# DOE-ID NEPA CX DETERMINATION



CX Posting No.: DOE-ID-21-107

**SECTION A. Project Title: Post-DNB Thermo-mechanical Behavior of Near-term ATF Designs in Simulated Transient Conditions – University of Wisconsin**

**SECTION B. Project Description**

The University of Wisconsin proposes to conduct coupled experimental and modeling investigations of thermo-mechanical performance of coated zirconium alloy (Zr-alloy) claddings with simulated burnup fuels to predict complex transient phenomena of near-term Accident Tolerant Fuel (ATF) designs during thermal transient conditions. One particular focus will be evaluation of time-dependent thermal boundary conditions at the interface between the coated Zr-alloy claddings and the surrounding coolant. Conventional Zr-alloy cladding tubes with thin coatings such as cold spray (CS) chromium (Cr) coating, physical vapor deposition (PVD) Cr coating, and GE-GNF's ARMORTM coating will be exposed to high temperature steam and subsequently subjected to water quenching to simulate LOCA (loss of coolant accident) scenarios. Fuel fragmentation, relocation and dispersal (FFRD) and oxidation-induced embrittlement of cladding will also be investigated using the coated claddings with prefabricated rupture and filled with fragmented surrogate fuel pellets with and without addition of oxide dopants. The surrogate fuel pellets will be prepared with different thermal properties and fragment sizes to simulate the effects of high burnups. Mechanical tests and material characterization to evaluate potential degradation mechanisms of the ATF designs under thermal transients will be performed throughout the project. The experimental data obtained will be compared with results calculated from the BISON fuel performance code and LWR transient analysis codes such as TRACE and RELAP5-3D to check the uncertainty of semi-empirical or empirical correlations used in their heat transfer packages. Finally, thermo-mechanical energetics of solid fragmented doped fuel or molten fuel/coated cladding injected into coolant will be predicted using TEXAS fuel-coolant interaction code. The objectives of the proposed research are: 1) Fabrication and Procurement of Coated Claddings and Surrogate Fuels; 2) Experimental Evaluation of Thermal Interactions of Cladding-to-Coolant and Fuel-to-Coolant under Transient Conditions; 3) Material Characterization and Mechanical Tests of Pre- and Post-test Samples; 4) Expand the applicability of Fuel Performance Code, BISON, and Reactor Safety Codes, TRACE and RELAP5-3D to ATF Designs; and 5) Prediction of Interactions between ATF Fuel Fragments and Coolant using TEXAS Code.

**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 of the thermal-mechanical response of coated Zr-alloy cladding tubes and surrogate doped fuel under simulated transient conditions by experimental approaches such as direct water quenching, mechanical tests, and microstructural characterization.

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 09/17/2021.