

**U.S. Department of Energy- Idaho Operations Office**  
**National Environmental Policy Act**  
**Categorical Exclusion Determination**

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Categorical Exclusion Posting No.: DOE-ID-INL-22-035

**Project Title:** Transient Water Irradiation System in TREAT (TWIST) Commissioning Tests (AFC SiC Experiments) R2

**Project Description and Purpose:**

**Revision 2:**

The Idaho National Laboratory (INL) will design, fabricate, and test silicon carbide (SiC) fuel cladding capsules to support transient testing under extreme reactor conditions. The primary objective is to experimentally validate the performance modeling of SiC-based advanced technology fuel (ATF) through irradiation testing at the Transient Reactor Test Facility (TREAT). SiC composites are being investigated for their potential to enhance nuclear reactor safety by offering superior resistance to high temperatures and accident scenarios compared to conventional zirconium alloy cladding. The INL will design and analyze SiC cladding capsules by leveraging existing SERTTA or TWIST capsule designs, followed by the fabrication of the initial test capsule with integrated instrumentation and fuel assembly preparation. Subsequent TREAT irradiation testing will assess SiC performance under transient conditions, with data collection and analysis conducted to compare experimental outcomes against prior BISON modeling predictions.

The fuel will be fabricated by General Atomics (GA) and shipped to the INL for this project. After the completion of this project, the experiment hardware and fuel will be taken to the Electron Microscopy Laboratory (EML) for disassembly and disposal. The fuel will then go from EML to the Hot Fuel Examination Facility (HFEF) for Post Irradiation Examination (PIE) and final disposal.

The waste that will be generated during this test includes one cubic foot of PPE and wipes and one cubic foot of capsule components that will be classified as low-level waste. No transuranic (TRU) or sodium waste will be generated during this project.

All industrial, universal, hazardous, contact handled low-level radioactive waste (CH-LLW), remote handled low-level radioactive waste (RH-LLW), contact handled mixed low-level waste (CH-MLLW), and remote handled mixed low-level waste (RH-MLLW) will be packaged and dispositioned in accordance with BEA Waste Management Program (WMP) requirements and assistance from the WMP's Waste Generation Services (WGS) subcontractor. All contact handled transuranic radioactive waste (CH-TRU), remote handled transuranic radioactive waste (RH-TRU), contact handled mixed transuranic radioactive waste (CH-MTRU), and remote handled mixed transuranic radioactive waste (RH-MTRU) will be packaged and dispositioned in accordance with BEA WMP requirements, including the WMP TRU Program requirements, and assistance from WGS.

**Revision 1:**

This revision includes an update to the experiment campaign at the Transient Reactor Test Facility (TREAT) at the Idaho National Laboratory (INL) and will now irradiate six fresh fuel experiments as commission tests for the experiment design:

- Five Loss of Coolant (LOC),
- One reactivity-initiated accident (RIA), and
- Thirteen pre-irradiated fuel experiments (nine LOC and four RIA from Byron Nuclear Generation Station) using the Transient Water Irradiation System in TREAT (TWIST) experiment vehicle.

This updated campaign also includes a portion of work that is currently covered under the original section of ECP INL-20-224, High-Burnup Experiments in Reactivity-Initiated Accidents (HERA).

The Materials Fuel Complex (MFC) and Research Education Campus (REC) locations for this work will include:

- Irradiated Materials Characterization (IMCL)
- Hot Fuels Examination Facility (HFEF)
- Analytical Research Laboratory (ARL)
- Advanced Fuels Facility (AFF)/Experiment Fuels Facility (EFF)
- Fuels Manufacturing Facility (FMF)
- Energy Innovation Laboratory (EIL)

The HERA experiments consists of performing in-pile RIA irradiations at TREAT at INL. Follow on irradiations (Phase II) will involve RIA testing of previously irradiated material irradiated in the Byron Nuclear Generating Station. These tests will validate findings from the fresh fuel tests and investigate fuel failure and core coolability thresholds at high burnup. Twenty-five previously irradiated fuel pins from the Byron Nuclear Generating station are at INL as a separate activity. Work on HERA will involve the non destructive and destructive characterization of two of the rods in the shipment as well as the preparation of four rod segments for transient testing in TREAT. Rod segments will be refabricated with new endcaps and diagnostic equipment and loaded into water capsules in the HFEF hot cell. After which they will be shipped to TREAT and irradiated in transient conditions.

Some of the prehydrided (unirradiated) cladding may also be sent to other research facilities for analogue experiments. All material and waste generated from these activities that is transferred outside of INL will remain external to INL, where waste will be handled utilizing the guidelines

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at those facilities as appropriate. This ECP will require a revision once the other research facilities are identified to verify transportation coverage and other off-site work, prior to off-site shipments.

After the post-irradiation examination (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 Spent Nuclear Fuel (SNF) Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (EIS) 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 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 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 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 low level waste (LLW) and mixed low level waste (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 potential for transportation accidents was analyzed in the SNF EIS (Section 5.1.5 and Appendix I-5 through I-10) and in the FRR EIS (Sections 4.2.1 and 4.2.2).

**Original ECP:**

The LOCA (Loss of Coolant Accident) commissioning (LOC-C) experiment will conduct tests on fresh pre-irradiated Light water reactor (LWR) fuel samples to simulate complex nuclear transients. The experiment campaign irradiates four fresh fuel experiments using the TWIST experiment vehicle and two pre-irradiated fuel experiments. TWIST will be a closed coolant loop that is driven by natural circulation to enable prototypic pre-transient coolant conditions. Transient Water Irradiation System in TREAT (TWIST) is ideally suited to the study of fuel response to both Reactivity Initiated Accident (RIA) and Loss-of-coolant Accident (LOCA) conditions. UO<sub>2</sub> and U<sub>3</sub>Si<sub>2</sub> based fuel segments will be supplied by fuel vendors and other national laboratories for testing in the TWIST vehicle. The experiment vehicle allows performance of transient testing at multiple power levels in the Transient Reactor Test Facility (TREAT) center core position. INL performs neutron radiography on the test vehicle and specimens before and after irradiation.

Project scope includes experiment design, analyses, hardware fabrication, fuel specimen fabrication, irradiation, and post-irradiation examination (PIE). Experiment hardware includes the experiment vehicle, instrumentation, and specimen fixtures. Assembly and fuel fabrication will occur at Energy Innovation Laboratory (EIL), Hot Fuels Examination Facility (HFEF), and Advanced Fuels Facility (AFF). After irradiation, INL disassembles the LOC-C experiments at HFEF and completes PIE of the materials at various Materials and Fuels Complex (MFC) PIE facilities: Irradiated Materials Characterization Lab (IMCL), HFEF, and Analytical Research Laboratory (ARL). Depending on status of equipment, experiments may be conducted at TREAT.

Contact handled low-level radioactive waste (LLW) such as PPE, wipes, etc. will be generated during the fabrication and assembly of experiments. Small amounts of radioactive waste will be generated during experiment disassembly and post-irradiation examination (PIE) activities that include cutting, grinding, and polishing of experiment samples. Some of the waste generated may be remote handled (> 200 mR/hr at contact). PIE activities will generate radioactive waste with transuranic isotopes, but the final waste package may be categorized as LLW. Chemicals will be used with prior approval. Approximately 2-10 gallons of irradiated coolant water will generate each year. The volume amounts produced are as follows: less than 1 m<sup>3</sup> of contact-handled low-level waste, less than 5 m<sup>3</sup> of remote-handled low-level waste (irradiated hardware, coolant water,

etc. that will be 200 mR/hr), less than 1 m<sup>3</sup> of remote-handled waste from PIE activities that will be contaminated with transuranic isotopes, and less than 1 m<sup>3</sup> of chemical and industrial waste. No mixed waste (chemical or hazardous waste that will be co-mingled with radioactive waste) will be produced.

### **Environmental Aspects or Potential Sources of Impact:**

#### **Air Emissions**

TWIST LOC: The proposed action has the potential to generate radiological and chemical emissions from fuel fabrication activities from MFC's EFF and FMF and from irradiation in NRAD or TREAT. In addition, the destructive and non-destructive PIE at MFC's IMCL, HFEF and ARL will generate emissions. Air emissions are anticipated to be minor, and concentrations would not exceed the current monitored/calculated air emissions from these facilities.

MFC performs metal fuel fabrication techniques at EFF and the Fuels Manufacturing Facility (FMF) to develop specifications for fabricating test pin fuels slugs for irradiation testing and to assess fuel characteristics. Fuel fabrication at MFC in these facilities 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.

Experiment neutron irradiation will be performed at NRAD or TREAT. The irradiation activities in the NRAD or TREAT are not modifications in accordance with Idaho Administrative Procedures Act (IDAPA) 58.01.01.201 and 40 Code of Federal Regulation (CFR) 61 Subpart H.

The irradiated specimens will be delivered to the MFC's HFEF for disassembly and then undergo routine PIE at MFC facilities, (IMCL and Analytical Research Laboratory (ARL)). All radionuclide release data associated with the PIE portion of this experiment is covered by either PTC or APAD. The PIE examination at MFC 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.

Emissions from these facilities are covered by either PTC or APAD. Radionuclide emissions are sampled/calculated and reported in accordance with Laboratory Wide Procedure (LWP)-8000 and 40 CFR 61 Subpart H.

HERA:TWIST RIA: The proposed action has the potential to generate radiological and chemical emissions from irradiation in TREAT and the destructive and nondestructive PIE at MFC. Air emissions are anticipated to be minor, and concentrations would not exceed the current monitored air emissions from these facilities. An Air Permit Applicability Determination (APAD) may be required.

The TREAT irradiation activities are not modifications in accordance with Idaho Administrative Procedures Act (IDAPA) 58.01.01.201 and 40 Code of Federal Regulation (CFR) 61 Subpart H. TREAT radionuclide emissions are sampled and reported in accordance with Laboratory Wide Procedure (LWP)-8000 and 40 CFR 61 Subpart H. All experiments will be evaluated by Environmental Support and Services staff. All radionuclide release data (isotope specific in curies) directly associated with this proposal will be calculated and provided to the Environmental Support organization.

The irradiated specimens will be delivered to the MFC HFEF for disassembly and then undergo routine PIE. All radionuclide release data associated with the PIE portion of this experiment will be recorded as part of the HFEF continuous stack monitor. 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. In 2019, the effective dose equivalent to the offsite maximally exposed individual (MEI) from all operations at the INL Site was calculated as 5.59 E-02 mrem/yr, which is 0.56% of the 10-mrem/yr federal standard and was calculated using all sources that emitted radionuclides to the environment from the INL site. The additional increment in emissions from the proposed action would not significantly change the total site-wide MEI dose. Therefore, the emissions are bounded by the analysis in the 1995 EIS, which estimated the annual cumulative doses to the maximally exposed worker, offsite maximally exposed individual (MEI), and the collective population from DOE's decision to implement the preferred alternative (DOE/EIS-0203). The potential air emissions and human health impacts associated with the proposed action would be smaller than and are bounded by the impacts presented in the 1995 EIS.

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

NA

#### **Disturbing Cultural or Biological Resources**

CULTURAL RESOURCES: Pursuant to the 2023 Programmatic Agreement as amended in 2025, the proposed action does not meet the threshold of a federal undertaking with the potential to affect historic properties and will have no effect to historic properties.

#### **Generating and Managing Waste**

TWIST LOC: Project personnel will consult the INL Waste Management Program and MFC Waste Generator Services staff for characterization and disposition pathway analysis for all waste prior to generation. The waste generated during the project is expected to be dispositioned using mature pathways in quantities that are readily manageable by WGS. Additional low-level waste such as PPE will be generated during the fabrication and assembly of the experiments.

HERA:TWIST RIA: In addition to disposal of the irradiated fuel that will be generated as described above, industrial, and low level waste will be generated throughout the R&D process. This waste will be classified and disposed in accordance with INL procedures and DOE regulations/requirements.

The amount of TRU waste to generated is anticipated to be less than 1 kgs.

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**Releasing Contaminants**

When chemicals are used during the project there is the potential for spills that could impact the environment (air, water, soil).

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

NA

**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); (5) involve genetically engineered organisms, synthetic biology, governmentally designated noxious weeds, or invasive species, unless the proposed activity would be contained or confined in a manner designed and operated to prevent unauthorized release into the environment and conducted in accordance with applicable requirements, such as those listed in paragraph B(5) of 10 CFR Part 1021, Appendix B. The proposal has not been segmented to meet the definition of a categorical exclusion. Segmentation can occur when a proposal is broken down into small parts in order to avoid the appearance of significance of the total action. However, segmentation does not include proposals that are developed and potentially implemented over multiple phases where each phase results in a decision whether to proceed to the subsequent phase. There is no extraordinary circumstance related to the proposal that is likely to cause a reasonably foreseeable significant adverse effect or for which DOE does not know the environmental effect. Extraordinary circumstances are unique situations presented by specific proposals, including, but not limited to, scientific controversy about the environmental effects of the proposal; uncertain effects or effects involving unique or unknown risks; and unresolved conflicts concerning alternative uses of available resources.

**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 (SEISII) (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 and Finding of No Significant Impact 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, December 2011).

**Justification:** For the DOE regulations regarding the application of categorical exclusions, including the full text of each categorical exclusion, see 10 CFR 1021.102 and Appendix B to 10 CFR Part 1021. Implementing guidance for categorical exclusions can be found in DOE's National Environmental Policy Act Implementing Procedures (June 30, 2025): (See full text in regulations and implementing procedures).

The proposal must fit within the classes of actions listed in Appendix B to 10 CFR Part 1021 and must satisfy the conditions that are integral elements of the classes of actions therein.

There are no extraordinary circumstances related to the proposal that may affect the significance of the environmental effects of the proposal. DOE or an applicant may modify the proposal to avoid reasonably foreseeable adverse significant effects such that the categorical exclusion would apply. The proposal has not been segmented to meet the definition of a categorical exclusion.

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The potential for transportation accidents was analyzed in the SNF EIS (Section 5.1.5 and Appendix I-5 through I-10) and in the FRR EIS (Sections 4.2.1 and 4.2.2).

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

Approved by Robert Herzog, DOE-ID NEPA Compliance Officer on: 1/14/2026