DOE-ID NEPA CX DETERMINATION

CX Posting No.: DOE-ID-18-061

SECTION A. **Project Title: Mechanistic Understanding of Radiolytically Assisted Hydrothermal Corrosion of SiC in LWR Coolant Environments – University of Michigan**

SECTION B. **Project Description**

The University of Michigan, in collaboration with the University of Wisconsin, Oak Ridge National Laboratory (ORNL), and Westinghouse Electric Company, LLC, proposes to develop a mechanistic understanding of the hydrothermal corrosion behavior of monolithic silicon carbide (SiC) and SiC/SiC composites in light water reactor (LWR) environments under the influence of water radiolysis products and radiation damage. Specifically, long-term post-irradiation exposures on neutron and ion irradiated samples will be conducted in the LWR temperature regime to evaluate the effect of damage on corrosion kinetics. The effects of water chemistry and radiolysis products on hydrothermal corrosion will be evaluated via *in-situ* irradiation-corrosion experiments. Extensive post-test characterization will be performed to determine the dissolution rate of the samples, surface morphology, surface chemical composition and depth profile of SiC from the surface, etc.

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

Radioactive Material Use – A set of SiC samples has been neutron irradiated in an inert atmosphere at 300°C for 66 days in a test reactor with a total neutron fluence of 4.8E22 n/cm62 (0.48 dpa), E>0.1MeV. The University of Michigan will conduct corrosion tests on these neutron irradiated samples, along with ion irradiated samples (~0.48 dpa), in an autoclave at 300°C in pressurized water reactor (PWR) water chemistry for 3000h. The neutron irradiated samples have a gamma radiation level of ~25mR/hr measured on contact, and a beta radiation level of 1500 mR/hr on contact.

Radioactive Waste Generation – Little radioactive waste generation is expected. Most radioactive waste isotopes generated during neutron irradiation is Silicone-32. During hydrothermal corrosion, SiC will likely dissolve but at a very slow rate. Most of the dissolved Silicone-32 will be captured by the ion filter. Although SiC dissolution was expected during autoclave exposure, there will be insignificant contamination of the autoclave and water loop from the dissolved SiC sample. The autoclave interior will be checked for contamination after exposure. All of the contaminants (Si-32, P-32, and S-32) that are soluble will be filtered out using ion filters. The contaminated filter will be disposed as dry active waste by Radiation Safety Service under University of Michigan license.

Radioactive Material Handling Procedures – Transportation of the neutron irradiated samples will be using a lead container with A1 liner, and handling and loading of the sample at the University of Michigan will be carried out in a hot cell using a mechanical manipulator. No machining is required for neutron irradiated samples at both institutions, including the University of Michigan and ORNL. Post-exposure samples will be returned to ORNL to be characterized and analyzed.

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). 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 activities aimed at predicting the long-term corrosion behavior of SiC.

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 08/16/2018