LANL Nuclear Criticality Safety Needs for Experimental Data

Jen Alwin, Riley Bulso, Alicia Salazar-Crockett, and Andrew Smiley

Presented by Bob Little
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Introduction to NCS at LANL

- Support a vast array of processes (storage, casting, machining, aqueous processes, oxidation, Pu-238, etc.)
- NCS uses some conservative modeling conventions to establish a level of consistency across Criticality Safety Evaluations
- Broad spectrum of processes makes it difficult to have existing benchmarks to use to cover the entre range of conditions and configurations
- Data from experiments could be useful to fill validation gaps or help support Upper Subcritical Limit (USL)

Summary of LANL NCS Issues

- Highest priorities:
  - Intermediate Pu
  - Ta reflection
  - Chlorine
- Other priorities:
  - Immersion Density Baths and Cleaning Solutions
  - KYNAR ®
  - Hand reflection
  - MOX
  - Heat Source Pu

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√ - being addressed by internal LANL projects and / or NCSP

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Immersion Density Baths and Cleaning Solutions

- Immersion Density Baths use hydrofluoroether (HFE) solutions mixed with Pu
  - Existing benchmarks use uranium, and so are not applicable for LANL's immersion density processes
- Analysis relies on comprehensive validation data for H and O
- Cleaning fluids are present throughout PF-4 but not well characterized, currently limited by volume to be bounded by water
  - Common cleaning fluids are Fantastik, machining oil, etc.

What is hydrofluoroether (HFE)

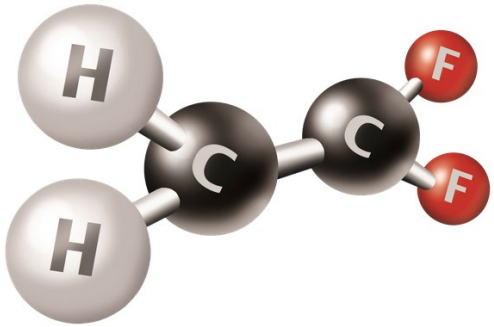
A hydrofluoroether (HFE) is a chemical compound characterized by a molecular structure containing a carbon chain with multiple fluorine atoms attached, along with an ether linkage (oxygen atom connecting two carbon chains), essentially a combination of hydrogen, fluorine, and oxygen atoms in an organic molecule, often represented as -CF2-O-alkyl in its chemical structure.

Key points about hydrofluoroether structure:

- **Functional group:**
The defining feature is the ether linkage (-O-) within a carbon chain containing fluorine atoms.
- **Fluorination:**
The carbon chain can have varying degrees of fluorination, impacting the properties of the HFE.
- Example of a common hydrofluoroether structure:
Perfluoropropyl methyl ether (HFE-7000): CF3-CF2-CF2-O-CH3

Kynar ®

- Kynar equipment in chloride solution processing areas
- Polyvinylidine fluoride polymers withstand acid environment



https://hpp.arkema.com/en/product-families/kynar-fluoropolymer-family/

What is Kynar ®

Kynar is a trade name for polyvinylidene fluoride (PVDF), a fluoropolymer resin coating and thermoplastic used in metal finishing

- PVDF is a type of polymer, specifically a fluoropolymer, and it stands for Polyvinylidene fluoride. It is a highly versatile material known for its exceptional chemical resistance, weatherability, and durability. PVDF is commonly used as a coating material and is available in various forms such as powders, liquids, and films.
- Kynar, on the other hand, is a trade name for a specific brand of PVDF resin manufactured by Arkema Inc. The Kynar brand is well-known in the industry and has become synonymous with PVDF due to its widespread use. Kynar PVDF is produced using a specific manufacturing process that results in high-quality PVDF resin with consistent properties.

Discussion

Mike suggests discussion to align NCSU, RPI, and LLNL regarding what TSL evaluation, sub-thermal neutron transmission, and PNDA measurements are needed and start scheduling them for Appendix B and the IE plan.

Caveat – I am unaware of any sensitivity calculations that have been performed with the TA-55 applications to show that the materials matter.