



# Reprocessing And Recycling: Waste Management

U.S. Nuclear Regulatory Commission  
Reprocessing Workshop  
September 7<sup>th</sup> and 8<sup>th</sup>, 2010  
Rockville, MD



# Reprocessing And Recycling Mass And Waste Balances

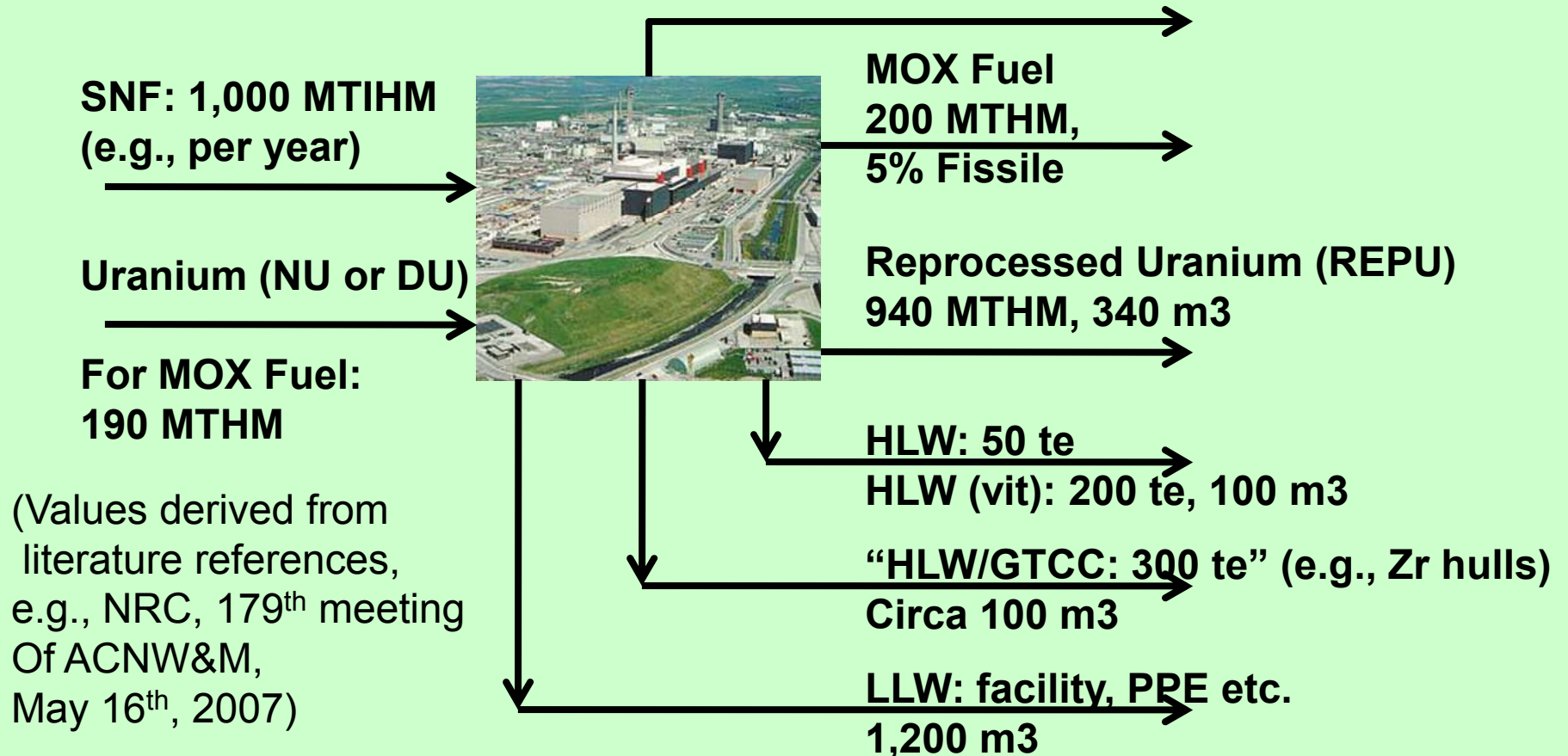
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- Mass quantities and waste categorizations depend on processes and efficiencies
- In general:
  - PUREX process is the Baseline - most developed/used and well defined
  - PUREX variations can have large differences in mass quantities, waste generation,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

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- 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

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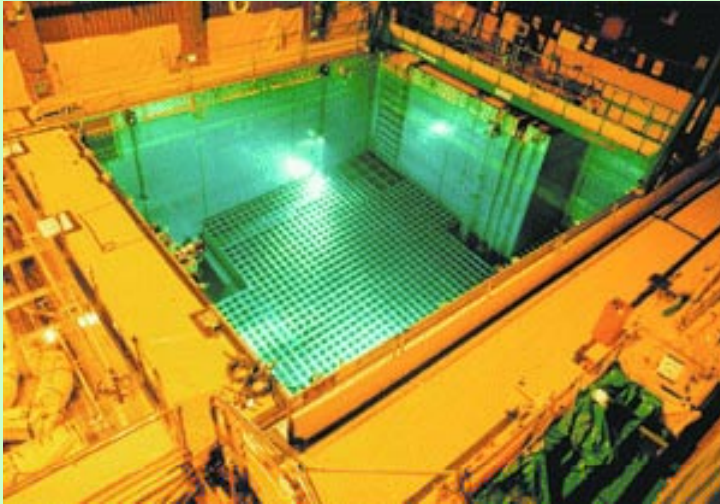
- Definition in 63.2 and 72.2:
  - Highly radioactive material from reprocessing SNF (liquid or solid), including liquid waste produced directly and any solid derived from such liquid waste containing sufficient concentrations of fission products
  - Irradiated nuclear fuel (SNF)
  - Other highly radioactive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

# HLW And PUREX

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- 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

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- 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

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- 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

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- 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)