

NEAC Fuel Cycle Technologies Subcommittee Report

Presentation to the
Nuclear Energy Advisory Committee
Washington, D.C.
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Al Sattelberger

Fuel Cycle Technologies Subcommittee Members

- Carol Burns
- Margaret Chu
- Raymond Juzaitis
- Chris Kouts
- Sekazi Mtingwa
- Ron Omberg
- Joy Rempe
- Dominique Warin
- Al Sattelberger (Chair)



Fuel Cycle Technologies Subcommittee

- **One day meeting on April 6, 2016**
- **Highlights:**
 - **Advanced Reactor Program – HQ Perspective**
 - **3D-Printed Centrifugal Contactors**
 - **Advances in Separations Science**
 - **Deep Borehole Update**
 - **Used Fuel Disposition Program Update**
 - **Round Table Discussion on Transportation and Interim Storage**

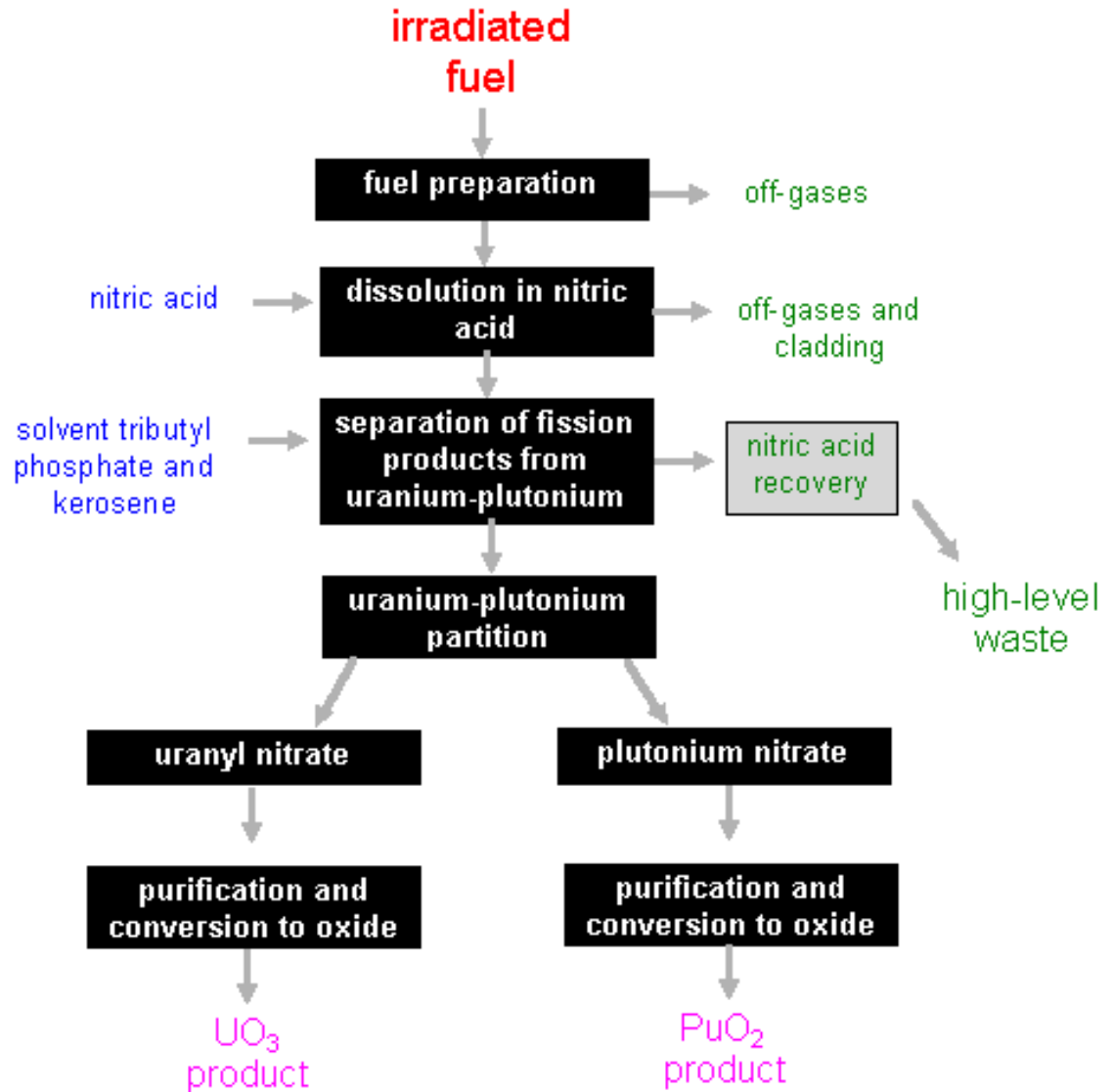
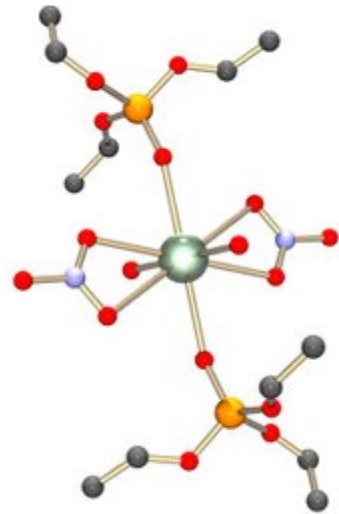


3D-Printed Centrifugal Contactors

- ANL has successfully applied 3DP techniques to the fabrication of centrifugal contactors, aimed at greater hold-up time per stage in order to accommodate solvent extraction processes with slow kinetics (ALSEP process)
- Initial experimental use with plastics has been successful, affording a potential for significant cost reduction compared with present-day fabrication methods
- The application of 3DP to stainless steel is still in the development stage - initial experiments have provided contactors with significant porosity, suggesting possible difficulties in decontamination and handling
- The Subcommittee recommends increasing funding for this effort

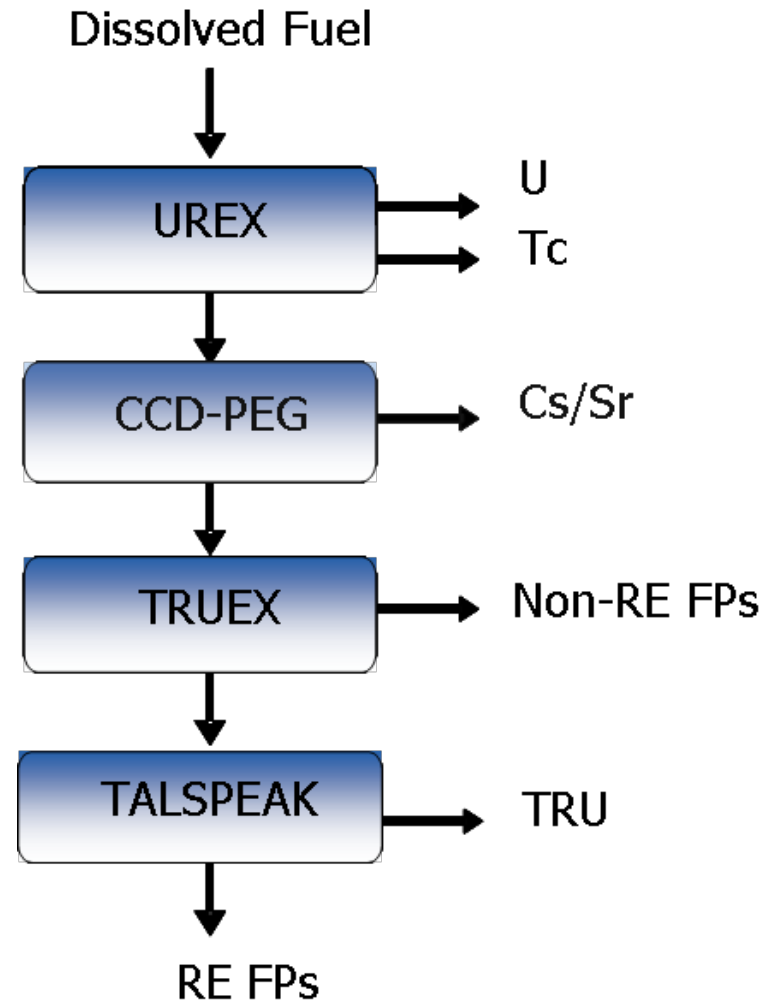


Separations - Purex Process



UREX+1a Spent Fuel Demonstration

- Current base line process for LWR treatment
- Process run with spent fuel dissolved in HNO_3/HF
- Flowsheets developed using the AMUSE code
- Equipment: ANL-design 2-cm contactor



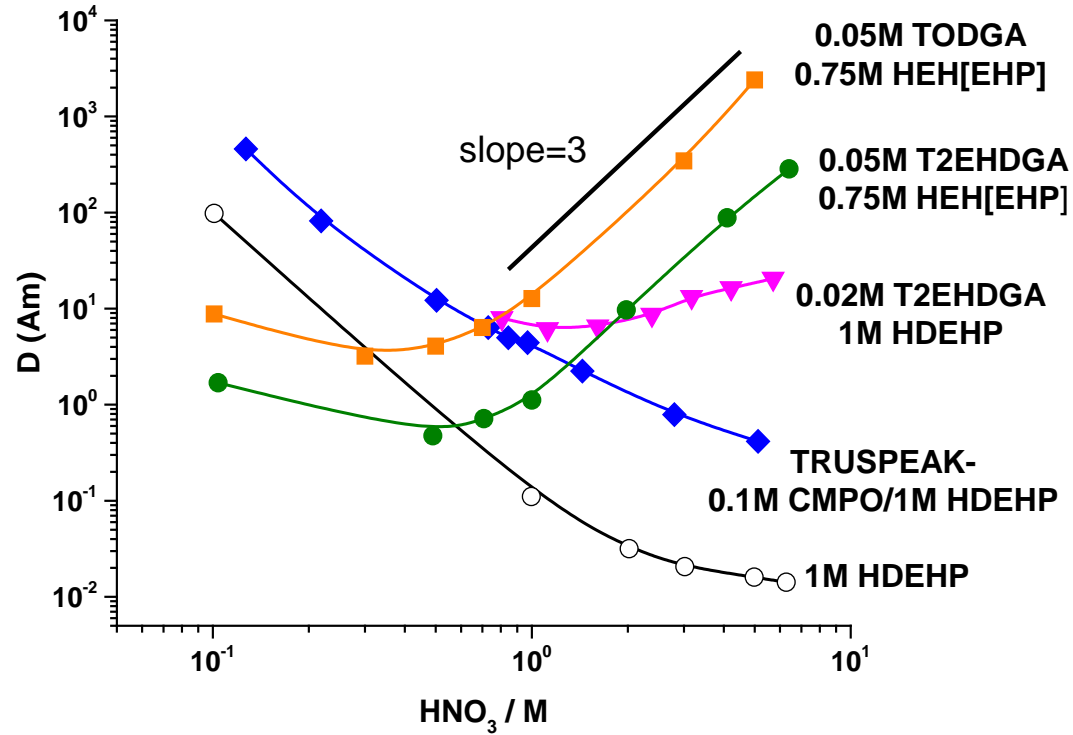
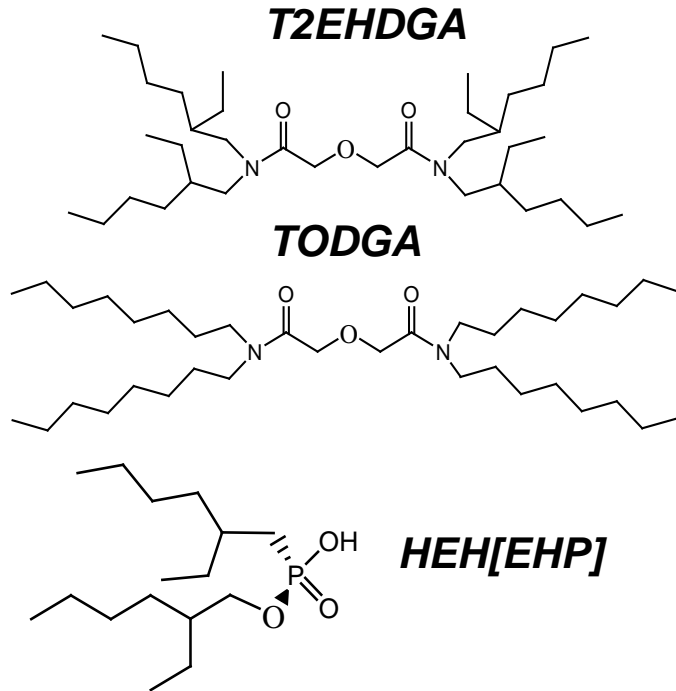
Progress in Actinide Separations

- Studies of co-extraction of americium(VI), as $[\text{AmO}_2]^{+2}$, with uranium and plutonium continues. Sodium bismuthate is the preferred chemical oxidant.
- Recent success with electrochemical oxidation of Am(III) to Am(VI) at the University of North Carolina suggest the need for further laboratory/university studies of this promising alternative.
- There have been encouraging results in the development of the Actinide-Lanthanide Separation (ALSEP) process for the recovery of minor actinides.
- There is a need for countercurrent testing of ALSEP with centrifugal contactors designed to provide greater hold-up per stage.





ALSEP concept: acidic extractant HEH[EHP] and neutral extractant T2EHDGA or TODGA



- **ALSEP shows outstanding Am recovery in a wide range of HNO_3 conc.**
- **The extractants show no sign of interaction with each other leading to a predictable, safe process conditions**

Progress in Noble Gas Recovery

- A computer-based screening process has been applied to the design of calcium-based, metal organic framework (MOF) molecules for use in the recovery and fractionation of the fission product noble gases, xenon and krypton.
- A limited number of MOF candidates were fabricated and tested.
- One specific structure (SBMOF-1) was found to have high xenon selectivity, good kinetics and, plus robust stability in cyclic adsorption/desorption tests.
- The projects demonstrated the power of modeling to narrow the number of molecular structures that are candidates for fabrication/experimental tests.



Progress in the CoDCon Project

- The Materials Recovery and Waste Form Development (MRWFD) campaign has begun an experimental evaluation of a co-decontamination (CoDCon) flowsheet to produce a specific U/Pu mixture both as a nitrate solution and MOX mixture.
- The flowsheet is currently being finalized, but will probably use uranium(IV) as a plutonium reductant applied to a PUREX process, with uranium back-extraction used for product ratio control.
- Critical control data will be supplied by on-line instrumentation.
- The Subcommittee recognized the value of the test program, but cautioned that its design should avoid negative impacts on other innovative MRWFD programs.
- Since the Subcommittee meeting, the CoDCon project has been modified with a phased approach and reduced programmatic effects.



Borehole Update

- DOE announced a solicitation, accepted applications, and awarded the project to Battelle
- Valuable lessons were learned during the initial siting effort in North Dakota
- Continue efforts to site the non-radioactive DBH project in a community that understands and accepts the limited, but important scope of the project.
- Continue to improve the research plan for this project, including steps that include independent review of the plan



Used Fuel Disposition Update

- **We heard about:**
 - **High Burnup Dry Cask Storage Research and Development Project (HDRP)**
 - **Experimental Determination and Modeling of Used Fuel Drying by Vacuum and Gas Circulation for Dry Cask Storage**
- **Prioritization efforts by the UFD program are important for focusing DOE research funding**
- **Prioritization results may change if the NRC issues interim staff guidance redefining “retrievability”**
- **Several high priority R&D needs are being addressed by university projects. We are pleased to see the UFD program maximize the benefits from these substantial DOE NEUP and IRP investments**



Roundtable Discussion on Transportation and Interim Storage

- Discussion focused on the storage and transportation aspects of the Administration's concept of an integrated waste management system
- It is likely the current policy environment will remain uncertain until a new Administration is in place, and potentially years longer, before a policy consensus is reached
- We recommend DOE be vigilant of possible policy shifts in the new Administration, but continue research and development activities, such as the design of long-lead time items, e.g., transportation railcars



**Thank you –
Questions**

