

DOE-ID NEPA CX DETERMINATION

Idaho National Laboratory

SECTION A. Project Title: Lightbridge Experiment (LB-1)

SECTION B. Project Description and Purpose:

Lightbridge is developing proprietary next-generation metallic nuclear fuel technologies and a fuel assembly design for power uprates in existing water reactors. The purpose of the Advanced Test Reactor (ATR) Experiment Design Project is to evaluate thermo-mechanical properties of the Lightbridge fuel material, including thermal conductivity and volumetric swelling of fuel material as a function of nuclear burnup. The proposed action may investigate additional properties of the fuel material (e.g., Young's modulus, etc.) if physical and programmatic conditions allow.

INL personnel at the Materials and Fuels Complex (MFC) and ATR Complex coordinate experiment fabrication, characterization, irradiation, and post irradiation examination (PIE). The Project designs, analyzes, and fabricates experiment components at the Research and Education Campus (REC). MFC fabricates and characterizes experiments and performs post irradiation examination (PIE) on irradiated specimens. The Test Train Assembly Facility fabricates the experiment components, and ATR irradiates the experiments.

The first designed experiment, designated as LB-1, will be a fueled drop-in experiment (B7). Experiment capsules each contain one fueled rodlet suitable for ATR irradiation. The fuel in the Lightbridge experiments will be U-50Zr (50 weight percent zirconium, ~UZr2). The project fabricates and assembles experiment capsules meeting the intent of ASME Section III, Class 1. Personnel at MFC validate fuel compositions and forms prior to insertion in the ATR.

The project performs neutronic, structural, and thermal analyses, and prepares the Experiment Safety Assurance Packages (ESAPs) required for ATR experiment insertion. Operations Systems Engineering, ATR Facility Safety Engineering, and the Safety Operations Review Committee (SORC) review and approve the ESAPs.

Following fabrication, INL ships FAST fuel assemblies from MFC to ATR using a Type-A shipping container. The proposed action irradiates the experiment in ATR for multiple cycles, in both the OA and SI positions. INL removes capsules from the ATR core during scheduled ATR outages as needed to replace the cadmium baskets, replace flux-wire monitors, and accommodate basket reconfigurations. INL may remove some capsules from the experiment assembly, ship them to HFEF for NRAD radiography imaging, and then ship them back to the ATR for continued irradiation. INL will insert an empty "dummy" capsule in place of the removed capsule(s) if INL cannot perform NRAD imaging during the cycle outage. INL removes capsules from ATR and stores capsules in the ATR Canal until the capsules have cooled down.

Following irradiation, INL ships the capsules to HFEF for PIEs using the GE-100 cask or another approved shipping container. Prior to shipment, INL determines the source term and heat load for the shipment. HFEF may transfer samples to the Analytical Lab (AL), Fuels and Applied Sciences Building (FASB) or the Electron Microscopy Lab (EML) at MFC or other internal (INL) laboratories for additional PIE analysis, as necessary. Shipping material to other laboratories requires revising this Environmental Compliance Permit (ECP).

The following paragraphs discuss general operations performed in HFEF to support PIE:

Photo-visual Inspection: After unloading from the shipping cask, INL visually inspects experiment exteriors using a digital camera via periscope or through a hot cell window to identify any damage or degradation.

Neutron Radiography: Prior to disassembly, INL may perform neutron radiography using the NRAD reactor to establish the general condition of fuel.

Gamma Scanning:

INL may examine experiments using precision (isotopic) gamma scanning to obtain information on both fission product migration and shifting of fuel compacts within the capsules.

Disassembly:

INL disassembles experiments extract capsule components, including fuel. Activities include photographing and measuring fuel components from the irradiation capsules. The project may send some components sent to the AL for analysis, some to the containment box for sectioning and mounting, and others to the FACS furnace for safety testing. The project also examines other hardware associated with disassembly in HFEF and the AL.

Safety Testing:

INL completes safety testing by placing irradiated fuel specimens in the high temperature furnace system in HFEF and heating the fuel while measuring the release of metallic and gaseous fission products as a function of time. A high-purity helium sweep gas is metered past the heated fuel sample in the furnace and is routed to a fission gas monitoring system, which cryogenically traps the Kr and Xe gases for radioactive emissions counting. Following counting, the Kr and Xe gases are exhausted to the HFEF stack.

After PIE, irradiated test pin segments and PIE remnants will be stored with other similar DOE-owned irradiated materials and experiments at MFC, most likely in the 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 irradiated test pin segments and PIE remnants 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...".

In addition, to complete proposed work activities, it is necessary for the project to use the HFEF hot cell which contains both defense and nondefense related materials and contamination. Project materials will come into contact with defense related materials. It is impractical to clean out defense related

DOE-ID NEPA CX DETERMINATION

Idaho National Laboratory

contamination, and therefore, waste associated with project activities is eligible for disposal at the Waste Isolation Pilot Plant (WIPP). National Environmental Policy Act (NEPA) coverage for the transportation and disposal of waste to WIPP are found in *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 transuranic (TRU) waste at the generator-storage facilities would be conducted. The Department has analyzed transuranic (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

Packaging, repackaging, transportation, receiving, and storing used nuclear fuel and R&D for used nuclear fuel management is covered by DOE's *Programmatic Spent Nuclear Fuel (SNF) Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (EIS) 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 (February 1996). The analyses include those impacts related to transportation to, storage of, and research and development related to used nuclear fuel at the INL (see Tables 3.1 of the SNF Record of Decision (May 30, 1995) and Table 1.1 of the Amended Record of Decision [February 1996]).

The potential for transportation accidents was analyzed in the SNF EIS (Section 5.1.5 and Appendix I-5 through I-10).

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.

In addition to disposal of the irradiated fuel that will be generated as described above, industrial, mixed, and low-level waste (LLW) will be generated throughout the R&D process. This waste will be classified and disposed of in accordance with INL procedures and DOE regulations and requirements.

SECTION C. Environmental Aspects or Potential Sources of Impact:

Air Emissions

Experiment irradiation and PIE will be performed at the ATR and MFC facilities. Air emissions would include minor amounts of radionuclides and toxic air pollutants. The irradiation in the ATR 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. ATR radionuclide emissions are sampled and reported in accordance with Laboratory Wide Procedure (LWP)-8000 and 40 CFR 61 Subpart H.

The irradiated specimens will be delivered to the MFC HFEF for disassembly and then undergo routine PIE before being sent to the AL for analysis. The PIE examination in HFEF and the analysis completed in the Analytical Lab 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.

Packaging in HFEF 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 airborne contaminants from the proposed action are not expected to increase to the annual dose to the Maximum Exposed Individual (MEI).

Discharging to Surface-, Storm-, or Ground Water

N/A

Disturbing Cultural or Biological Resources

MFC-752 is over 50 years old. However, there will be no structural or aesthetic changes made to the building.

Generating and Managing Waste

Total project transuranic waste volume is projected to be less than 1 m³. Experiment disassembly creates relatively small amounts of LLW radioactive waste for disposal. Cutting, slicing, grinding, and polishing activities create small volumes of remote handled LLW.

Releasing Contaminants

Although not anticipated, there is a potential for spills when using chemicals

DOE-ID NEPA CX DETERMINATION

Idaho National Laboratory

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.

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"

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."

NEPA coverage for the transportation and disposal of waste to 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

**DOE-ID NEPA CX DETERMINATION
Idaho National Laboratory**

Approved by Jason L Anderson, DOE-ID NEPA Compliance Officer on: 03/15/2021