# DOE-ID NEPA CX DETERMINATION
# Idaho National Laboratory



CX Posting No.: DOE-ID-INL-20-066

**SECTION A.** Advancement of Technology to Remove Bond Sodium from Fermi-1 Blanket Material

**SECTION B. Project Description and Purpose:**

Revision 2

As part of the multi-facility wide effort for the MEDE project, an initial quantitative analysis of selected elements will be tested to verify no residual sodium following the MEDE process. A gas collection manifold will be installed in the MFC-752 Analytical Laboratory, room B-116 where the analysis will be performed. The manifold will be located on the east wall (near the south-east corner) of room B-116. The manifold is used for the determining metallic sodium through its interaction with water and subsequent production of hydrogen gas. Following the MEDE process, the fuel rod is placed in a Lab Transfer Cartridge (LTC) and received by 752AL. The cartridge has two VCR connections on the top which will be connected to the manifold. The system is purged with argon and the void volume measured using the calibrated volume and gas sample bottle. A geared pump is used to deliver a prescribed amount of pure water into the LTC. Upon contact with sodium metal, the water and sodium will react generating gaseous hydrogen that is captured (approximately 70%) in the gas collection cylinder. The temperature and pressure of the system is monitored until the system comes to equilibrium, then the sample is removed. Water removal is done by removing the LTC from the manifold and placing it with the bottom elevated, draining the water into a bottle. Water removal can be aided using argon. The excess hydrogen gas is evacuated into the suspect exhaust system after isolating the gas collection cylinder and before removing the LTC.

This manifold will enable researchers to perform the necessary analysis needed for completing Analytical Lab's part in the multi-facility effort MEDE project.

Part of this revision is to address changes or clarification to the original scope. The changes/clarifications include:

- The location of the project scope in revision 1 is at the Engineering Development Laboratory (EDL) (MFC-789)
- Clarification in the original EC for the following:
    - The proposed action designs and fabricates one (not two identical) MEDE system for operation with a single full length Fermi-1 radial blanket assembly.
    - Change the term "one" to "multiple" in reference to full-length unirradiated Fermi-1 blanket elements.

Revision 1

This revision addresses project scope to be completed at the Engineering Development Laboratory (EDL) at MFC. The proposed melt-drain-evaporate (MEDE) system is made from various components and will be tested using mock components (e.g., furnace, retort, mockup elements, mockup assemblies, furnace controller, furnace stand, glove box tools, etc..). The proposed action delivers these materials to the EDL for assembly. Personnel will cut the 150 lbs. mockup assembly (stainless steel tubing) then slide it into a horizontal retort. Work at the EDL will not involve sodium or sodium components. Personnel then rotate the retort (220 lbs.) and place it in the furnace. The furnace is heated to 650 °C then cooled to develop a heating recipe based on readings from a multipoint thermocouple embedded in the mockup assembly. Removing the assembly follows the previous steps in reverse order.

The remaining scope, work activities, and environmental impacts analyzed in the original EC remain unchanged.

Original EC

The Enrico Fermi Atomic Power Plant (Fermi-1) was designed and built to demonstrate the feasibility of the fast breeder reactor for electric power production. Fermi-1 was a sodium cooled, fast reactor. Argonne National Laboratory (ANL) contributed information based upon Experimental Breeder Reactor (EBR)-I and EBR-II to assist in the design of the Fermi-1 reactor. The reactor achieved initial criticality in 1963 and operated until September 1972.

After the Fermi-1 reactor shutdown, blanket assemblies were placed into 14 stainless steel canisters (each with a carbon steel basket inside), which were filled with helium and welded shut, and transported to the Idaho Nuclear Technology and Engineering Center (INTEC) in 1974 and 1975 in 14 shipments. The canisters measure 3.4 meters (11 feet, 2.5 inches) long and 65 centimeters (25.5 inches) in diameter. Twelve of the canisters contain radial blanket assemblies and two of the canisters contain shorter axial blanket assemblies. The total quantity of Fermi-1 blanket material stored at the Idaho National Laboratory (INL) Site, both axial and radial, is about 34 metric tons of heavy metal (MTHM).

The Department of Energy (DOE) committed to remove all spent nuclear fuel from Idaho by 2035 in a 1995 agreement with the State of Idaho (Settlement Agreement and Consent Order issued on October 17, 1995, in the actions of *Public Service Co. of Colorado v. Batt*, No. CV 91–0035–S–EJL [D. Id.], and *United States v. Batt*, No. CV 91–0054–EJL [D. Id.]). Before sodium-bonded spent nuclear fuel can be removed from the State of Idaho for ultimate disposal, the fuel requires treatment. In the Final Environmental Impact Statement (EIS) for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel (DOE/EIS-0306, July 2000) and Record of Decision (ROD) (September 2000), DOE decided to electrometallurgically treat EBR–II spent nuclear fuel (about 25 metric tons of heavy metal) and miscellaneous small lots of sodium-bonded spent nuclear fuel at Argonne National Laboratory-West (ANL-W), now known as the Materials and Fuels Complex (MFC), and monitor the results and costs while continuing the development of sodium removal techniques for the Fermi-1 blanket spent nuclear fuel.

Consequently, in 2003 INL completed a technical feasibility study to remove the bond sodium from the Fermi-1 blanket material via a melt-drain-evaporate (MEDE) technique. The study demonstrated bond-sodium removal from cut segments of unirradiated Fermi-1 blanket elements. The study also included a life-cycle cost estimate, which proposed treatment of the Fermi-1 blanket material as full-length assemblies. However, bond-sodium removal from full-length

assemblies of Fermi-1 blanket material has not been demonstrated. Therefore, the purpose of the proposed action is to demonstrate the technological feasibility of using the MEDE process on full-length assemblies.

The proposed action uses multiple full-length unirradiated Fermi-1 blanket elements and one intact assembly in a radiological glovebox at the Fuels and Applied Science Building (FASB), building MFC-787, at MFC. Identical equipment could be used in a hot cell at MFC to demonstrate the bond-sodium removal technology with one additional irradiated full-length Fermi-1 blanket assembly. INL anticipates the proposed action will contribute needed information and technical assurance towards scale-up and treatment of 34 MTHM of Fermi-1 blanket material.

The proposed action designs and fabricates one MEDE system for operation with a single full length Fermi-1 radial blanket assembly. The project installs the first MEDE system in a new inert-atmosphere radiological glovebox at FASB. The project initially operates the MEDE apparatus using multiple loose unirradiated Fermi-1 blanket elements to assess operating conditions necessary for bond sodium removal from full length materials. Once operating conditions are defined, the proposed action operates the glovebox MEDE apparatus to demonstrate bond sodium removal using the last intact unirradiated full-length Fermi-1 radial blanket assembly. The activity includes sampling and analyzing the blanket slugs and cladding to verify removal of the sodium metal. The project retains blanket slugs and cladding for potential future disposition assessments and uses the collected bond sodium for developing a suitable waste form for this material.

The proposed action prepares the second MEDE apparatus for remote operations in the Fuel Conditioning Facility (FCF) Mock-up Area, incorporating lessons learned from operations with the FASB glovebox apparatus. The project installs the second MEDE apparatus in either the Hot Fuel Examination Facility (HFEF) or FCF argon-atmosphere hot cell to accommodate operations with full-length irradiated blanket material. The primary objective of the hot-cell MEDE operations is to verify swelling of irradiated blanket slugs does not impede the removal of bond sodium. The project initially operates the hot-cell MEDE apparatus using multiple, unirradiated full-length Fermi-1 blanket elements to qualify the remotely operated system.

Following qualification, the proposed action operates the system using one irradiated full-length Fermi-1 blanket assembly, which requires retrieval from the INL Underground Fuel Storage Facility (CPP-749) at INTEC. The project anticipates transporting the Fermi-1 blanket assembly from CPP-749 to MFC using the HFEF-14 cask. If retrieving the Fermi-1 blanket assembly from CPP-749 is impractical, the project could use an irradiated EBR-II blanket assembly–particularly if the burnup of the EBR-II blanket material closely matches that of the Fermi-1 blanket material.

Following hot-cell MEDE operations, the project samples and analyzes blanket slugs and cladding to verify sodium removal. The project also analyzes blanket slug samples, cladding samples, and removed bond sodium samples to determine fission and activation composition to assess classification of the products. Recovered bond sodium could be used to demonstrate and qualify a suitable waste form for this recovered material.

The Final Environmental Impact Statement (EIS) for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel (DOE/EIS-0306, July 2000) and Record of Decision (ROD) (September 2000) analyzed the environmental impacts from evaluating treatment methods for Fermi-1 sodium bonded fuel at INL. The analysis included installing equipment and modifying existing facilities to complete activities associated with evaluating treatment methods for the Fermi-1 blanket material. The evaluation in DOE/EIS-0306 also covers treatment of both Fermi-1 blanket (34 metric tons of heavy metal) and other sodium-bonded spent nuclear fuel. DOE/EIS-0306 states the environmental consequences of treating Fermi-1 blanket fuel using the MEDE process are equal to or bounded by the EIS (p. 4-97).

This environmental checklist covers demonstration of bond sodium removal from Fermi-1 blanket material using the MEDE process with dedicated equipment using full-length assemblies to furnish necessary information and technical assurance towards scale-up and treatment of 34 MTHM of Fermi-1 blanket material. Before making a decision to treat or dispose of the Fermi-1 blanket spent nuclear fuel, DOE will determine whether the analysis in DOE/EIS-0306 is adequate to support a subsequent Record of Decision or whether additional NEPA review is required and notify the public of its preferred approach for the Fermi-1 blanket spent nuclear fuel at least 30 days before issuing a Record of Decision regarding treatment or disposal as stated in DOE/EIS-0306 (p. 2-41).

## SECTION C. Environmental Aspects or Potential Sources of Impact:

**Air Emissions**

Project activities will result in radiological and chemical emissions at FCF, HFEF, Analytical Laboratory, EDL (only chemical) and FASB buildinexhaust system. All radionuclide release data associated with project activities will be recorded as part of the HFEF, FCF, and FASB stack monitors.

Emissions at FCF are regulated by a Permit to Construct (PTC P-2015-0023) and are continuously monitored with a stack monitoring system that complies with the requirements of 40 CFR 61.93. In Section 11.1 of P-2015-0023, "Process Description," the activities at FCF are described as "electrometallurgical treatment of sodium-bonded spent nuclear fuel from EBR-II, Fermi-1, the Fast Flux Test Facility (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 2.4 "Throughput Limit" of this Permit indicates that processing of sodium-bonded nuclear fuel (driver fuel, blanket fuel, and experimental fuels described in the FEIS) would be limited to no more than 5,000 kg (11,023 pounds) of fuel per year. The proposed activity, when combined with current facility operations, would not cause FCF to exceed or approach the 5,000 kg of fuel processed per year, and would not necessitate a modification to the Idaho Air Quality Permit to Construct.

The Sodium Bonded Fuel EIS (DOE/EIS-0306) evaluated air emissions from continuing the development of sodium removal techniques for the Fermi-blanket spent nuclear fuel. In DOE/EIS-0306, DOE determined these activities would have a negligible impact on air quality, and air quality at INL would not change (DOE/EIS-0306 p. 2-43).

Radionuclide release data associated with the analysis of these experiments will be recorded as part of the HFEF, Analytical Lab, and FASB stack monitors and provided to Programs Environmental Support organization. The work in HFEF, Analytical Lab, and FASB is not a modification in accordance with Idaho Administrative Procedures Act (IDAPA) 58.01.01.201 and 40 Code of Federal Regulation (CFR) 61 Subpart H. Releases of radioactive and non-radioactive airborne contaminants from these processes are not expected to result in an increase in emissions

**Discharging to Surface-, Storm-, or Ground Water**

N/A

**Disturbing Cultural or Biological Resources**

HFEF (MFC-785) and the Analytical Laboratory (MFC-752) are eligible for nomination to the National Register of Historic Places. Removal and/or changes of original features may adversely impact this historic property.

**Generating and Managing Waste**

The Sodium Bonded Fuel EIS evaluated waste generation from the proposed action, including low-level waste (LLW), transuranic (TRU), mixed, hazardous, and nonhazardous waste. Some additional low-level radioactive waste and transuranic waste would be generated from the deactivation of the demonstration project. The volumes of these waste types are presented in DOE/EIS-0306 Table 2–4 (pp. 2-50 through 2-51).

The project retains blanket slugs and cladding for potential future disposition assessments and uses the collected bond sodium for developing a suitable waste form for this material.

**Releasing Contaminants**

Chemicals will be used and will be submitted to chemical inventory lists with associated Safety Data Sheets (SDSs) for approval prior to use. The Facility Chemical Coordinator will enter these chemicals into the INL Chemical Management Database. All chemicals will be managed in accordance with laboratory procedures. When dispositioning surplus chemicals, project personnel must contact the Facility Chemical Coordinator for disposition instructions.

Although not anticipated, there is a potential for spills when using chemicals or fueling equipment. In the event of a spill, notify facility Environmental Staff. If Environmental Staff cannot be contacted, report the release to the Spill Notification Team (208-241-6400). Clean up the spill and turn over spill cleanup materials to WGS.

**Using, Reusing, and Conserving Natural Resources**

All applicable waste will be diverted from disposal in the landfill when possible. Project personnel will use every opportunity to recycle, reuse, and recover materials and divert waste from the landfill when possible. The project will practice sustainable acquisition, as appropriate and practicable, by procuring construction materials that are energy efficient, water efficient, are bio-based in content, environmentally preferable, non-ozone depleting, have recycled content, and are non-toxic or less-toxic alternatives.

**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, B1.31 "Installation or relocation and operation of machinery and equipment"

Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel (DOE/EIS-0306, 2000).

**Justification:** Project activities are consistent with 10 CFR 1021, Appendix B to Subpart D, 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".

DOE directed continued evaluation methods for treating Fermi-1 blanket fuel stored at INL and evaluated the enviromental impacts of the that action, including waste generation and disposal, in the "Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel" (DOE/EIS-0306).

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: 08/24/2020