DOE-ID NEPA CX DETERMINATION

CX Posting No.: DOE-ID-21-113

SECTION A. Project Title: Location-specific material characterization of LPBF SS316L & IN718 TCR core structural materials – Utah State University

SECTION B. Project Description

Utah State University proposes to experimentally characterize the spatial variability of the quasi-static (tensile), creep (tension and impression), and creep-fatigue properties for laser powder bed fusion (LPBF) SS316L and IN718 components for an application as Transformational Challenge Reactor (TCR) core structural materials as training data to the TCR machine learning model. The underlying structures (microstructure and defect structures) of areas of interest will be evaluated to relate back to the material's meltpool signature in order to reveal the material's process-structure-property (p-s-p) relationships and provide a design path for TCR core structural materials. This project will provide a large set of mechanical properties data for additively manufactured metallic components. The material properties data will be linked to the spatial location within the build part for LPBF SS316L and IN718 and the underlying structures. The measured spatially varied materials property data from this work will serve as input training data to the TCR program's machine learning model to reveal the p-s-p link. The innovation in the work will be in revealing the complex p-s-p relationship in LPBF SS316L and IN718, a task that is known to be critical for the qualification of AM materials for application in multiple applications including TCR core structural materials. The proposed work will be performed in the following five primary tasks: 1) Specimen extraction; 2) Mechanical testing; 3) Structure-property-performance linkage and mapping of the spatial variability of material properties; 4) Microstructural characterization; and 5) Quality assurance.

SECTION C. Environmental Aspects / Potential Sources of Impact

Chemicals might be used for material preparation before microstructural characterization. All materials will be stored in suitable containers following the environmental health and safety (EHS) department procedures at the respective institution. All users will use suitable PPE. Chemical etching waste materials, if produced, will be labeled and stored following OSHA Standards then picked up by the EHS team for 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 perform material characterization of additively manufactured materials (namely, SS316L and IN718) of interest for the TCR program as input training data for their data-driven model revealing the p-s-p relationships in additive manufacturing.

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.