PMC-ND
(1.08.09.13)

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

RECIPIENT: Colorado School of Mines **STATE:** CO

PROJECT TITLE: Narrow-Channel, Fluidized Beds for Effective Particle Thermal Energy Transport and Storage

Funding Opportunity Announcement Number	Procurement Instrument Number	NEPA Control Number	CID Number
DE-FOA-0001840	DE-EE0008538	GFO-0008538-001	GO8538

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 federal funding to the Colorado School of Mines to develop narrow-channel, counterflow fluidized beds designed for efficient particle-to-sCO2 (supercritical carbon dioxide) heat exchangers and indirect solar particle receivers in a concentrating solar power (CSP) thermal energy storage subsystem.

The types of activities associated with the proposed project would consist of outreach, data analysis, computer modeling, and laboratory research and development (R&D) to include the fabrication of prototype heat exchangers and a particle/gas flow test rig for experimental purposes. The project would employ ceramic particle and oxide coating engineering and multiphase-flow modeling to optimize fluidized bed design and assess performance. Techno-economic computational analysis would be performed throughout the project to evaluate viability of the narrow-channel counterflow fluidized beds for full-scale CSP applications.

Colorado School of Mines (CSM; Golden, CO) would perform project work in collaboration with Sandia National Laboratories (SNL; Albuquerque, NM) and CARBO Ceramics Inc. (CARBO; Houston, TX). Subrecipient CARBO would design, produce, and characterize small quantities of fine ceramic particles to be utilized in lab-scale, fluidized bed durability tests at CSM. In-lab testing along with inert particle handling, high-temperature furnace processing of heat exchanger materials, and heat exchanger rig assembly would occur at the CSM Department of Mechanical Engineering Energy Conversion and Storage Laboratory. Thermal and optical testing of oxide coatings on structural metal surfaces in addition to materials characterization (e.g. particle analysis and electron microscopy) would occur at the CSM Colorado Center for Advanced Ceramics. Additional design and testing of oxide barrier coatings plus computational modeling would occur at the SNL National Solar Thermal Test Facility. Other project work to be performed at SNL would include the design and testing of a 40-kWth heat exchanger enabled by an existing on-site sCO2 flow loop.

The proposed project would consume on the order of approximately 1000 pounds (lbs) of alumina/silica particles

fabricated by CARBO and tested at CSM and Sandia. Correspondingly large amounts of commercially-available stainless steel would be procured via approved 3rd party vendors as part of the commissioning of new equipment detailed above. No significant wastes are expected to be generated by the project. Prototypes and testing rigs fabricated during the project would be retained for future research.

The proposed project would not involve the use of hazardous materials; the particles to be utilized are inert, non-toxic, and have a diameter greater than 100 microns. Potential health and safety hazards associated with the proposed project would include exposure to high temperatures, extreme light, and fines created due to some particle attrition. All experiments would be conducted in accordance with relevant protocols established by the responsible Environmental Health and Safety Office at each facility. All project employees would be provided with Personal Protective Equipment (PPE) and required to complete proper training in standard operating procedures and safe practices developed to mitigate the risk of hazards, such as particle inhalation, during specific testing activities. Although not considered nanotechnology, fluidized bed experiments and materials would be maintained within the confines of appropriately ventilated lab space.

Project work would be conducted entirely within dedicated university R&D laboratories, a purpose-built federal CSP testbed, and established industrial manufacturing facilities. CSM, SNL, and CARBO are outfitted with flow rigs, fume hoods, solar simulators, analytical instruments, and/or other tools necessary to carry out the respective activities at these locations. No major physical modifications to current lab space or new permits would be required. No change in the use, mission, or operation of existing facilities would arise out of project efforts. 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.

Include the following condition in the financial assisstance agreement:

Any work proposed to be conducted at a federal facility may be subject to additional NEPA review by the cognizant federal official and must meet the applicable health and safety requirements of the facility.

Notes:

Solar Energy Technologies Office
This NEPA determination requires a tailored NEPA Provision.
NEPA review completed by Whitney Doss, 3/13/2019

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: Kristin Kerwin Date: 3/14/2019

NEPA Compliance Officer

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: _____ Date: _____

Field Office Manager