



U.S. Department of Energy

Categorical Exclusion Determination Form

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Proposed Action Title: Ultrahigh Temperature Impervious Materials Advancing Turbine Efficiency Phase 2 -- ULTIMATE and ULTIMATE SBIR/STTR (FOA Nos. DE-FOA-0002337 and DE-FOA-002338)

Program or Field Office: Advanced Research Projects Agency - Energy

Location(s) (City/County/State): AL, CA, CT, IL, MA, MD, MN, MO, NY, OH, OR, PA, SC, SD, TN, TX, UT, WA, WI

Proposed Action Description:

SECOND AMENDED PROGRAMMATIC NEPA DETERMINATION (See attached original Programmatic Determination, dated September 7, 2023 and First Amended Programmatic Determination, dated February 27, 2024). The ULTIMATE Phase 2 Program seeks to investigate selected alloy compositions and coatings to evaluate a comprehensive suite of physical, chemical, and mechanical properties as well as produce generic small-scale gas turbine blades to determine manufacturability. If successful, ULTIMATE Phase 2 projects will enable new ultrahigh temperature materials with compatible coatings and manufacturing technologies with the potential to increase gas turbine efficiency up to 7%, which will significantly reduce wasted energy and carbon emissions.

The ULTIMATE Phase 2 Program is composed of 8 small-scale research and development projects that will be conducted by universities, small businesses, and for-profit entities. This Second Amended Determination covers 2 of the 8 projects (listed in Attachment A). All 8 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.

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: 2024.03.15 15:34:09 -04'00'

Date Determined:

Attachment A: Projects in the ULTIMATE Phase 2 (FOA Nos. DE-FOA-0002337 and DE-FOA0002338) Program

| Prime Recipient (Control No.) | Project Title | Categorical Exclusion |
|---|---|----------------------------------|
| QuesTek Innovations (2338-1507) | Concurrent Design of a Multimaterial Niobium Alloy System for Next-generation Turbine Applications | A9, B3.6 |
| Boeing Research and Technology (2337-1564) | Ultra-High Performance Metallic Turbine Blades for Extreme Environments | A9, B3.6, B3.15 |
| General Electric Global Research (2337-1501) | ULTIMATE Refractory Alloy Innovations for Superior Efficiency (RAISE) | A9, B3.6 |
| University of Utah (2337-1531) | Designing Novel Multicomponent Niobium Alloys for High Temperature: Integrated Design, Rapid Processing and Validation Approach | A9, B3.6 |
| Pennsylvania State University (2337-15) | Design and Manufacturing of Ultrahigh Temperature Refractory Alloys | A9, B3.6 |
| Texas A&M University (2337-1535) | Batch-wise Improvement in Reduced Design Space using a Holistic Optimization Technique (BIRDSHOT) | A9, B3.6 |
| University of Maryland (2337-1512) | New Environmental-Thermal Barrier Coatings for Ultrahigh Temperature Alloys | A9, B3.6 |
| University of Wisconsin – Madison (2337-1507) | Additive Manufacturing of an Ultrahigh Temperature Mo Base Alloy with an Environmental Protection System for Turbine Blade Applications | A9, B3.6, B3.15 |

Bold text indicates the 2 projects included in the Second Amended CX.



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Proposed Action Title: Ultrahigh Temperature Impervious Materials Advancing Turbine Efficiency Phase 2 -- ULTIMATE and ULTMATE SBIR/STTR (FOA Nos. DE-FOA-0002337 and DE-FOA-002338)

Program or Field Office: Advanced Research Projects Agency - Energy

Location(s) (City/County/State): CA, CT, MD, MA, NY, OR, PA, SC, TN, TX, UT, WI

Proposed Action Description:

FIRST AMENDED PROGRAMMATIC NEPA DETERMINATION (See attached original Programmatic Determination, dated September 7, 2023) The ULTIMATE Phase 2 Program seeks to investigate selected alloy compositions and coatings to evaluate a comprehensive suite of physical, chemical, and mechanical properties as well as produce generic small-scale gas turbine blades to determine manufacturability. If successful, ULTIMATE Phase 2 projects will enable new ultrahigh temperature materials with compatible coatings and manufacturing technologies with the potential to increase gas turbine efficiency up to 7%, which will significantly reduce wasted energy and carbon emissions.

The ULTIMATE Phase 2 Program is composed of 8 small-scale research and development projects that will be conducted by universities, small businesses, and for-profit entities. This First Amended Determination covers 4 of the 8 projects (listed in 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.

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: 2024.02.27 14:55:28 -05'00'

Date Determined:

Attachment A: Projects in the ULTIMATE Phase 2 (FOA Nos. DE-FOA-0002337 and DE-FOA0002338) Program

| Prime Recipient (Control No.) | Project Title | Categorical Exclusion |
|---|---|------------------------------|
| General Electric Global Research (2337-1501) | ULTIMATE Refractory Alloy Innovations for Superior Efficiency (RAISE) | A9, B3.6 |
| University of Utah (2337-1531) | Designing Novel Multicomponent Niobium Alloys for High Temperature: Integrated Design, Rapid Processing and Validation Approach | A9, B3.6 |
| Pennsylvania State University (2337-1617) | Design and Manufacturing of Ultrahigh Temperature Refractory Alloys | A9, B3.6 |
| Texas A&M University (2337-1535) | Batch-wise Improvement in Reduced Design Space using a Holistic Optimization Technique (BIRDSHOT) | A9, B3.6 |
| University of Maryland (2337-1512) | New Environmental-Thermal Barrier Coatings for Ultrahigh Temperature Alloys | A9, B3.6 |
| University of Wisconsin – Madison (2337-1507) | Additive Manufacturing of an Ultrahigh Temperature Mo Base Alloy with an Environmental Protection System for Turbine Blade Applications | A9, B3.6, B3.15 |

Bold text indicates the 4 projects included in the Amended CX.



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Proposed Action Title: Ultrahigh Temperature Impervious Materials Advancing Turbine Efficiency (ULTIMATE) Phase 2 (DE-FOA-0002337)

Program or Field Office: Advanced Research Projects Agency - Energy

Location(s) (City/County/State): Connecticut, Maryland, Massachusetts, Wisconsin

Proposed Action Description:

The ULTIMATE Phase 2 Program seeks to investigate selected alloy compositions and coatings to evaluate a comprehensive suite of physical, chemical, and mechanical properties as well as produce generic small-scale gas turbine blades to determine manufacturability. If successful, ULTIMATE Phase 2 projects will enable new ultrahigh temperature materials with compatible coatings and manufacturing technologies with the potential to increase gas turbine efficiency up to 7%, which will significantly reduce wasted energy and carbon emissions.

The ULTIMATE Phase 2 Program is composed of 2 small-scale research and development projects that will be conducted by universities and for-profit entities. All 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.

Categorical Exclusion(s) Applied:

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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.

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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: 2023.09.07 12:39:34 -04'00'

Date Determined:

Attachment A: Projects in the ULTIMATE Phase 2 (FOA No. DE-FOA-0002337) Program

| Prime Recipient (Control No.) | Project Title | Categorical Exclusion |
|---|---|------------------------------|
| University of Maryland (2337-1512) | New Environmental-Thermal Barrier Coatings for Ultrahigh Temperature Alloys | A9, B3.6 |
| University of Wisconsin – Madison (2337-1507) | Additive Manufacturing of an Ultrahigh Temperature Mo Base Alloy with an Environmental Protection System for Turbine Blade Applications | A9, B3.6, B3.15 |