SECTION A. Project Title: Special Nuclear Material Test Bed (Beartooth) Rev. 1

SECTION B. Project Description and Purpose:

Revision 1:

This revision includes the preparation for the Beartooth testbed, a mockup for tracer level work and nonradioactive work to inform the full-scale dissolutions and separations for Beartooth testbed. Work will be performed at the following Idaho National Laboratory (INL) facilities, in addition to the ongoing Beartooth test bed work at the Materials and Fuels Complex (MFC), in the Fuels Conditioning Facility (FCF) :

- INL Research Center (IRC), IF-603 (Labs A-7 and A-13),
    - Conceptual and preliminary testing of tracer level work prior to fabrication of the Beartooth testbed. No radiological work will take place at IRC.
- Central Facilities Area (CFA)-625 (Labs 210 and 240)

All of the work performed at IF-603 and CFA-625 will be aqueous based process related, no spent fuel reprocessing will take place. This includes preliminary dissolution and solvent extraction batch scale testing. This will also help to develop a solid staff foundation as Beartooth testbed comes on-line.

Waste from Revision work scope may include:

IF-603:

- Resin cartridges/year (<1,000 each/year)
- Wipes, containing acetone, methanol, ethyl alcohol (<1 lb/year)
- Broken glassware (<10 L/year)
- Used syringes (<50 each/year)

CFA-625:

- Resin cartridges/year (<1,000 each/year)
- Solid low level waste (LLW), containing glassware, personal protection equipment (200 L/year)
- LLW acidic (20 L/year)
- LLW syringes (<50 each/year)

No transuranic waste (TRU) waste will be associated with this portion of the work scope at IF-603 and CFA-625.

Samples will be collected to analyze extraction efficiencies.

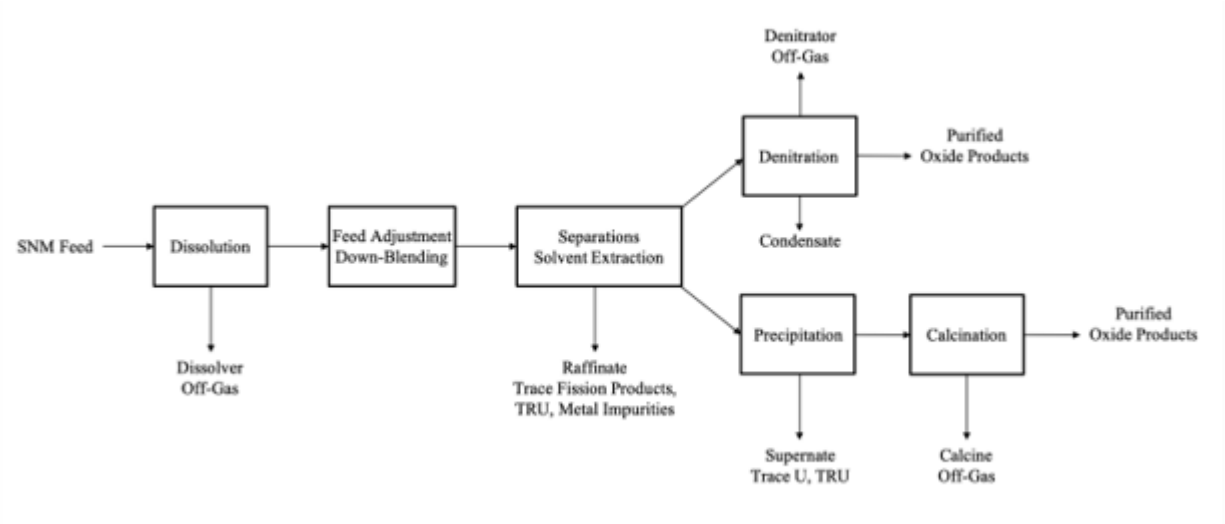
INL waste will be managed by Waste Generator Services in accordance with laboratory procedures.

No off-site work or partnership will be involved.

Original ECP:

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.

Figure 1: General Process Flow Diagram



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.

Solid wastes generated will predominantly be laboratory supplies (pipettes, gloves, wipes, polybottles, sample vials, towels wipes, 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 NOx, 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

Original ECP: 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.

Revision 1: No radiological work will be conducted at IRC.

Discharging to Surface-, Storm-, or Ground Water

NA

Disturbing Cultural or Biological Resources

Cultural: A Section 106 review was completed under CRMO project number (BEA-21-H110) and resulted in No Historic Properties Affected.

Generating and Managing Waste

Revision 1 waste may include:
Resin cartridges/year (<1,000 each/year)
Wipes, containing acetone, methanol, ethyl alcohol (<1 lb/year)
Broken glassware (<10 L/year)
Used syringes (<50 each/year)
Solid low level waste (LLW), containing glassware, personal protection equipment (200 L/year)
LLW acidic (20 L/year)
LLW syringes (<50 each/year)

Original ECP scope waste (Beartooth test bed at FCF) may include:
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.

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

Environmental Justice

According to the CEQ Climate and Economic Justice Screening Tool, the INL site as well as the Research and Education Campus in Idaho Falls, ID are located in U.S. Census tracts that are identified as disadvantaged communities. Census tracts identified as disadvantaged meet or exceed socioeconomic, environmental, health, or demographic thresholds identified by CEQ. Given that activities analyzed in this document will happen within the boundaries of existing DOE/INL land and/or facilities where there are no permanent residents, any impacts to Environmental Justice in

surrounding communities are anticipated to be negligible.

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

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: 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 B1.31 and B3.6. 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.

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.

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 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 Robert Douglas Herzog, DOE-ID NEPA Compliance Officer on: 11/7/2024