DOE-ID NEPA CX DETERMINATION
Idaho National Laboratory

CX Posting No.: DOE-ID-INL-22-042

SECTION A. Project Title: Mercury Vapor Abatement Process Development and Demonstration

SECTION B. Project Description and Purpose:

This project is a continuation of prior work to develop a fogged or sprayed fixative for entraining airborne particulates and affixing them to surfaces. The initial development effort was focused on control of radiological particulates. An offshoot of that development work produced a fixative, named FX Hg, for reducing mercury (Hg) vapor production from exposed elemental mercury. A demonstration of the FX Hg formulation was conducted at the Y-12 site in Oak Ridge, Tennessee. The product was fogged into an enclosed dumpster filled with metallic decommissioning and demolition (D&D) debris that was contaminated with mercury. Presently, UCOR, the clean-up contractor at Y-12, would like to do a second demonstration of FX Hg.

The project will consist of two phases:

1) Process and chemistry development

2) Field demonstration at Y-12

Phase 1 will focus on improving the FX Hg formulation by reducing the water content and finding a water miscible mercury reactant. Dewatering the solution will simply reduce the amount of water added to the mixture. Test batches will be mixed to determine the limit at which the other ingredients no longer fully dissolve and/or the solution becomes too viscous. Solubility limits for any new mercury reactant will also be explored. The new mercury reactant's efficacy at passivating elemental mercury will be evaluated as part of the Phase 2 field demonstration. No mercury 1 will be used in Phase 1.

The original FX Hg recipe was tested and determined to be non-flammable, even when atomized into a high surface area mist. Any new additives for reacting with mercury will have to be evaluated for potential flammability. If the resultant recipe has the potential to be flammable, an American Society for Testing and Materials (ASTM) flame propagation test will be conducted. Flame testing will be conducted under the supervision of the fire protection engineer.

Phase 1 will be conducted at the INL Research Center (IRC), and/or potentially at subcontractor facilities. The project is planning on collaborating with MarCom (Subcontractor) and, tentatively, the University of Glasgow, Scotland. However, INL personnel will not be present for the chemistry work done at the University. Work conducted at the University will be covered by the University's work controls.

Phase 1 development work will generate small quantities of chemical waste. Much of it can likely be disposed of in the sanitary sewer. The project will comply with all regulatory limits for the facility in which the work is conducted. Waste that cannot be poured down the drain will be solidified and disposed according to WGS instructions. The base FX formulation consists of water, glycerin, sodium lauryl sulfate (SLS), and latex paint or poly-vinyl alcohol primer (PVA). Sodium lauryl sulfate is flammable in its dry form. Dry SLS requires storage in a flammable materials cabinet. It is also a respiratory irritant. Mixing will be conducted in a fume hood, and proper PPE will be worn – safety glasses, nitrile gloves, lab coat, and an N95-type dust mask.

To that base recipe, an additive that reacts with mercury will be added. Previously, elemental sulfur was used; however, sulfur is extremely hydrophobic leading to issues with keeping it suspended in the solution during application and with clogging the nozzle of the applicator. The project will test alternative sulfur compounds that will dissolve readily in water. The SDS for any compounds used will be reviewed for any additional hazards and to ensure proper disposal of waste material. Chemicals may be transferred to the subcontractor facility in which the chemicals will be handled according to their facility waste management procedures and chemical safety procedures. If the facility does not permit to rinse quantities of solutions as part of cleaning glassware, solutions will be dried or solidified.

Potential new recipe formulations will be tested for spray-ability and coating formation. These tests will consist simply of spraying the solution with a handheld spray bottle or high volume, low pressure (HLVP) paint sprayer onto various coupon surfaces (e.g., metal, wood, fabric.), and evaluating drying time, cured coating thickness, coating durability, etc. The project will purchase a high pressure low volume (HPLV) paint sprayer.

Phase 2 will occur in a facility at the Y-12 site in Oak Ridge, Tennessee. The demonstration activities will be added to the facility's ES&H work control documentation, and INL personnel will participate subject to Y-12 work controls. Depending on the demonstration at Oak Ridge, a Curtis Dyna-Fog fogger may be purchased for Phase 2 of the project.

In Phase 2, the FX Hg solution will be applied to surfaces and objects in a facility that is heavily contaminated with mercury. The application method will be by spraying with a HVLP (high volume low pressure) paint sprayer and/or by fogging with a Curtis Dyna-Fog fogger. To evaluate performance, measurements of mercury vapor levels will be taken before application, while the solution dries and cures, and after curing is complete. The risk to the environment from the mercury present in the facility is substantial. The environmental risk presented by the FX Hg material is minimal. Nonetheless, it will be accounted for in the facility's ES&H documentation. The work done at Y-12 facility in Oak Ridge Tennessee will be covered by the DOE/EIS-0387: Y-12 National Security Complex Site-Wide Environmental Impact Statement.

Containment measures will be used to minimize the spread of debris during the cleaning operations. Samples will be placed inside a translucent plastic tub (e.g., Rubbermaid type bin) placed on its side during sanding or grinding. A handheld shop vacuum will be positioned to capture material as it is liberated into the air due to brushing, sanding, grinding, etc. Residual loose material will be vacuumed up from surrounding surfaces after each test as well.

SECTION C. Environmental Aspects or Potential Sources of Impact:

Air Emissions

The project will use 1 - 15% glycerin, 5 - 40% latex paint, and either (a) 1 - 10% sodium lauryl sulfate (SLS) or (b) 1 - 10% ammonium lauryl sulfate in water. Some solutions may contain up to 20% polyvinyl alcohol. None of these materials, or components, are classified as Toxic Air Pollutants. The chemicals will be mixed in up to 5 gallon increments in a fume hood. Less than 25 gallons (total) will be produced. If SLS is used, small quantities of dust fines will be suspended but will be handled accordingly under a fume hood with proper safety protocols. The amounts released from both activities will be minimal amounts (mg). Emissions will need to be evaluated prior to conducting laboratory work to verify compliance with Air Permitting Applicability Determinations (APADs)/permits for the affected facilities.

Discharging to Surface-, Storm-, or Ground Water

N/A

Disturbing Cultural or Biological Resources

N/A

Generating and Managing Waste

The types of waste that will be generated are nitrile gloves, paper towels, kim wipes, etc. Solid substrates such as wood, steel or aluminum, plastic, etc. The total amount of waste would be a few gallons total volume. A solidified FX Hg coating will amount in gram quantities dried on paper towels or solid substrates as well as a couple gallons solidified with Super Absorbent Polymer (SAP) or a similar solidification agent. There will be liquid waste from chemical solutions (FX Hg) consisting of mixtures of water and one or more of the following: glycerin, sodium laurel sulfate (SLS), latex paint, polyvinyl alcohol primer (PVA), and/or one or more organic sulfur compounds (possibly L-cysteine). If allowed, small quantities will be disposed of down the drain depending on the facility used for the chemistry development work. If the facility does not permit to rinse quantities of solutions as part of cleaning glassware, solutions will be dried or solidified.

Waste generated at off-site facilities will be managed per their facility waste management practices.

Releasing Contaminants

When chemicals are used during the project there is the potential for spills that could impact the environment (air, water, soil).

Using, Reusing, and Conserving Natural Resources

All materials will be reused and recycled where economically practicable. All applicable waste will be diverted from disposal in the landfill where conditions allow.

SECTION D. Determine Recommended Level of Environmental Review, Identify Reference(s), and State Justification: Identify the applicable categorical exclusion from 10 Code of Federal Regulation (CFR) 1021, Appendix B, give the appropriate justification, and the approval date.

For Categorical Exclusions (CXs), the proposed action must not: (1) threaten a violation of applicable statutory, regulatory, or permit requirements for environmental, safety, and health, or similar requirements of Department of Energy (DOE) or Executive Orders; (2) require siting and construction or major expansion of waste storage, disposal, recovery, or treatment or facilities; (3) disturb hazardous substances, pollutants, contaminants, or Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)-excluded petroleum and natural gas products that pre-exist in the environment such that there would be uncontrolled or unpermitted releases; (4) have the potential to cause significant impacts on environmentally sensitive resources (see 10 CFR 1021). In addition, no extraordinary circumstances related to the proposal exist that would affect the significance of the action. In addition, the action is not “connected” to other action actions (40 CFR 1508.25(a)(1) and is not related to other actions with individually insignificant but cumulatively significant impacts (40 CFR 1608.27(b)(7)).

References:

10 CFR 1021, Appendix B to subpart D, items B3.6, "Small-scale research and development, laboratory operations, and pilot projects."

Y-12 National Security Complex Site-Wide Environmental Impact Statement (DOE/EIS-0387), Oak Ridge, Tennessee.

Justification:

The proposed R&D activities are consistent with CX B3.6 "Siting, construction, modification, operation, and decommissioning of facilities for small-scale research and development projects; conventional laboratory operations (such as preparation of chemical standards and sample analysis); 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 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."

NNSA, a separately organized agency within DOE, is responsible for maintaining the safety, reliability, and security of the U.S. nuclear weapons stockpile to meet national security requirements. NNSA manages nuclear weapons programs and facilities, including those at the Y-12 National Security Complex (Y-

12) at Oak Ridge, Tennessee. This Final Y-12 SWEIS (DOE/EIS-0387) analyzed the potential environmental impacts of the reasonable alternatives for ongoing and foreseeable future operations and activities at Y-12, including alternatives for changes to site infrastructure and levels of operation (using production capacity as the key metric for comparison).

Is the project funded by the American Recovery and Reinvestment Act of 2009 (Recovery Act) ☐ Yes ☒ No

Approved by Jason L. Anderson, DOE-ID NEPA Compliance Officer on: 05/17/2022