

**SECTION A. Project Title: Effects of Alpha and Gamma Radiation on Complex and Metal Loaded Solvents for Advanced Solvent Extraction Processes – University of California, Irvine****SECTION B. Project Description**

The University of California, Irvine proposes to investigate the alpha and gamma radiolysis-induced chemical degradation of ligands used for the removal of minor actinides from used nuclear fuel in advanced extraction systems such as ALSEP. The project will quantitatively elucidate the organic phase degradation, particularly complex solvents containing multiple ligands as well as organic solvents loaded with significant levels of metal ions. The project will identify the major degradation pathways, which is necessary to improve the predictive capabilities of chemical effects in these current processes. This will involve obtaining, in pure form, identified major degradation products from these reactions to test their effect on the extraction systems and to gain additional insight on the effect of radiation on advanced solvent extraction processes. The project would address the most important challenges existing in aqueous separations processes currently under development for used fuel treatment. The efforts will provide a quantitative understanding of the effect of radiation on the organic phase, particularly the less-studied heavy ion (alpha) radiolysis, and its role in the reactions and species that directly affect metal ion distribution ratios and that govern the formation of third phases in these systems. The project will utilize a number of different tools available for performing high LET radiation damage, including a TRIGA® reactor and two different ion-beam irradiators with varying dose rates and total dose.

**SECTION C. Environmental Aspects / Potential Sources of Impact**

**Radioactive Material Use** – The proposed work requires using trace amounts of radioactive material for metal ion distribution studies. The quantities for each experiment will be in the order of nano-Curies ( $10^{-9}$  Ci). The material will be handled in the lab of the PI which is under a radiation user authorization administered by the radiation safety office of UC Irvine. The University of California has a broad radiation user license under the State of California Department of Health. In addition, samples will be irradiated in the UC Irvine TRIGA reactor and certain activation radioactive activation products will be generated and the samples will be considered radioactive. The UC Irvine TRIGA reactor facility is also operating under the administration of the radiation safety office. In addition the UCI TRIGA reactor facility has a separate NRC license.

**Radioactive Material Generation** – The samples from irradiation and extraction studies and perishables used will be disposed of according to guidelines provided by the UC Irvine Radiation Safety Office. The representative from RSO will schedule waste pickup for any radioactive waste generated during this project.

**Mixed Waste Generation** – Mixed waste will be generated during the irradiation and solvent extraction experiments as non-aqueous solutions will be used. Mixed waste will be disposed of according to the guidelines of UC Irvine Environmental Health and Safety (EH&S) and waste pickup will be scheduled with EH&S representatives.

**Chemical Use/Storage** – Chemicals will be used to prepare solutions that are used for liquid-liquid extraction experiments and these solvents will be stored in the lab in appropriate cabinets. Fume hoods are available for use of potentially volatile chemicals.

**Chemical Waste Disposal** – Chemical waste will be generated during solvent extraction experiments as well as during the irradiation and analytical studies. Chemical waste will be disposed of according to the guidelines of UC Irvine Environmental Health and Safety (EH&S) and waste pickup will be scheduled with EH&S representatives.

**Hazardous Waste Generation** – Hazardous waste may be generated during solvent extraction experiments. Hazardous waste will be disposed of according to the guidelines of UC Irvine Environmental Health and Safety (EH&S) and waste pickup will be scheduled with EH&S representatives.

**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

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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). Not included in this category are demonstration actions, meaning actions that are undertaken at a scale to show whether a technology would be viable on a larger scale and suitable for commercial development.

B3.10 Siting, construction, modification, operation, and decommissioning of particle accelerators, including electron beam accelerators, with primary beam energy less than approximately 100 million electron volts (MeV) and average beam power less than approximately 250 kilowatts (kW), and associated beamlines, storage rings, colliders, and detectors, for research and medical purposes (such as proton therapy), and isotope production, within or contiguous to a previously disturbed or developed area (where active utilities and currently used roads are readily accessible), or internal modification of any accelerator facility regardless of energy, that does not increase primary beam energy or current. In cases where the beam energy exceeds 100MeV, the average beam power must be less than 250 kW, so as not to exceed an average current of 2.5 milliamperes (mA).

Justification: The activity consists of university-scale research aimed at investigating the alpha and gamma radiolysis-induced chemical degradation of ligands used for the removal of minor actinides from used nuclear fuel in advanced extraction systems.

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

Approved by Jason Sturm, DOE-ID NEPA Compliance Officer on 06/29/2017