

Adding Realism to Nuclear Material Dissolving Analysis

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Outline

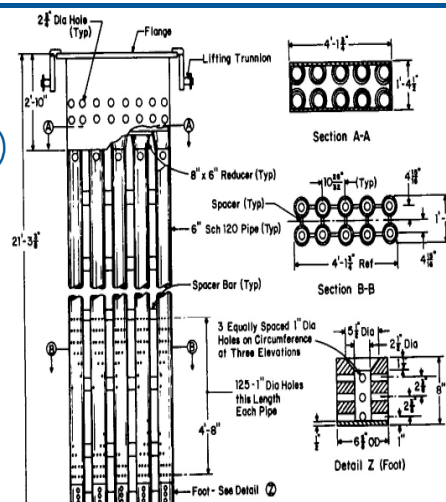
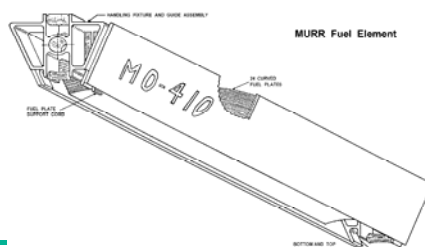
- Savannah River Site & H-Canyon
- Dissolving
- Historical Approach
- New Improvements
- Results

Savannah River Site & H-Canyon

- SRS
 - 310 mi² complex (~800 km²)
 - Owned by the Department of Energy
 - Managed and operated by Savannah River Nuclear Solutions
- H-Canyon
 - The only operating nuclear chemical separations plant remaining in the United States
 - Heavily shielded
 - Employs remote operations

Dissolving

- 2 tanks
 - 8' d x 8' h (2.5 m x 2.5 m)
 - 12' d x 8' h (3.5 m x 2.5 m)
- Nitric acid
- 10-well insert
- Used Fuel or EU-Pu



Dissolving – Historical Approach

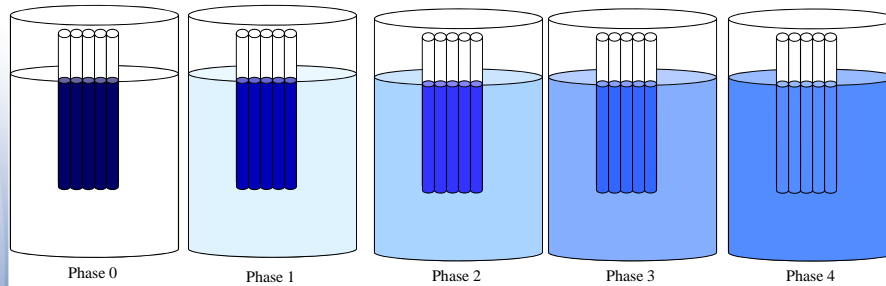
- Material is instantaneously dissolved @ 150 g U/L
- Variations in mass are modeled as variations in solution level
- The same material is modeled in the wells and the bulk solution
- One unrealistic snapshot in time

Linear Density Method (for Used Nuclear Fuel)

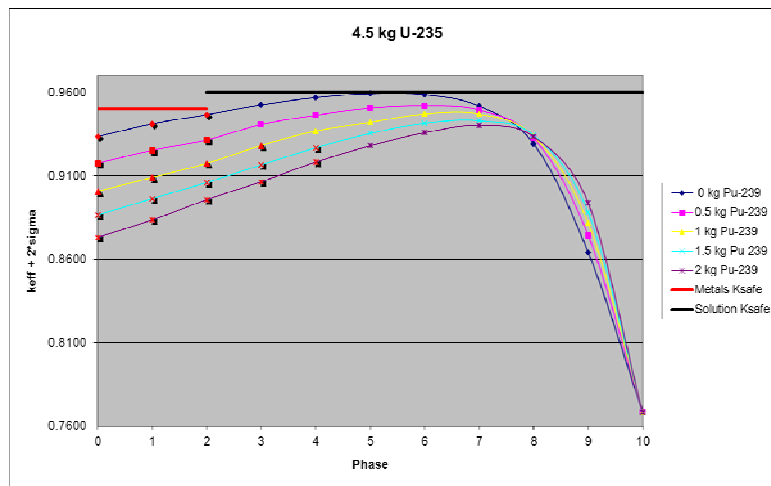
- Takes credit for the physical distribution of mass throughout the length of the fuel assembly
 - MURR has a linear density of 12.9 g U-235/cm
 - The well contains 0.1825 L/cm
 - Concentration of 70.8 g U-235/L
- Maximum safe concentration in all 10 wells found (SCALE)
 - 81.8 g U-235/L
- Converted back into a linear density
 - 14.2 g U-235/cm
- Candidate fuels compared to maximum linear density

Dissolving Phases (for EU-Pu)

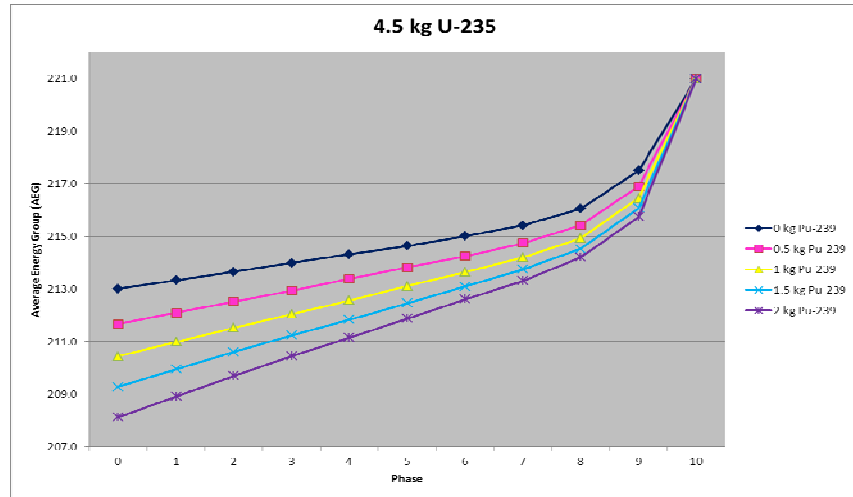
- Multiple snapshots in time
- Fissile material moves from the wells into the bulk solution



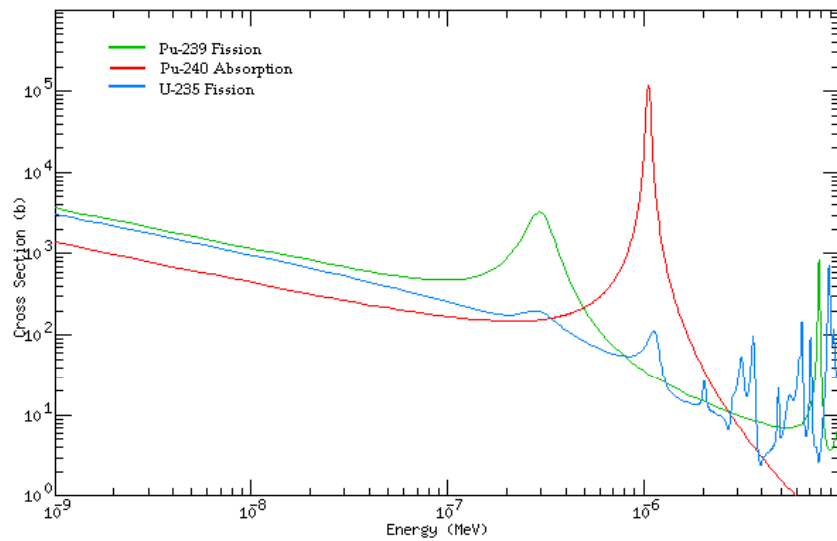
Interesting Effects



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Results of Improvements

- **Linear Density Method**
 - CSLs for loading all 10 wells, 1 kg U-235 -> 3.4 kg U-235
 - MURR could be loaded in 6 wells, now it can be loaded in 10
 - Saves 6 months of time, ~\$75 million
- **Dissolving Phases**
 - Old CSLs for 5 wells, 3.4 kg U-235 & 1.0 kg Pu-239
 - New CSLs for 5 wells, 4.7 kg U-235 & 2.0 kg Pu-239
 - Run time was 48 weeks -> 36 weeks
 - ~\$39 million

Is it worth it?

- **Criticality safety shall not be compromised for the sake of expediency, production, or economic pressure.**
- **Conservatisms still present:**
 - Material is instantaneously dissolved
 - No burn-up credit
 - Still meets Double Contingency
 - Enrichment/Isotopics
 - Corrosion
- **Yes, it is worth it!**

Questions?