U.S. Department of Energy
Categorical Exclusion Determination Form

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Proposed Action Title: Exploratory Topic G - Production of Geologic Hydrogen Through Stimulated Mineralogical Processes (DE-FOA-0002784 and DE-FOA-0002785)

Program or Field Office: Advanced Research Projects Agency - Energy

Location(s) (City/County/State): AZ, CA, CO, MA, MO, NC, NY, TX

Proposed Action Description:

Exploratory Topic G - Production of Geologic Hydrogen Through Stimulated Mineralogical Processes (Topic G) seeks to develop methods for stimulating the generation of hydrogen within subsurface mineral deposits. Specifically, methods such as enhanced serpentinization, hydrogen-producing geochemical reactions, processes to enhance or control the rate of hydrogen production, or other hydrogen generating processes will be developed, tested and verified, as well as modeling and characterization methods focused on predicting or monitoring yield of these stimulation methods. If successful, Topic G projects will result in low cost and low environmental impact production of hydrogen fuels from subsurface sources, reducing fossil fuel combustion and greenhouse gas emissions.

Topic G is composed of 11 small-scale research and development projects that will be conducted by universities, federal laboratories, non-profits, small businesses, and for-profit entities. This Determination includes 6 of the 11 projects (Colorado School of Mines, Lawrence Livermore National Laboratory, Lawrence Berkeley National Laboratory, Massachusetts Institute of Technology, Eden GeoPower, and 39 Alpha Research, see Attachment A). These projects fit within the class of actions identified under the DOE Categorical Exclusions identified below. This assessment was based on a review of the proposed scope of work and the potential environmental impacts of each project. All project tasks will be conducted in accordance with established safety and materials/waste management protocols and pursuant to applicable Federal, State, and Local regulatory requirements. Colorado School of Mines has not identified all field site locations nor obtained all necessary permits and approvals applicable to their proposed actions, including any necessary for field testing, and is prohibited from commencing project work until those permits are obtained. Per the terms of the award, a permits certification and, if necessary, an amended NEPA Determination, are required prior to the conduct of applicable project work.

Categorical Exclusion(s) Applied:

A9 - Information gathering, analysis, and dissemination

B3.6 - Small-scale research and development, laboratory operations, and pilot projects

B3.15 - Small-scale indoor research and development projects using nanoscale materials

B3.1 - Site characterization and environmental monitoring

For the complete DOE National Environmental Policy Act regulations regarding categorical exclusions, including the full text of each categorical exclusion, see Subpart D of 10 CFR Part 1021.

Regulatory Requirements in 10 CFR 1021.410(b): (See full text in regulation)

☑ The proposal 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 proposal that may affect the significance of the environmental effects of the proposal.

☑ The proposal 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.

Based on my review of the proposed action, as NEPA Compliance Officer (as authorized under DOE Order 451.1B), I have determined that the proposed action fits within the specified class(es) of action, the other regulatory requirements set forth above are met, and the proposed action is hereby categorically excluded from further NEPA review.

NEPA Compliance Officer: GEOFFREY GOODE Digitally signed by GEOFFREY GOODE Date: 2024.04.10 14:49:51 -04'00' Date Determined:

(This form will be locked for editing upon signature)

Attachment A: Projects in the Exploratory Topic G - Production of Geologic Hydrogen Through Stimulated Mineralogical Processes (FOA No. DE-FOA-0002784 and DE-FOA-0002785) Program

Prime Recipient (Control No.)	Project Title	Project Description	Categorical Exclusion
Colorado School of Mines (2784-1765)	Geophysical Characterization and Site-Scale Real-Time Monitoring in Stimulated Hydrogen	The Colorado School of Mines is developing real-time, efficient, and economical characterization and monitoring methods. Conventional monitoring techniques are too slow, sparse, and ill-tailored for measuring the mineralogical changes that produce hydrogen. Real-time feedback would enable the adjustment of stimulation parameters critical for maintaining hydrogen generation rate, which can change over the course of hours. The Colorado School of Mines has not obtained all necessary permits and approvals applicable to their proposed actions, including any necessary for field studies, and is prohibited from commencing applicable project work until those permits are obtained. Per the terms of the award, a permits certification and, if necessary, an amended NEPA Determination, are required prior to the conduct of applicable project work.	A9, B3.6, B3.1
Lawrence Livermore National Laboratory (2784-1777)	Enhanced Hydrogen Production from Subsurface Mineral Deposits by Organic Acids and Catalyst Stimulation with Novel Optical Fiber Monitoring (Fiber-OACS)	Lawrence Livermore National Laboratory (LLNL) is developing chemical stimulants to increase the rate of hydrogen production by accelerating the breakdown of minerals. LLNL is targeting short-chain organic acids that can both break down minerals while also recovering other critical minerals. The team is also evaluating whether other transition metals could catalyze geologic hydrogen production. This project is limited to bench-scale laboratory activities, with no outdoor or field-testing component, and has already obtained the required EH&S (Environmental, Health and Safety) approvals necessary for use of all the materials that it will need over the course of this project.	A9, B3.6
Lawrence Berkeley National Laboratory (2784-1775)	Orange Hydrogen from Catalytic Low Temperature Serpentinization	Lawrence Berkley National Laboratory is developing methods to understand the chemical mechanisms responsible for stimulating geologic hydrogen at low temperatures. Serpentinization rates are faster at higher temperatures, but the natural environment in future hypothetical geologic hydrogen production sites would have lower temperatures, meaning that reaction rates would not be as economical. The team is leveraging computation and experimental chemistry to determine how catalysts or other chemical approaches affect the formation of geologic hydrogen in low temperature environments. This project is limited to bench-scale laboratory activities, with no outdoor or field-testing component, and has already obtained the required	A9, B3.6, B3.15

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		EH&S (Environmental, Health and Safety) approvals necessary for use of all the materials that it will need over the course of this project.	
Massachusetts Institute of Technology (2784-1787)	Towards Efficient Geological Hydrogen Production: Rate Determination, Control and Reactor Development	Massachusetts Institute of Technology (MIT) is developing a laboratory reactor that will test many parameters and variables for geologic hydrogen production, such as temperature, pressure, and fluid composition. MIT's customized reactor would utilize artificial intelligence, allowing for rapid screening of different parameters that can affect stimulated hydrogen. Since one of the largest hurdles in pioneering geologic hydrogen stimulation is the slow reaction rate between rock and water, the team will focus on identifying methods to increase the rates, yields, and user control over the reaction. This project is limited to bench-scale laboratory activities, with no outdoor or field-testing component, and has already obtained the required EH&S (Environmental, Health and Safety) approvals necessary for use of all the materials that it will need over the course of this project.	A9, B3.6
39 Alpha Research (2784-1811)	Enabling the Discovery of H2 Producing Systems with Large-scale Chemical Cartography	39 Alpha Research is developing a water-rock-gas modeling product for users to determine the hydrogen potential of drill sites and recommended stimulation techniques. The models will aggregate results of water-rock-gas systems to aid in predicting geologic hydrogen potential from naturally occurring and laboratory water-rock-gas systems across a diverse range of compositions and reaction conditions. The technology would help tie together laboratory-scale models with future studies on rock formations. This project is limited to information gathering, data analysis and information dissemination only.	A9
Eden Geopower (2784-1797)	Electric-Based Mechanical and Thermal Stimulation to Increase Geologic Hydrogen Reaction Rates in the Samail Ophiolite, Oman	Eden GeoPower is developing a way to apply their electrical reservoir stimulation techniques to increase geologic hydrogen production through testing their stimulation methods on peridotite core samples from multiple sites to be selected in the Samail Ophiolite in Oman. The company's electrical stimulation method could produce significant surface area enhancement while also increasing the local temperature to promote reaction conditions suitable for hydrogen production. Experimentally testing how peridotite rock types respond to electrical stimulation could support identifying the	A9, B3.6

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Prime Recipient (Control No.)	Project Title	Project Description	Categorical Exclusion
		optimal conditions and geologic formations for stimulation. This project is limited to bench-scale laboratory activities, with no outdoor or field-testing component, and has already obtained the required EH&S (Environmental, Health and Safety) approvals necessary for use of all the materials that it will need over the course of this project.	