

DOE-ID NEPA CX DETERMINATION

Idaho National Laboratory

SECTION A. Project Title: Fuel Oxidation and Gas Release

SECTION B. Project Description and Purpose:

The outer portion of high burnup (HBU) nuclear fuel, i.e., fuel with an average rod burnup of >60 giga-watt-days/ton (GWd/tU) of uranium, can fragment into a powder during loss of coolant accident (LOCA) scenarios and can relocate or disperse throughout and out of the cladding. The mechanism of fragmentation needs to be understood and is thought to be a combination of pressurized fission gas on the grain boundaries and thermal stress release. The proposed action characterizes the retention of fission gas on the grain boundaries to improve the understanding of fuel fragmentation, relocation, and dispersal (FFRD) phenomena and allow improved accident modeling required by the Nuclear Regulatory Commission (NRC). The proposed action targets specific locations of irradiated fuel for gas retention and release analysis to evaluate fragmentation mechanisms during LOCA scenarios.

The proposed action removes small fuel cubes (200-300 microns in size) from a selected location of high burnup (HBU) UO₂ fuel using the plasma focused ion beam (P-FIB) and exposes the cubes to oxidizing atmospheres at low temperatures (300-500°C) to induce preferential grain boundary release of fission gas. The project uses samples currently located at the Irradiated Materials Characterization Laboratory (IMCL) from Rod A Section B16 IAW from the North Anna power plant in Virginia currently stored at the IMCL. The parent fuel rod was irradiated to an average burnup level of 71 GWd/tU. Each sample cube is approximately 3E-07 g and will be hand carried from IMCL to the Hot Fuel Examination Facility (HFEF) for analysis.

After transfer to HFEF, the proposed action connects samples to the gas assay sample and recharge (GASR) system. The operator evacuates the capsule and backfills it with the experimental atmosphere—either 100% He or 20%O₂-He balance three times to verify complete removal of gases from the loading glovebox. Gases from the loading glovebox include helium, argon, and nitrogen. These gases, except He, need to be removed because they dilute fission gases of interest.

After filling, capsules move to a bake-out furnace. A steel plate places capsules in the furnace. The entire apparatus in the HFEF main cell consists of up to two capsules, the steel top plate, a thermocouple placed in the middle of the samples, and the bake-out furnace.

Following heat treatment, the fission gas measurement system (FGMS) analyzes each capsule. The system evacuates the capsule gas into a cryogenic trap to eliminate remaining oxygen and fission gases (Xe and Kr). The cryogenic trap uses liquid nitrogen to generate the cryogenic conditions. The capsule is then swept clear with helium gas and the helium is exhausted.

After sample analysis on the FGMS system, the project transfers the samples back to the IMCL where the capsule is opened and discarded after sample retrieval. The sample is then examined at IMCL for microstructure and chemical character.

After examination, the irradiated sample segments and remnants would be stored with other similar DOE-owned irradiated materials and experiments at the Materials and Fuels Complex (MFC), most likely in the HFEF or the Radioactive Scrap and Waste Facility (RSWF) in accordance with DOE's Programmatic Spent Nuclear Fuel (SNF) Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs 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 sample segments and PIE remnants would be along with similar DOE-owned irradiated materials and experiments currently at MFC.

Packaging, repackaging, transportation, receiving, and storing used nuclear fuel and research and development 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 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 analysis includes 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 EIS limits the number of shipments to the INL, and the proposed activities would fall within the limits of the EIS.

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 contamination, and therefore, waste associated with project activities is eligible for disposal at the Waste Isolation Pilot Plant (WIPP). 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 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.

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SECTION C. Environmental Aspects or Potential Sources of Impact:

Air Emissions

The irradiated samples will undergo routine PIE at HFEF and all radionuclide release data will be recorded as part of the HFEF continuous stack monitors and provided to the Environmental Support organization. The PIE examination 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 these processes are not expected to result in an increase to the annual dose to the Maximum Exposed Individual (MEI). An air Permitting Applicability Determination (APAD) will be completed to document this determination.

Generating and Managing Waste

Project personnel will work with Waste Generator Services (WGS) to properly manage and store samples. Normally, storage of samples is limited to one year in accordance with company procedures. After completion of research activities, storage of samples greater than one year will require project or HFEF personnel to annually review sample inventory. Project or HFEF personnel will notify the Program Environmental Lead for post-research samples exceeding one year in storage and provide updates on sample disposition.

Project personnel would work with Waste Generator Services (WGS) to properly package and transport regulated, hazardous or radioactive material or waste according to laboratory procedures.

The proposed action could generate Personal Protective Equipment (PPE) and towels used for cleaning and polishing.

Project activities have the potential to generate transuranic (TRU) waste. Project activities will generate less than 1 m³ of TRU waste.

Releasing Contaminants

All chemicals utilized by the project would be managed in accordance with laboratory procedures.

Using, Reusing, and Conserving Natural Resources

All materials would be reused and recycled where economically practicable. All applicable waste would be diverted from disposal in the landfill where conditions allow. Project personnel will use every opportunity to recycle, reuse, and recover materials and divert waste from the landfill when possible.

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, 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 Nevada Test Site and Off-Site Locations in the State of Nevada (DOE/EIS-0243) and supplemental analysis (SA) (DOE/EIS-0243-SA-01).

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, Sept. 1997).

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Justification: Project activities are consistent with 10 CFR 1021, Appendix B, 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); and 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 or developed 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."

R&D activities are further encompassed by DOE/EIS-0203, DOE/EIS-0203-SA-01, and DOE/EIS-0203-SA-02 and the Amended ROD (1996). DOE/EIS-0200 made the Nevada National Security Site available to all DOE sites for low-level waste disposal, and DOE/EIS-0243 and ROD (65 FR 10061, February 2000) analyzed the impacts of transportation from the INL and disposal at the Nevada National Security Site.

The impacts of transporting and disposing of waste resulting from defense activities that was placed in retrievable storage pursuant to a 1970 Atomic Energy Commission policy (see Section 1.2) and TRU waste that was reasonably expected to be generated by ongoing activities and programs was analyzed in DOE/EIS-0026 (October 1980) and the Final Supplement Environmental Impact Statement for the Waste Isolation Pilot Plant (SEIS-I) (DOE/EIS-0026-FS, January 1990).

NEPA coverage for the transportation and disposal of waste to WIPP are found in 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. DOE has analyzed TRU waste management activities in 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. (SEIS-II also includes potential transportation between generator sites.)

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: 12/06/2018