DOE-ID NEPA CX DETERMINATION

CX Posting No.: DOE-ID-19-014

SECTION A. Project Title: Simultaneous Corrosion/Irradiation Testing in Lead and Lead-Bismuth Eutectic – Massachusetts Institute of Technology

SECTION B. Project Description

The Massachusetts Institute of Technology proposes to study the corrosion effects of radiation on candidate materials for Lead Fast Reactors (LFBs) and Lead-Bismuth Eutectic Fast Reactors (LBEFRs). The tasks associated with this project are (1) Prepare or modify facilities for long-term lead-bismuth euetectic (LBE) corrosion effects and fabricate testing samples; (2) Conduct simultaneous corrosion/ion irradiation experiments of candidate alloy materials at 650 ºC to quantify the potential radiation slow-down in corrosion; (3) Perform long-term (up to 500 hours) validation corrosion tests in static LBE to confirm performance of the unirradiated region; (4) Analyze corrosion penetration depth, microstructural evolution and mechanisms of LBE corrosion in candidate materials with and without irradiation; and (5) Test the mechanical performance of unirradiated and irradiated specimens using dynamic mechanical analysis and *in situ* transmission electron microscopy pillar compression and foil deformation.

SECTION C. Environmental Aspects / Potential Sources of Impact

Radioactive Waste Generation – MIT will be irradiating steels and liquid lead with 3-MeV protons, which generate gamma rays and neutrons. MIT has enough shielding present to reduce ambient levels of both gammas and neutrons in the test rooms to below 1 mR/hr, as measured by HPGe detectors (gamma rays) and BF3 gas detectors (neutrons). Both are interlocked with the proton accelerator, so an increase in radiation levels beyond2 mR/hr (the safe limit) automatically shuts of the accelerator, ending the experiment and cutting dose rates to zero. Very small amounts of residual activation are present in the samples, but past experience shows that the levels fall to publicly-releasable levls (below 2 mR/hr on contact) after one to four days of sitting around. MIT typically allows the samples to sit for one week to make sure. MIT's Environmental Health & Safety (EHS) department is responsible for clearing these materials for analysis on public equipment, and their eventual release and disposal.

Chemical Use/Storage, Chemical Waste Disposal, and Hazardous Waste generation – MIT will be exposing stainless steels and other alloys to liquid lead and lead-bismuth eutectic. All experiments are conducted in concert with the EHS Department at MIT, who helps to write and certify all standard operating procedures (SOPs), oversees the first few trial experiments, and collects and disposes of all hazardous waste, whether chemical, radioactive, sharps, or all of the above.

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 evaluating metal alloy response to radiation and corrosive chemical exposure.

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 07/25/2019