

SECTION A. Project Title: Development of Full Understanding of Mechanical-Chemical Coupling in Bentonite THMC Processes – Virginia Polytechnic Institute and State University**SECTION B. Project Description**

Virginia Polytechnic Institute and State University proposes to develop both experimental and modeling capabilities for a full understanding of mechanical-chemical (MC) coupling in an engineered barrier and to provide needed constitutive relationships and supporting data for modeling a long-term thermal-hydrological-mechanical-chemical (THMC) evolution in an engineered barrier system (e.g., potential emergence of buffer material heterogeneity through the MC coupling). Specific research objectives are: 1) Develop advanced equipment and an improved clay dehydration model to enhance the accuracy of pore water chemistry characterization in bentonite clay under the influence of MC coupling; 2) Use well-controlled column experiments and a pressure-dissolution model to evaluate the possibility of pressure solution-induced continuum-scale heterogeneity in buffer materials; and 3) Develop advanced deep learning models, based on the convolutional neural network (CNN) and generative adversarial network (GAN), to obtain constitutive relationships among stress state, pore structure, and hydrological transport properties for a long-term performance assessment of an engineered barrier system through fully coupled THMC simulations.

SECTION C. Environmental Aspects / Potential Sources of Impact

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.

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 advanced equipment and an improved clay dehydration model to enhance the accuracy of pore water chemistry characterization in bentonite clay under mechanical-chemical (MC) coupling as well as an enhanced understanding of thermal-hydrological-mechanical-chemical (THMC) processes.

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 09/21/2021.