DOE-ID NEPA CX DETERMINATION

CX Posting No.: DOE-ID-21-063

SECTION A. Project Title: Uranium recovery from used nuclear fuel using metal sulfides – Northwestern University

SECTION B. Project Description

Northwestern University proposes to recover uranium from spent fuel using a new class of materials with high selectivity in capturing uranium from complex mixtures in acidic solutions. Many advanced reactor technologies, including micro-reactors, require the use of high-assay low-enriched uranium (HALEU) fuels that are significantly more enriched (up to 19.75% U-235) than conventional light water reactor fuels (up to 5% U-235). This project is aimed at the achieved recovery of over 99% of uranium from the highly acidic solutions used for dissolution of used nuclear fuel (UNF) and proposes a potentially superior complement to solvent extraction, the go-to process for separating uranium from UNF. It involves the modality of ion exchange employing low-cost metal-sulfide materials tailored to capture the uranyl ion selectively and quantitatively while at the same time being regenerable and usable multiple times. The specific fundamental research objectives of the proposed project are: 1) Study the ion-exchange properties of layered metal sulfides for uranyl ions in very concentrated acidic aqueous solutions relevant to HALEU; 2) Investigate three different types of metal sulfides each with different structural characteristics that can modulate the selectivity and capacity for the uranyl ions under HALEU-relevant conditions. Each type presents a unique intracrystalline environment that can be investigated for its specific interactions with the cations of interest; 3) Develop a conceptual framework of trends in extractive selectivity by studying related derivatives of materials from each class; and 4) Study complexation modes in the solid phase with single crystals of suitable model systems. This project will evaluate the wide range of metal sulfide chemistries for selective uranium capture efficiency and develop a cost-effective sorbent with high capacity and recyclability. The project will also assess the long-term stability, molecular level mechanism or uranium capture and release, and develop high performance forms to suit the HALEU application.

SECTION C. Environmental Aspects / Potential Sources of Impact

The university leading the task has all the facilities necessary to carry out the design, synthesis, and characterization of all the proposed precursors and layered metal sulfides in this project. The university has procedures in place to handle any waste that will be generated through this project. The action would not create additional environmental impacts above those already occurring at the university. This project also draws expertise from Argonne National Laboratory (ANL), which has purpose-built hot laboratories with the infrastructure and personnel needed to conduct experiments on samples containing radionuclides. This DOE facility has all the approved infrastructure and procedures in place for the safe use, storage, and disposal of chemical and radioactive materials and waste.

SECTION D. Determine the Level of Environmental Review (or Documentation) and Reference(s): Identify the applicable categorical exclusion from 10 CFR 1021, Appendix B, give the appropriate justification, and the approval date.

Note: For Categorical Exclusions (CXs) the proposed action must not: 1) threaten a violation of applicable statutory, regulatory, or permit requirements for environmental, safety, and health, including requirements of DOE orders; 2) require siting and construction or major expansion of waste storage, disposal, recovery, or treatment facilities; 3) disturb hazardous substances, pollutants, contaminants, or CERCLA-excluded petroleum and natural gas products that pre-exist in the environment such that there would be uncontrolled or unpermitted releases; 4) adversely affect environmentally sensitive resources. In addition, no extraordinary circumstances related to the proposal exist which would affect the significance of the action, and the action is not "connected" nor "related" (40 CFR 1508.25(a)(1) and (2), respectively) to other actions with potentially or cumulatively significant impacts.

References: B3.6 Siting, construction, modification, operation, and decommissioning of facilities for small-scale research and development projects; conventional laboratory operations (such as preparation of chemical standards and sample analysis); and small-scale pilot projects (generally less than 2 years) frequently conducted to verify a concept before demonstration actions, provided that construction or modification would be within or contiguous to a previously disturbed or developed area (where active utilities and currently used roads are readily accessible). For purposes of this category, "demonstration actions" means actions that are undertaken at a scale to show whether a technology would be viable on a larger scale and suitable for commercial deployment. Demonstration actions frequently follow research and development and pilot projects that are directed at establishing proof of concept.

Justification: The activity consists of an investigation to develop a simple method of rapid uranium recovery with high capacity from HALEU used nuclear fuels.

Is the project funded by the American Recovery and Reinvestment Act of 2009 (Recovery Act) ☐ Yes ☒ No

Approved by Jason Anderson, DOE-ID NEPA Compliance Officer, on 09/02/2021.