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Alternative Dispositions of Used Nuclear Fuel

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May 19, 2014

SRNL-MS-2014-00040

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Purpose

To satisfy Nuclear Materials Committee Work Plan item by:

Presenting several alternatives for disposition of Used Nuclear Fuels (UNF)

Agenda

- Current interim storage and disposition path
  - L-Basin interim storage
  - H-Canyon aqueous separation
  - High Level Waste (HLW) system
- Possible alternatives
  - Dry Storage
  - Melt-Dilute
  - Electrochemical Separation
  - Electrodialysis Separation
  - Selective Electrochemical Extraction
  - Chromatographic Separation
- Summary

Current interim storage and disposition path

L-Basin Interim Storage

- Uranium (U) clad with aluminum (Al)
- Purified water with a highly controlled chemistry
- SRS Basins Management and Surveillance Program used as a model by the United Nations' International Atomic Energy Agency (IAEA) for development of International Standards Organization (ISO) standards for basins around the world
- **This is not disposition; it is interim storage**

Current Disposition Path for Typical UNF

- Transport by Savannah River Site (SRS) rail in heavily shielded casks to H-Canyon
- Dissolve in nitric acid in stainless steel tanks
- Separate U from Al, fission products (FPs), and minor actinides (MAs)
- Uranium is down-blended to Low Enriched uranium and provided to TVA for future use
- Al, FPs, and MAs dispositioned through the HLW system

Possible alternatives

All will require years of research, development, demonstration, and scale up which requires funding that is not currently available

Dry Storage

- Build heavy duty storage pads
- Transport UNF out of L-Basin
- Dry via mechanical means
- Place into shielded storage casks
- Place casks on storage pads

- Need research & development (R&D) on storage and monitoring of Al clad UNF in a harsh environment (heat and radiation)
- Not a disposition
- Ready to ship to federal repository

Melt-Dilute

- Melt UNF in a furnace vs. dissolve in nitric acid in a tank
- Add natural U (NU) (almost exclusively U-238) to reduce U-235 percentage to less than 20%

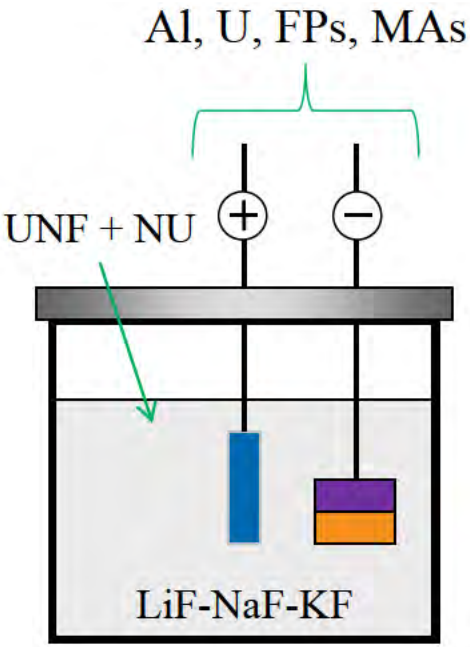
- Nonradioactive demonstration runs conducted ~15 years ago
- Ready to ship to federal repository as UAl metal (w/ fission products and minor actinides encased)
- Need new equipment
- Scale up will require years

Common Attributes for the Following Separation Slides

- Research & development of all is in the early stages
- Small footprint, continuous throughput, low waste, and low inventory alternatives to the current baseline aqueous process in H-Canyon but would require a longer period of time to complete
- NU is added to the UNF to reduce the U-235 percentage (enrichment) to less than 20% to reduce significantly the Safeguards & Security on the U. This is what is called down-blending –changing HEU into LEU.
- End state examples
  - Al to Low Level Waste (LLW)
  - U to LLW or to the Tennessee Valley Authority (TVA)
  - Fission Products (FPs) and Minor Actinides (MAs) to the High Level Waste (HLW) system

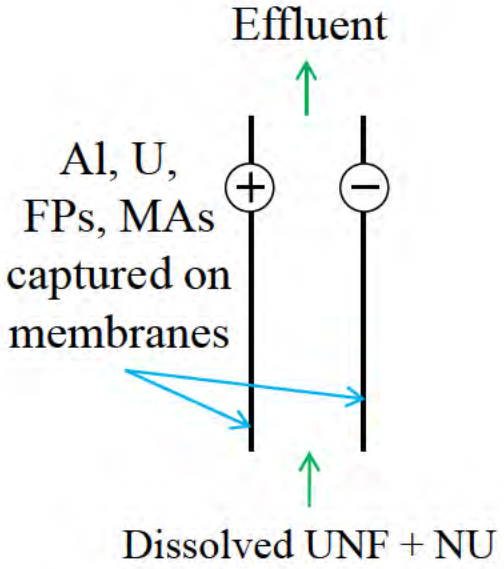
Electrochemical Separation

- Melt UNF in an electrolytic salt in a crucible vs. dissolve in nitric acid in a tank
- Charge electrodes to capture elements of interest on electrodes or remain in electrolyte
- Potential significant reduction in liquid waste due to recycle of electrolyte
- Proof of Concept study through Lab Directed Research & Development (LDRD) project demonstrated laboratory bench scale feasibility
  - Several phases of scale up will require years



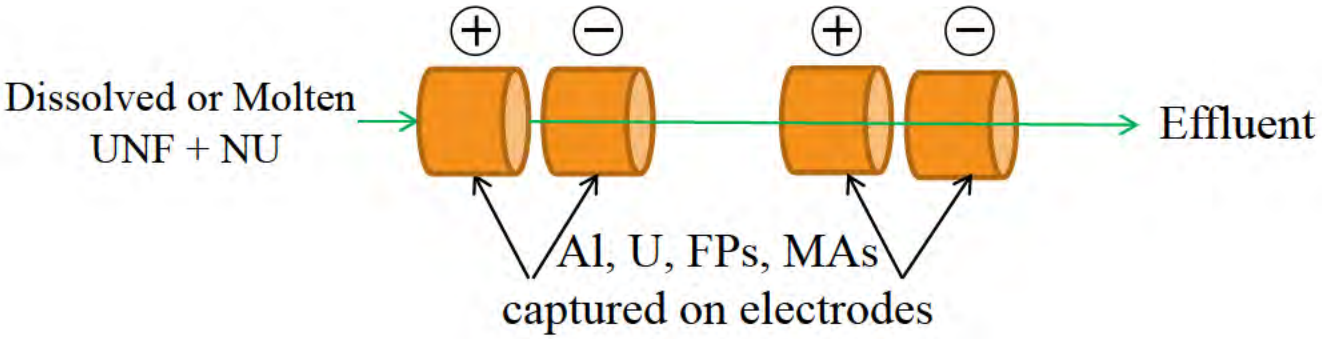
Electrodialysis Separation

- Dissolve UNF in nitric acid in a tank as done now
- Flow solution between membranes
- Capture elements of interest on charged membranes
- Rinse or package membranes depending upon desired end states
- Lab Directed Research & Development (LDRD) Proof of Concept project began last month



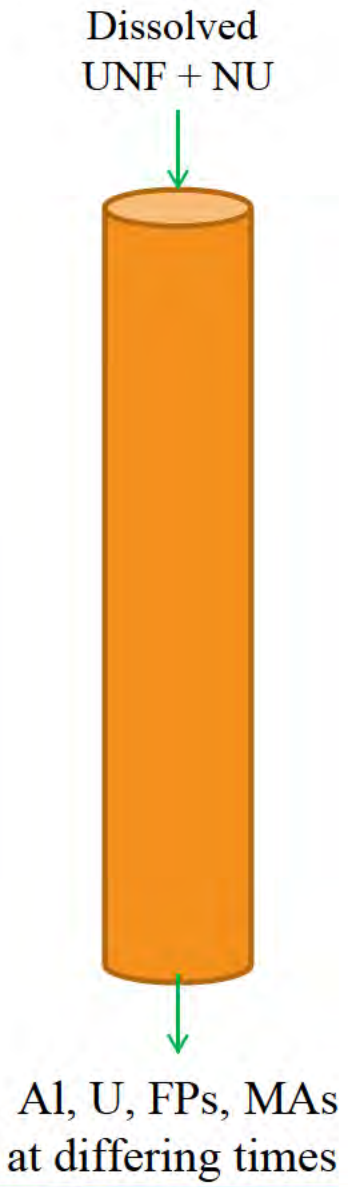
Selective Electrochemical Extraction

- Dissolve UNF in nitric acid in a tank or melt in an electrolyte in a crucible
- Choose voltages to capture elements of interest
- Rinse or package electrodes depending upon desired end states
- Lab Directed Research & Development (LDRD) Proof of Concept project began last month



Chromatographic Separation

- Dissolve UNF in nitric acid in a tank
- Flow solution through resin column
- Al, U, FPs, MAs have differing transit times through resin based upon affinity for the resin material
- Route elements for additional processing depending upon desired end states
- Lab Directed Research & Development (LDRD) Calculational Modeling project began last month



Summary

- The UNF at SRS is stored safely & securely
- The UNF and the L-Basin water are monitored routinely
- The UNF disposition through H-Canyon and the High Level Waste system is the most viable option given today's technology
- Savannah River National Laboratory is pursuing tomorrow's technology by beginning years of research and development