



Reprocessing And Recycling: Waste Management

U.S. Nuclear Regulatory Commission
Reprocessing Workshop
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Reprocessing And Recycling Mass And Waste Balances

- Mass quantities and waste categorizations depend on processes and efficiencies
- In general:
 - PUREX process is the Baseline - most developed/used and well defined
 - PUREX variations can have large differences in mass quantities, waste generation, and categorization
 - Other processes less defined for waste quantities and categorization
- Contact handling (e.g., Recycling – fuel fabrication) requires high efficiencies and decontamination factors, and potentially simplifies the waste area

Modern PUREX - Top Level Balances

(All Values Are Approximate)

Emissions and Effluents:

Kr-85: 27,940 g, 11E6 Ci C-14: 455.3 g 2,030 Ci
 H-3: 95.4 g, 9.21E5 Ci I-129: 313,300 g, 55.3 Ci

SNF: 1,000 MTHM
 (e.g., per year)

Uranium (NU or DU)

**For MOX Fuel:
 190 MTHM**

(Values derived from literature references, e.g., NRC, 179th meeting Of ACNW&M, May 16th, 2007)



**MOX Fuel
 200 MTHM,
 5% Fissile**

**Reprocessed Uranium (REPU)
 940 MTHM, 340 m³**

**HLW: 50 te
 HLW (vit): 200 te, 100 m³**

**“HLW/GTCC: 300 te” (e.g., Zr hulls)
 Circa 100 m³**

**LLW: facility, PPE etc.
 1,200 m³**

Radioactive Wastes

- In general:
 - HLW – highly radioactive and hazardous for many 100s or 1,000s of years, can be self-heating, geologic isolation generally needed
 - Non-HLW – radioactive and hazardous for 10s or a few 100s years, not self-heating, engineered isolation generally needed
- Waste categorization primarily by generation and source (origin), not hazard

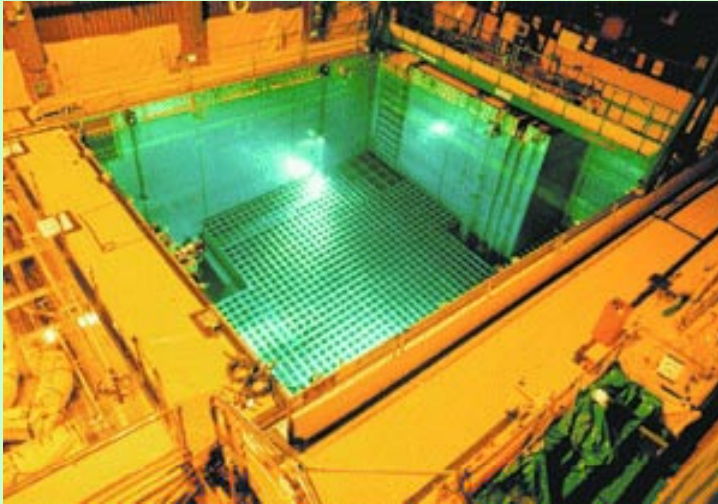
HLW - High Level Waste

- Definition in 63.2 and 72.2:
 - Highly radioactive material from reprocessing SNF (liquid or solid), including liquid waste produced directly and any solid derived from such liquid waste containing sufficient concentrations of fission products
 - Irradiated nuclear fuel (SNF)
 - Other highly radioactive material NRC determines by rule that requires permanent [geologic] isolation
- Generated by all reprocessing processes but quantities and forms vary

HLW And PUREX

- First cycle liquid waste
 - Vitrified (a glass), inside containers
 - Stored onsite
- Fuel rod cladding – “hulls”
 - Technically not HLW
 - But hard to separate and verify separation from HLW, and, thus, usually handled as HLW
- Other HLW-like streams small, usually routed to vitrification (e.g., scrubber solutions, alpha and TRU materials)

Photos Of HLW Storage



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Non-HLW

- Normally considered to be low level waste (LLW). Typically includes:
 - Non-repaired equipment
 - Facility waste (e.g., filters, ion exchange media, catalysts, solvents)
 - Includes radioiodine adsorbents
- PPE – Personnel Protective Equipment
- Reprocessing plants overseas sometimes generate another waste type called intermediate level waste (ILW) between LLW and HLW

Other Materials

- Reprocessed uranium – recycle, store, or disposal
 - Large amount
 - Slightly enriched
 - Contact handled (PUREX) but slightly more radioactive
- Plutonium – reuse as a fuel material (e.g., MOX)
 - Isotopic mixture depends on burnup and decay time
- Volatiles
 - Usually released via scrubbers
- Potential reuse of materials for catalysts, radiation sources etc.

Potential Points For Discussion

- Onsite storage of SNF
- Onsite storage of HLW
- Onsite storage of non-HLW
- Onsite storage to allow decay
- Parameters for onsite storage – form, radiation limits, activity limits, active vs passive (cooling, monitoring)
- Reuse – current, future – parameters
- Risk-inform waste categorization based upon hazards
- Include additional waste categories (e.g., ILW)