DOE-ID NEPA CX DETERMINATION

CX Posting No.: DOE-ID-21-109

SECTION A. Project Title: Cost Reduction of Advanced Integration Heat Exchanger Technology for Micro-Reactors – University of Wisconsin

SECTION B. Project Description

The University of Wisconsin proposes to investigate the development and optimization of an advanced heat pipe interface heat exchanger (HPIHX) technology based on the diffusion bonded printed circuit heat exchanger (PCHE) concept. The PCHE utilizes many metal sheets, each with channel geometries etched into them. The sheets are then stacked and diffusion bonded to make a monolithic block heat exchanger. In a typical, two-fluid heat exchanger application, adjacent sheets can accommodate counter-flowing fluid streams. In the envisioned micro-reactor integration heat exchanger, the PCHE sheets would each accommodate the same fluid for the case where the micro-reactor was providing heat to a single end-use; for example, the sCO_2 working fluid associated with the power block that is being heated at high pressure prior to entering the turbine. The heat pipe condenser ends will be inserted into holes in the sheets resulting in a monolithic block. Additional features that will be examined in this project include high conductivity inserts that allow the heat from the heat pipe condenser ends to be more uniformly distributed over the active surface of the sheet. The interstitial space between the heat pipe and the PCHE structure may be filled with an appropriate non-reacting metal to improve thermal contact while maintaining multiple sealing envelopes between the sodium and the application fluid. The key project objectives include: 1) Development and validation of micro-reactor integration heat exchanger design tools; 2) Validation and verification benchmark data useful for relevant NEAMS systems codes such as SAM; 3) Development of an optimal integration heat exchanger design for the eVinciTM micro-reactor that could significantly reduce cost and improve performance; 4) Development of further data for ASME Boiler Pressure Vessel code case for PCHE to be used for nuclear applications; 5) and Demonstration of a sub-size integration heat exchanger for sCO_2 and N_2 working fluids.

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 occurring 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). 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 advance the HPIHX technology including the development and verification of design tools as well as the demonstration of the technology.

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 09/17/2021.