PMC-ND

(1.08.09.13)

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

RECIPIENT: Pixelligent Technologies LLC **STATE:** MD

PROJECT TITLE : Rapid and Efficient Deposition of Metal Oxide Coatings for Bearings and Gears in Harsh Environments

Funding Opportunity Announcement Number	Procurement Instrument Number	NEPA Control Number	CID Number
DE-FOA-0002553	DE-EE0010211	GFO-0010211-001	GO10211

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.
B3.15 Small-scale indoor research and development projects using nanoscale materials	Siting, construction, modification, operation, and decommissioning of facilities for indoor small-scale research and development projects and small-scale pilot projects using nanoscale materials in accordance with applicable requirements (such as engineering, worker safety, procedural, and administrative regulations) necessary to ensure the containment of any hazardous materials. Construction and modification activities would be within or contiguous to a previously disturbed or developed area (where active utilities and currently used roads are readily accessible).

Rationale for determination:

The U.S. Department of Energy (DOE) is proposing to provide funding to Pixelligent Technologies, LLC for the research and development of coating technology for the manufacturing of bearings and gears by in-situ tribosintering of metal oxide nanocrystals onto the contacting surfaces. This would be achieved by enabling the commercialization of a novel nano-enabled TriboCoating fluid capable of depositing protective metal oxide coatings at contact points in gears and bearings, thus alleviating the need to apply expensive coatings during component manufacturing. The project would be completed over three Budget Periods (BPs). This NEPA determination is applicable to all three BPs.

Project work would include the identification and laboratory testing of existing run-in fluids and coatings currently used in the market in order to identify the best performing nanocrystals. The best performers would then be further evaluated for structural, mechanical, and surface analysis to confirm and understand the TriboCoating formation, mechanisms, and associated performance. Additionally, the durability and wear performance of the metal oxide coatings deposited from the nano-enabled TriboCoating fluids would be examined under harsh contact conditions through a combination of a mini traction machine, micropitting, and scuffing tests. The performance of the metal oxide coatings under electrically induced wear conditions prevalent in electrical vehicles (EVs) and wind turbines (WTs) would also be tested. One combination of nanocrystal, capping agents, additives, and base oil that is suitable for both WT and EV application would be selected for process optimization and scale-up. Lastly, the selected nano-enabled TriboCoating fluid would be optimized and scaled-up to 10 kg/batch, in order to create sufficient quantities for performance testing. Accelerated aging and shelf-life stability testing of the nanocrystal coating-forming fluids would be done. Coatings from the TriboCoating fluid would be tested on full-scale wind turbine gearbox components, including gears, pinions, and bearings, in both sub-scale and full-loaded capacity. Testing would also be performed for the degradation of the coatings under harsh electromechanical contact conditions. Analysis of the electromechanical wear would be accomplished by performing electron microscopy imaging and chemical mapping of worn surfaces.

This analysis will provide insights and strategies for designing resilient coatings.

Proposed project activities by location are listed below:

Argonne National Laboratory - Lemont, IL
- Formulation testing of the nanocrystal-enhanced fluids in various tests for industry.

Flender-Winergy - Elgin, IL
- Device testing of the developed nanocrystal-enhanced fluids.

PixelligentTechnologies, LLC - Baltimore, MD
- Synthesis of the metal oxide nanocrystals, capping and dispersion of metal oxide nanocrystals, preparation of the TriboCoating fluids.

University of Pennsylvannia - Philadelphia, PA
- Laboratory analysis of the TriboCoating fluids to understand the growth mechanism and formation under a broad range of conditions.

ExxonMobil Research and Engineering - Annandale, NJ
- Conduct endurance testing of gears & bearings. Evaluate interactions between lubricating fluids and coated gears and bearings. Perform metrology and wear analysis of coated bearings.

Infineum USA L.P. - Lenden, NJ
- Formulation testing of the nanocrystal-enhanced fluids in various tests for industry.

The project would involve the use and handling of various hazardous materials, nanomaterials and industrial solvents. All such handling would occur in-lab and each site is dedicated to proper hazardous materials handling and disposal practices. All hazardous materials would be managed in accordance with federal, state, and local environmental regulations. Existing corporate health and safety policies and procedures would be followed at all sites, including employee training, proper protective equipment, engineering controls, monitoring, and internal assessments. All project work would be performed at existing, purpose-built laboratory or manufacturing facilities. No modifications to existing facilities, ground disturbing activities, or changes to the use, mission, or operation of existing facilities would be required. No additional permits, licenses, or authorizations would be required.

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.

NEPA PROVISION

DOE has made a final NEPA determination.

Notes:

Advanced Manufacturing Office
NEPA review completed by Andrew M. Montano, 8/29/2022

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: Casey Strickland Date: 8/30/2022

NEPA Compliance Officer

FIELD OFFICE MANAGER DETERMINATION

- [x] 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