

SECTION A. Project Title: Advanced Voloxidation Hardware and Direct Extraction Process in the Analytical Research Laboratory (MFC-752)

SECTION B. Project Description and Purpose:

Test hardware will be designed, fabricated, and installed to flow high purity NO₂ through a heated apparatus over used nuclear fuel (UNF). This test is to perform voloxidation in the hardware configuration. Voloxidation, also known as oxidative decladding, will provide a means for decladding UNF. This technique is applicable to the head end of both aqueous and pyrochemical nuclear fuel recycling processes. The heated apparatus will be placed inside a furnace located in the MFC-752 Hot Cell in the Analytical Lab. The test duration will be at least one year but also depends on facility availability and funding.

The test hardware will utilize high purity O₂ and N₂ from cylinders located outside the hot cell and high purity NO₂ from a gas lecture bottle, pressure control assemblies, mass-flow-controllers, a furnace, the test apparatus, and a scrubber apparatus (as appropriate), and then vented to the hot cell ventilation. The system will be designed to be leak tight. Some fittings may need to be replaced or modified, and the ventilation will remain operating while the system is in the hot cell.

The test apparatus shall be designed for the following working gases:

- Lecture bottle of NO₂
- Cylinder of O₂
- Cylinder of N₂

The process will accept around 100-gram scale amounts of UNF mainly consisting of UO₂ in an enclosed apparatus where NO₂ gas can be flowed over the sample with the intent to create UO₃/U₃O₈.

This work is similar to ERP 3481, but instead of operating the system in a glovebox, it will be operated in the hot cell due to an increased capability of processing higher activity samples.

Following voloxidation, a direct extraction dissolution technique is being developed as part of the Material Recovery and Waste Forms Development (MRWFD) Program to enhance the efficiency of direct extraction as a unit operation for reprocessing UNF. This new technique is designed for aqueous nuclear fuel recycling processes and utilizes voloxidized UNF in the form of UO₃ or U₃O₈ as input to a direct extraction chamber. The chamber employs a hydrocarbon solvent formulation containing an extractant and an aliphatic diluent. The UNF dissolution test will identify fission product and transuranic impurities that require attention during uranium purification efforts. Once operational, the equipment is expected to be used for a series of fuel experiments lasting approximately one month within the operational year. Based on the results and performance of the equipment, follow-up experiments may be conducted with the same apparatus, necessitating proper storage.

SECTION C. Environmental Aspects or Potential Sources of Impact:

Air Emissions

Activities may require an Air Permitting Applicability Determination (APAD) and have the potential to contribute to air emissions by generating air pollutants, including but not limited to radionuclides.

Discharging to Surface-, Storm-, or Ground Water

NA

Disturbing Cultural or Biological Resources

NA

Generating and Managing Waste

When wastes are generated, how they are disposed can adversely affect the environment. Managing wastes appropriately and responsibly and implementing recycling or reuse practices, where feasible, during project activities can reduce the potential impact on the environment.

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

NA

DOE-ID NEPA CX DETERMINATION
Idaho National Laboratory

Page 2 of 2

CX Posting No.: DOE-ID-INL-25-014

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 and is not related to other actions with individually insignificant but cumulatively significant impacts.

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

Justification: Based on the purpose and need and description of the proposed action and potential environmental impacts, the proposed action fits within the class of actions that is listed in Appendix B CX B3.6. There are no extraordinary circumstances related to the proposed action that may affect the significance of the environmental effects of the proposal (10 CFR 1021.410(b)(2)). The proposed action has not been segmented to meet the definition of a categorical exclusion (10 CFR 1021.410(b)(3)). This proposal is not connected to other actions with potentially significant impacts, is not related to other actions with individually insignificant but cumulatively significant impacts, and is not precluded by 10 CFR 1021.211 concerning limitations on actions during preparation of an environmental impact statement (10 CFR 1021.410(b)(3)).

Authorizing the proposed action will not (1) threaten a violation of applicable statutory, regulatory, or permit requirements for environment, safety, and health, including DOE and/or Executive orders; (2) require siting of new facilities or expansion of existing facilities; (3) disturb hazardous substances, pollutants, or contaminants; (4) adversely affect environmentally sensitive resources; or (5) involve genetically engineered organisms, synthetic biology, governmentally designated noxious weeds, or invasive species.

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

Approved by Robert Douglas Herzog, DOE-ID NEPA Compliance Officer on: 6/18/2025