	5	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	55
	NIST	Maryland	Assemblies		42		42		42		42		42		42		42						294
	NIST		Casks		1		1		1		1		1		1		1						7
DRR Assemblies				36	102	60	102	36	94	36	94	36	92	34	92	31	90	31	47	23	24	16	1076
DRR Casks				8	19	18	19	15	18	15	18	15	16	13	16	10	14	10	12	9	3	2	250
FRR	AGN-211 Basel	Switzerland	Assemblies	13																			13
	AGN-211 Basel		Casks	1																			1
	BER-2	Germany	Assemblies	33		66																	99
	BER-2		Casks	1		2																	3
	DCA	Japan	Assemblies					4															4
	DCA		Casks					2															2
	IRR-1	Israel	Assemblies			51																	51
	IRR-1		Casks			2																	2
	JMTR	Japan	Assemblies			120	120	120	120	120	120	120	120	120	120	120	120	60					1500
	JMTR		Casks			4	4	4	4	4	4	4	4	4	4	4	4	2					50
	JMTRC	Japan	Assemblies			16	16																32
	JMTRC		Casks			2	2																4
	JRR	Japan	Assemblies			80	80	80				40		40		40		40					400
	JRR		Casks			2	2	2				1		1		1		1					10
	KUR	Japan	Assemblies				60																60
	KUR		Casks				2																2
	NRU	Canada	Assemblies	180	252	252	164																848
	NRU		Casks	10	14	14	10																48
	NRX	Canada	Assemblies				72	59															131
	NRX		Casks				4	4															8
	OPAL	Australia	Assemblies			140		112															252
	OPAL		Casks			5		4															9
	RPI	Portugal	Assemblies				14																14
	RPI		Casks				1																1
	SLOWPOKE Alberta	Canada	Assemblies				1																1
	SLOWPOKE Alberta		Casks				1																1
	SLOWPOKE Jamaica	Jamaica	Assemblies	1																			1
	SLOWPOKE Jamaica		Casks	1																			1
	SLOWPOKE Saskatchewan	Canada	Assemblies			1																	1
	SLOWPOKE Saskatchewan		Casks			1																	1
FRR Assemblies				227	252	726	527	375	120	120	120	160	120	160	120	160	120	100					3407
FRR Casks				13	14	32	26	16	4	4	4	5	4	5	4	5	4	3					143
Total Assemblies				263	354	786	629	411	214	156	214	196	212	194	212	191	210	131	47	23	24	16	4483
Total Casks				21	33	50	45	31	22	19	22	20	20	18	20	15	18	13	12	9	3	2	393

Nuclear Materials Disposition Process



Savannah River Site, South Carolina

Processing potentially vulnerable fuel (Sodium Reactor Experimental fuel) in H-Canyon – completed August 2014

In March 2013, DOE decided to process limited quantity of aluminum-clad fuel (including HFIR) & target material residues Generates extra storage capacity (especially for HFIR fuel)

Economic benefits (converts separated HEU to LEU for commercial use to support production of electrical power

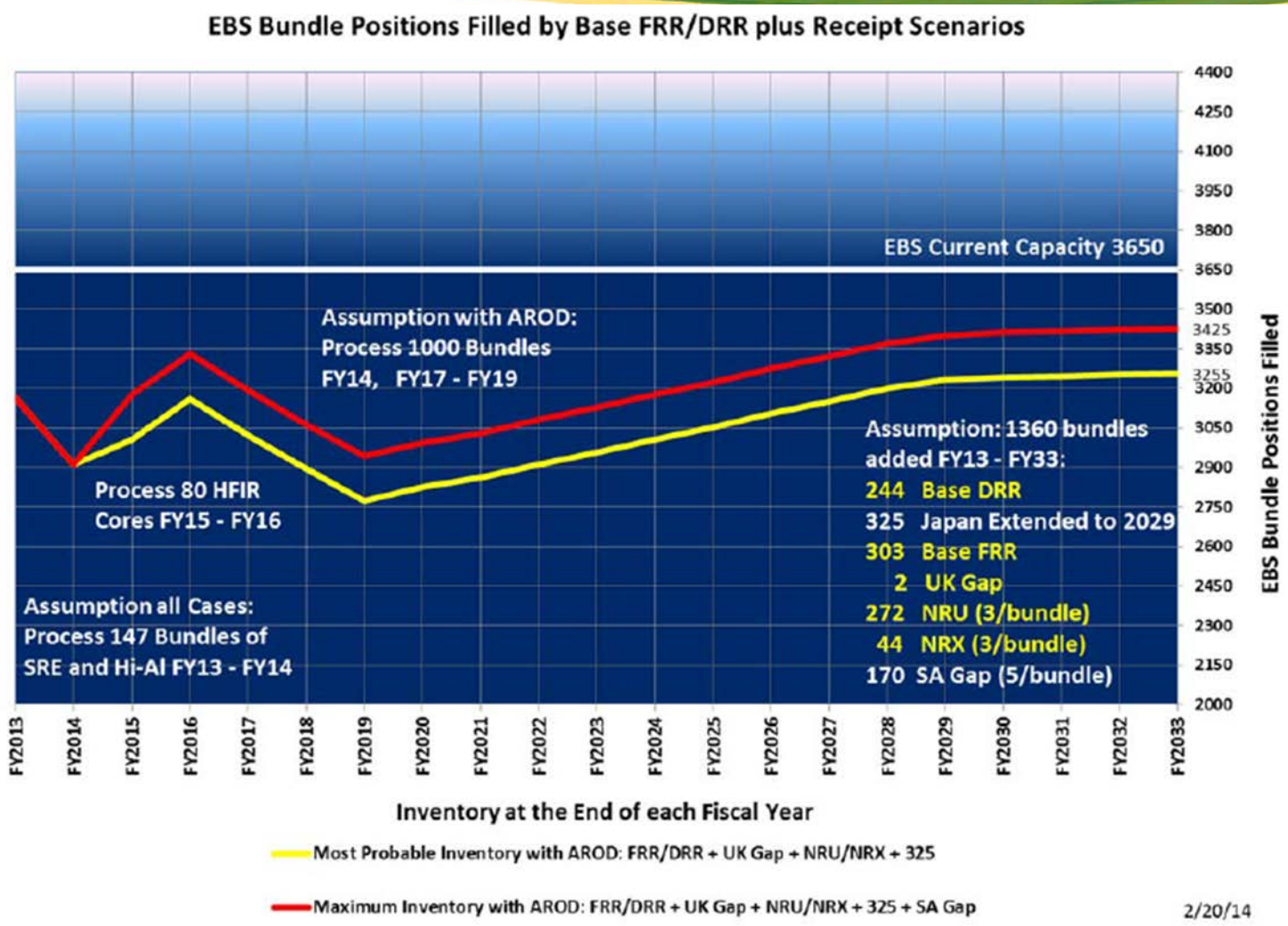
Non-proliferation benefits

Plan to start processing fuel in September 2014

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.

L-Basin *Expanded Basin Storage (EBS)* Capacity

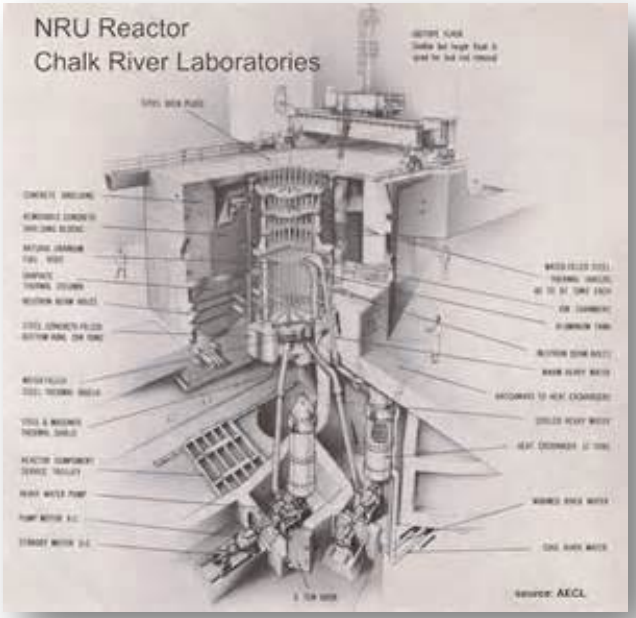


EBS Capacity chart shows the extension of the receipt window for Japan to 2029 with an additional 1300 fuel assemblies (325 bundles, would not impact L-basin capacity as long as the 1000 bundles are processed.

Ongoing International Activities

- EM, in coordination with NNSA, is working with international partners to develop viable disposition paths for planned and potential receipts of nuclear materials
  - Canada
  - Germany
  - Japan
  - Belgium

Atomic Energy of Canada Limited



NRU is a 135MW thermal research reactor at AECL

- EM and the Atomic Energy of Canada Limited (AECL) signed a contract (March 2012) to receive 1000 fuel assemblies (HEU) from National Research Universal *(NRU)* /National Research Experimental *(NRX)* Reactors
  - SRS modifying Shielded Transfer System at L-Basin to receive this fuel
  - About a 5-year shipping campaign, projected to start in late 2015
- DOE and AECL signed a contract (Sept 2012) to receive 6000 gallons of liquid HEU containing a small amount of HEU
  - Modifications at SRS to receive and transfer HEU in H-Canyon
  - About a 1 to 2 year shipping campaign, projected to start in summer 2015
- HEU from NRU/NRX fuel and 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

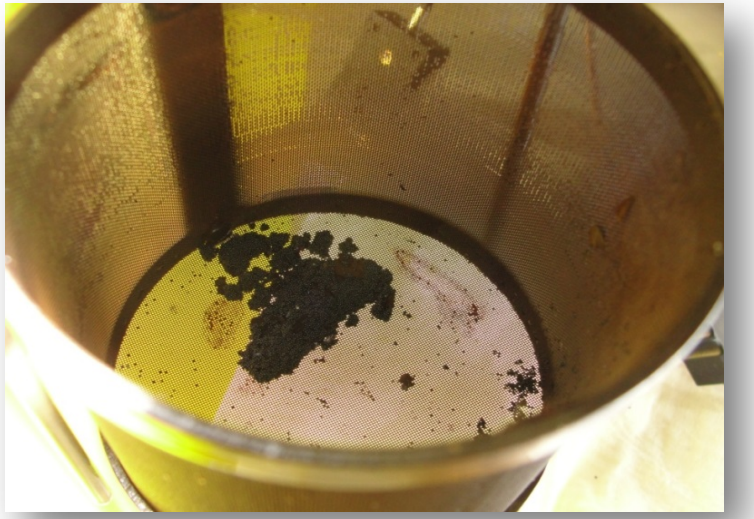
- HEU material was provided for purposes of peaceful uses and development of nuclear energy
  - Explored the use of coated fuel particles embedded in graphite spheres, used in pebble-bed research reactors, cooled by helium (high temperature gas-cooled reactor, HTGRs)
- Used in two reactors in Germany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

AVR Research Reactor, 15MW(e), Jülich

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

R&D Challenges and Results

graphite SNF spheres



Recovered Fuel from Digested Graphite Sphere

0.5mm dia metal ball from ballpoint pen

Basket with Recovered Fuel

Statement of Intent with Japan

- DOE and Japan signed SOI (March 2014) to reduce proliferation risks
  - Japan will ship their HEU and Pu to U.S. before 2019
  - Extend receipt of FRR fuel from Japan until 2029 (from 2019)
- DOE working on receipt and disposition options for Pu
- Subject to completion of appropriate NEPA analysis

Institute for Radio Elements Target Residue Material

- Institute for Radio Elements (IRE), located in Fleurus, Belgium, has HEU (~93% enriched uranium) target material residues from the production of Molybdenum-99 for nuclear medicine

- Target material residues stored in stainless steel cans (3” dia x 7.5” length) containing fiberglass filters
  - ~560 containers stored at IRE; ~62 containers stored at Dounreay (UK)
  - Total of ~ 100 kg HEU oxides, 90% US-origin

- DOE is working with IRE in developing receipt and potential disposition concept for processing materials at SRS.
  - Removal of fiberglass filters
  - Processing and down-blending in H-Canyon

Summary

- EM is continuing to work closely with GTRI and international partners to support non-proliferation and HEU minimization objectives

- EM is continuing to develop and implement disposition pathways for nuclear materials

For More Information

Please contact:

Jay Rhoderick, Associate Deputy Assistant Secretary
Office of Tank Waste & Nuclear Materials
U.S. Department of Energy
1000 Independence Ave., S.W.
Washington, D.C. 20585
Jay.Rhoderick@em.doe.gov
http://www.em.doe.gov