



Reprocessing And Recycling: Waste Management

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

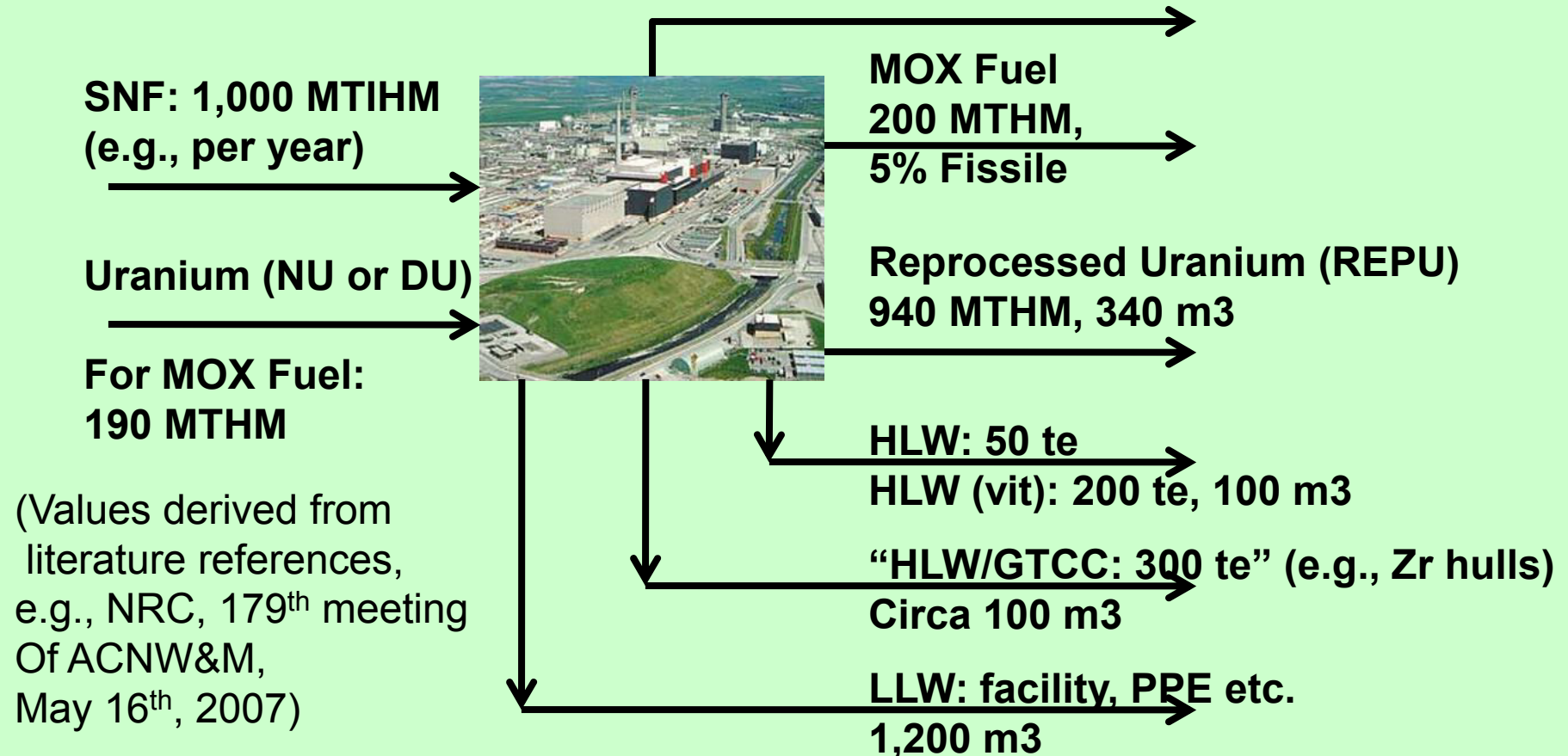
- Mass quantities and waste categorizations depend on processes and efficiencies
- In general:
 - PUREX process is the Baseline - most developed/used and well defined
 - PUREX variations can have large differences in mass quantities, waste generation, and categorization
 - Other processes less defined 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



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

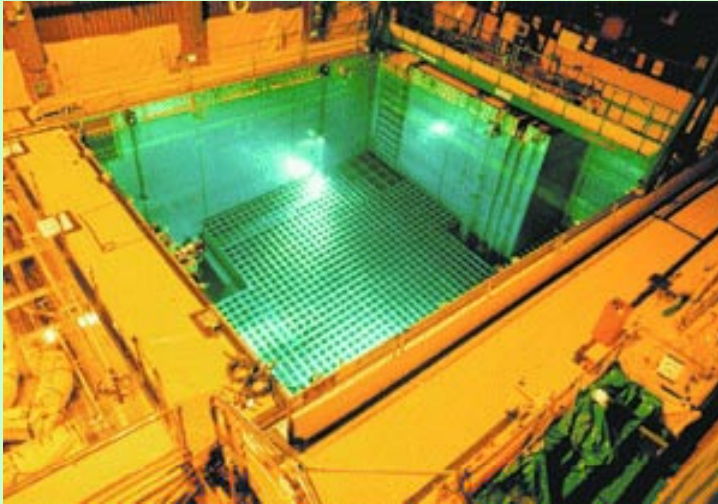
HLW - High Level Waste

- 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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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.

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

Regulatory Analysis

- Waste-related gaps ...
 - **Gap 3:** Waste incidental to reprocessing ... *High priority*
 - **Gap 15.** *Waste confidence for reprocessing facilities*
 - **Gap 16:** Waste classification ... *Moderate priority*

Gap 3: *Waste Incidental to Reprocessing*

- Commercial reprocessing facilities likely to generate waste that is WIR-like
- WIR is not defined by statute or regulation
- Commercial WIR is not ...*
 - High-level radioactive waste (HLW)
 - Spent nuclear fuel (SNF)
 - Transuranic radioactive waste (TRU)
 - Low-level radioactive waste (LLW)
 - Greater-than-Class C LLW (GTCC)

* See Appendix B of NUREG-1853

Gap 3:

Why is this of Concern?

- Regulatory definition implies manner of disposition
- Management options currently available ...
 - HLW, SNF, TRU, GTCC: Deep geologic disposal
 - LLW: Shallow land burial
 - DOE WIR: *In situ* disposal
- For a commercial reprocessing facility, what should NRC propose for WIR-type wastes?
 - Not all waste generated by reprocessing facilities expected to be ‘HLW’
 - Large volumes of LLW-like wastes expected to be generated with small amounts of radioactive materials

Gap 3:

Potential Options ...

- Define what is meant by the term “highly radioactive” in Section 2.(12) of the NWPA, as amended
- Develop regulatory guidance similar to that used by DOE to differentiate WIR-like wastes
- Define commercial WIR in the context of current Part 61 (by default)
- Develop a definition of WIR as applied to commercial SNF reprocessing facilities
- Address via SRM-SECY-08-0147 or SRM M100617B (amendments to Part 61)
- Restore LLW Requirements for Reprocessing Plants in Appendix D (Now Appendix F) to Part 50

GAP 16:

Waste Classification-10 CFR Part 61

- Some radionuclides potentially associated with reprocessing not addressed by §61.55 tables
 - Example: Krypton-85: H-3 (No limits for Class B and C waste)
 - Kr-85 could be classified as Class-A LLW
 - If radioactive waste does not contain any radionuclides listed either in Tables 1 and 2 of 10 CFR Part 61, it is Class A LLW

Potential Points For Discussion

- What alternatives or options should NRC consider for the independent storage of reprocessing high-level waste (HLW)?
- What alternatives or options should NRC consider for the management of non-HLW reprocessing waste
- What specific time limit considerations should the NRC consider for the storage of reprocessing waste?
- Should the waste incidental to reprocessing concept be implemented for a commercial fuel reprocessing production facility?
- What waste performance requirements are needed to safely dispose waste generated at reprocessing facilities?

BACK-UP SLIDES

Background

- NRC has licensing jurisdiction over commercial production facilities
 - Reprocessing facilities are production facilities
 - NRC neither proposes nor opposes reprocessing and recycling
- In the 1960s-70s, the AEC (now NRC) licensed a reprocessing facility and issued construction authorizations under 10 CFR Part 50
 - West Valley Demonstration Project
 - Operated from 1966-72 by Nuclear Fuel Services (NFS)
 - Closed for design modifications in 1972
 - NFS ceased operations in 1976

SECY-09-0082

- Identify information needs necessary to support licensing framework for reprocessing and associated activities
 - Focused on 10 CFR Part 70
 - Considered ACNW&M's NUREG-1909
 - Other materials
- Included identification of regulatory gaps for which existing NRC regulations are likely insufficient to address needs