# DOE-ID NEPA CX DETERMINATION
# Idaho National Laboratory



CX Posting No.: DOE-ID-INL-19-005

**SECTION A. Project Title:** Transient Testing Program FY19 Experiment Work

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

Idaho National Laboratory (INL) conducts irradiation experiments in the Transient Reactor Test (TREAT) Facility for the purpose of assessing the performance of instrumentation and various fuel types. INL leads the planning, design, and analyses of TREAT irradiation experiments in coordination with institutions that develop various fuel concepts. INL performs transient irradiation experiments in TREAT and coordinates post-irradiation examination (PIE) on the irradiated fuels. INL ships the irradiated fuels from TREAT at the Materials and Fuels Complex (MFC) to Hot Fuels Examination Faciltiy (HFEF), Neutron Radiography Reactor (NRAD) or Irradiated Materials Characterization Laboratory (IMCL). Although the majority of the PIE is expected to be performed at HFEF and supporting laboratories at MFC, selected samples may be shipped to other hot cell facilities or laboratories for complementary or additional examinations, contingent on the availability of an acceptable shipping cask/container. If samples are shipped off-Site, this EC must be revised.

Characterization-scale Instrumented Neutron Dose Irradiation module (CINDI) Experiment

The initial CINDI-based irradiations evaluate fundamental fission damage mechanisms on the microstructure evolution and material properties of uranium/plutonium-zirconium alloys. The CINDI experiments irradiate several metal fuel alloys of uranium and/or plutonium with zirconium in two capsule configurations--the Thermo-mechanical Properties Specimen (TPS) capsule and Numerous Disc Specimen (NDS) capsule. Commercial stainless steel Swagelok® components seal the capsules. INL performs the CINDI irradiations in steady state operations at TREAT where an electric heater controls environmental temperature. This effort aids lower length-scale modeling and fundamental fuel irradiation science development. The experiments aim to create a microstructural change due to fundamental irradiation damage mechanisms at controlled and monitored temperatures, but not to simulate prototypic power reactor fission rates. For this reason, the relatively low powers provided by TREAT in steady state operations create enough fission events while low nuclear heating enables the heater controller to control specimen temperature. After irradiation, INL disassembles the CINDI experiments at IMCL and completes PIE of the materials. The total estimated cost of the experiment is $750,000.

Materials and Instruments Modular Irradiation Capability (MIMIC) Test

The MIMIC test facilitates cost-effective irradiations to aid developing reactor-based instrument technologies. MIMIC serves as a module for the Minimal Activation Retrievable Capsule Holder (MARCH) system and enables key TREAT sensor irradiations in the primary test position with greater available test geometry and elevated temperature capability. The first MIMIC-based irradiation demonstrates a sensor applying Resonant Ultrasonic Spectroscopy – Laser (RUSL) to change material microstructure. MIMIC-RUSL uses laser ultrasonics to measure changes in the polycrystalline elastic stiffness tensor caused by grain restructuring (recrystallization). In this arrangement, a fiber delivers an amplitude modulated laser to the base of the cantilever beam. A second fiber, near the tip of the beam, measures oscillations in light reflected from the beam surface (due to beam defocusing/deflection) to determine displacement and monitor elasticity by measuring resonant frequency. Irradiation causes changes to the elastic stiffness tensor. TREAT yields low total radiation dose to avoid darkening of optical fibers.

The first RUSL demonstration is not fueled and uses a textured, pure copper specimen. TREAT irradiation demonstrates sensor behavior under neutron/gamma flux while slow temperature ramping via MARCH heater module causes recrystallization for comparison to out-of-pile tests.

The second MIMIC irradiation (known as MIMIC-N) compares various nuclear instruments and contains various neutron sensors and dosimeters. The neutron sensors measure neutron flux in the thermal and fast energy spectrum. The dosimeters deliver total neutron fluence measurements to evaluate sensor performance. The MIMIC-N evaluates the developmental neutron sensors' performance under a variety of transient irradiations, focusing sensitivity, signal linearity, and degradation. Repeated linear ramp, stepwise insertion, and temperature limited pulse transients demonstrate sensor performance. MIMIC-N uses small instrument guide tubes surrounding a dosimeter wire holder to allocate 12 irradiation locations close to each other to compare sensor responses. These tests do not require PIE. The cost of this project is estimated at $730,000.

Utah State University (USU) Integrated Research Program (IRP) Pellet Cracking (IRP-FC-1) Experiment

The USU IRP Pellet Cracking (IRP-FC-1) experiment irradiates five fresh fuel experiments using the MARCH-Separate Effects Tests Holder (SETH) capsule in the Broad Use SpecimenTransient Experiment Rig (BUSTER) primary and secondary containments. The SETH capsule includes the Dry In-Pile Fracture Test (DRIFT) on the inside. Westinghouse manufactures selected $UO_2$ fuel segments and supplies about 25 pellets (about five per capsule). The experiment performs transient testing at multiple power levels in the TREAT center core. Following irradiation, INL completes neutron radiography on the test specimens. This experiment campaign validates transient testing pellet cracks in fuels for the MOOSE-BISON-MARMOT (MBM) fuel fracture models to improve future fuel performance codes and models. The project includes experiment design, analyses, experiment hardware fabrication, irradiation, and PIE. Experiment hardware includes capsules and specimen fixtures. Following irradiation, INL stores experiments at TREAT for a cooldown period the ships the experiments to HFEF for PIE. PIE includes visual examination and neutron radiography before disassembly. The cost of the project is estimated at $1,148,000.

Accident Tolerant Fuel (ATF) $UO_2$ Chromium Doped Pellet Cracking Experiment

The ATF $UO_2$ Chromium Doped Pellet Cracking experiment campaign irradiates five fresh fuel experiments using the MARCH-SETH capsule in the BUSTER primary and secondary containments. The SETH capsule includes the DRIFT on the inside of the capsule. Westinghouse supplies 25 (5 per capsule) chromium-doped $UO_2$ fuel pellets. The campaign includes transient testing at multiple power levels in the center of the TREAT core. INL performs neutron radiography on the test specimens after irradiation. This experiment campaign validates transient testing pellet cracks in fuels for the MBM fuel fracture models to improve future fuel performance codes and models. The scope includes experiment design, analyses, hardware fabrication, irradiation, and PIE. Experiment hardware includes capsules and specimen fixtures. Following irradiation, INL stores experiments at TREAT for a cooldown period the

ships the experiments to HFEF for PIE. PIE includes visual examination and neutron radiography before disassembly. The cost of the project is estimated at $650,000.

ATF Uranium Silicide ($U_3Si_2$) Experiment
The ATF $U_3Si_2$ experiment uses the SETH Capsule to determine the melting point of the fuel and determine the fuel reacts during transient testing. The experiment campaign irradiates five fresh fuel experiments using the MARCH-SETH capsule in the BUSTER primary and secondary containments. INL manufactures the $U_3Si_2$ fuel pellets in the Experiments Fuel Facility (EFF) at MFC. The campaign includes transient testing at multiple power levels in the center of the TREAT core. INL performs neutron radiography on the test specimens after irradiation. Project scope includes experiment design, analyses, hardware fabrication, irradiation, and PIE. Experiment hardware includes capsules and specimen fixtures. Following irradiation, INL stores experiments at TREAT for a cooldown period the ships the experiments to HFEF for PIE. PIE includes visual examination and neutron radiography before disassembly. The cost of the project is estimated at $500,000.

ATF Pre-Hydriding RIA Experiment
The ATF-3-1 test series compares performance of various ATF concepts in Reactivity-Initiated Accident (RIA) transients to understand failure thresholds for experiment materials. The Pre-Hydride RIA uses fresh fuel materials and the MARCH-Static Environment Transient Testing Apparatus (SERTTA) capsule in the BUSTER primary and secondary containments. Westinghouse manufactures the $UO_2$ fuel pellets. MFC supplies the Ziracloy cladding materials subjected to a pre-hydride treatment at the INL Research Complex (IRC). INL fabricates and characterizes test rodlets at MFC and in town facilities. The ATF-3-1 experiment includes irradiating experiments in TREAT, removing experiment from the reactor, and characterizing irradiated materials at MFC. The scope includes experiment design, analyses, hardware fabrication, irradiation, and PIE. Experiment hardware includes capsules and specimen fixtures. Following irradiation, INL stores experiments at TREAT for a cooldown period the ships the experiments to HFEF for PIE. PIE includes visual examination and neutron radiography before disassembly. The cost of the project is estimated at $1,250,000.

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. Irradiated sample debris and secondary waste could total as much as 20-30 Kg. 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].

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.

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

**Air Emissions**

The proposed action has the potential to generate radiological and chemical emissions from irradiation in TREAT and the destructive and non-destructive 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 2017, the effective dose equivalent to the offsite maximally exposed individual (MEI) from all operations at the INL Site was calculated as 8.02 E-03 mrem/yr (8.02 E–08 Sievert/yr), which is 0.08% 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 1995a, Volume 2, Table 5.7-4). 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 PEIS.

**Generating and Managing Waste**

Transient testing at TREAT generates waste at the facilities where test assemblies are assembled, disassembled, and analyzed. Transient testing in FY 2019 has the potential to generate up to 12 $m^3$ of LLW from assembling, transporting, irradiating, disassembling, and analyzing test assemblies at MFC.

Operations also have the potential to generate MLLW. MLLW, if generated, is accumulated and stored in accordance with Federal and state regulations, treated if required, and disposed at an off-site permitted/licensed facility.

The proposed FY 2019 transient testing activities could generate <1 $m^3$ of transuranic (TRU) waste.

**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 PEL. If the PEL 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 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"

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).

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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 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).

**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."

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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: 2/04/2019