



U.S. Department of Energy

Categorical Exclusion Determination Form

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Proposed Action Title: National Energy Technology Laboratory - Rapid Design and Manufacturing of High-Performance Materials for Turbine Blades Applications above 1300 Celsius

Program or Field Office: Advanced Research Projects Agency - Energy

Location(s) (City/County/State): Albany, Oregon; Oak Ridge, Tennessee; Pittsburgh, Pennsylvania

Proposed Action Description:

SECOND AMENDED NEPA DETERMINATION: (See attached original Determination, dated February 23, 2021 and the First Amended Determination dated March 25, 2021). This Amended Determination follows the approval of additional funds and extended project schedule to support the project team's small-scale, research and development activities to further refine, assess, and test alloys for use in manufacturing turbine blades. Specifically, the project team will use the additional funds to conduct further research to study alloy strength and properties for further optimization. If successful, the materials developed by the project will be able to withstand the high temperatures in a turbine and the extreme stresses imposed on turbine blades, and potentially increase gas turbine efficiency up to 7%. Project activities will be conducted at existing facilities at National Energy Technology Laboratory (Albany, OR), Oak Ridge National Laboratory (Oak Ridge, TN), and Carnegie Mellon University (Pittsburgh, PA). Project tasks continue to fit within the class of actions identified under the DOE Categorical Exclusion identified below and do not involve any extraordinary circumstances that may affect the significance of the environmental effects of the project. This assessment was based on a review of the proposed scope of work and the potential environmental impact of the project. 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. No modifications will be made to the existing facilities to accommodate the proposed work.

Categorical Exclusion(s) Applied:

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

A9 - Information gathering, analysis, and dissemination

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: 2023.02.16 14:56:49 -05'00'

Date Determined:



U.S. Department of Energy Categorical Exclusion Determination Form

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Proposed Action Title: Ultrahigh Temperature Impervious Materials Advancing Turbine Efficiency (ULTIMATE & ULTIMATE SBIR/STTR) (FOA Nos. DE-FOA-0002337 & DE-FOA-0002338) Program

Program or Field Office: Advanced Research Projects Agency - Energy (ARPA-E)

Location(s) (City/County/State): AL; CA; CT; FL; IA; IL; IN; KY; MA; MD; MN; NE; NY; OH; OR; PA; RI; SC; TN; TX; UT; VA; WA; WI; WV

Proposed Action Description:

AMENDED PROGRAMMATIC NEPA DETERMINATION (See the attached original Programmatic Determination, dated February 23, 2021). This Amended Determination follows ARPA-E's receipt of required information and certifications from 11 additional Prime Recipients (See Attachment A in Bold) that were not covered under the original Programmatic Determination. The ULTIMATE Program is composed of 17 small-scale research and development projects that will be conducted by universities, non-profit entities, for-profit entities, and federal laboratories. This Amended Programmatic Determination along with the initial Programmatic Determination covers all 17 of the projects (See Attachment A). All 17 projects fit within the class of actions identified under the DOE Categorical Exclusions identified below and do not involve any extraordinary circumstances that may affect the significance of the environmental effects of the projects. 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.

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

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: 2021.03.25 12:23:45 -04'00'

Date Determined:



U.S. Department of Energy Categorical Exclusion Determination Form

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Proposed Action Title: Ultrahigh Temperature Impervious Materials Advancing Turbine Efficiency (ULTIMATE & ULTIMATE SBIR/STTR) (FOA Nos. DE-FOA-0002337 & DE-FOA-0002338) Program

Program or Field Office: Advanced Research Projects Agency - Energy (ARPA-E)

Location(s) (City/County/State): CA; CT; IN; KY; MN; NY; OH; OR; PA; SC; TN; UT; WA; WI

Proposed Action Description:

The ULTIMATE Program seeks to develop ultrahigh temperature materials for gas turbines, enabling them to operate continuously at 1300° C in stand-alone material tests, or 1800° C or higher with coatings. ULTIMATE teams will demonstrate proof of concept of alloy compositions, coatings, and manufacturing processes through modeling and lab testing. If successful, materials developed by ULTIMATE teams will be able to withstand the high temperatures in a turbine and the extreme stresses imposed on turbine blades, and potentially increase gas turbine efficiency up to 7%.

The ULTIMATE Program is composed of 17 small-scale research and development projects that will be conducted by universities, non-profit entities, for-profit entities, and federal laboratories. This Determination covers 6 of the 17 projects (listed in Attachment A). All 6 projects fit within the class of actions identified under the DOE Categorical Exclusion identified below and do not involve any extraordinary circumstances that may affect the significance of the environmental effects of the projects. 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.

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

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: 2021.02.23 09:18:13 -05'00'

Date Determined:

Attachment A: Projects in the ULTIMATE (FOA No. DE-FOA-0002337) & ULTIMATE SBIR/STTR (FOA No. DE-FOA-0002338) Programs

Full Application Control Number	Lead Organization	Project Title	Categorical Exclusion
2337-1501	General Electric Company, GE Research	ULTIMATE Refractory Alloy Innovations for Superior Efficiency (RAISE)	A9; B3.6
2337-1503	Oak Ridge National Laboratory	Facility for Evaluating High Temperature Oxidation and Mechanical Properties	A9; B3.6
2337-1506	Raytheon Technologies Research Center	ARPA-E ULTIMATE:ARPA-E: ULTIMATE Additive Manufactured OSD High Entropy Alloys (P.E00.0456)	A9;B3.6; B3.15
2337-1507	Raytheon Technologies Research Center	Environmental Protection Coating System for Refractory Metal Alloys (EPCS for RMA) (P.E00.0473)	A9;B3.6; B3.15
2337-1512	University of Maryland College Park	New Environmental-Thermal Barrier Coatings for Ultrahigh Temperature Alloys	A9; B3.6
2337-1530	University of Virginia	High Entropy Rare earth Oxide (HERO) Coatings	A9; B3.6
2337-1531	University of Utah	Designing Novel Multicomponent Niobium Alloys for High Temperature Integrated Design, Rapid Processing & Validation Approach	A9; B3.6
2337-1535	Texas A&M Engineering Experiment Station	Batch-wise Improvement in Reduced Design Space using a Holistic Optimization Technique (BIRDSHOT)	A9; B3.6
2337-1538	West Virginia University Research Corporation	High-Throughput Computational Guided Development of Refractory Complex Concentrated Alloys-based Composite	A9;B3.6; B3.15
2337-1564	The Boeing Company	Ultra-High-Performance Metallic Turbine Blades for Extreme Environments	A9;B3.6; B3.15
2337-1568	National Energy Technology Laboratory	Rapid Design and Manufacturing of High-Performance Materials for Turbine Blades Applications above 1300 Celsius	A9; B3.6
2337-1570	University of Wisconsin – Madison	Additive Manufacturing of Ultrahigh Temperature Refractory Metal Alloys	A9; B3.6
2337-1585	Oak Ridge National Laboratory	DEVELOPMENT OF NIOBIUM-BASED ALLOYS FOR TURBINE APPLICATIONS	A9;B3.6; B3.15

Attachment A: Projects in the ULTIMATE (FOA No. DE-FOA-0002337) & ULTIMATE SBIR/STTR (FOA No. DE-FOA-0002338) Programs

2337-1590	Pacific Northwest National Laboratory	SELECTIVE THERMAL EMISSION COATINGS FOR IMPROVED TURBINE PERFORMANCE	A9; B3.6
2337-1601	Massachusetts Institute of Technology	Additive Manufacturing of Oxygen-Resistant Gradient Refractory Composites	A9;B3.6; B3.15
2337-1619	Pennsylvania State University	Design and Manufacturing of Ultrahigh Temperature Refractory Alloys	A9; B3.6
2338-1507	Questek Innovations LLC	Concurrent Design of a Multimaterial Niobium Alloy Systems for Next-generation Turbine Applications	A9; B3.6