

SECTION A. Project Title: Determining the Effects of Neutron Irradiation in the Structural Integrity of Additively Manufactured Heat Exchangers for Very Small Modular Reactor Applications – Auburn University**SECTION B. Project Description**

Auburn University (AU), in collaboration with the University of Missouri (MU), proposes to study the effects of neutron irradiation and extreme environment conditions on the structural integrity of parts additively manufactured (AM) via the laser-power bed fusion (L-PBF) method. This project will focus on AM materials most suitable for heat exchangers (HeXs) operating within extreme environments within very small modular reactors (vSMRs). The project will use existing L-PBF equipment at both universities to fabricate specimens. Testing of unirradiated samples will take place at AU, while samples at MU will undergo neutron irradiation/dosing and subsequent testing at the University of Missouri Research Reactor (MURR).

SECTION C. Environmental Aspects / Potential Sources of Impact

Radioactive Material Use – Irradiated Inconel samples will be characterized. On the order of 20 small samples will be irradiated in the MURR facility with activation on the order of 1 Ci each after irradiation. The facility has handled such material previously and this activity is covered by an existing NRC license. The facility typically handles irradiated materials with significantly higher activation and volume. MURR has dedicated Health Physics and Shipping departments with policies and procedures in place to handle this material, and the University of Missouri's Environmental health and Safety office oversees these operations from the University perspective.

Radioactive Waste Generation – On the order of 20 small Inconel samples will be irradiated in the MURR facility with activation on the order of 1 Ci each after irradiation. The facility has handled such material previously and this activity is covered by an existing NRC license. The facility typically disposes of irradiated materials with significantly higher activation and volume and regularly ships radioactive waste complying with all relevant NRC and DOT regulations and oversight. MURR has dedicated Health Physics and Shipping departments with policies and procedures in place to handle this material, and the University of Missouri's Environmental health and Safety office oversees these operations from the University perspective.

Chemical Use/Storage – Any chemicals used for preparing metal, additive-manufactured specimens for microscopy or other characterization routines will be safely used and stored. Etchants are stored in safety cabinets in fume hoods. Students are trained and supervised by the Materials Engineering technician who is responsible for safe storage, handling and disposal of etchants per Auburn University Chemical Safety Policy.

Chemical Waste Disposal – Auburn University has used several etchants for various alloys. For this work, Waterless Kalling's Reagent will be used. All used chemicals will be disposed of following procedures set up by Auburn University's Environmental Health and Safety Division's Waste Management Program.

Hazardous Waste Generation – Nickel-based superalloy powder metal will be laser-power bed fused using a Concept laser system. Any non-melted powder will be recycled for later printing. After approximately seven reuse cycles, the metal powder may be disposed of using Auburn University's Environmental Health and Safety Division's Waste Management Program. All technicians and students working with the Concept Laser system and/or handling the unused powder will be wearing a respirator mask, gloves and closed-toe shoes to minimize the powder/skin contact and inhalation.

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.

DOE-ID NEPA CX DETERMINATION

Justification: The activity consists of university-scale research activities to improve scientific understanding of the structural properties of AM components, especially under irradiating conditions.

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 09/04/2019