DOE-ID NEPA CX DETERMINATION
Idaho National Laboratory

CX Posting No.: DOE-ID-INL-20-004

SECTION A. Project Title: TRISO Fuel Capability

SECTION B. Project Description and Purpose:

The National Aeronautics and Space Administration (NASA) uses nuclear systems to propel space exploration vehicles in environments where conventional solar or chemical power generation is impractical or impossible. The Department of Defense (DOD) also explores nuclear reactor technology to reduce reliance on traditional liquid fuels and eliminate the need for logistics fuel for producing electrical power. Under the authority of the Atomic Energy Act of 1954, the Department of Energy's (DOE's) mission includes meeting the nuclear material needs of other federal agencies. Idaho National Laboratory (INL), the management and operating (M&O) contractor for the DOE Idaho Operations Office (DOE-ID), supports research and development (R&D) efforts for the nuclear technologies of interest to DOD, NASA, and others.

NASA and DOD have identified a need for tri-structural isotropic (TRISO) particle nuclear fuel for ongoing R&D efforts to support their respective missions. The proposed collaborative project between DOD, INL, and NASA develops an initial TRISO fuel production capability for DOD and NASA for various reactor concepts. These concepts address an array of missions, including nuclear thermal propulsion (NTP) and mobile nuclear reactor modules. NASA anticipates using TRISO fuel for future NTP prototype systems while DOD's Strategic Capabilities Office (SCO) needs the fuel for R&D efforts associated with the mobile nuclear reactor prototype program. For DOE, TRISO fuel supports a variety of nuclear reactor R&D needs. However, the availability of TRISO fuel is a critical path issue for some of these missions.

Nuclear fuel can be classified into two enrichment types: highly enriched uranium (HEU) and low enriched uranium (LEU). In general, HEU has 20 percent or more uranium enrichment, while LEU has less than 20 percent uranium enrichment. Commercial nuclear power plants use LEU fuel enriched up to a 5 percent level. Higher enrichment reduces the physical size of a reactor and its core and enables longer operating life between refueling periods. Enriched uranium above 5 percent and up to the 20 percent LEU maximum is known as high-assay low enriched uranium (HA-LEU).

TRISO fuel particles are made of uranium kernels coated with multiple layers of porous or dense C and SiC. Each fuel particle relies on its own pressure vessel, in the form of the coating layer, to retain fission products. TRISO fuel has higher thermal conductivity and multiple barriers for fission product release compared to other nuclear fuel types, but its low fissile material loading density is an issue. Increasing the uranium enrichment of the fuel kernel up to the practical upper limit of LEU, about ~19.8% of U235, increases the fissile loading.

Multiple domestic vendors have small quantity TRISO fuel manufacturing capabilities, but actual full-scale production is dormant due to a lack of demand. The proposed action develops a TRISO fuel production capability with an NRC licensed facility specifically for advanced system prototyping for DOE, DOD, and NASA mission needs. Under the proposed action, INL coordinates the fuel production development, including developing technical specifications, an acquisition strategy, and a procurement approach for obtaining TRISO fuel to meet project needs. DOE, or a DOE contractor, will retain legal ownership and custody of any special nuclear material (SNM) during TRISO fuel development.

The proposed action sets up and demonstrates a TRISO HA-LEU fuel fabrication facility to meet the reactor design needs for DOD, DOE, and NASA. This analysis covers setting up the fabrication capability and initial pre-operational testing. Pre-operational testing of the fabrication line involves fabricating enough TRISO fuel particles and compacts to determine the line can meet quality control specifications (about 20 kg of HA-LEU is needed to manufacture about 100 kg of TRISO fuel particles). Following heat testing, samples will be saved for analytical purposes, then dissolved to recover the uranium for future use. Samples meeting quality control specifications may also be stored for later program use.

The proposal anticipates that Y-12 will ship HEU to a facility licensed by the NRC for producing AGR TRISO fuel in an NRC approved shipping container (VersaPac), and the licensed facility will down-blend the HEU into HA-LEU for fabricating into TRISO fuel. The specific amounts of TRISO fuel fabricated for individual program needs is currently unknown. Therefore, the environmental effects of fuel fabrication, transportation, and used fuel management for specific advanced reactor concepts will be evaluated under NEPA when those concepts reach a technological readiness level where the environmental impacts associated with those concepts can be adequately discerned.

In 1996, the Department of Energy issued the *Final Environmental Impact Statement (FEIS) and Record of Decision (ROD) for the Disposition of Highly Enriched Uranium* (DOE/EIS-0240). The FEIS, ROD, and supplement analysis evaluated the impacts of blending highly enriched uranium (HEU) to low enriched uranium (LEU) to eliminate the risk of diversion for nuclear proliferation, and, where practical, to reuse the resulting LEU in peaceful, beneficial ways that recover its commercial value. The EIS, ROD, and supplement analysis evaluated and authorized blending of surplus HEU in DOE's inventory at the Y-12 Plant at the Oak Ridge Reservation. It also analyzes the transportation of necessary materials from their likely places of origin to the potential blending sites, and from blending sites to the following destinations for nuclear fuel fabrication: General Electric in Wilmington, NC; Asea Brown-Boveri Combustion Engineering in Hematite, MO, B&W Commercial Nuclear Fuel Plant in Lynchburg, VA, Siemens Nuclear Power Corporation in Richland, WA, and Westinghouse Columbia Fuel Facility in Columbia, SC.

Once an NRC-licensed facility is identified for fabricating TRISO, this EC will be revised to evaluate additional environmental impacts in accordance with NEPA.

In addition, the 2011 *Final Site-Wide Environmental Impact Statement for the Y-12 National Security Complex* (DOE/EIS-0387) and supplemental analyses evaluated the potential environmental impacts for ongoing and foreseeable future operations and activities at Y-12, including alternatives for changes to site infrastructure and levels of operation.

SECTION C. Environmental Aspects or Potential Sources of Impact:

The following discussion summarizes the potential environmental impacts from the proposed project management activities at INL:

Generating and Managing Waste

Small amounts of common office trash are expected and would be disposed of appropriately. All work is considered office work and routine administrative activities in nature.

Using, Reusing, and Conserving Natural Resources

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 A to Subpart D, A9 "Information gathering/data analysis/document preparation/dissemination" and Appendix B, B3.6, "Small-scale research and development, laboratory operations, and pilot projects."

Final Environmental Impact Statement (FEIS) and Record of Decision (ROD) for the Disposition of Highly Enriched Uranium (DOE/EIS-0240, 1996) and supplement analysis (EIS-0240-SA-01, 2007) and amended ROD (2011).

Final Site-Wide Environmental Impact Statement for the Y-12 National Security Complex (DOE/EIS-0387, 2011) and supplemental analyses (EIS-0387-SA-01 (2016), EIS-0387-SA-02 (2016), and EIS-0387-SA-03 (2018)) and associated Amended RODs.

Justification: Project activities described in this EC are consistent with 10 CFR 1021, Appendix A to Subpart D, item A9 "Information gathering (including, but not limited to, literature surveys, inventories, site visits, and audits), data analysis (including, but not limited to, computer modeling), document preparation (including, but not limited to, conceptual design, feasibility studies, and analytical energy supply and demand studies), and information dissemination (including, but not limited to, document publication and distribution, and classroom training and informational programs), but not including site characterization or environmental monitoring. (See also B3.1 of appendix B to this subpart.)"

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;"

In 1996, the Department of Energy issued the *Final Environmental Impact Statement (FEIS) and Record of Decision (ROD) for the Disposition of Highly Enriched Uranium* (DOE/EIS-0240). The FEIS, ROD, and 2007 supplement analysis (EIS-0240-SA-01) and 2011 amended ROD evaluated the impacts of blending highly enriched uranium (HEU) to low enriched uranium (LEU) to eliminate the risk of diversion for nuclear proliferation, and, where practical, to reuse the resulting LEU in peaceful, beneficial ways that recover its commercial value. The EIS, ROD, and supplement analysis evaluated and authorized blending of surplus HEU in DOE's inventory at the Y-12 Plant at the Oak Ridge Reservation. It also analyzes the transportation of necessary materials from their likely places of origin to the potential blending sites, and from blending sites to likely destinations for nuclear fuel fabrication.

The 2011 *Final Site-Wide Environmental Impact Statement for the Y-12 National Security Complex* (DOE/EIS-0387) and supplemental analyses (EIS-0387-SA-01, EIS-0387-SA-02, and EIS-0387-SA-03) and associated Amended RODs evaluated the potential environmental impacts for ongoing and foreseeable future operations and activities at Y-12, including alternatives for changes to site infrastructure and levels of operation.

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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: February 11, 2020