

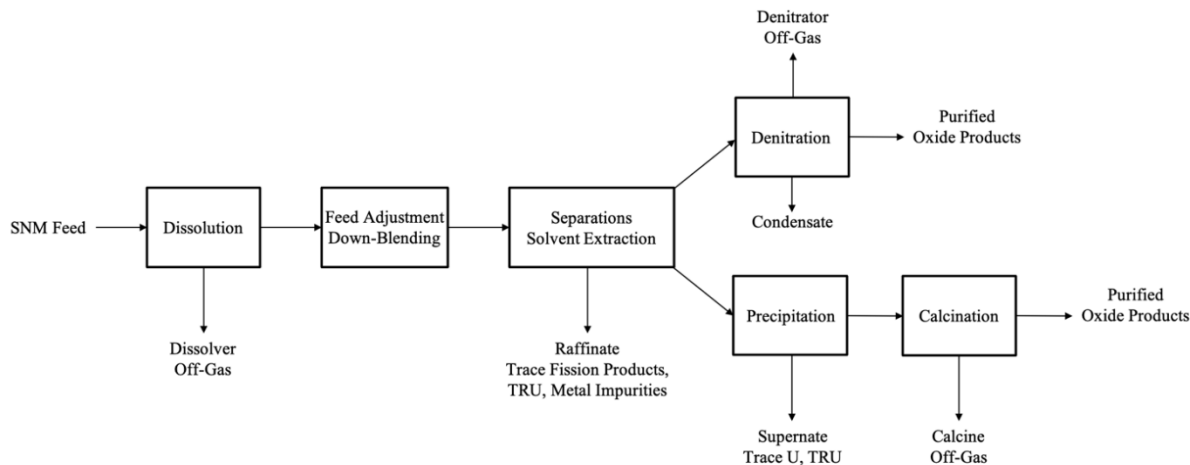
DOE-ID NEPA CX DETERMINATION

Idaho National Laboratory

SECTION A. Project Title: Special Nuclear Material Test Bed (Beartooth)

SECTION B. Project Description and Purpose:

The Special Nuclear Material test bed (Beartooth) is a R&D test bed that will contain the necessary unit operations for the dissolution, separation, and conversion of special nuclear materials (SNM) such as plutonium (Pu), enriched uranium (EU), thorium (Th) in support of fuel cycle R&D. The project team has significant experience installing, operating, and maintaining systems of this scale and nature. Beartooth's capabilities will position INL at the forefront for the evolving needs of the nonproliferation and scientific communities while maintaining vital U.S. leadership in fuel cycle technologies. This has particular relevance to the variety of Advanced Reactor/Small Modular Reactor (AR/SMR) designs under consideration worldwide employing a whole array of fuel types, to include Low EU (LEU), Highly EU (HEU), High Assay LEU (HALEU), mixed U and Pu oxides (MOX), Th and Pu. A general process flow diagram is shown below.



The test bed will consist of glovebox lines containing the necessary unit operations and associated equipment required to process SNM. Main unit operations are shown in the process flow diagram above and the major equipment includes:

Dissolution Equipment: Dissolver vessel compatible with nitric acid and hydrofluoric acid, off-gas condenser and scrubbers, dissolver heating/cooling system, recirculation pumps, gas sparge equipment, instrumentation. Small laboratory-scale dissolvers will also be utilized for smaller volumes of oxide feedstocks.

Feed adjustment equipment: Pumps, tanks, and instrumentation.

Separations Equipment: CINC V02 centrifugal contactors, heating/cooling system, pumps, tanks, instrumentation.

Conversion equipment: Rotary kiln, evaporators, condensers, pumps, tanks, filtration equipment, purge gas system, instrumentation.

Instrumentation: instrumentation needs will vary depending on the unit operation, but generally will monitor process parameters such as temperature, pressure, flow, density, conductivity, and others. Analytical instrumentation including gamma spectroscopy, ICP, UV-VIS, and others are anticipated.

Where possible equipment will be purchased off-the-shelf. Centrifugal contactors, the rotary kiln, and instrumentation are expected to be purchased from reputable vendors on the qualified suppliers list. Other equipment such as dissolvers, tanks, condensers, and evaporators will likely be sized and manufactured to project specifications. The glovebox housing all of the equipment will also be manufactured to project specifications.

Beartooth will be capable of processing various SNM feedstocks, including minor actinides and fission products. SNM for the process will come from a combination of locations (all within the INL domain, i.e., MFC vaults, MRPP product materials, as well as processed EBR-II HALEU Reguli). Chemicals used for processing i.e., acids, diluents, extractants, will be procured from commercial sources. Product materials will be stored in MBAs or appropriate vaults at MFC. Diluents/extractants will be re-used to the greatest extent possible. SNM such as Pu and low levels of TRU will be reused to the greatest extent possible to reduce waste volumes. The design allows scientists and engineers the ability to test new technologies and develop chemical process fundamental understanding with high fidelity and bench scale throughput. This test bed capability enables the testing of nonproliferation technologies and scientific understanding of U/Pu processing operations and other alternative fuel cycles. In addition, the Beartooth test bed is designed to collect process data in real time to support (1) the creation of a Digital Twin to promote artificial intelligence and machine learning, (2) the development of Safeguards by Design and Security by Design measures for a reprocessing facility, and (3) the analysis of reprocessing effluents for proliferation detection.

The Beartooth test bed will be constructed at MFC in the Fuels Conditioning Facility (FCF) with a life expectancy of more than 20 years. The project will include the engineering design as well as the purchase and installation of equipment including tanks, contactors, pumps, gloveboxes, off-gas equipment and other support components. Wastes generated from the Beartooth project will be a combination of solid and liquid waste. During construction and installation of the process equipment there will be normal construction waste generated from typical activities. The facility may require minor modifications such as extending water to the room, connecting to the waste tank system, and connecting the glovebox ventilation to the existing ventilation in the room. No work will be conducted outside of the building.

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Solid wastes generated will predominantly be laboratory supplies (pipettes, gloves, wipes, polybottles, sample vials, towels, PPE, etc.). Liquid wastes generated from process operations will vary depending on source material composition. In general, it is expected that waste compositions will span a variety of waste forms from low level liquid waste to TRU waste. Beartooth will produce TRU >100 nCi/g Pu and other TRU isotopes. It is the intent of this project to manage the TRU waste through the FCF facility TRU waste process stream. TRU isotopes will be recovered to the greatest extent possible as solid oxide products, and TRU waste volumes will be minimized to the greatest extent possible through chemical separation and conversion processes. The predominant air emission will be NO_x, generated from dissolution. Additional air emissions may also be present and will have to be assessed according to the proper APAD controls. Upon completion of the project or when it is no longer beneficial the equipment will be cleaned and disposed of according to environmental policy and procedures.

As part of the preliminary design process, the project team has conducted mass balance calculations for relevant unit operations to assess the potential for TRU waste generation associated with Beartooth's R&D scope. Due to the value and scarcity of actinide source material(s) being utilized in Beartooth, the system will be designed to maximize recovery of U/TRU species and minimize waste generation. Two scenarios were considered to estimate the anticipated volume of TRU waste produced annually, a PUREX-basis flowsheet and an EBR-II HALEU flowsheet. It is estimated that no more than 250 liters/year TRU waste will be generated by the project (assuming 1 campaign per month, 12 months). As a chemical separations test bed, opportunities may exist to further reduce TRU waste volumes through judicious selection of operating parameters and utilization of process equipment (e.g., solvent extraction equipment, evaporators, reaction vessels, recycle streams, etc.). It is important to note that this is a preliminary estimate; the project team will coordinate closely with the environmental lead to continuously assess evolving impacts throughout the life of the project.

Product materials, and liquid waste materials will be quantified at the analytical laboratory at MFC. Analysis will look at an array of elements but also including TRU, RCRA, and UHC's analysis prior to declaration of waste. FCF is not a RCRA permitted facility, so no modification to the MFC RCRA permit is required.

SECTION C. Environmental Aspects or Potential Sources of Impact:

Air Emissions

The proposed action has the potential to generate chemical and radionuclide air emissions at FCF. However, these emissions are controlled by INL Sitewide Permit to Construct and Facility Emission Cap P-2015.0023 (PER-152) and are monitored continuously with a 40 CFR 61 Subpart H compliant stack monitoring system. An Air Permit Applicability Determination (APAD) is required to document the anticipated emissions from the project.

Discharging to Surface-, Storm-, or Ground Water

N/A

Disturbing Cultural or Biological Resources

FCF (MFC-765) is eligible for nomination to the National Register of Historic Places; therefore a cultural resource review and clearance from the Cultural Resource Management Office (CRMO) is required.

Generating and Managing Waste

Project activities have the potential to generate industrial, low-level and TRU waste. The analytical lab could also generate some mixed low-level waste. It is estimated that a maximum of 250 liters of TRU waste could be generated each year. Project personnel will work with WGS to characterize and properly disposition waste.

Releasing Contaminants

When chemicals are used, there is the potential the chemicals could be spilled to air, water, or 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. Project description indicates materials will need to be purchased or used that require sourcing materials from the environment. Being conscientious about the types of materials used could reduce the impact to our natural resources. Project activities may release known greenhouse gases (GHGs) to the atmosphere and increase INL's energy use.

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.

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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, Item B3.6, "Small-scale research and development, laboratory operations, and pilot projects" and B1.31 "Installation and relocation of machinery and equipment".

Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement and Record of Decision (DOE/EIS-0203, 1995) and supplemental analyses (DOE/EIS-0203-SA-01 and DOE/EIS- 0203-SA-02) and the Amended Record of Decision (1996)

Final Environmental Impact Statement for the Waste Isolation Pilot Plant (DOE/EIS-0026, October 1980) and Final Supplement Environmental Impact Statement for the Waste Isolation Pilot Plant (SEIS-I) (DOE/EIS-0026-FS, January 1990)

Final Waste Management Programmatic Environmental Impact Statement [WM PEIS] (DOE/EIS-0200-F, May 1997) and Waste Isolation Plant Disposal Phase Supplemental EIS (SEIS-II) (DOE/EIS-0026-S-2, September 1997)

Final Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (DOE/EIS-0426, December 2014).

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."

B1.31, "Installation or relocation and operation of machinery and equipment (including, but not limited to, laboratory equipment, electronic hardware, manufacturing machinery, maintenance equipment, and health and safety equipment), provided that uses of the installed or relocated items are consistent with the general missions of the receiving structure. Covered actions include modifications to an existing building, within or contiguous to a previously disturbed or developed area, that are necessary for equipment installation and relocation. Such modifications would not appreciably increase the footprint or height of the existing building or have the potential to cause significant changes to the type and magnitude of environmental impacts."

After processing in FCF, residues and products will be stored with other similar DOE-owned irradiated materials and experiments at MFC, most likely in the Hot Fuels Examination Facility (HFEF) or the Radioactive Scrap and Waste Facility (RSWF) in accordance with DOE's Programmatic SNF Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (FEIS) and ROD (DOE/EIS-0203, 1995) and supplemental analyses (DOE/EIS-0203-SA-01 and DOE/EIS-0203-SA-02) and the Amended Record of Decision (February 1996). Ultimate disposal of the residues will be along with similar DOE-owned irradiated materials and experiments currently at MFC. Categorizing this material as waste is supported under Department of Energy Order (DOE O) 435.1, Att. 1, Item 44, which states "...Test specimens of fissionable material irradiated for research and development purposes only...may be classified as waste and managed in accordance with this Order...".

NEPA coverage for the transportation and disposal of waste to Waste Isolation Pilot Plant (WIPP) are found in the Final Waste Management Programmatic Environmental Impact Statement [WM PEIS] (DOE/EIS-0200-F, May 1997) and Waste Isolation Plant Disposal Phase Supplemental EIS (SEIS-II) (DOE/EIS-0026-S-2, Sept. 1997), respectively. The 1990 ROD also stated that a more detailed analysis of the impacts of processing and handling TRU waste at the generator-storage facilities would be conducted. The Department has analyzed TRU waste management activities in the Final Waste Management Programmatic Environmental Impact Statement (WM PEIS) (DOE /EIS-200-F, May 1997). The WM PEIS analyzes environmental impacts at the potential locations of treatment and storage sites for TRU waste; SEIS-II addresses impacts associated with alternative treatment methods, the disposal of TRU waste at WIPP and alternatives to that disposal, and the transportation to WIPP.

The environmental impacts of transferring LLW from the INL Site to the Nevada National Security Site were analyzed in the 2014 Final Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (DOE/EIS-0426) and DOE's Waste

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Management Programmatic EIS (DOE/EIS-200). The fourth Record of Decision (ROD) (65 FR 10061, February 25, 2000) for DOE's Waste Management Programmatic EIS established the Nevada National Security Site as one of two regional LLW and MLLW disposal sites.

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

Approved by Jason Anderson, DOE-ID NEPA Compliance Officer on: 03/31/2021