

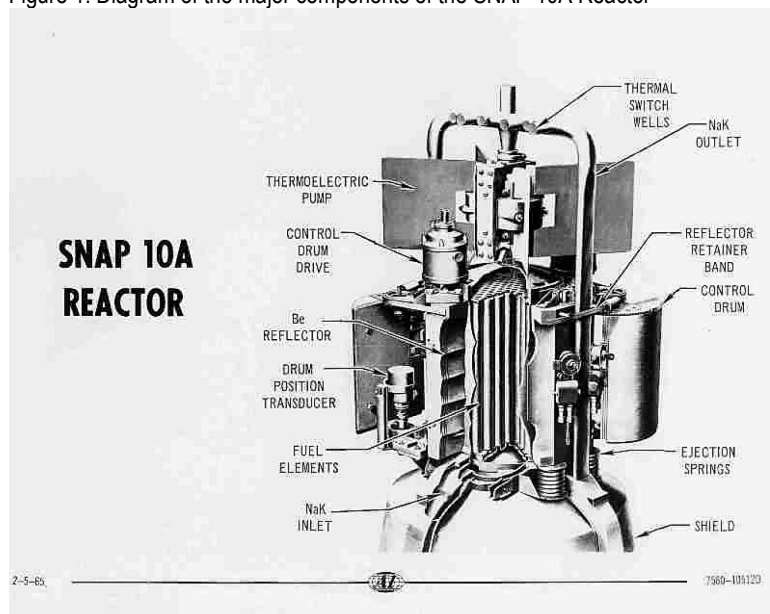
SECTION A. Project Title: Project LIII - Historic Micro-Reactor Technical Design Reverse Engineering and Digital Twinning

SECTION B. Project Description and Purpose:

Idaho National Laboratory (INL) is revising this environmental checklist (EC) from a second tier EC to a first tier EC and to clarify project scope.

The National Aeronautics and Space Administration (NASA), the U.S. Department of Energy (DOE), and industry have been evaluating nuclear reactors for propulsion and generating process heat and electricity for applications such as advanced science and space exploration missions since the 1950s. The Atomic Energy Commission (AEC), now DOE, launched the Systems for Nuclear Auxiliary Power (SNAP) program in 1955. SNAP focused on using nuclear reactors and radioisotopes for generating satellite-based electrical power. The SNAP Experimental Reactor (SER), also called the SNAP-2 Experimental Reactor, was the first SNAP reactor design. SNAP program objectives changed numerous times during development, and the SNAP 10A series of reactors followed the SNAP-2 series. Atomics International (AI), under contract to AEC, built and tested eight prototype and qualification systems to evaluate the SNAP 10A's performance—three were devoted to structural tests, three were prototype thermal vacuum performance tests, and two were final system qualification tests. The latter two systems consisted of a non-nuclear unit, Flight System Mockup (FSM)-4, in which the reactor core was replaced by an electrical heater, and a nuclear system (Flight System (FS)-3) that was identical to the flight units. The SNAP 10A FS-3 was a complete reactor-based electric generating plant that operated for more than 10,000 hours at full power under simulated space-flight conditions. The program launched a duplicate system, the 10A Flight System (FS)-4, into orbit from Vandenberg Air Force Base on April 3, 1965 in a flight test named SNAPSHOT. Figure 1 shows the major components of the SNAP 10A reactor.

Figure 1. Diagram of the major components of the SNAP 10A Reactor



SNAPSHOT demonstrated the adequacy of the SNAP 10A design and test program and generated information for improving future reactor or thermoelectric space power systems. SNAP 10A and SNAPSHOT provided a firm, proven basis for designing, fabricating, and testing more advanced space power systems. However, legacy record keeping practices have led to present day knowledge gaps in the design details of the SNAP 10A system that need to be resolved to support future microreactor systems. INL's Advanced Design & Manufacturing Initiative (ADMi) program plans to fill knowledge gaps in the SNAP 10A design details by applying reverse engineering activities to create a digital twin of the SNAP 10A reactor system. The proposed action supports R&D efforts for designing future microreactor systems.

The SNAP 10A program fabricated a third duplicate of the FS-3 system, the 10A FS-5, that was never operated. The SNAP 10A FS-5 was a complete power system that was loaded with fuel and NaK and acceptance tested. DOE eventually removed the fuel from the 10A FS-5 system and shipped the fuel elements to Oak Ridge National Laboratory for disposal. The U.S. Space and Rocket Center in Huntsville, Alabama shipped the SNAP 10A FS-5 to INL on 10/16/2019. INL received the shipment and secured it in the Power Burst Facility (PBF) building 613 (PBF-613) on 10/21/2019. INL proposes to disassemble and digitally scan the reactor to develop computer aided design (CAD) models and to measure reactor components to develop accurate physical design models. The SNAP 10A reactor design also used two moveable beryllium reflectors for neutron control, and the FS-5 system contains about 60 pounds of beryllium. INL may replicate the beryllium reflectors and other structural components from stainless steel using additive (3D Printing) techniques that employ Laser Engineered Net Shaping at the Energy Innovation Laboratory (EIL) or under a subcontract. Following modeling and simulation activities, INL may manufacture a clone of the device for display or mockup and prototyping, which will require further review under the National Environmental Policy Act (NEPA).

INL will ship the FS-5 back to the museum at project completion, possibly without the beryllium components. Beryllium is valuable, and INL has proposed that DOE accept ownership of the beryllium for building a functioning microreactor or for other R&D activities not yet identified. The project will scan these

DOE-ID NEPA CX DETERMINATION

Idaho National Laboratory

components and package them in plastic bags then place them in a 55 gallon drum for storage at the Advanced Test Reactor (ATR) Complex, the Central Facilities Area (CFA), or another approved location. INL prefers to use the CFA warehouse for short-term beryllium storage until needed for other projects. Future R&D efforts proposing to use the beryllium require project-specific NEPA evaluations. Waste Generator services can dispose of the material if other uses are not identified, but this is unlikely due to the value of beryllium.

SECTION C. Environmental Aspects or Potential Sources of Impact:

Air Emissions

Project activities have the potential to release hazardous and chemical contaminants into the air. The proposed action will require an Air Permitting Applicability Determination (APAD).

Disturbing Cultural or Biological Resources

PBF-613 (CITRIC Communications Research Facility, formerly SPERT IV), constructed in 1960, is eligible for listing on the National Register and is considered a Category 3 historic property. SNAP 10A FS-5 may be eligible for listing on the National Register as a historic object. Additionally, the FS-5 reactor is part of the collections of the National Museum of Nuclear Science and History located in Albuquerque, New Mexico; as such, the FS-5 reactor may be subject to management under 36 CFR 79, *Curation of Federally-Owned and Administered Archaeological Collections*.

The Area of Potential Effect (APE) for the project includes the interior of PBF-613 and the FS-5 reactor. Under the project activities as described, No Effects are anticipated for historic properties (PBF-613 and the FS-5 reactor).

Any change in scope or project description requires additional cultural resource review and revision of this EC.

Any alteration to the FS5 reactor beyond disassembly, removal of Beryllium, and reassembly, may result in Adverse Effects to a historic property, which will require additional cultural resource review, potentially mitigation of adverse effects, and revision of this EC.

Before altering the system, the project must contact the Cultural Resource Management Office for a historic property evaluation.

Generating and Managing Waste

The proposed action will generate industrial waste from packaging material, Resource Conservation and Recovery Act (RCRA) empty chemical containers, and rags, etc. and office waste.

Cleaning solvents and spill material have the potential to generate hazardous waste.

Since beryllium is a valuable element, the most desirable method of handling beryllium wastes is to recycle or reuse them. Project personnel must control the generation of beryllium-containing waste, and beryllium-contaminated equipment and other items that are disposed of as waste, through the application of waste minimization principles. Before implementing land disposal of waste beryllium, consult with the Program Environmental Lead (PEL).

Beryllium-containing waste, and beryllium-contaminated equipment and other items that are disposed of as waste, must be disposed of in sealed, impermeable bags, containers, or enclosures to prevent the release of beryllium dust during handling and transportation. The bags, containers, and enclosures that are used for disposal of beryllium waste must be labeled according to 10 CFR § 850.38.

All waste generated during the project will be characterized, stored, and disposed at the direction of Waste Generator Services (WGS).

Releasing Contaminants

If the project uses chemicals, it must submit the chemicals to chemical inventory lists with associated Safety Data Sheets (SDSs) for approval prior to use. The Facility Chemical Coordinator enters these chemicals into the INL Chemical Management Database. The ADMi programs must manage all chemicals according to laboratory procedures. When dispositioning surplus chemicals, project personnel must contact the facility Chemical Coordinator for disposition instructions.

Although not anticipated, the proposed action has the potential for spills when using chemicals. 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.

Beryllium exposure poses a risk to worker health. Workers in industries where beryllium is present may be exposed to beryllium by inhaling or contacting beryllium in the air or on surfaces. Inhaling or contacting beryllium can cause an immune response that results in an individual becoming sensitized to beryllium. Individuals with beryllium sensitization are at risk for developing a debilitating disease of the lungs called chronic beryllium disease if they inhale airborne beryllium after becoming sensitized. Beryllium-exposed workers may also develop other adverse health effects such as acute beryllium disease, and lung cancer. Adequate local exhaust ventilation is necessary to prevent inhalation of, and skin contact with beryllium, and

DOE-ID NEPA CX DETERMINATION
Idaho National Laboratory

shipping regulations and other DOT regulatory requirements must be consulted before transport. INL manages beryllium operations in compliance with applicable regulations and using recommended controls.

Using, Reusing, and Conserving Natural Resources

The project will divert all applicable waste from disposal in the landfill when possible. Program personnel will use every opportunity to recycle, reuse, and recover materials, including beryllium, and divert waste from the landfill when possible. The program will practice sustainable acquisition, as appropriate and practicable, by procuring construction materials that are energy efficient, water efficient, are bio-based in content, environmentally preferable, non-ozone depleting, have recycled content, and are non-toxic or less-toxic alternatives.

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 B1.24, "Property transfers" and B3.6, "Small-scale research and development, laboratory operations, and pilot projects"

Justification: The proposed R&D activities are consistent with CX B1.24 "Transfer, lease, disposition, or acquisition of interests in personal property (including, but not limited to, equipment and materials) or real property (including, but not limited to, permanent structures and land), provided that under reasonably foreseeable uses (1) there would be no potential for release of substances at a level, or in a form, that could pose a threat to public health or the environment and (2) the covered actions would not have the potential to cause a significant change in impacts from before the transfer, lease, disposition, or acquisition of interests;" and

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."

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: 12/11/2019