DOE-ID NEPA CX DETERMINATION

CX Posting No.: DOE-ID-21-055

SECTION A. Project Title: New advances in engineered backfill materials: phosphates as a potentially important add-on to the existing bentonite concept – Mississippi State University

SECTION B. Project Description

Mississippi State University (MSU) proposes to evaluate the efficiency of phosphate minerals (phosphates) in removing radionuclides (iodine and uranium) from aqueous solutions. Such efficiency will be evaluated by conducting crystallization experiments and characterizing the experimental products with advanced mass spectrometry, electron diffraction, X-ray spectroscopy, and high-resolution microscopy techniques. Experiments will be carried out at a range of conditions similar to the states of the environment, corresponding to both the past and the potential disasters of a water breakthrough through engineering barrier systems (EBS) in nuclear facilities. Expected results will be highly relevant towards evaluating these phosphates as novel backfill materials to improve the efficacy of existing EBS at water saturated conditions. Obtained results will be combined with the results from an NE R&D project ongoing at Los Alamos National Laboratory (LANL) (on reactivity of phosphates with bentonite at high T°C) to assess the performance of EBS materials during nuclear waste storage as a path forward study. The proposed research is aimed at improving the performance of EBS via the addition of phosphate minerals, expanding the EBS potential to entrap different radionuclides. The results of the project will provide a foundation necessary for safety enhancement of long-term nuclear waste storage and will provide information on the immobilization of radionuclides near and at the distance from SNF in case of catastrophic water breach through EBS. Expected results will provide quantitative information for the first time on the interaction of SNF with hydrothermal solutions at different redox conditions and T°C, elevated from radioactive decay, as an immediate consequence of the ground waters break through EBS. The obtained data will provide the basis for a more timely remote perspective on studying immobilization of other radiotoxic elements (e.g., Tc, Pu), as well as testing the natural accessible phosphate materials, e.g., phosphorite deposits, where apatite is up to 80%. In addition, this proposed research will improve the current knowledge of the following mineralogical and geochemical aspects critical to environmental remediation: 1) The mechanisms of *I* and *U* incorporation into minerals and quantitative constants permitting to evaluate this process under a range of relevant conditions; 2) The role of *I* and *U* incorporation in formation of associated minerals; and 3) The effect of T°C on the uptake of *I* and *U*.

SECTION C. Environmental Aspects / Potential Sources of Impact

The experiments proposed in the project suggest use of acidic solutions of depleted uranium with concentrations of one thousand parts per million or lower and standard reagents, such as nitric acid, hydrochloric acid, etc. Use and disposal of these reagents comply with regulations at Mississippi State University. Facilities suggested for use are certified by Mississippi State University, disposal of radioactive and chemical waste will be performed in accordance with the procedure of disposal at Mississippi State University.

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 determine the optimal composition of apatite (i.e., proportions of F^-, OH^-, and Cl^-) with respect to effective immobilization and storage of *I* and *U*.

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 08/31/2021.