

EPRI Research Summary: Very Low Level Waste

U.S. Nuclear Regulatory Commission's 30th
Annual Regulatory Information Conference

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2 Reports – Publicly Available

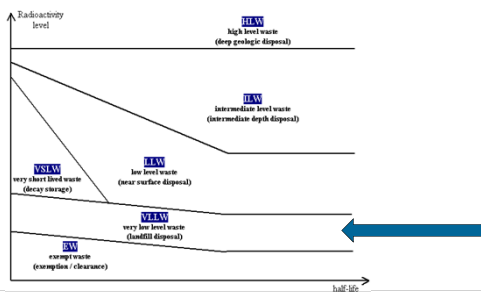
- Report ID 1024844, published 2012
- Investigates international and US application of the concept of VLLW
- Compares international disposal requirements for VLLW to RCRA landfill requirements in the US



- Report ID 3002000587, published 2013
- Provides generic technical basis for defining VLLW in the US
- Compares results to international definitions of VLLW



VLLW - IAEA



Global Radwaste Management Practices

	US	ROK	Spain	Canada	Sweden	France
Clearance	No	✓	✓	✓	✓	Waste Zoning
VLLW	Limited - Hazardous waste site disposal option (RCRA)	✓	✓	Piloting	✓	✓
Recycling		✓	✓	✓	✓	✓
Stabilization	Very limited solidification	Some solidification	Cementation Mortar	Some solidification	Cement Bitumen	Cementation Polymerization

Source: EPRI Report 3002008190, International Low Level Radioactive Waste Classification and Management Practices

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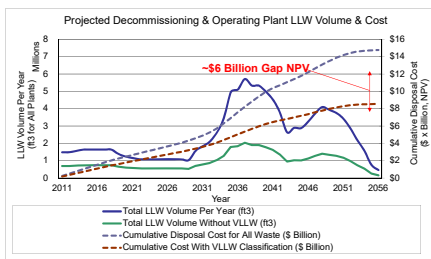
Key Take-Aways From EPRI Report 1024844

- VLLW is part of IAEA waste categories
- Successfully used in France, Spain, and Sweden
- Concept is applied in US
 - 20.2002 exemption process
 - Agreement states
- RCRA subtitle C disposal facilities compare favorably to disposal requirements for VLLW used abroad
- Significant industry O&M and decommissioning savings can be realized with RCRA VLLW disposal path
- Could play an important role in addressing disposal needs associated with radiological dispersal devices (RDD)

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VLLW Cost Savings Projection



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VLLW Overview Report Number 3002000537

▪ *Generic Technical Basis for Implementing a Very Low Level Waste Category for Disposal of Low Activity Radioactive Wastes Low Level Waste; 3002000587*

- To provide a generic basis for increasing the use of VLLW disposal.
 - ✓ VLLW represents a significant fraction of LLW
 - ✓ Continuation of work performed in 2012 for VLLW disposal viability (1024844)
- Used extensively in France, Spain and Sweden on a routine basis.



Key Takeaways 3002000587

Generic Very Low Level Waste Basis (VLLW)

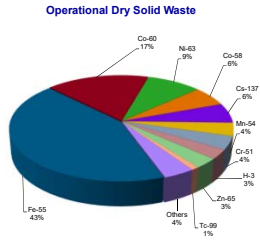
- VLLW can be safely disposed in properly designed generic hazardous waste disposal facilities.
 - Provides a generic approach based on reasonable yet conservative assumptions for disposal of VLLW.
 - Global applicability for lined, monitored, and capped hazardous waste disposal facilities.
 - Substantial cost savings to utilities, preservation of limited LLW disposal resources, LLW disposal relief afforded to universities and hospitals.
 - A pathway for generic disposal of VLLW is of benefit to public.

Generic VLLW Analysis Methodology

- Using reasonable yet conservative assumptions for disposal of VLLW in lined, monitored, and capped hazardous waste disposal facilities
- Establish parameters based on global guidance and experience and sound scientific reasoning.
- The challenges:
 - Some requirements vary by country
 - What performance objective (dose limits) should apply?
- Some factors are relatively constant such as minimum hazardous waste disposal facility design requirements for lining, capping, monitoring, etc. conforming to:
 - Annex 1 of EU council directive 1999/31/EC
 - US EPA RCRA subtitle C

VLLW Facility Design & Waste Streams Other Inputs

- Humid and Semi-arid site parameters from Part 61 Basis
- Representative radionuclide mix is important to performing proper dose evaluations, evaluated both:
 - Operational waste stream taken from 2007 four year EPRI database (1016120)
 - Decommissioning waste stream derived from Connecticut Yankee, Yankee Rowe and Humboldt Bay approved alternate disposal applications (similar to VLLW)



VLLW: What dose limits to apply and to whom? Various Limits in use Globally

Source	Non-Occupationally Exposed Worker and Member of the Public mrem/yr (µSv/yr)	Future Human Activities or Intrusion mrem/yr (µSv/yr)
US Rad Protection	100 (1,000)	N/A
10 CFR Part 20.2002	No more than a few millirem	No more than a few millirem
EPA (residual limits for remediated facilities)	15 (150)	15 (150)
Spain VLLW	10 (100)	10 (100)
France VLLW	25 (250)	25 (250)
IAEA VLLW (Note 1)	Not Defined - Activity up to ~100X Exempt Waste	Not Defined - Activity up to ~100X Exempt Waste
Tennessee Class 1 Landfill Process (Note 2)	1 (10)	1 (10)

5 mrem/yr (50 µSv/yr) Selected as Generic Limit

Notes: (1) IAEA Exempt Waste Limits <1 mrem/yr (<10 µSv/yr) and 100X higher for low probability events
(2) Process more comparable to IAEA Exempt Waste

Generic VLLW Scenario Development

- Used conservative global guidance and experience to define exposure scenarios
- Determine the maximally exposed individual (MEI) from both workers and post closure intruders:
 - Bulldozer (compactor) Operator
 - Landfill Driver (truck driver or worker)
 - Resident Farmer (lives on site after closure)
 - Post Closure Worker (factory or other industry built over closed facility)
- Conservative as all worker doses are calculated w/o site inventory decay
- Peak intruder factors used, but all assumed at T=30 years regardless of when individual radionuclide dose peaks occur (several at 600 – 700 years)

Generic VLLW Derived Limits

Select values from report

Radionuclide	Limit pCi/gm (Bq/gm)
Co-60	33 (1,24)
Cs-137	235 (8.7)
H-3	164 (6.07)
C-14	2,700 (100)
Ni-63	10,300 (383)

- Initial derived limits for some radionuclides were higher but were adjusted down to align with other global guidance
- For mixes of radionuclides, the sum of fractions of the waste activity divided by its limit cannot exceed unity (1)

What Waste is Eligible for VLLW?

- Estimated waste eligible for VLLW disposal under this generic process:
 - Minimum 10% of Operational Waste from both dry solid waste and PWR secondary resins
 - Minimum 60% of Decommissioning Waste
 - Eligible volumes can be increased with modest additional segregation efforts
- Potential cost savings decommissioning value at ~\$6 billion for US fleet alone in 2011 dollars through 2056 (1024844)
- Operational waste averted per reactor year estimated at 12,000 lbs (5,500 kg) or 2,200 ft³ (62 m³)



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