CINR Webinar

FC-1.1 – FC-1.6: Material Recovery and Waste Form Development

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U.S. DEPARTMENT OF ENERGY

Material Recovery and Waste Form Development (MRWFD)

The MRWFD campaign supports early-stage applied R&D on advanced fuel cycle technologies that have the potential to accelerate progress on managing and disposing of the nation's spent fuel, improve resource utilization and energy generation, reduce waste generation, and limit proliferation risk.

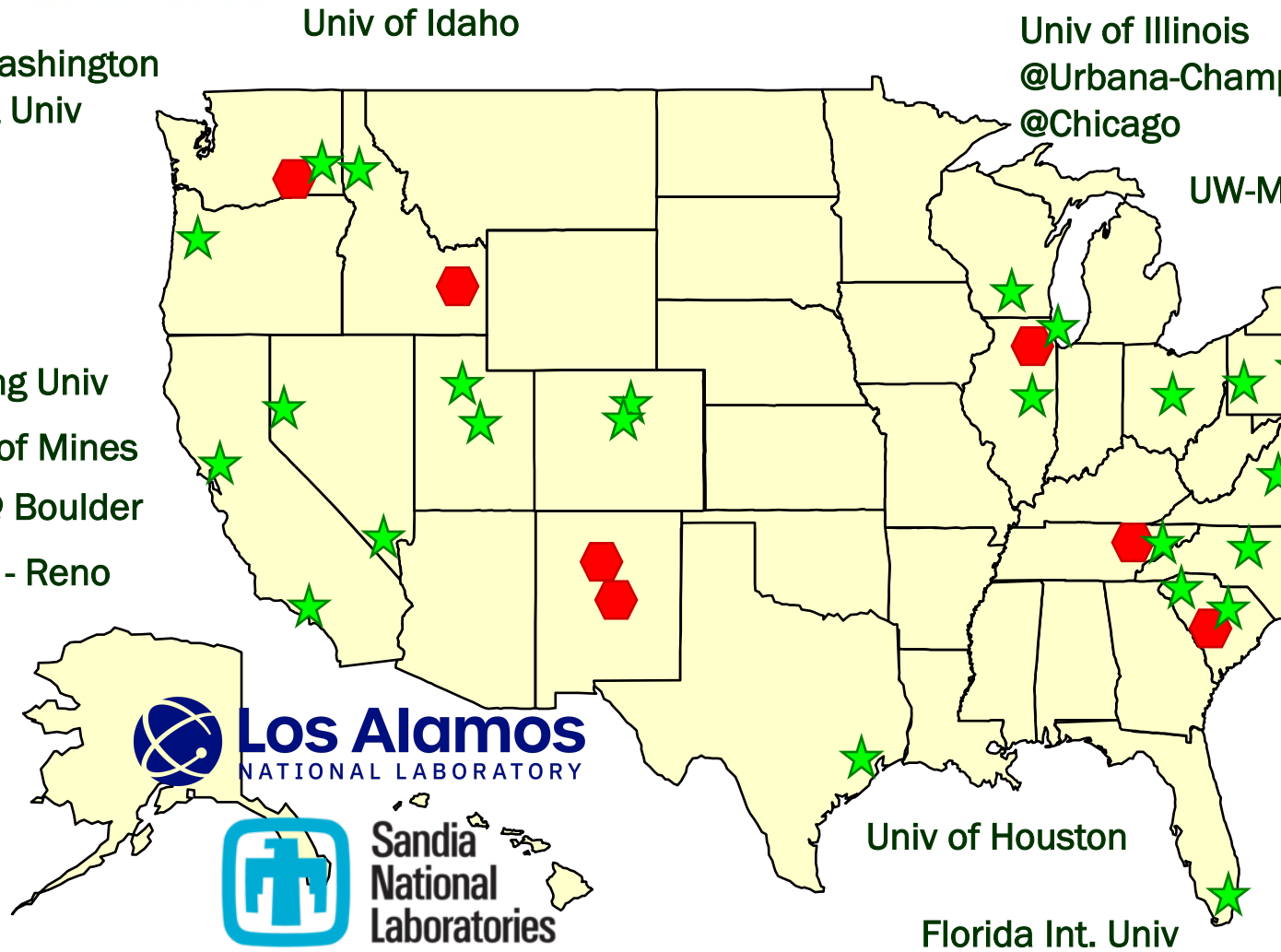
RD&D Approaches:

- Support aqueous and pyro/molten salt chemistries at DOE national labs and U.S. universities for civil nuclear energy applications;
- Evaluate and demonstrate the feasibility of recovery of high-assay low enriched uranium (HALEU) from federally-owned nuclear fuels; and
- Develop simplified advanced fuel recycling technologies targeting high-value used fuels.

MRWFD Major RD&D Thrust Areas

Aqueous Fuel Cycle Chemistry and Technology	Support R&D in chemical speciation, complexation, radiation, and process chemistry to predict and improve actinide separation efficiencies.
Molten Salt Chemistry & Processing	Support transformative salt chemistry R&D to enable tailoring and optimizing of salt properties and behaviors for salt technology applications.
Cross-Cutting for Aqueous & Salt Processing	Develop advanced waste forms & off-gas capture and immobilization technologies to enhance waste loading, durability, and cost reduction.
Joint Fuel Cycle Study	Jointly with South Korea to assess the technical feasibility of electro-chemical recycling technology for managing used LWR fuels.
Hybrid ZIRCEX RD&D	Evaluate the feasibility of HALEU production from high-value excess federally-owned nuclear fuels.
EBR-II Acceleration	Support the accelerated production of HALEU material to meet near-term advanced reactor HALEU fuel R&D needs.

NE-43 Investments at DOE National Labs and Universities



Pacific Northwest NATIONAL LABORATORY

INL Idaho National Laboratory

Argonne NATIONAL LABORATORY

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Material Recovery and Waste Form Development Program
FY 2022 Solicitation Topics Overview

PROGRAM SUPPORTING: FUEL CYCLE TECHNOLOGIES (FC)

ELIGIBLE TO LEAD: UNIVERSITIES ONLY

FC-1.1: INNOVATIVE GAS-PHASE SEPARATIONS CHEMISTRY FOR HIGH-VALUE USED FUELS

FC-1.2: NUCLEAR FUEL CYCLE AQUEOUS SEPARATIONS CHEMISTRY

FC-1.3: UNDERSTANDING, PREDICTING, AND OPTIMIZING THE PHYSICAL PROPERTIES, STRUCTURE, AND DYNAMICS OF MOLTEN SALTS

FC-1.4: UNDERSTANDING THE STRUCTURE AND SPECIATION OF MOLTEN SALTS AT THE ATOMIC AND MOLECULAR SCALE

FC-1.5: IRON PHOSPHATE PROCESS: EVALUATION OF PROCESSING PARAMETERS ON THE PRODUCT PROPERTIES (Kim Gray)

FC-1.6: OFF GAS CAPTURE: IDENTIFICATION OF PROMISING KR STORAGE MATERIALS (Kim Gray)

FC-1.1 INNOVATIVE GAS-PHASE SEPARATIONS CHEMISTRY FOR HIGH-VALUE USED FUELS

Up to 3 Years and $600,000

- Many advanced reactor technologies will use high-assay low-enriched uranium (HALEU) fuels which have significantly more enriched U-235 than conventional light water reactor (LWR) fuels.
- Used/spent fuel from these advanced reactors may still contain a large quantity of valuable enriched U-235 that can be recycled economically for LWR use.
- Applications are sought to develop and better understand innovative non-aqueous methods of recovering uranium and other valuable actinides from a variety of used HALEU nuclear fuels.
- Specially, advanced gas/vapor phase separation methods and technologies are encouraged.

  Halogenation – Advanced chlorination, hydrochlorination, sulfur chlorination digestion methods, novel fluoride volatility processing

  Advanced voloxidation technologies

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FC-1.2 NUCLEAR FUEL CYCLE AQUEOUS SEPARATIONS CHEMISTRY

Up to 3 Years and $600,000

- This solicitation topic focuses on developing and better understanding of advanced aqueous separation processes and technologies.
- Recovery of actinides and other valuable elements may provide additional economic benefits for recycling.
- Specifically seeking innovative approaches to better understand and enable simplified aqueous separation technologies. Examples include:
  - Novel organic ligand design and synthesis;
  - Metal-ligand complexation and coordination chemistry;
  - Radiolysis of complexant and adiation stability; and
  - Computational modeling of solvent extraction phenomena.

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FC-1.3 Understanding, Predicting, and Optimizing the Physical Properties, Structure, and Dynamics of Molten Salts

Up to 2 Years and $400,000

- Proposals are requested to better understand, predict, and optimize the physical properties and thermochemical behavior of molten salts. Thermodynamic models are needed to predict critical salt characteristics such as melting points, heat capacities, free energies for potential corrosion reactions, and solubilities of fission and corrosion products as a function of temperature and composition.
- Objective: To develop and use first-principles molecular dynamics simulations and computational electronic structure methods to model a broader range of chemical evolution and environments.
- Seeking innovative computational approach to:

  Apply molecular dynamics simulations to predict thermophysical and transport properties;

  Build multi-component models for prediction of phase diagrams; and

  Develop advanced models to guide experimental efforts to manipulate molten salt thermophysical properties

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FC-1.4 Understanding the Structure and Speciation of Molten Salt at the Atomic and Molecular Scale

Up to 3 Years and $600,000

- To understand the effects of structure and dynamics of molten salts on their physical and chemical properties, it is necessary to determine the speciation of salt components as well as the local and intermediate structures at operationally relevant temperatures.
- We are seeking proposals that use innovative tools and instrumentation to obtain information at the atomic and molecular scale.
- Goals are (1) to determine the local structure and bonding of chemical species in salt solutions, and (2) to develop innovative real-time analytical methods for micro- and macroscopic property measurements.
- Specifically seeking innovative experimental approaches to (1) determine salt molecular structure using scattering and spectroscopic methods, (2) develop novel electrochemistry and spectroscopy methods for in-situ monitoring and predictive modeling, and (3) develop a molten salt optical basicity scale to determine corrosivity and solubility of actinides.

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