DOE-ID NEPA CX DETERMINATION
Idaho National Laboratory

CX Posting No.: DOE-ID-INL-20-004 R2

SECTION A. Project Title: TRISO Fuel Production Capability Rev 2

SECTION B. Project Description and Purpose:

Revision 2
This revision clarifies that the proposed action needs about 20 kg of HEU to manufacture about 100 kg U of tri-structural isotropic (TRISO) fuel. Previous versions of this environmental checklist (EC) stated that about 20 kg of HA-LEU was needed to manufacture about 100 kg of TRISO fuel. The remaining scope, work activities, and aspects remain the same as in previous versions.

Revision 1
This revision identifies a Nuclear Regulatory Commission (NRC)-licensed facility for fabricating TRISO particle fuel.

The project proposes to develop the TRISO high-assay low enriched uranium (HALEU) fuel fabrication capability at the BWX Technologies, Inc. (BWXT) facility in Lynchburg, VA. The BWXT plant produces fuel containing both high and low-enriched uranium, for use in the U. S. Naval Reactors program. BWXT also blends down HEU to lower Enrichments. With their Category I fuel facility license, BWXT can produce HALEU. The NRC completed the *Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) for License Renewal for BWX Technologies, INC., Lynchburg, VA* in 2006 for renewing Materials License SNM-42 (NRC Agency-wide Documents Access Management System (ADAMS) ML053410253). Materials License SNM-42 authorizes BWXT to possess nuclear materials, manufacture nuclear fuel components, fabricate research and university reactor components, fabricate compact reactor fuel elements, perform research on spent fuel performance, and handle the resultant waste streams, including recovery of scrap uranium. The term of the license is 20 years.

In 1996, the Department of Energy (DOE) 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 likely or representative destinations for nuclear fuel fabrication, including BWXT.

Other aspects of the original EC scope remain valid as described below:

Original EC
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, DOE's mission includes meeting the nuclear material needs of other federal agencies. Idaho National Laboratory (INL) 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 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."

NRC *Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) for License Renewal for BWX Technologies, INC., Lynchburg, VA* (2006) for renewing Materials License SNM-42 (NRC Agency-wide Documents Access Management System (ADAMS) ML053410253).

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;"

The Nuclear Regulatory Commission (NRC) completed the *Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) for License Renewal for BWX Technologies, INC., Lynchburg, VA* in 2006 for renewing Materials License SNM-42 (NRC Agencywide Documents Access Management System (ADAMS) ML053410253). Materials License SNM-42 authorizes BWXT to possess nuclear materials, manufacture nuclear fuel components, fabricate research and university reactor components, fabricate compact reactor fuel elements, perform research on spent fuel performance, and handle the resultant waste streams, including recovery of scrap uranium.

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.

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: April 22, 2020