# DOE-ID NEPA CX DETERMINATION
# Idaho National Laboratory



CX Posting No.: DOE-ID-INL-19-050

**SECTION A. Project Title:** Transformational Challenge Reactor

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

The Transformational Challenge Reactor (TCR) program, led by Oak Ridge National Laboratory (ORNL) and supported by Argonne National Laboratory (ANL) and Idaho National Laboratory (INL), aims to build an additively manufactured microreactor to address the high costs and long deployment timelines that plague nuclear energy. INL contributes programmatic leadership, input into the digital platform, TCR design support, and irradiation testing capabilities at the Transient Reactor Test (TREAT) Facility. The TCR program is divided in to three distinct phases, each dependent on results of activities completed in prior phases. This environmental checklist (EC) covers research and development (R&D) activities at INL that support TCR design development efforts. Future efforts deriving from initial R&D activities require additional evaluation under the National Environmental Policy Act (NEPA). The following activities are proposed at INL:

Phase I

Programmatic Leadership
During Phase I, INL supports planning activities; reviews programmatic documents (e.g., requirements, deliverables, and future planning documents); participates in programmatic meetings; identifies and assigns laboratory resources; and supports other project requests as-needed.

Input for Digital Platform
INL also develops requirements and quality assurance for the digital platform and defines a design-agnostic digital platform supporting the TCR core manufacturing efforts. The digital platform uses design data, modeling data, in-situ data, ex-situ data, integral test data and established links between these five categories. Advanced manufactured parts undergo testing and characterization at ORNL. The program monitors the advanced manufacturing process at ORNL to capture data from various sources, including machine operating parameters, environmental conditions, and diagnostic tools. This data, along with the design and analysis data, constitutes the in-situ data suite. INL uses the results to develop a digital platform containing design, analysis, manufacturing, and test data for establishing the core basis.

INL produces modeling data for this task focusing on thermo-structural analysis using tools developed under the nuclear energy modeling and simulation (NEAMS) program. The modeling data includes robust neutronics and thermal hydraulics analysis and delivers bounding conditions for the thermo-structural analysis. This approach enables later integration with advanced physics tools to develop the digital platform. INL also integrates NEAMS modeling tools with the digital manufacturing framework (Dream.3D).

Reactor Design Support
INL also performs confirmatory neutronics and thermal hydraulics analyses. INL is primarily responsible for thermomechanical analysis of the TCR design. The design analyses span normal operations and safety analysis under postulated off-normal scenarios. This activity uses INL's high-fidelity modeling and simulation tools to confirm and verify ORNL results. This task includes developing an alternate reactor core design using the digital platform to confirm "design agnostic" capabilities. Specific INL tasks under this effort are listed below:

1. Review, confirm, and assess TCR design neutronics and thermal hydraulics for gap analysis
2. Complete TCR design thermomechanical analysis with ORNL
3. Develop Phenomena Identification and Ranking Tables (PIRT)
4. Develop "Alternate Methodology" for ORNL Reactor Authorization
5. Develop Safety Design Strategy
6. Develop the Documented Safety Analysis (DSA) and Technical Safety Requirements (TSR) for reactor operations at ORNL
7. Support accident analysis and dispersion calculations for maximum hypothetical accident cases
8. Develop alternative core/reactor design to exercise the digital platform.

Testing at TREAT
For the final activity in Phase I, ORNL produces a small uranium-bearing core segment for integral testing at INL's TREAT facility to validate the predictive modeling results describing core behavior under normal operating conditions. Once complete, INL adds the results into the digital platform. INL develops TREAT test requirements and test plans and designs and performs tests in the TREAT reactor. ORNL manufactures and assembles advanced manufactured core test components then ships them to INL. INL reviews and approves all test materials prior to testing in TREAT. INL collects measurements and data from irradiation testing in TREAT to validate the test components and for use in the digital engineering platform.

Unirradiated test segments will be assembled at ORNL and shipped from ORNL to INL using standard shipping methods. Initial testing at TREAT is limited to two (2) test segments about 6-inches long and less than 1/2 -inch in diameter. TREAT testing includes irradiating the segments in TREAT, removing segments from the reactor, and characterizing irradiated materials at MFC. The scope includes experiment design, analyses, hardware fabrication, irradiation, and PIE.

INL will explore design and fabrication of a larger test vehicle for tests in fiscal year (FY) 2021 and FY 2022. The larger vehicle will accommodate larger core segments and will impart active cooling through the segments.

Phase II

During Phase II, ORNL produces a nuclear-fueled core and populates the established digital platform with the associated design and manufacturing data. Integral testing at TREAT continues throughout Phase II to subject the core segments to conditions representative of off-normal and transient conditions. Like Phase I, the results from these integral tests will be used to verify model predictions on core behavior. The monitoring and separate effects test will be input in the digital platform. Specific INL activities under this phase have not been defined and will be reviewed under NEPA when more information is available to meaningfully evaluate the environmental impacts prior to making any decision to perform Phase II efforts at INL.

Phase III

At present, Phase III activities are not proposed at INL.

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 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 2018, the effective dose equivalent to the offsite maximally exposed individual (MEI) from all operations at the INL Site was calculated as 1.02 E-02 mrem/yr, which is 0.10% 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

The proposed action generates waste at the facilities where test segments are assembled, disassembled, and analyzed. The proposed activites at INL have the potential to generate low-level waste (LLW) from transporting, irradiating, disassembling, and analyzing test assemblies at MFC.

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

The 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).

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 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: 08/20/2019