

**U.S. DEPARTMENT OF ENERGY
OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY
NEPA DETERMINATION**



RECIPIENT: University of California, Davis

STATE: CA

PROJECT TITLE : Additively-Manufactured Molten salt-to-supercritical Carbondioxide Heat Exchanger

Funding Opportunity Announcement Number	Procurement Instrument Number	NEPA Control Number	CID Number
DE-FOA-0001840	DE-EE0008536	GFO-0008536-002	GO8536

Based on my review of the information concerning the proposed action, as NEPA Compliance Officer (authorized under DOE Policy 451.1), I have made the following determination:

CX, EA, EIS APPENDIX AND NUMBER:

Description:

A9 Information gathering, analysis, and dissemination Information gathering (including, but not limited to, literature surveys, inventories, site visits, and audits), data analysis (including, but not limited to, computer modeling), document preparation (including, but not limited to, conceptual design, feasibility studies, and analytical energy supply and demand studies), and information dissemination (including, but not limited to, document publication and distribution, and classroom training and informational programs), but not including site characterization or environmental monitoring. (See also B3.1 of appendix B to this subpart.)

B3.6 Small-scale research and development, laboratory operations, and pilot projects Siting, construction, modification, operation, and decommissioning of facilities for smallscale 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 deployment.

Rationale for determination:

The U.S. Department of Energy (DOE) is proposing to provide funding to the University of California at Davis to design, fabricate and experimentally validate the performance of molten salt-to-supercritical carbon dioxide (sCO₂) heat exchangers (HX) for concentrating solar power applications using additive manufacturing (AM) of nickel superalloys through research in material science and engineering, advanced manufacturing, cost modeling, and microchannel HX design.

The proposed project would involve the fabrication of AM HX with nickel superalloys using laser powder bed 3D printing. During the first two years, small-scale AM specimens using different alloy powders will be fabricated and characterized for feature size, microstructure, porosity and corrosion. In the first year, a prototype HX design will be developed based on thermofluidic and mechanical stress simulations and models, including considerations of fatigue and creep. In the second year, prototype HXs will be fabricated. Their structural integrity will be verified at extreme conditions and the thermal performance will be characterized experimentally in a heated air-to-sCO₂ configuration. The experiments will be used to validate a thermal model that will be used to predict performance in a chloride salt environment. In the third year, a prototype HX will be fabricated and experimentally characterized. Through the project duration, process-based cost modeling will be performed along with an assessment of market potential for the technology. Cost modeling results will be used to select the lowest-cost alternative when multiple designs are technically feasible.

The proposed project activities for this environmental review are to include a new subrecipient, the Colorado School of Mines (CSM), for which CSM will apply their optimized self-terminating etching process HX fabricated using Powder Bed Fusion AM techniques. This would include processing three pin array test pieces; evaluating the roughness of the resulting surface morphology and roughness; and processing one HX setup at the CSM Hildreth Research Group Laboratory in Golden, Colorado. CSM is being added to conduct tasks that were covered by the initial categorical exclusion issued for these proposed project activities on 3/15/2019. This NEPA review is to include the addition, location of, and tasks being performed by the new subrecipient

The various proposed project activities will be performed at the locations listed below:

University of California at Davis, Davis, CA
- Heat exchanger performance experiments; pressure and temperature testing

Carnegie Mellon University, Pittsburgh, PA

- 3D metal printing with nickel superalloy; microscopy on the powders and printed metals

National Renewable Energy Laboratory, Golden, CO

- Molten chloride corrosion and materials compatibility with additive manufacturing nickel superalloys

Metal Powder Works, Pittsburgh, PA and Austin, TX

- process economics and characterization analysis; produce powders

Colorado School of Mines, Golden, CO

- Post-processing of 3D printed materials

The project would involve the use and handling of various hazardous materials, including iodine, metals and industrial solvents. Additionally, the project would also involve generating high temperature and high-pressure conditions in a laboratory facility. The facility was designed and constructed to mitigate attendant risks, and standard operating procedures and best practices are followed at all times to reduce exposure to hazards. All handling of hazardous materials would occur in the laboratory facility and proper hazardous material handling and disposal practices will be implemented. All hazardous materials would be managed in accordance with federal, state, and local environmental regulations. Existing university health and safety policies and procedures would be followed, including student training, proper protective equipment, engineering controls, monitoring, and internal assessments. Additional policies and procedures would be implemented, as necessary, as new health and safety risks are identified. This would help ensure compliance with applicable health and safety regulations and minimize health and safety risks to employees and the public. At the conclusion of the proposed project, fabricated equipment components would be retained for future research.

The laboratory facility in which project work would occur were purpose-built for the types of research and development activities being proposed; therefore, no physical modifications or new permits would be necessary. No change in the use, mission or operation of existing facilities would arise out of this effort. Any work proposed to be conducted at a DOE laboratory may be subject to additional NEPA review by the cognizant DOE NEPA Compliance Officer for the specific DOE laboratory prior to initiating such work. Further, any work conducted at a DOE laboratory must meet the laboratory's health and safety requirements.

NEPA PROVISION

DOE has made a final NEPA determination.

Notes:

Solar Energy Technologies Office

NEPA Review completed by Andrew M. Montano, 9/26/2022

FOR CATEGORICAL EXCLUSION DETERMINATIONS

The proposed action (or the part of the proposal defined in the Rationale above) fits within a class of actions that is listed in Appendix A or B to 10 CFR Part 1021, Subpart D. To fit within the classes of actions listed in 10 CFR Part 1021, Subpart D, Appendix B, a proposal must be one that would not: (1) threaten a violation of applicable statutory, regulatory, or permit requirements for environment, safety, and health, or similar requirements of DOE or Executive Orders; (2) require siting and construction or major expansion of waste storage, disposal, recovery, or treatment facilities (including incinerators), but the proposal may include categorically excluded waste storage, disposal, recovery, or treatment actions or facilities; (3) disturb hazardous substances, pollutants, contaminants, or CERCLA-excluded petroleum and natural gas products that preexist in the environment such that there would be uncontrolled or unpermitted releases; (4) have the potential to cause significant impacts on environmentally sensitive resources, including, but not limited to, those listed in paragraph B(4) of 10 CFR Part 1021, Subpart D, Appendix B; (5) involve genetically engineered organisms, synthetic biology, governmentally designated noxious weeds, or invasive species, unless the proposed activity would be contained or confined in a manner designed and operated to prevent unauthorized release into the environment and conducted in accordance with applicable requirements, such as those listed in paragraph B(5) of 10 CFR Part 1021, Subpart D, Appendix B.

There are no extraordinary circumstances related to the proposed action that may affect the significance of the environmental effects of the proposal.

The proposed action has not been segmented to meet the definition of a categorical exclusion. This proposal is not connected to other actions with potentially significant impacts (40 CFR 1508.25(a)(1)), is not related to other actions with individually insignificant but cumulatively significant impacts (40 CFR 1508.27(b)(7)), and is not precluded by 40 CFR 1506.1 or 10 CFR 1021.211 concerning limitations on actions during preparation of an environmental impact statement.

The proposed action is categorically excluded from further NEPA review.

SIGNATURE OF THIS MEMORANDUM CONSTITUTES A RECORD OF THIS DECISION.

NEPA Compliance Officer Signature: _____

 Electronically
Signed By: [Lisa Jorgensen](#)

NEPA Compliance Officer

Date: 9/27/2022

FIELD OFFICE MANAGER DETERMINATION

- Field Office Manager review not required
- Field Office Manager review required

BASED ON MY REVIEW I CONCUR WITH THE DETERMINATION OF THE NCO :

Field Office Manager's Signature: _____

Field Office Manager

Date: _____