

DOE-ID NEPA CX DETERMINATION

SECTION A. Project Title: C-SiOC-SiC Coated Particle Fuels for Advanced Nuclear Reactors – Virginia Polytechnic Institute and State University

SECTION B. Project Description

Virginia Tech, in collaboration with the University of Michigan, proposes to study an entirely new concept for nuclear fuel encapsulation using an amorphous silicon oxycarbide (SiOC) plus carbon system as the inner coating and nanocrystalline silicon carbide (SiC) plus minor carbon as the outer coating for nuclear fuel kernel particles. The objectives are to provide novel C-SiOC-SiC nuclear fuel encapsulants, improve fuel damage tolerance, understand fuel self-stabilizing behavior under irradiation, and predict this new material system behaviors for nuclear fuel advancement. The C:SiOC:SiC ratios will be systematically tuned based on the fuel performance needs. These new materials will be exposed to self-ionization irradiation at different doses and high temperatures to understand their damage tolerance and fission product confinement ability.

SECTION C. Environmental Aspects / Potential Sources of Impact

Chemical Use/Storage, Chemical Waste Disposal, and Hazardous Waste Generation – Commercially available polymer precursors and solvents are needed for the proposed C-SiOC-SiC nuclear fuel coatings. During the course of the research, different chemical wastes can be generated from these precursors and solvents. Some of the wastes might be acidic or basic and need to be properly disposed.

Water/Well Use and Discharge of Wastewater – For the proposed research, distilled water and regular tap water supplies for chemical reactions, experimental container cleaning, and lab maintenance will be needed. The distilled water will be made from the lab using tap water. The tap water is through the existing water supply from Virginia Tech.

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 providing novel C-SiOC-SiC nuclear fuel encapsulants and understanding fuel self-stabilizing behavior under irradiation.

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 08/14/2018