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SECTION A. Project Title: advanced LEU Fuel Project (aLEU Fuel)

SECTION B. Project Description and Purpose:

The advanced low enriched uranium fuel (aLEU Fuel) Project conducts reactor analysis (simulations) and experiments focused on sizing and developing power-producing, load-following, long core-life, reactor systems with 19.75% enriched uranium. At present, no commercial reactor deployment is available with such features. The proposed experiments use different materials depending on experimental goals, and Idaho National Laboratory (INL) will conduct the experiments in numerous INL facilities, including the Transient Reactor Test (TREAT) Facility TREAT, Advanced Test Reactor (ATR), Experimental Fuels Facility (EFF), Advanced Fabrication Facility (AFF), Fuels and Applied Science Building (FASB), Hot Fuel Examination Facility (HFEF), Irradiated Materials Characterization Laboratory (IMCL), Experimental Breeder Reactor (EBR)-II Engineering Lab, Energy Innovations Laboratory (EIL), the Analytical Laboratory (AL), and the Center for Advanced Energy Studies (CAES).

In many cases, the personnel prepare test materials, assemble the materials into test trains, irradiate the experiments, and then complete post-irradiation examination (PIE). Other experiments focus on developing new materials and methods to support using novel materials and to support advanced manufacturing for use in nuclear fuels. The project has been ongoing for 2+ years with activities focused on reactor analysis and on test planning, and INL anticipates follow-on funding to continue for four or more years.

Fuel materials used in the experiments include UO₂, pure uranium, U-based alloys, UN, and UC. Materials and alloying agents include Nb, Zr, Mo, steels, zircaloy. Fuel enrichment varies. The proposed action performs experiments with uranium at the Materials and Fuels Complex (MFC). The project may submit samples (microgram quantities) for characterization such as scanning electron microscopy (SEM), transmission electron microscopy (TEM), atom-probe tomography, or secondary ion mass spectrometry.

Fuel development activities include atomization, tape casting of ceramics, sintering, 3D printing, arc-melting, grinding, cutting, etc. Post-irradiation examination in IMCL, HFEF, and TREAT includes electron probe microanalysis, focused-ion beam sample preparation, gamma spectrometry, metrology, neutron radiography, SEM, TEM, and tomography, x-ray tomography and diffraction. Activities in the engineering lab and EIL focus on coatings research on cladding substrates.

Table 1 displays the monthly rates of uranium-bearing materials the proposed action anticipates using. Table 1 values indicate estimates for a month. Neither funding nor resources exist to support these rates for 12 months per year. An annualized rate is therefore about six times the values indicated in the table. The table does not indicate actual uranium compounds, such as UO₂, UC, UN, U-Nb-Zr alloys or other materials listed above, including alloying agents, thermal conductors, and experiment capsule hardware.

Table 1. aLEU Fuel Project Facilities, Grouped by Experiment Type and Conservative Estimates of Uranium Amounts (kg) Used in a Single Month (but not twelve months per year). For conservative annual estimates, multiply monthly rate by 6 (not 12), as explained in the text.

Activity	Facility										
	FASB	EFF	AFF	ATR	TREAT	HFEF	IMCL	AL	CAES	Eng. Lab	EIL
Develop Novel Fuels and Materials	0.10	0.10	0.10							0	0
Fresh Materials Characterization	0.10						0.050	0.050	<0.001*		
Develop Advanced Manufacturing	0.2	0.5	1.0								
INL Irradiation Sample Prep	0.10	0.10	0.10								
INL Irradiation Testing				0.050	0.050						

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PIE of Irradiated Fuels and Materials					0.050	0.10	0.050		<0.001*	
* microsamples of fuels, following established work controls, which already exist in most if not all potential cases										

The proposed experiments are laboratory scale, and INL does not plan to increase scale to engineering scale, pilot scale, or beyond. At present, and for the near future, the proposed action is a development effort, from conceptual to bench-scale, to demonstrate feasibility of materials and methods.

The Department of Energy (DOE) evaluated the environmental impacts of transient irradiations in the TREAT reactor, including 1) transporting experiment materials between MFC and TREAT, 2) pre- and post-irradiation radiography, 3) PIE of test components at HFEF or other MFC facilities, and 4) waste generation and disposal in the Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) for the Resumption of Transient Testing of Nuclear Fuels and Materials (DOE/EA-1954, February 2014).

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 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]).

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 in accordance with INL procedures and DOE regulations and requirements. 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.

SECTION C. Environmental Aspects or Potential Sources of Impact:

Air Emissions

INL will perform experiment irradiation and PIE at the ATR and MFC facilities. Air emissions would include minor amounts of radionuclides and toxic air pollutants. The irradiation in the ATR and in TREAT 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 and TREAT radionuclide emissions are sampled and reported in accordance with Laboratory Wide Procedure (LWP)-8000 and 40 CFR 61 Subpart H. ATR and MFC Environmental Support and Services staff will evaluate experiments prior to insertion in the ATR and TREAT. All radionuclide release data (isotope specific in curies) directly associated with this experiment will be calculated and provided to ATR Programs and MFC Environmental Support organization.

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The irradiated specimens will be delivered to the MFC HFEF for disassembly and then undergo routine PIE before being sent to the Analytical Lab for analysis. All radionuclide release data associated with the PIE portion and analysis of this experiment will be recorded as part of the HFEF and Analytical Lab continuous stack monitors and provided to Programs Environmental Support organization. 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. 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).

All radionuclide release data associated with packaging compacts described in Revision 1 will be recorded as part of the HFEF continuous stack monitor and provided to Program Environmental Support organization. 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 these processes are not expected to result in an increase to the annual dose to the Maximum Exposed Individual (MEI).

Radiological emissions at EIL are not anticipated.

Generating or Managing Waste

Total project waste volume from the research and development performed on the used fuel feedstock is projected to be less than 1 m3. Project personnel must consult the INL Waste Management Program and MFC Waste Generator Services (WGS) staff for characterization and to determine disposition pathways prior to waste generation.

Experiment disassembly creates small amounts of radioactive waste.

Cutting, slicing, grinding, and polishing activities creates remote handled radioactive wastes. Wastes include the grinding and polishing residues and the unused portions of the fuel compacts.

Project and HFEF personnel 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 completing research activities, storage of samples greater than one year will require project and/or HFEF personnel to annually review sample inventory. Project and/or HFEF personnel will notify the Program Environmental Lead (PEL) for post-research samples exceeding one year in storage and provide updates on sample disposition.

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 the 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. New equipment will meet either the Energy Star or SNAP requirements as appropriate (see <http://www.sftool.gov/GreenProcurement>).

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)).

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References: B3.6 : Small-scale research and development, laboratory operations, and pilot projects

Final Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) for the Resumption of Transient Testing of Nuclear Fuels and Materials (DOE/EA-1954, February 2014).

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).

Final Environmental Assessment for the Multipurpose Haul Road Within the Idaho National Laboratory Site (DOE/EA-1772, August 2010).

Final Environmental Assessment for the Replacement Capability for Disposal of Remote-Handled Low- Level Radioactive Waste Generated at the Department of Energy's Idaho Site (DOE/EA-1793, 2011).

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); smallscale 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."

Transportation, receiving, and storing used nuclear fuel, as well as, 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.

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

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 impacts of transporting spent fuel, special nuclear materials, and research fuels between MFC and other INL Site facilities using the Multi-Purpose Haul Road were analyzed in the Final Environmental Assessment for the Multipurpose Haul Road Within the Idaho National Laboratory Site (DOE/EA-1772).

Onsite disposal of RH-LLW was analyzed in the Final Environmental Assessment for the Replacement Capability for Disposal of Remote-Handled Low-Level Radioactive Waste Generated at the Department of Energy's Idaho Site (DOE/EA-1793, 2011).

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: 7/06/2020