Project Title: System Physics Advanced Reactor Criticality (SPARC)

Project Description and Purpose:

The System Physics Advanced Reactor Criticality (SPARC) Project is a long-term, zero-power critical experiment led by Idaho National Laboratory (INL) in collaboration with Oak Ridge National Laboratory, Los Alamos National Laboratory, and Lawrence Livermore National Laboratory. The project is funded by the U.S. Department of Energy (DOE) and the Nuclear Regulatory Commission under the Collaboration for Criticality Safety. SPARC is intended to operate for multiple decades, with initial operations anticipated by mid-2028. The facility will utilize a Horizontal Split-Table (HST) machine that allows nuclear fuel and materials to be remotely combined and separated to form a zero-power reactor configuration. The reactor will not produce electricity, measurable heat, or significant radiation, and will operate at extremely low neutron flux levels for short experimental durations, typically a few hours per experiment. All experiments will use uranium fuel enriched to less than 20%, and administrative and engineered controls will limit power and operating time to prevent significant fuel activation.

The HST reactor will be installed in the open basement of Building PBF-613 at INL's Critical Infrastructure Test Range Complex (CITRC). The project will leverage existing infrastructure while modifying the facility to meet current nuclear safety and natural phenomena hazard requirements. A modular control room will be installed outdoors within the designated project area adjacent to PBF-613 and connected to the facility via a new cable trench. The final placement of the control room structure will be determined during implementation based on operational and logistical considerations; however, it will be located within the defined boundary depicted below. Placement anywhere within this identified area would not alter the impact conclusions described in this document.

The base fuel inventory for SPARC will consist of several hundred contact-handleable fuel rods (~5% enriched UO2 in ~1-meter stainless steel cladding) returned to INL from the Walthousen Reactor Critical Facility at Rensselaer Polytechnic Institute as part of its decommissioning effort. These fuel rods have a proven history in criticality benchmarking. Additional fuel may be temporarily provided by private companies or government organizations for specific experiments and will be removed following testing. Fuel will not be irradiated to levels that would result in spent nuclear fuel or decontamination and decommissioning concerns. Fuel loading and unloading will be conducted manually, and fuel will be stored in criticality-safe racks or drums within PBF-613. Following experiments, fuel will either be retained for future testing or returned to the originating organization. Any radioactive materials generated will be managed under INL's Radiation Protection Program. Activated components,

if any, will be safely controlled, stored, and disposed of in compliance with regulatory requirements to protect workers, the public, and the environment.

Table 1 Overview of Anticipated SPARC Project components and Operational Parameters

Parameter	Definition	Bounding Condition
Thermal Output	Maximum thermal power generated by SPARC during normal operations	< 10 KWth
Electrical Output	Estimate of maximum electric generator output from SPARC	Not applicable – SPARC will not produce electricity.
Fuel Type	Reactor Fuel type	Uranium
Fuel Enrichment	Extent to which fuel has been enriched	< 20% enrichment
Commissioning Time	Maximum time to be spent commissioning the reactor	Multiple decades
Experiment Operational Time	Normal operation times for each experiment	< 166 hours
Cooldown Time	Time in-between experiments the reactor will remain unused for radioactive decay.	~0 days
Heat Transfer	Medium and mechanism used for transfer of reactor core heat to heat sink	Not applicable — SPARC is a zero-power criticality test reactor and does not include a heat transfer system.
Heat Sink	Medium and mechanism used for conversion and/or dissipation of reactor core heat	Not applicable — the reactor does not generate thermal power and does not require a heat sink or power conversion system.
Water Consumption	Water used by facility and reactor usage.	SPARC will not require use of water outside of normal habitation utilities.
Safety Class Components	Components critical to reactor safety, as defined in DOE-STD-3009	See appendix A for relevant safety systems, structures, and components.

A bounding analysis was performed, assuming a Uranium fueled reactor that was operated at 10 kWth for 6 hours, followed by a 100 MJ transient. All radionuclides were then released, with a conservative Airborne Release Fraction (ARF) of 1.0, which assumes all radioactive material in the reactor is aerosolized. No credit was taken for filtration. Then, RSAC-7 was used to calculate the downwind exposures to the maximally exposed offsite individual (MOI). The nearest offsite location (public MOI) from the SPARC facility is approximately 10,000 meters.

Given all these assumptions, the total effective dose that the public would receive during a bounding accident condition at SPARC would be approximately 0.034 rem (34 mrem). This value is significantly below the Evaluation Guidelines that DOE has established for public dose consequences.

Furthermore, SPARC will implement a suite of hazard controls following the DOE-STD-3009 methodology -- as committed to in the DOE approved SPARC Nuclear Safety Design Agreement (NSDA-433) -- which will further reduce the public dose. However, even without the implementation of preventative and mitigative hazard controls to further protect the public, the risk of adverse offsite consequences is minimal.

Waste:

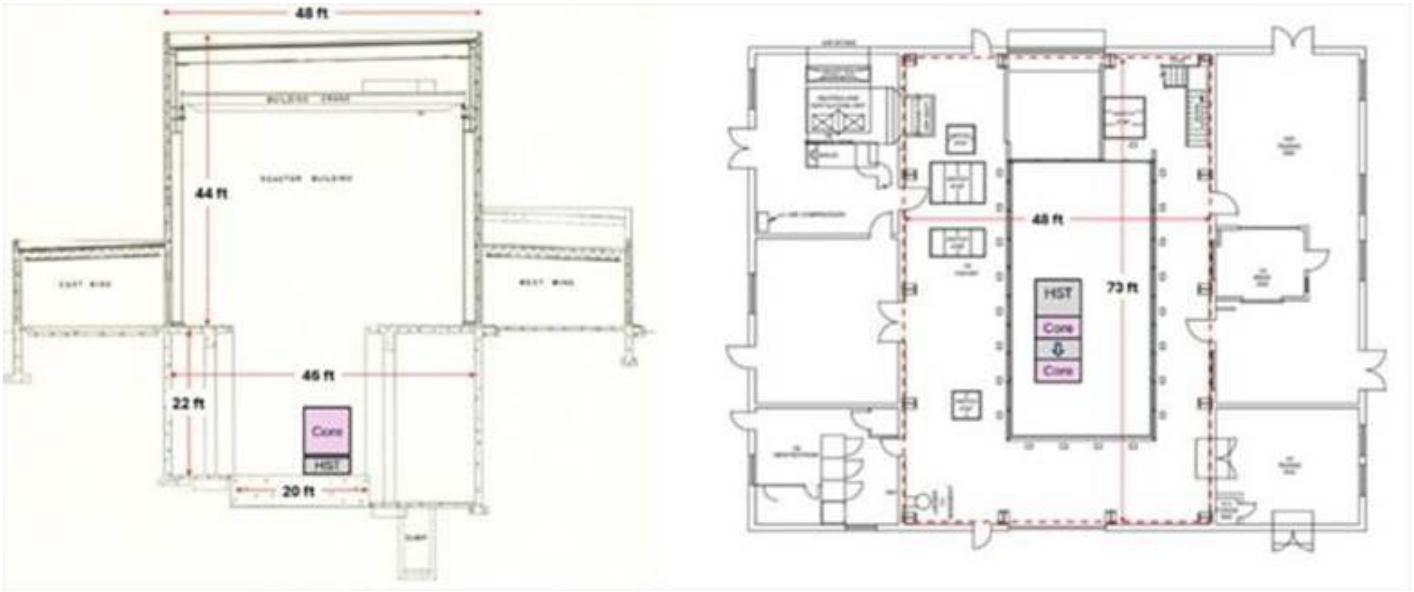
Type	Materials	Amount
Industrial	Batteries, oils, greases	<55 gallons/year

Hazardous	Maintenance-related items	<55 gallons/year
PPE, wipes	Gloves, safety glasses, wipes	<10 gallons/year
Low-Level	Solid Nulear Materials	<55 gallons/year
Mixed Waste	None Planned	None Planned

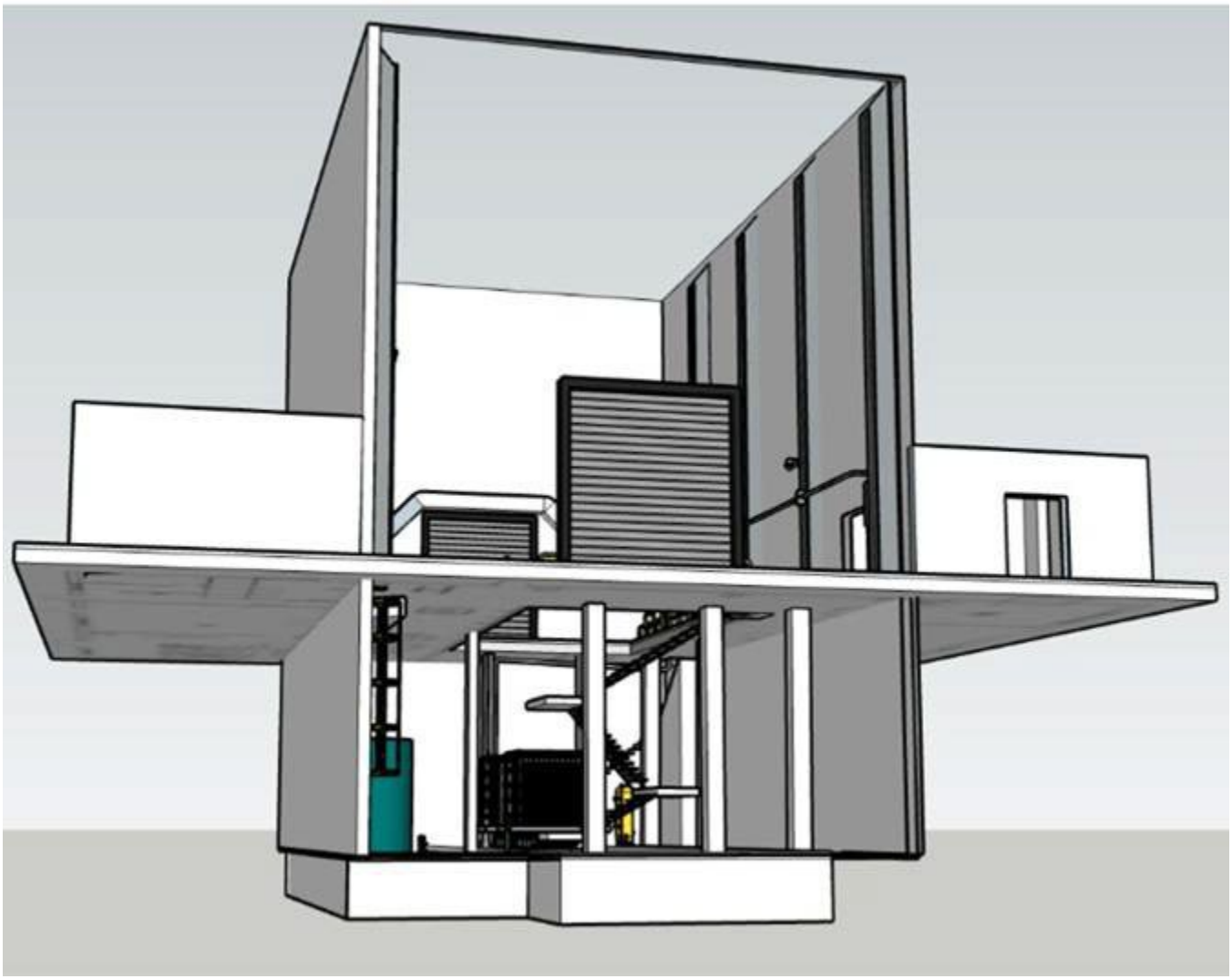
The PPE, wipes, gloves, safety glasses, etc. will not be contaminated with hazardous or radioactive materials. It will be industrial waste.

No transuranic (TRU) or mixed waste is expected, and all waste will be produced at PBF-613.

Additional Figures:



PBF-613 Interior Layout.



PBF-613 CAD Model showing reactor in basement.

PBF-613 Site Features.

PBF-613 Exterior View.

Environmental Aspects or Potential Sources of Impact:

Air Emissions

SPARC will host Zero-Power reactors, typically operating around 10 watts, resulting in enough power to generate an extremely low neutron flux, and ultimately very low activation potential. Activated air may be result in small amounts of airborne radiation. This is expected to be below radiological control thresholds and will most likely decay prior to being vented outside of the building. Potential radiological emissions are insignificant.

Discharging to Surface-, Storm-, or Ground Water

NA

Disturbing Cultural or Biological Resources

There is the potential for this work to impact vegetation and for project personnel to interact with various wildlife species. A Biological Resource Review will be arranged within two weeks prior to the initiation of any activities that might disturb soil or vegetation and again following completion of project activities. A nesting bird survey is included with the Biological Resource Review for actions occurring between April 1 - October 1 per compliance with the Migratory Bird Treaty Act. Bat surveys are also included with the Biological Resource Review in accordance with the INL Bat Protection Plan.

CULTURAL: A Section 106 review has completed under CRMO project number (BEA-26-020) and resulted in No Historic Properties Affected. Project-specific consultation is not required for this project. Please refer to Holds Points and Project Specific Instructions of the ECP.

Generating and Managing Waste

At INL facilities, activities may generate industrial, hazardous, radioactive, and mixed waste. The BEA Waste Management Program's (WMP) Waste Generation Services (WGS) subcontractor assists projects in characterizing and managing waste. WGS brokers handling and shipping of hazardous and radioactive waste."

Releasing Contaminants

When chemicals are used during the project there is the potential for spills that could impact the environment (air, water, soil).

Using, Reusing, and Conserving Natural Resources

Project activities have the opportunity to reduce the impact on our natural resources by recycling or diverting materials from disposal in the landfill.

Determination:

References: B5.26 "Advanced Nuclear Reactors"

B5.26: Authorization, siting, construction, operation, reauthorization, and decommissioning of advanced nuclear reactors, provided the DOE determines that: 1) the project's attributes, including potential fission product inventory, fuel type, reactor design, and operational plans, reduce sufficiently the risk of adverse offsite consequences from the release of radioactive or hazardous waste, and 2) the project demonstrates that any hazardous waste, radioactive materials, or spent nuclear fuel generated by the project can be managed in accordance with the applicable requirements.

For the purposes of this category, a project may include multiple reactors within a nuclear facility.

Justification: The proposal fits within the classes of actions listed in Appendix B to 10 CFR Part 1021 or Appendix B and C of DOE's NEPA Implementing Procedures and satisfies the conditions that are integral elements of the classes of actions therein. The proposal does not: (1) threaten a violation of applicable statutory, regulatory, or permit requirements for environment, safety, and health, or similar requirements of DOE or Executive Orders; (2) require siting and construction or major expansion of waste storage, disposal, recovery, or treatment facilities (including incinerators), but the proposal may include categorically excluded waste storage, disposal, recovery, or treatment actions or facilities; (3) disturb hazardous substances, pollutants, contaminants, or CERCLA-excluded petroleum and natural gas products that preexist in the environment such that there would be uncontrolled or unpermitted releases; (4) have the potential to cause significant impacts on environmentally sensitive resources, including, but not limited to, those listed in paragraph B(4) of 10 CFR Part 1021, Appendix B; (5) involve genetically engineered organisms, synthetic biology, governmentally designated noxious weeds, or invasive species, unless the proposed activity would be contained or confined in a manner designed

and operated to prevent unauthorized release into the environment and conducted in accordance with applicable requirements, such as those listed in paragraph B(5) of 10 CFR Part 1021, Appendix B.

There is no extraordinary circumstance related to the proposal that is likely to cause a reasonably foreseeable significant adverse effect or for which DOE does not know the environmental effect. Extraordinary circumstances are unique situations presented by specific proposals, including, but not limited to, scientific controversy about the environmental effects of the proposal; uncertain effects or effects involving unique or unknown risks; and unresolved conflicts concerning alternative uses of available resources.

The proposal has not been segmented to meet the definition of a categorical exclusion. Segmentation can occur when a proposal is broken down into small parts in order to avoid the appearance of significance of the total action. However, segmentation does not include proposals that are developed and potentially implemented over multiple phases where each phase results in a decision whether to proceed to the subsequent phase.

Based on my review of the proposed action, I have determined that the proposed action fits within the specified class(es) of action, the other regulatory requirements set forth above are met, and the proposed action is hereby categorically excluded from further NEPA review.

Approved by Jason L Anderson, DOE-ID NEPA Compliance Officer on: 5/6/2026