DOE-ID NEPA CX DETERMINATION
Idaho National Laboratory

CX Posting No.: DOE-ID-INL-20-084

SECTION A. Project Title: Integrated Fast Flux Test Facility and EBR-II Driver Fuel Treatment

SECTION B. Project Description and Purpose:

Revision 1:

This revision updates the general project description to recognize the integration of High Assay Low Enriched Uranium (HALEU) production into the electrometallurgical treatment (EMT) process used in the treatment of sodium bonded metallic fuel, as well additional process enhancements intended to increase process reliability and efficiency. Additions include the incorporation of a multi-tier crucible arrangement ("Drip Cast Crucible") to cast uranium into individual metallic ingots referred to as regulus, a large capacity crucible to be utilized during salt distillation activities, a modified electrode assembly (EA) allowing for in-situ dendrite collection and compaction (SCRAPE) during electrorefining, a revised work station that incorporates fuel bottle inspection and element wire removal in preparation for size reduction, and an additional high temperature vacuum atmosphere furnace capable of salt distillation as well as uranium casting (Multi-Function Furnace (MFF)). The design and install of the MFF is covered on a separate EC, INL-18-001. These additions support the November 2019 Supplemental Agreement to the Idaho Settlement Agreement which requires EBR-II Driver Fuel Treatment to be completed by 12/31/2028., and also supports the DOE decision to make EBR-II HALEU available as feedstock for advanced nuclear fuels (see Environmental Assessment DOE/EA-2087). Purpose Statement

As part of the Idaho National Laboratory's (INL) Nuclear Material Management Strategy to mitigate the risks, liabilities, and vulnerabilities related to continued storage of excess special nuclear material, this project seeks to commence and execute a campaign for the treatment of approximately 2,270 kg of Experimental Breeder Reactor-II (EBR-II) sodium-bonded metal fuel currently in storage at the Idaho Nuclear Technology Engineering Center (INTEC) and approximately 250 kg of similar Fast Flux Test Facility (FFTF) fuel currently stored at the Materials and Fuels Complex (MFC). This project will utilize the electrometallurgical treatment (EMT) system currently installed within the Fuel Conditioning Facility (FCF) to process the fuel in accordance with the July 2000 Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel [Department of Energy/Environmental Impact Statement (DOE/EIS)-0306] and associated Record of Decision. The EMT system and associated process enhancements will also support the HALEU supply mission, as well as support compliance with the 2019 Supplemental Agreement to the Idaho Settlement Agreement.

Needs Statement

In order to mitigate exisiting risks, liabilities and vulnerabilites associated with the continued wet storage of the irradiated, highly enriched uranium, EBR-II metal driver fuel in the INTEC CPP-666 storage basin, as well as the irradiated FFTF metal driver fuel stored in the Hot Fuel Examination Facility (HFEF) hot cell, the INL has commenced with an initiative to campaign the treatment of this material through the EMT treatment system. The treatment of this material is contingent on the return of the EBR-II driver inventory from INTEC, as well as the disassembly of the FFTF material in HFEF, and its subsequent transfer to FCF. Metal and Carbide FFTF fuel stored at the Radioactive Scrap and Waste Facility will also be taken to FCF for treatment. A $19.5M Congressional earmark approved as part of the 2010 appropriations bill for "management of sodium-bonded fuels in the EM portfolio, has provided the funding to cover the FFTF material treatment, and additional funding is being sought to support future treatment of the EBR-II material. This Environmental Checklist (EC) seeks to support and confirm the previous National Environmental Policy Act (NEPA) coverage developed as part of the DOE/EIS-0306. Additionally, the EC is intended to cover the handling, sizing, and eventual electrorefining of the EBR-II and FFTF sodium-bonded material being returned to the INL from the Alpha Gamma Hot Cell at the Argonne National Laboratory. The November 2020 revision to this EC also recognizes the integration of the HALEU production mission as it relates to EMT processing of EBR-II sodium bonded fuel, as well as efficiency and reliability enhancements being pursued to comply with the conditions establishedf in the November 2019 Supplement Agreement to the Idaho Settlement Agreement.

General Project Description

- The EMT of used nuclear fuel allows recovery of uranium through electrochemical and metallurgical techniques and conditioning of the fission products and transuranics in stable waste forms. This process is described in detail in the July 2000 Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel [Department of Energy/Environmental Impact Statement (DOE/EIS)-0306], Chapter 2.

- The FFTF elements that were candidates for electrorefining have undergone disassembly, de-wiring, and repackaging in HFEF, and then were transferred to FCF for interim storage in zones P50 & P51 prior to introduction to the Production Element Chopper. Hex cans and related irradiated hardware were packaged as waste and dispositioned accordingly. After EMT the cladding may be sent to the metal waste form furnace in HFEF for processing into metal ingots, or undergo comparable treatment and handling steps to facilitate its ultimate disposition in a suitable repository.

- Processing of the majority of FFTF driver fuel in the FCF MK-IV electrorefiner completed in 2011, however some research quantities may require treatment in the future if not retained for ongoing research. The receipt of return shipments of EBR-II driver fuel from INTEC using the HFEF-6 Cask commenced in 2010 and will continue through 2023. This fuel will be received, inspected for the presence of water, and if none is found, placed into interim storage. While it is anticipated that very few bottles will test positive for the presence of water, planning has been developed to remove any water

via heated vacuum evaporation, followed by condensing of the resulting vapor, and ultimate disposal via the Radioactive Liquid Waste Treatment Facility (RLWTF). Empty bottles previously used to contain the fuel will be containerized and dispositioned as low-level radioactive waste.

- FFTF processing completed in FY2012, at which time the processing of the EBR-II driver fuel resumed. Return of the EBR-II fuel from INTEC is expected to continue through 2023 at which time the entire EBR-II fuel inventory at INTEC will have been transferred to MFC.

- The EMT processing rate will increase to minimize the duration of the campaign and result in a change to the operating schedule from 9 x 80's to 7 x12's, and eventually 7 x 24.The increased EBR-II spent nuclear fuel (SNF) processing is within the fuel disposition quantities analyzed in DOE/EIS-0306 and is consistent with the associated Record of Decision.

- It is currently assumed that upon completion of the driver fuel campaign, blanket processing (of 18780 kg) through the FCF electrorefiners will commence at an accelerated rate. Note that equipment development/replacement may need to occur to achieve target production rates in the out years.

- Production of smaller size metallic uranium ingots has been integrated into the EMT process and utilizes a multi-tier graphite crucible to produce High Assay Lowe Enriched "regulus" to facilitate re-use of the EBR-II uranium (see Environmental Assessment DOE/EA-2087 for additional details).

- Additional process enhancements will be pursued to support increases in process reliability and treatment efficiency. These enhancements include: deployment of a larger capacity graphite crucible during salt distillation activities at the cathode processor, a modified electrode assembly (EA) allowing for in-situ dendrite collection and compaction (SCRAPE) during electrorefining, and a revised work station that incorporates fuel bottle inspection and element wire removal in preparation for size reduction. An additional high temperature vacuum atmosphere furnace, capable of salt distillation as well as uranim casting (Multi-function furnace (MFF)) will also be installed. The design and install of the MFF is covered in a separate EC, INL-18-001.

- Additional equipment installations and replacements may be required to achieve the desired objectives; however the exact nature of these requirements is unknown at this time.

Sodium Bonded Fuel Treatment Strategy and Assumptions

- Return to service the HFEF-6 cask – including maintenance, engineering, procedure development, and training as required.

- Development of Criticality Safety Evaluations and supporting documents for interim storage and handling of EBR-II fuel being returned from INTEC, along with subsequent nuclear safety support.

- Development of a Transportation Safety Plan covering use of the HFEF-6 Cask to transport EBR-II driver fuel between INTEC and FCF.

- Conduct engineering evaluations to investigate the tooling and fixturing required to support receipt and handling of the HFEF-6 cask and its associated payload. Upon completion of engineering, produce the required equipment.

- Investigate potential processing of highly enriched driver fuel in the Mark-V ER – engineering evaluation to identify the limitations associated with processing driver fuel in the Mark-V ER, and compare them with the perceived opportunity of potentially reducing the duration for driver fuel treatment.

- Pilot electrorefining test of EBR-II/INTEC fuel – prepare EBR-II driver fuel returned from INTEC in 1998 and conduct pilot scale experimental tests in the existing Hot Fuel Dissolution Apparatus (HFDA) in HFEF.

- Fulfill spare and critical equipment requirements to support treatment of SNF at increased processing rates.

- Evaluate impacts to EMT process if cadmium is removed from Mark-IV ER operations.

- The system will be located in the FCF argon cell at window 10 (Zone P10) on a common support work table [2]. The State of Idaho Department of Environmental Quality has concurred that the manufacturing process unit (MPU) exemption in IDAPA 58.01.05.005 (40 CFR 261.4(c)] is applicable for the SNF treatment process taking place in the FCF in the Air Cell, Argon Cell, Transfer Tunnel, Decon Spray Chamber, and the Radioactive Liquid Waste System.

SECTION C. Environmental Aspects or Potential Sources of Impact:

Air Emissions

The MFC FCF operates pursuant to Idaho Air Quality Permit to Construct Number P-2015.0023. Under Section 11.1 of the Permit, titled Process Description, the primary mission of FCF is described as "electrometallurgical treatment of sodium-bonded spent nuclear fuel from EBR-II, Fermi-1, the FFTF, and smaller amounts of other sodium-bonded fuels. The spent fuel inventory is described in a July 2000 Final Environmental Impact Statement (FEIS) (DOE/EIS-0306) for sodium-bonded fuels from EBR-II, Fermi-1, FFTF and from miscellaneous smaller sources. Section 11.3 "Throughput Limit" of this Permit indicates that processing of sodium-bonded nuclear fuel (driver fuel, blanket fuel, and experimental fuels described in the FEIS shall be limited to no more than 5,000 kilograms (11,023 pounds) of fuel per year." The proposed activity will not exceed or significantly approach the 5,000 kg of fuel process per year, and will not necessitate a modification to the Idaho Air Quality Permit to Construct.

Discharging to Surface-, Storm-, or Ground Water

N/A

Disturbing Cultural or Biological Resources

MFC-765/FCF (Fuel Conditioning Facility), constructed in 1963, is eligible for listing on the National Register of Historic Properties (36 CFR 60) and is considered a Category 2 historic property (INL Cultural Resource Management Office 2016, 338).

Generating and Managing Waste

Conservative estimates on the amount of waste produced as part of the EMT process include approximately 5600 kg of metal waste (element cladding) and 55,000 kg of ceramic waste (ER salt and glass additives), in the recovery of approximately 12,000 kg of Uranium. The EIS presently defines these metal wastes and ceramic wastes as high level waste.

Hex cans from the FFTF campaign and related irradiated hardware will be packaged and dispostioned as remote handled low level waste. This waste will have a total volume of approximately 3.7m 3. Hex cans and irradiated hardware associated with EBR-II driver fuel have previously been sized and packaged (1970's and 1980's). Some of this hardware has been placed into Radioactive Waste Management Complex (RWMC) at the INL, and some has been placed into Radioactive Scrap and Waste Facility (RSWF) awaiting final disposition.

Empty bottles from EBR-II driver fuel will be dispositioned as low level waste (LLW). There are 3,624, 2 inch diameter stainless steel bottles. If it is assumed that none of them are leakers (the most conservative from a waste disposition standpoint) and they will all be dispositioned as LLW, we conclude that 3,624 bottles have a volume 5.1 m3.

The liquid generated will be pumped into containers via fill stations. The containers will then be sent off-site for compliant disposal. The project assumes that 5% of the bottles will contain water. There are 3624 bottles, so this equates to 181 wet bottles. The largest volume estimation of each bottle found is 1225 cm3 (source: F0000-0050-AK-00). Being conservative by not accounting for the displaced volume of any of the fuel elements, and assuming that all wet bottles are completely full of water, it is assumed that 222 liters will be sent to the RLWTF.

Samples will be taken of every fourth batch of the molten salt medium to ensure criticality limits are being met. These samples will be managed in accordance with Waste Generator Services procedures.

Releasing Contaminants

Project activities will include the routine use of chemicals and reagents by the MFC Analytical Laboratory for chemical and uranium isotopic analysis.

Using, Reusing, and Conserving Natural Resources

The project will implement appropriate waste minimization and recycling practices where practicable. Production of smaller size metallic uranium ingots to produce High Assay Low Enriched "regulus" will facilitate re-use of the EBR-II uranium.

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"

July 2000 Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel (DOE/EIS-0306), July 2000. Air Emissions - Idaho Air Quality Permit to Construct Number P-2015.0023

Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (DOE/EIS-0243) and supplemental analysis (SA) (DOE/EIS-0243-SA-01)

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."

The environmental impacts of transferring low level waste from the INL to the Nevada National Security Site were analyzed in the 1996 Nevada Test Site EIS (DOE/EIS-0243) and supplemental analysis (SA) (DOE/EIS-0243-SA-01) 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. The SA considers additional waste streams, beyond those considered in the 1996 NTS EIS, that may be generated at or sent to the Nevada National Security Site for management.

The spent fuel inventory under consideration and the planned method of treatment is specified in the July 2000 Final Environmental Impact Statement (FEIS) for sodium-bonded fuels from EBR-II, Fermi-1, FFTF and from miscellaneous smaller sources. Air Emissions - The proposed activity will not exceed or significantly approach the 5,000 kg of fuel process per year, and will not necessitate a modification to the Idaho Air Quality Permit to Construct.

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

Approved by Jason Sturm, DOE-ID NEPA Compliance Officer on: 11/19/2020