



New Approaches to Defining “High-Level Radioactive Waste”

A WIEB Webinar

March 26, 2019

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ABBREVIATIONS

- DOE = U.S. Department of Energy
- NRC = Nuclear Regulatory Commission
- EPA = Environmental Protection Agency
- HLW = high-level radioactive waste or high-level waste
- LLW = Low-level waste
- NWPA = Nuclear Waste Policy Act
- WIR = Waste Incidental to Reprocessing

ROADMAP

1. High-level waste in the past: what it is, where it is, current definition's limitations, its legal background
2. High-level waste today: DOE's proposed interpretation
3. High-level waste in the future? – possible implications of DOE's new interpretation
4. Moving forward: to redefine or not to redefine?

Part 1.

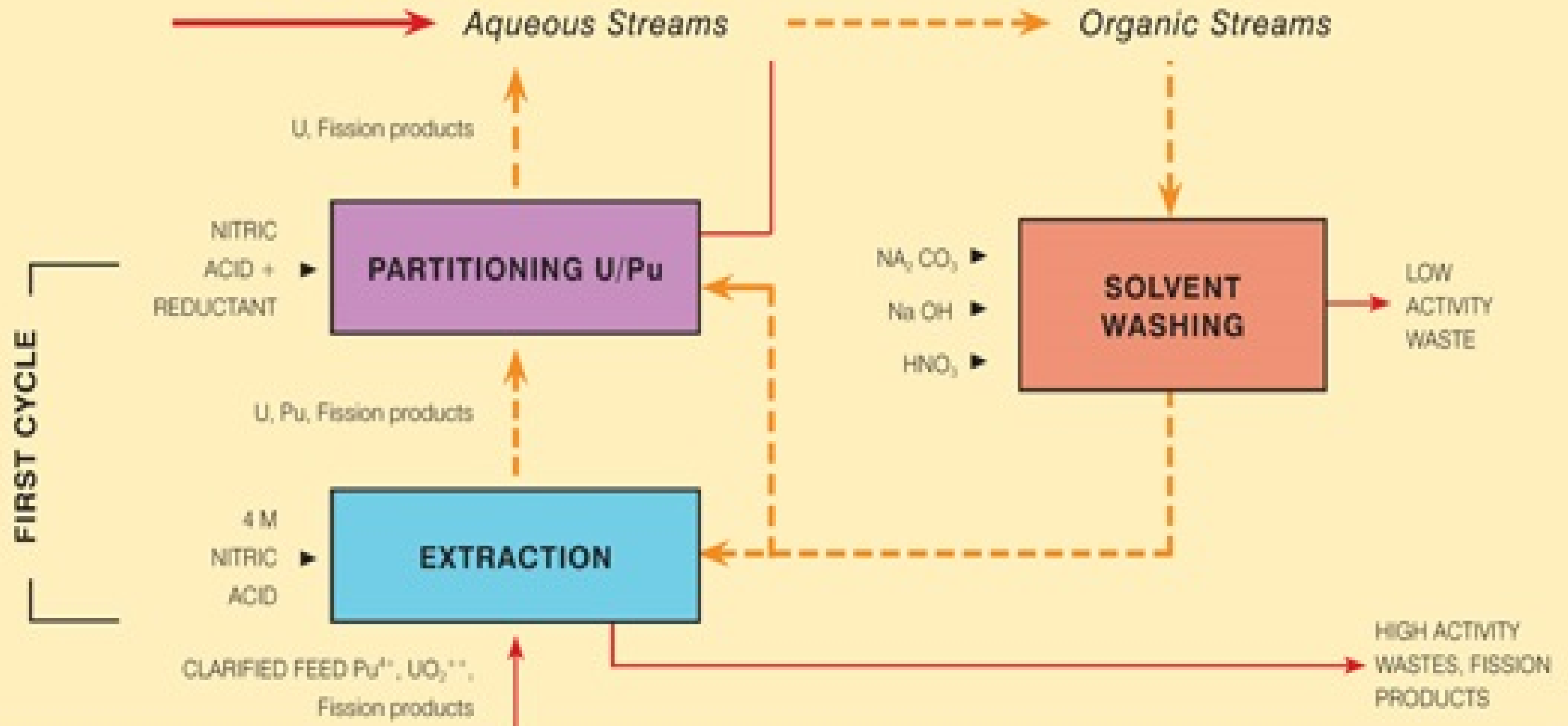
**High-level waste in the past:
what it is, where it is, its definitional
limitations, its legal background**

DOE's Current Definition:

From the Nuclear Waste Policy Act: “high-level radioactive waste” means:

- I. the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; **AND**
- II. other highly radioactive material that the Commission (NRC), consistent with existing law, determines by rule requires permanent isolation.

REPROCESSING USED FUEL: PUREX Flow Sheet



U.S. Waste Classifications

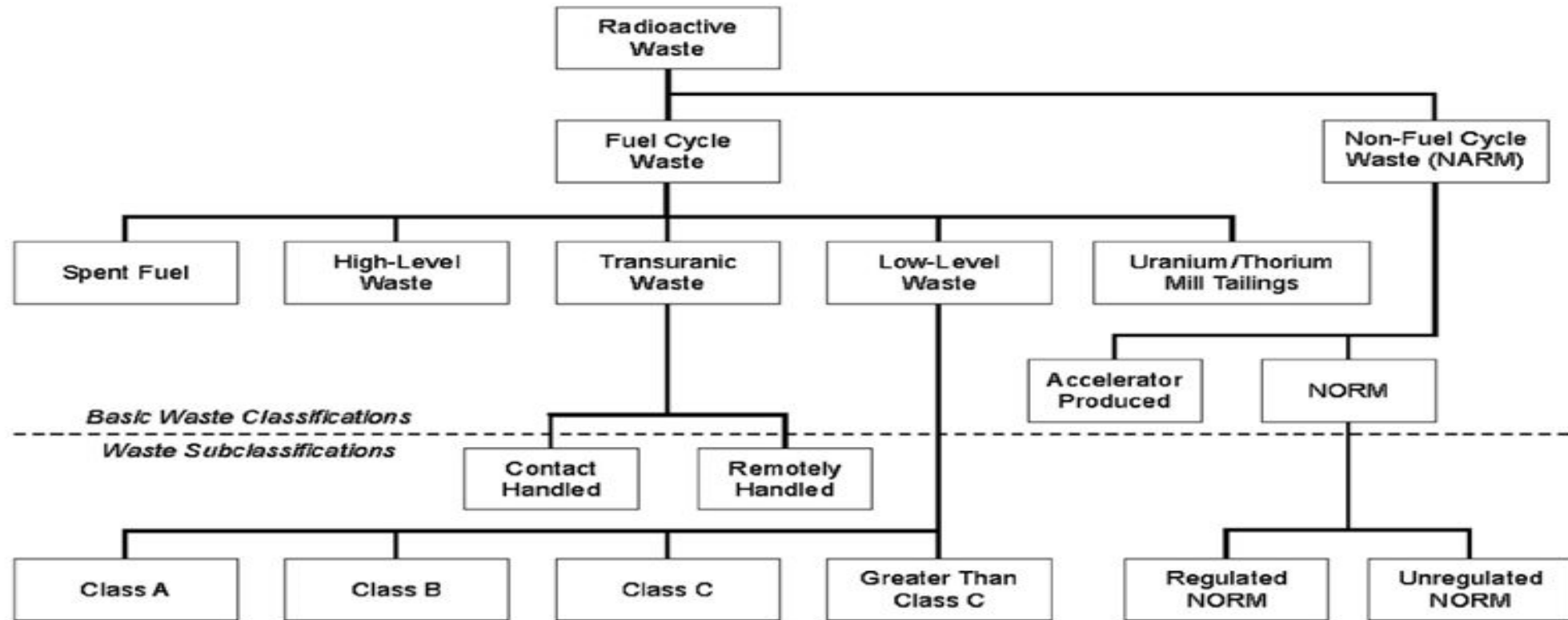


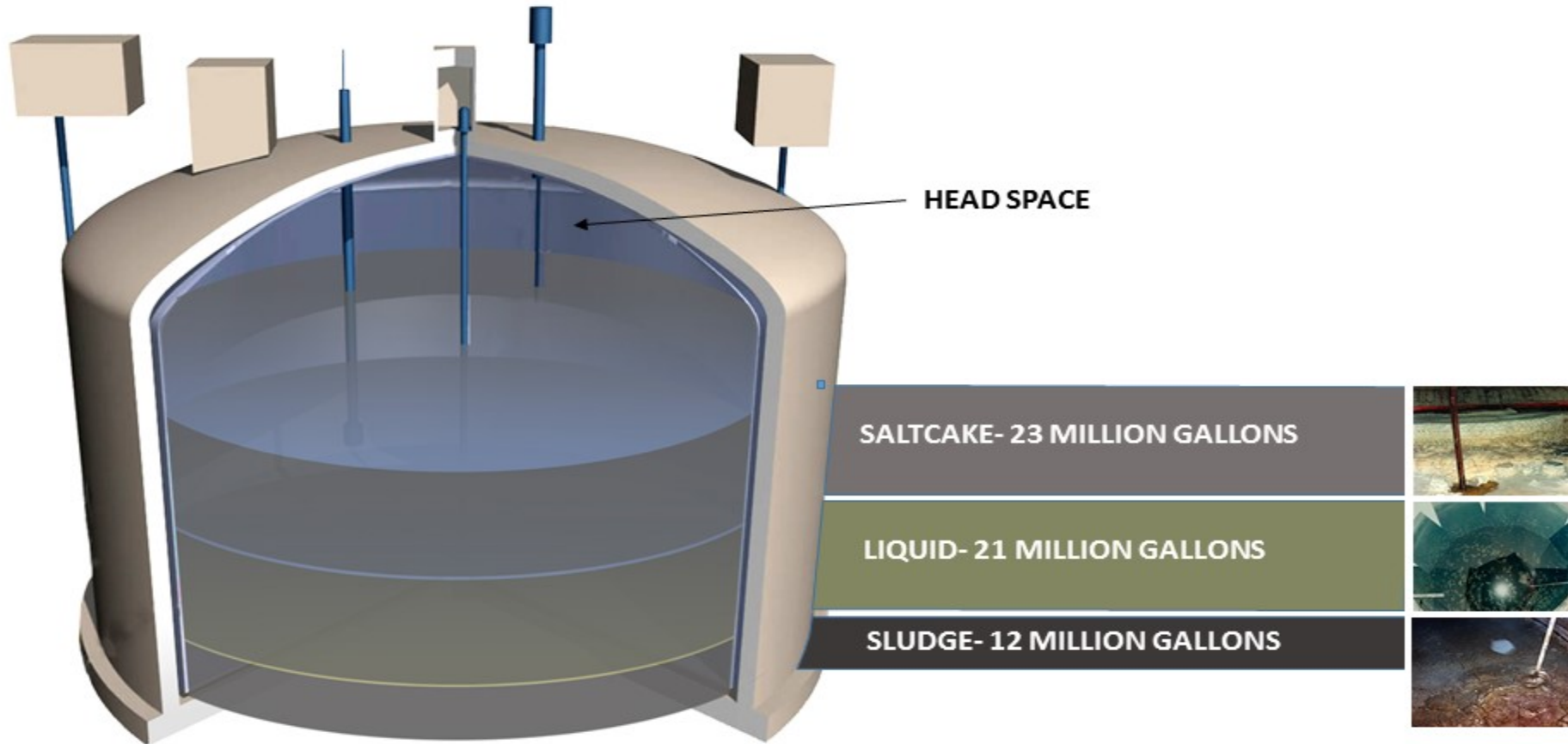
Fig. 1. Current radioactive waste classification system in the United States (NCRP 2002).



Where is HLW Currently Located?



Tank Waste Contents



Wherefore Definitions?



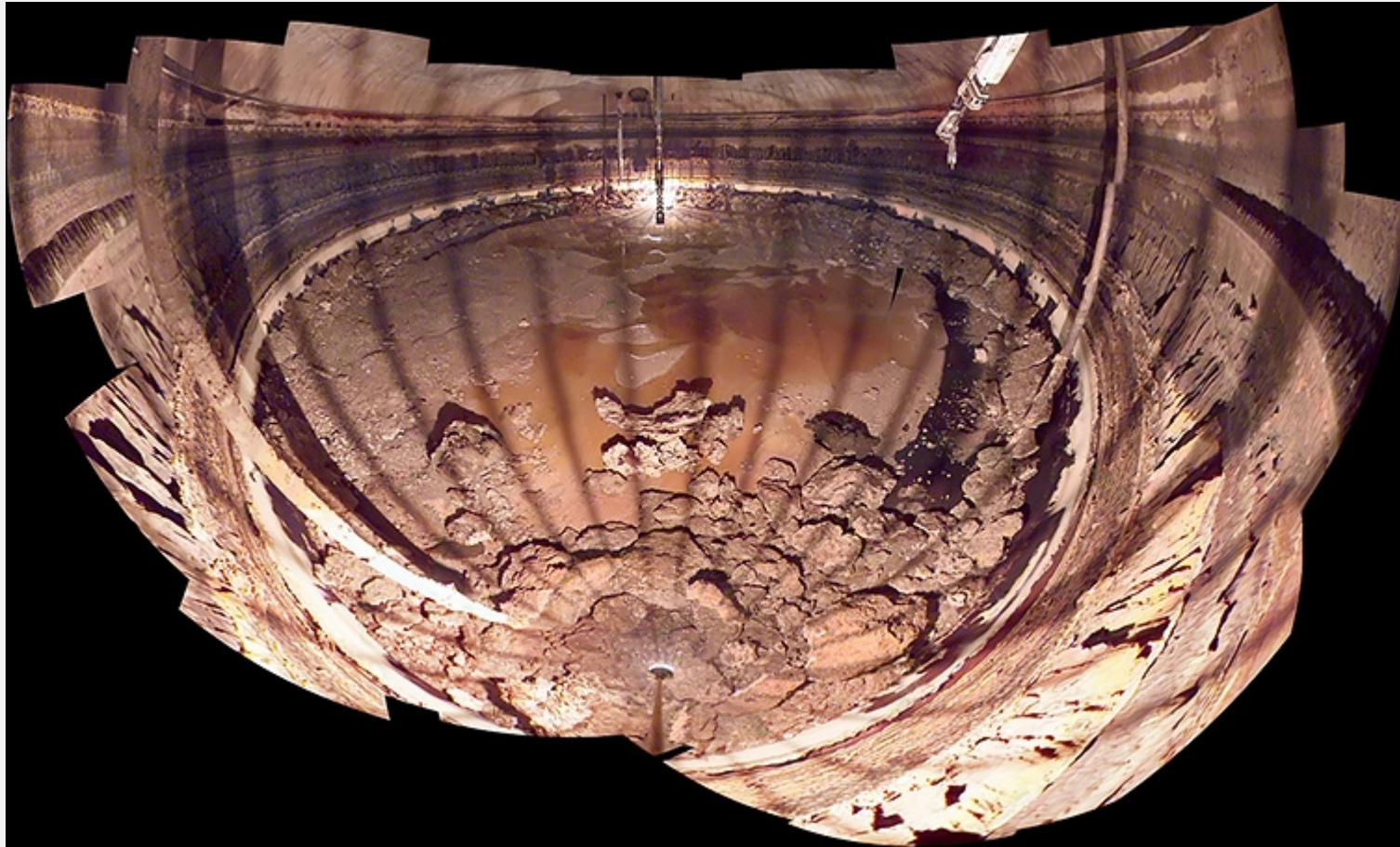
OTHER DEFINITIONS

- **1954: Atomic Energy Act (AEA), as amended 2018:** high-level radioactive waste means the same as in the Nuclear Waste Policy Act (definition incorporated in 1988)
- **1970: 10 C.F.R. Part 50, Appendix F (siting of fuel reprocessing plants):** “high-level liquid radioactive wastes” means those aqueous wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuels. High-level liquid radioactive wastes shall be converted to a dry solid... All of these high-level radioactive wastes shall be transferred to a Federal repository...
- **1972: Marine Sanctuaries Act (ban on ocean dumping):** “high level nuclear waste” means the same as above, and includes spent nuclear fuel (SNF)
- **1980: West Valley Demonstration Project Act:** “high level radioactive waste” means the high level radioactive waste which was produced by the reprocessing at the Center [at West Valley] of spent nuclear fuel. Such term includes both liquid wastes which are produced directly in reprocessing, dry solid material derived from such liquid waste, and such other material as the Commission [NRC] designates as high level radioactive waste for purposes of protecting the public health and safety.

OTHER DEFINITIONS

- **1982: Nuclear Waste Policy Act (NWPA):** “high-level radioactive waste” means
 - A. the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; AND
 - B. other highly radioactive material that the Commission (NRC), consistent with existing law, determines by rule requires permanent isolation.
- **1983: 10 C.F.R. § 63.2 (disposal at Yucca Mountain):** “high-level radioactive waste or HLW” means the same as above, and includes irradiated reactor fuel
- **1983: 10 C.F.R. § 60.2 (disposal in geologic repository):** High-level radioactive waste or HLW means:
 - 1. Irradiated reactor fuel,
 - 2. liquid wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuel, AND
 - 3. solids into which such liquid wastes have been converted.
- **1992: WIPP Land Withdrawal Act:** Same as Nuclear Waste Policy Act

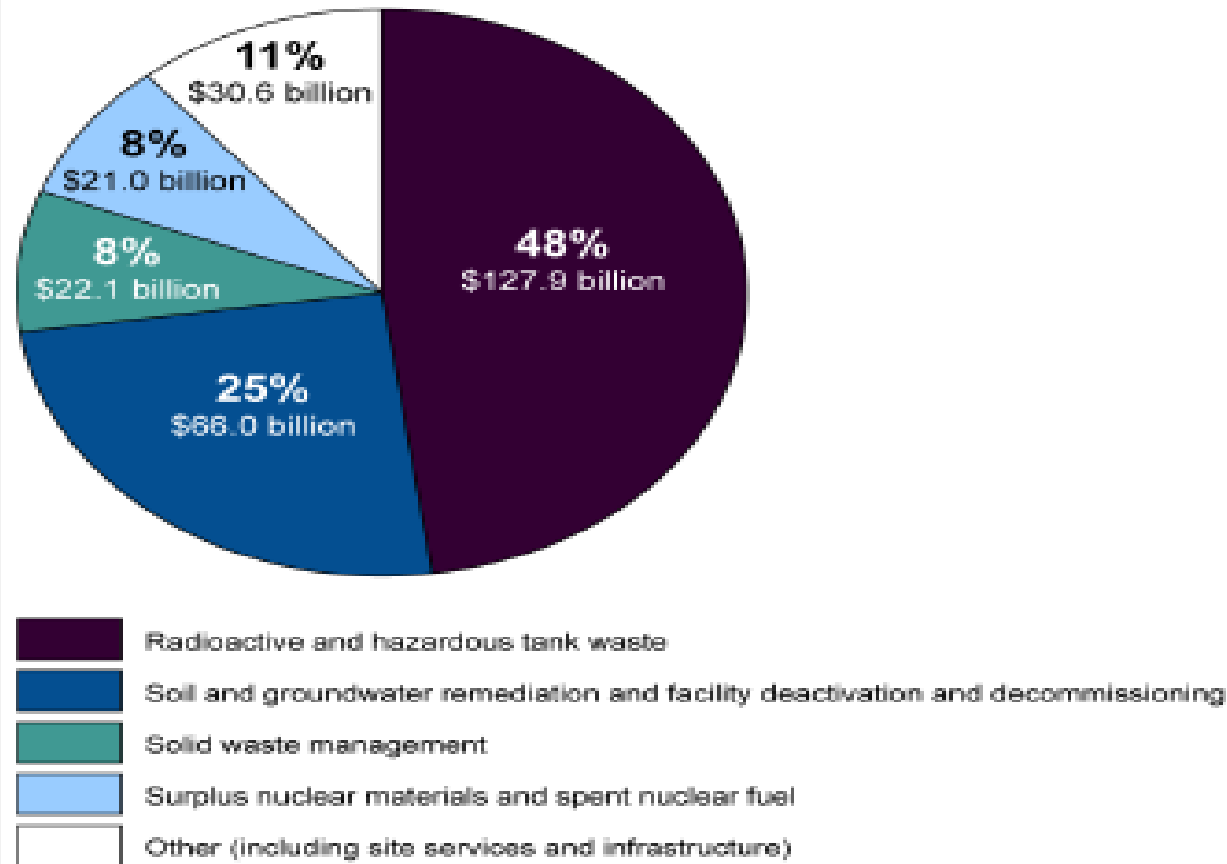
So, what's the problem?



<https://www.srs.gov/general/srnl/events/docs/MacVean%20to%20DOE%20Robotics%20Team%202012.9.pdf>; <https://www.energy.gov/em/articles/em-s-office-river-protection-completes-waste-retrieval-another-hanford-tank>

#1 Problem with Current HLW Definition: \$\$\$\$\$\$?

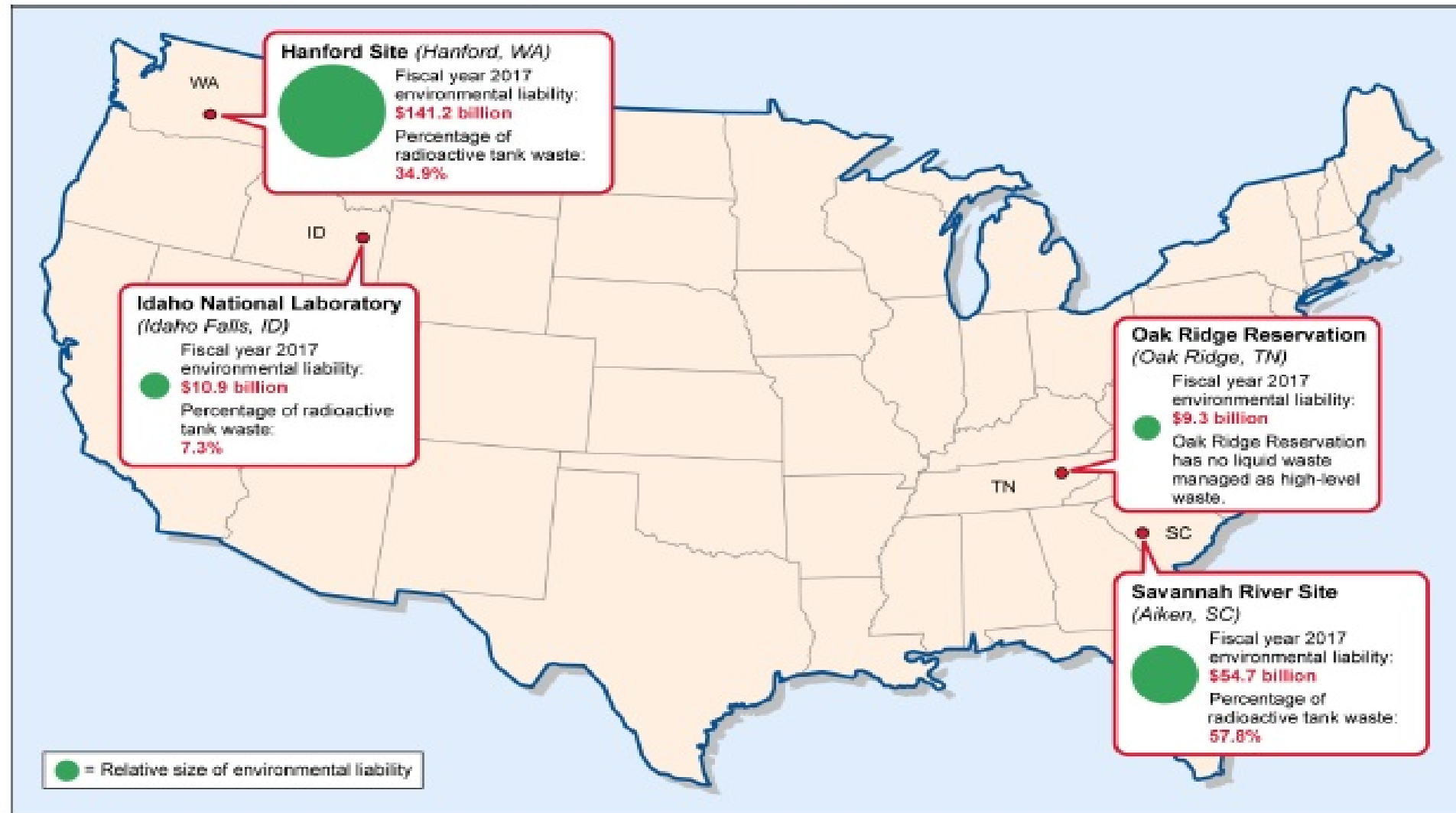
Figure 2: Office of Environmental Management's Portion of the Department of Energy's Fiscal Year 2017 Environmental Liability by Cleanup Activity and Waste Type



Source: GAO analysis of Department of Energy information. | GAO-19-28

#1 Problem with Current HLW Definition: \$\$\$\$\$?

Figure 3: Comparison of Four Office of Environmental Management (EM) Sites with the Majority of EM's Fiscal Year 2017 Environmental Liability with Corresponding Tank Waste Radioactivity



#1 Problem with Current HLW Definition: \$\$\$\$\$\$?

DOE/RL-2018-45, Rev. 0

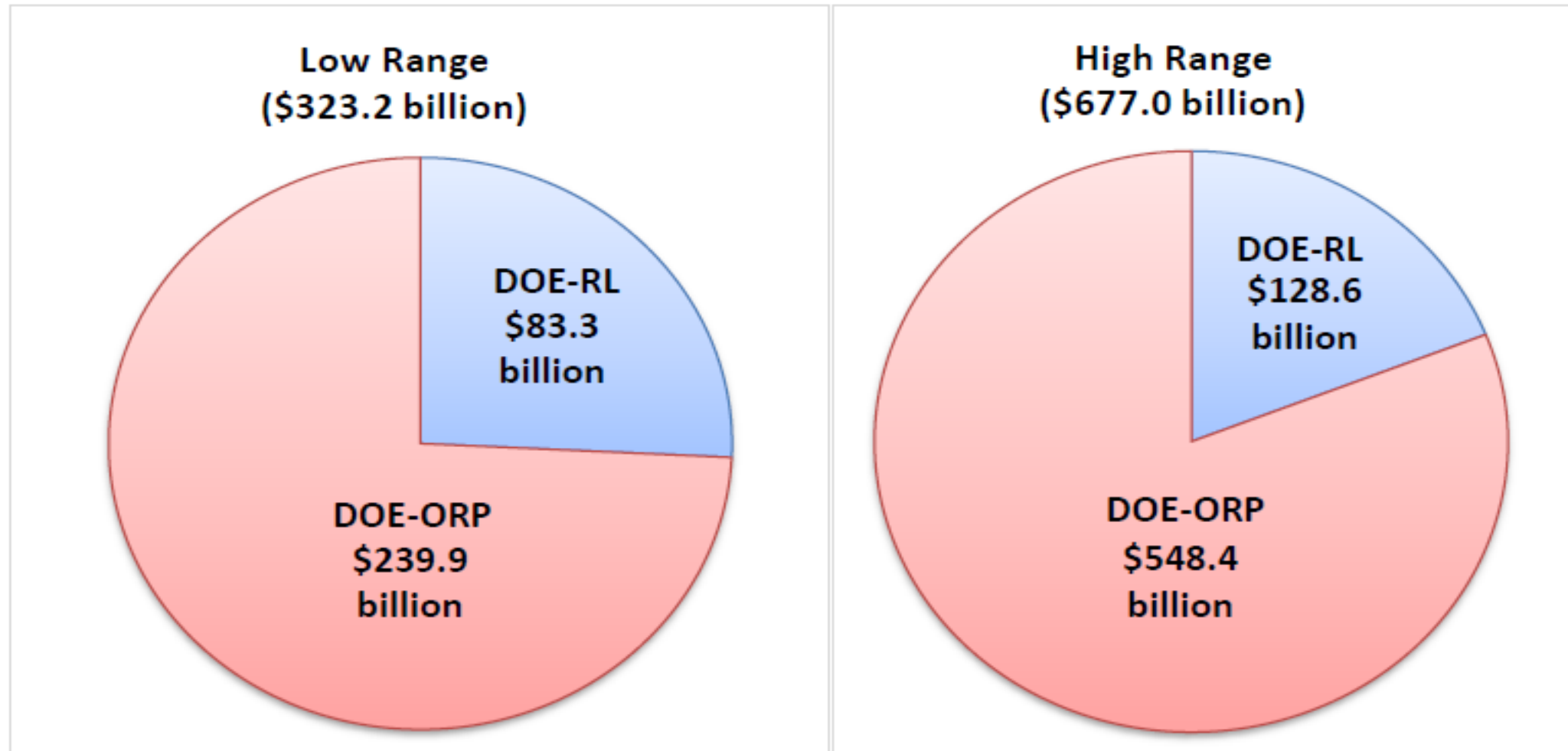
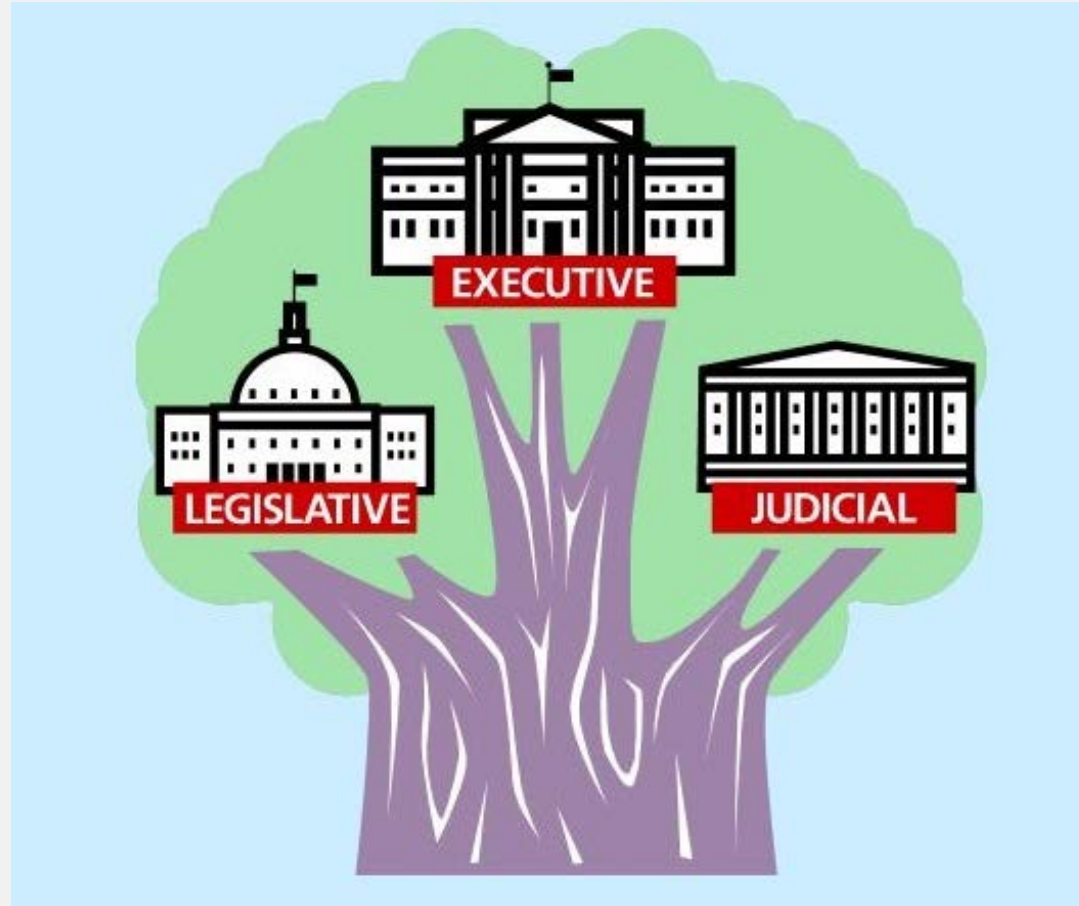


Figure 2-2. Hanford Site Estimated Cleanup Cost Distribution by DOE Field Office.



Who gets to decide what HLW means?





Jury still out on who gets to decide...

- **1987:** NRC proposes a rulemaking to set numerical criteria to define “highly radioactive” – abandons effort in 1988
- **1993:** OR, WA, and others petition NRC for a rulemaking on standards to determine what reprocessing wastes are HLW – NRC denies it, “principles for waste classification are well established”
- **2003:** National Resources Defense Council (NRDC) v. Abraham, 271 F. Supp. 2d 1260 (D. Idaho 2003) – DOE’s effort to reclassify some HLW in Order 435.1 inconsistent with NWPA
- **2004:** NRDC v. Abraham, 388 F.3d 701 (9th Cir. 2004) – previous case vacated, matter not ripe



Other Ways of Getting Reprocessing Wastes to ‘Non-HLW’

1. Section 3116 of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 - FOR IDAHO AND SOUTH CAROLINA ONLY – reprocessing waste is not HLW if it
 1. Does not require permanent isolation in a deep geological repository;
 2. Has had highly radioactive radionuclides removed to the maximum extent feasible; AND
 3. Is disposed of in accordance with CFR performance objectives and pursuant to State approval, whether or not its concentration limits exceed limits for Class C low-level waste.
2. One of the DOE M 435.1 Waste Incidental to Reprocessing (WIR) processes
 - a) Citation – stuff regularly regarded as WIR waste by the NRC, such as contaminated tools, gloves, etc.
 - b) Evaluation – liquid or sludge reprocessing wastes can be reclassified as low-level waste or transuranic waste via case-by-case testing and documentation – may require removal of key radionuclides

Part 2.

**High-level waste in the present:
DOE's proposed interpretation**

DOE's Proposed Interpretation:

Waste generated from the reprocessing of spent nuclear fuel will no longer be considered high-level waste (HLW) if the waste:

- A. **Does not exceed concentration limits for Class C low-level radioactive waste as set out in section 61.55 of title 10, Code of Federal Regulations; OR**
- B. Does not require disposal in a deep geological repository and meets the performance objectives of a disposal facility as demonstrated through a performance assessment conducted in accordance with applicable regulatory requirements.

Class C Waste Long-Lived Radionuclide Concentration Limits – 10 C.F.R. § 61.55

Table 1

¹Units are nanocuries per gram.

Radionuclide	Concentration curies per cubic meter
C-14	8
C-14 in activated metal	80
Ni-59 in activated metal	220
Nb-94 in activated metal	0.2
Tc-99	3
I-129	0.08
Alpha emitting transuranic nuclides with half-life greater than 5 years	¹ 100
Pu-241	¹ 3,500
Cm-242	¹ 20,000

Class C Waste Short-Lived Radionuclide Concentration Limits – 10 C.F.R. § 61.55

Table 2

Radionuclide	Concentration, curies per cubic meter		
	Col. 1	Col. 2	Col. 3
Total of all nuclides with less than 5 year half-life	700	(¹)	(¹)
H-3	40	(¹)	(¹)
Co-60	700	(¹)	(¹)
Ni-63	3.5	70	700
Ni-63 in activated metal	35	700	7000
Sr-90	0.04	150	7000
Cs-137	1	44	4600

¹ There are no limits established for these radionuclides in Class B or C wastes.

“Does not exceed concentration limits for Class C low-level radioactive waste”

Issue:

LLW concentration limits were meant to go hand-in-hand with site-specific performance assessments

Possible solution:

Change the “or” in the suggested interpretation to an “and”

“Does not exceed concentration limits for Class C low-level radioactive waste”

Issue:

What happened to removal of key radionuclides to the maximum extent feasible?

Possible solution:

DOE must somehow make the safety case to stakeholders that this process is not necessary, if that is indeed the case;

OR

Reincorporate removal of key radionuclides into new interpretation

DOE's Proposed Interpretation:

Waste generated from the reprocessing of spent nuclear fuel will no longer be considered high-level waste (HLW) if the waste:

- A. Does not exceed concentration limits for Class C low-level radioactive waste as set out in section 61.55 of title 10, Code of Federal Regulations; or
- B. **Does not require disposal in a deep geological repository** and meets the performance objectives of a disposal facility as demonstrated through a performance assessment conducted in accordance with applicable regulatory requirements.

**“Does not require disposal in a deep geological repository”
Who decides, and how?**

Compare:

Part II of NWPA HLW definition: “other highly radioactive material that the Commission (NRC), consistent with existing law, determines by rule to require permanent isolation.”

With

DOE’s M 435.1 definition: “other highly radioactive material that is determined, consistent with existing law, to require permanent isolation.”

With

Part B of DOE’s proposed interpretation: “Does not require disposal in a deep geological repository and meets the performance objectives of a disposal facility as demonstrated through a performance assessment conducted in accordance with applicable regulatory requirements.”

“Does not require disposal in a deep geological repository”

Issue:

Without guidance on what does or does not require disposal in a deep geological repository, this further interpretation of the HLW definition is not really helpful

Possible solution:

DOE asks NRC, or works with NRC, to develop some kind of guidance on what does and does not require disposal in a deep geological repository. This would follow Part II of the NWPA definition of HLW.

DOE's Proposed Interpretation:

Waste generated from the reprocessing of spent nuclear fuel will no longer be considered high-level waste (HLW) if the waste:

- A. Does not exceed concentration limits for Class C low-level radioactive waste as set out in section 61.55 of title 10, Code of Federal Regulations; or
- B. Does not require disposal in a deep geological repository **and meets the performance objectives of a disposal facility as demonstrated through a performance assessment conducted in accordance with applicable regulatory requirements.**

“...and meets the performance objectives of a disposal facility as demonstrated through a performance assessment conducted in accordance with applicable regulatory requirements.”

Issue:

Performance assessments are site-specific.

Possible solution:

Need to have site(s) in mind before classification of wastes based on meeting performance objectives is useful.

Part 3.

**High-level waste in the future?
Potential expanded disposal options under
DOE's new interpretation**

Expanded disposal options under new interpretation?

Waste Isolation Pilot Plant (WIPP)

- Non-HLW meeting the transuranic definition (>100 nanocuries of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years) could possibly be disposed of at WIPP
- BUT, this is currently prohibited under the New Mexico Environment Department (NMED) Hazardous Waste Facility Permit
- Sec. 2.3.3.8 “TRU mixed waste that has ever been managed as high-level waste and waste from tanks specified in Permit Attachment C are not acceptable at WIPP unless specifically approved through a Class 3 permit modification.”
 - Class 3 permit modification process includes pre-submittal hearings, a mandatory 60-day public comment period, formal public hearings and the opportunity of the public to request a public hearing
- Also, the WIPP Land Withdrawal Act prohibits HLW (as defined in the NWPA) from being disposed of at WIPP.

Waste Tanks Subject to Exclusion Under NMED WIPP Permit

1
2

Table C-4
Waste Tanks Subject to Exclusion

Hanford Site - 177 Tanks	
A-101 through A-106	C-201 through C-204
AN-101 through AN-107	S-101 through S-112
AP-101 through AP-108	SX-101 through SX-115
AW-101 through AW-106	SY-101 through SY-103
AX-101 through AX-104	T-101 through T-112
AY-101 through AY-102	T-201 through T-204
B-101 through B-112	TX-101 through TX-118
B-201 through B-204	TY-101 through TY-106
BX-101 through BX-112	U-101 through U-112
BY-101 through BY-112	U-201 through U-204
C-101 through C-112	
Savannah River Site - 51 Tanks	
Tank 1 through 51	
Idaho National Engineering and Environmental Laboratory - 15 Tanks	
WM-103 through WM-106	WM-180 through 190

Expanded disposal options under new interpretation?

Leave more waste on site

- Non-HLW that qualifies for near-surface disposal could be left on site
- BUT, potential for state-level issues – could be considered a violation of agreements such as the Tri-Party Agreement between the state of Washington and the feds; the Federal Facility Agreement between the state of South Carolina and the feds; and the Batt Agreement between Idaho and DOE
- See, e.g., the Batt Agreement:
 - “DOE shall treat all high-level waste currently at INEL [Idaho National Engineering Laboratory] so that it is ready to be moved out of Idaho for disposal by a target date of 2035.”
 - Batt Agreement incorporates NWPA definition of HLW

Expanded disposal options under new interpretation?

Low-Level Waste (LLW) Disposal

- Non-HLW that qualifies for near-surface disposal could also be disposed of at a LLW disposal facility
- LLW disposal is regulated under the Code of Federal Regulations (NRC rules)
- 4 commercial LLW disposal facilities – Washington, Utah, Texas, and South Carolina, operating under state permits
- Also, DOE disposes of some LLW at the Nevada National Security Site (NNSS)
 - Must meet NNSS Waste Acceptance Criteria
 - LLW with a hazardous component (mixed LLW) must comply with a Nevada Resource Conservation and Recovery Act permit

Summary of suggestions on DOE's proposed HLW interpretation

1. Change the “or” separating the two clauses in the suggested interpretation to an “and”
2. Reincorporate removal of key radionuclides into new interpretation, OR
3. Make the safety case to stakeholders that this process is not necessary, if that is indeed the case
4. DOE asks NRC, or works with NRC, to develop some kind of guidance on what does and does not require disposal in a deep geological repository
5. Need to have site(s) in mind before classification of wastes based on meeting performance objectives is useful.

4. Moving forward: To redefine or not to redefine?

1. Keep refining new interpretation, incorporating public comments
2. Stay the course
3. Request that Congress change the definition of HLW to remove reference to reprocessing wastes as high-level waste
4. Work with the NRC and the public to define standards for what reprocessing wastes are and are not HLW



THANK YOU!

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