DOE-ID NEPA CX DETERMINATION

CX Posting No.: DOE-ID-21-069

SECTION A. Project Title: Effect of neutron irradiation on friction stir welded Ni-based ODS MA754 alloy – Pacific Northwest National Laboratory

SECTION B. Project Description

Pacific Northwest National Laboratory (PNNL) proposes to perform research in three critical areas: 1) neutron irradiation behavior of Ni-based oxide dispersion strengthened (ODS) alloy; 2) potential of friction stir welding (FSW) for nuclear applications; and 3) compare the neutron irradiation performance of ODS (advanced structural materials) and FSW (innovative manufacturing) concepts, using samples irradiated under similar conditions. In order to consider Ni-based ODS alloys and FSW technique for nuclear applications, it is important to understand the microstructural evolution and concomitant changes in mechanical properties of parent and friction stir welded MA754 after neutron irradiation. Hence, the goal of the proposed work is to perform PIE on previous neutron irradiated samples (MA754 parent and friction stir welded). Experimental techniques such as focused ion beam (FIB), transmission electron microscopy (TEM), atom probe tomography (APT), Vickers microhardness and shear punch testing would be employed to characterize the effect of neutron irradiation (1 and 2.5 dpa) on parent and friction stir welded Ni-based ODS MA754 in order to understand the general trend of microstructural evolution and resulting radiation-hardening, and to develop appropriate processing-structure-property-dose correlations. The proposed work could open up new opportunities for Ni-based ODS alloys as reactor structural materials, and FSW could be developed as an 'enabling innovative manufacturing technology' for nuclear applications. The proposed study thus meets the mission of DOE-NE in the development of relatively more radiation resistant materials and innovative manufacturing techniques especially for the next generation nuclear reactors with design goals of more severe service conditions along with longer life cycles.

SECTION C. Environmental Aspects / Potential Sources of Impact

Radioactive material handling (16 irradiated specimens) and testing will be performed as per the standard PNNL operating procedures. Standard metallographic procedures would be employed for sample preparation. Silicon carbide (SIC) grinding papers, diamond suspensions, water, terry towel, gloves and polishing cloths would be used for sample preparation and disposed as per standard PNNL chemical and radioactive waste disposal procedures. Acetone and ethanol would be employed for cleaning specimens and disposed using standard PNNL waste disposal procedures. Atom Probe needle-tips of neutron irradiated samples will be pre-prepared at PNNL and then transferred to the Microscopy and Characterization Suite (MaCS) of the Center for Advanced Energy Studies (CAES) at Idaho National Laboratory (INL) for final milling and APT experiments. The length of each needle tip is about 2 - 3 um and the diameter of tip apex is about 50 nm. The APT experiment is destructive, remaining partial tips after the experiment will be sent to waste. Idaho State University EHS and CAES will handle the use or disposal.

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 characterize the effect of neutron irradiation on the microstructure and mechanical properties of ODS MA754 parent samples and compare it with the corresponding characteristics of friction stir welded (FSW) material.

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 09/20/2021.