Reprocessing And Recycling
(context from NUREG-1909)

- Reprocessing
  - Also termed processing or separations
  - Dissolves SNF and separates SNF constituents
  - Recovers potentially useful constituents
    - Fuel materials (U, Pu for LWRs, and TRUs for advanced reactors)
    - Potential for others (e.g., Cs, Xe, Ru/Pt)
  - Removes and conditions wastes
  - Processes highly radioactive and self-heating materials

- Recycling
  - Converts recovered useful constituents into reusable items
    (e.g., MOX fuel assembly for LWRs) and avoid SNM accumulation and inventory
  - Potentially involves more separations and blending
  - Processes materials less radioactive and less self-heating
  - Usually represents last operations in a reprocessing facility
Atomic Energy Act (AEA), As Amended

- Defines production facility
- Reprocessing facilities meet the definition of a production facility
  - “… facility … separation of isotopes of plutonium …”
  - “… process irradiated materials containing special nuclear material …” [e.g., plutonium, uranium-233, uranium enriched in U-233 or U-235]
- Identifies minimum requirements for reprocessing facilities, which are codified in 10 CFR 50 (e.g., 50.34, 50.36, Appendices A, F etc.)
- Nuclear power reactors are also regulated by Part 50
- Special Nuclear Material is regulated by Part 70
Main NRC Regulations For Reprocessing/Recycling – R&R (today)

### Part 50
- Production facilities (this context): processing irradiated materials containing SNM
- Reprocessing facilities are production facilities
- Deterministic, DBAs, adjust via PRAs
- GDCs, tech specs, source term, QA, ALARA
- Focus has become LWRs
- **Current regulation for R&R**

### Part 70
- SNM – Special Nuclear Material
- Process non-irradiated materials containing SNM
- Includes enrichment, fuel fab., and MOX facilities
- Risk informed via ISA
- Most licenses and applications involve LEU processing
  - One involves MOX
  - Two involve HEU
NRC’s Focus Is Safety: Relative Hazards/Consequences

<table>
<thead>
<tr>
<th>Material</th>
<th>Relative Inhalation Dose/mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEU, 5% U-235</td>
<td>1</td>
</tr>
<tr>
<td>U-235, 100%</td>
<td>5</td>
</tr>
<tr>
<td>MOX, 5% Pu-239, 95% U-238</td>
<td>19,000</td>
</tr>
<tr>
<td>MOX, 5% Puf, Weapons-grade Pu</td>
<td>25,000</td>
</tr>
<tr>
<td>Fission Products – Cs + Sr</td>
<td>41,000</td>
</tr>
<tr>
<td>SNF – Cs, Sr, U, TRUs</td>
<td>220,000</td>
</tr>
<tr>
<td>MOX, 5% Puf, Reactor Pu</td>
<td>230,000</td>
</tr>
<tr>
<td>MOX, 5% Puf, Reactor Pu, 0.25% Am</td>
<td>310,000</td>
</tr>
</tbody>
</table>

SNF, FPs based upon 60,000 MWD/MTIHM Burnup
One-Step Or Two-Step Licensing

• Part 50 is based upon two-step licensing
  – Construction Permit, followed by
  – Operating License

• Part 50/52 combination allows one-step licensing
  – Combined construction permit and operating license
  – Also includes ESP, design certification, ITAAC

• Part 70 allows one or two-step licensing; for two-step:
  – Construction Permit, followed by
  – Possession and Use license
Reprocessing And Recycling Technology

• Existing, overseas commercial scale technologies
  – Use aqueous dissolution followed by decontamination
  – Separates and decontaminates based upon partitioning between aqueous and immiscible solvent phases
  – Optimizations of the PUREX process
• Laboratory or pilot-scale processes
  – Several aqueous, some non-aqueous processes (e.g., pyrochemical, electrorefining)
• Potential domestic commercial reprocessing facilities might use additional modifications of PUREX or pyrochemical processes
Potential Points For Discussion

- Regulate more like a reactor (Part 50)
- Regulate more like a fuel cycle facility (Part 70)
- New or modify existing regulation
- One step or two step licensing, or option
- Should other licensing options be included, such as ESP, certification etc.?
- Level and type of design information, and detail in application(s) and technical parts of SARs
- Balance between regulations and guidance
- Inspections, ITAACs etc.
- Technology neutral, technology specific, or a blend