DOE-ID NEPA CX DETERMINATION

CX Posting No.: DOE-ID-20-058

SECTION A. Project Title: Corrosion Sensitivity of Stainless Steels in Pressurized Water Reactor Water Chemistry: Can KOH replace LiOH in PWRs?

SECTION B. Project Description

North Carolina State University proposes to determine if switching from lithium hydroxide (LiOH) to potassium hydroxide (KOH) to control the pH in nuclear reactors is possible without worsening the corrosion behavior of the structural alloys used in pressurized water reactor (PWR) core internal components. A series of corrosion and stress corrosion tests will be done on unirradiated alloys, including stainless steels and nickel-based alloys. The effect of KOH vs LiOH will be evaluated as a function of alloy composition to establish if higher or lower alloyed materials exhibit different alkali susceptibility dependencies. The tests will be followed by post corrosion characterization with different techniques depending on the test: weight change measurements will be performed as well as characterization and chemical mapping to describe oxide layers chemistry and microstructure. These will be further complemented by select atom probe tomography measurements of the passive film composition, including quantification of the alkali species that are difficult to detect by electron beam techniques. The effects of irradiated microstructures will be studied via proton irradiation, followed by testing in KOH and LiOH environments (including under stress). The effect of radiolysis will be investigated with the use of in-situ high intensity gamma sources through a sapphire window of the autoclaves. These results will be compared with previously tested, neutron irradiated samples.

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 permitted 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). 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.

Justification: The activity consists of university-scale research activities to determine if switching from LiOH to KOH to control the pH in nuclear reactors is possible without worsening the corrosion behavior of the structural alloys used in pressurized water reactor core internal components

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 8/31/2020