U.S. Department of Energy
Office of Nuclear Energy
National Environmental Policy Act
Determination

NEPA Identification: DOE-ID-INL-24-071 R2

Proposed Action Title: Versatile Autonomous Lightweight Kilowatt-class Reactor Experiment (VALKRE) R2

Location(s) (City/County/State):

Proposed Action Description:

Revision 2:

Proposed Action:

The Idaho National Laboratory (INL) proposes to conduct the Versatile Autonomous Lightweight Kilowatt-class Reactor Experiment (VALKRE) at the INL Site. The proposed action includes final design; procurement and receipt of reactor components, fuel, and supporting equipment; fabrication and assembly of the experiment; installation, configuration, and integration within a DOE-controlled test facility; preoperational testing; reactor startup and operation; post-test shutdown and cooldown; removal of the experiment; restoration of the test facility; and decommissioning of the experiment and management of associated materials and waste.

Reactor activities include receipt, inspection, handling, interim storage, and loading of reactor fuel; radiological surveys and nuclear material controls; testing and validation of the reactivity-control, instrumentation-and-control, reactor-protection, and thermal-management systems; reactor startup; steady-state and transient testing; collection of reactor physics, materials-performance, thermal-performance, and operational data; controlled shutdown and defueling; decontamination, as necessary; and management of radioactive, hazardous, mixed, industrial, and nonhazardous waste through approved storage, treatment, and disposition pathways.

Operational Parameters:

This section provides a summary of the anticipated components and activities associated with the implementation of the VALKRE project. The project is expected to include a range of design and operational elements that support its technical, safety, and environmental objectives. These elements are described to offer a clear understanding of the project's scope, including expected emissions, waste streams, and other relevant considerations associated with construction and operation of the VALKRE advanced nuclear reactor.

Location:

The VALKRE experiment is planned to be installed and operated in the PFB-613 facility within the Critical Infrastructure Test Range Complex at the INL. The experiment will be configured within the existing facility footprint and will use available facility space and utilities, together with project-specific shielding, control, instrumentation, and support systems.

The Demonstration and Operation of Microreactor Experiments test bed at the Materials and Fuels Complex may be considered as an alternate location. Use of the alternate location would be subject to completion of applicable DOE environmental, cultural-resource, safety, facility, and operational reviews before installation or operation.

Fuel:

The experiment will use fuel in the approved VALKRE reactor configuration. Fuel-related activities include receipt, inspection, radiological survey, nuclear material control and accountability processing, handling, interim storage, core loading, post-test defueling, packaging, storage, and transfer. Fuel activities will be conducted under applicable safety-basis documents, nuclear-material controls, transportation authorizations, radiation-protection requirements, and approved operating procedures. Project-specific fuel-enrichment and fuel-inventory bounds are maintained in the controlled technical appendix.

Heat-Removal System:

The reactor includes an engineered heat-removal system supporting startup, steady-state operation, transient testing, controlled shutdown, and post-shutdown decay-heat removal. Detailed heat-transfer media, quantities, system configuration, and performance characteristics are maintained in the controlled technical appendix.

Safety and Accident-Analysis Basis:

The VALKRE project attributes relevant to DOE's NEPA determination are summarized in the table below. The project will be supported by design and accident analyses documented in the Preliminary Documented Safety Analysis dated 8/4/2026.

The applicable analyses will evaluate normal operation, anticipated operational occurrences, and bounding accident conditions, including the potential release of radioactive or hazardous materials and resulting consequences at applicable onsite and offsite receptor locations. Controlled design inputs, fuel-inventory assumptions, source-term information, and heat-removal characteristics are maintained in the controlled technical appendix.

Operational Timeline:

Phase One: Final Design and Procurement

Final Design Complete: 11/25/2026

Procurements: 7/23/2026-3/31/2027

Phase Two: Fabrication, Assembly, and Facility Integration

2/01/2027-6/30/2027

Phase Three: Startup, Commissioning, and Experimental Operation

Initial Critical: 7/2027

Phase Four: Cooldown, Experiment removal, Facility Restoration, and Decommissioning

8/01/2027-12/31/2027

The table below summarizes the key parameters and characteristics of the anticipated project. These parameters define the project envelope evaluated under this evaluation. Changes that exceed or materially alter the reviewed bounds require prior DOE environmental review and revision of this evaluation, as appropriate.

Parameter	Definition	Bounding Condition
Thermal Output	Maximum thermal power generated by the reactor	No more than 300 Kw
Electrical Output	Estimate of maximum electric generator output from the reactor	N/A, No power conversation being conducted

Fuel Type	Reactor fuel type	Tristructural Isotropic (TRISO) (HALEU)
Fuel Amount	Amount of fuel is to be used over the operational life of the reactor.	No more than 80 kg U-235
Commissioning Time	Maximum time commissioning the reactor.	3 months
Operational Time	Maximum duration of reactor operation	1 month
Heat Transfer Medium	Mechanism for removal of reactor heat	A closed loop system using heat pipes and heat exchanger to discharge to the atmosphere.
Heat Sink	Medium used to dissipate reactor core heat	Atmosphere
Water Consumption	Process or operational water use	Approximately 50-100 gallons
Liquid Effluent	Routine discharge of liquid waste streams	None anticipated
Radiological Air Emissions	Projected airborne radionuclide releases	Bounded by design and accident analysis demonstrating minimal offsite dose consequences

Waste Generation	Anticipated operational waste streams	Low-level radioactive waste, mixed waste, and nonradiological industrial waste managed through established processes and offsite disposal pathways

Revision 1:

This revision includes modification to the Year 1 scope and involves building a reactor experiment set up and gathering data. In Year 1, a non-radiological mockup of the experiment will be built at Idaho National Laboratory (INL) in the Microreactor Agile Non-Nuclear Experimental Test Bed (MAGNET) facility at the Energy Systems Laboratory (ESL). This experiment involves electrically heating the system, exercising the key components of the system, and taking various measurements (such as temperature).

No waste will be associated with this revision.

Equipment purchases will include hardware and various components, which will remain at INL for future use.

Original :

This Idaho National Laboratory (INL) project involves working to assemble use cases and user requirements for a High-Assay Low-Enriched Uranium (HALEU), solid moderator, kilowatt class nuclear reactor, and then designing, procuring, and testing a First-of-a-Kind, minimum viable reactor protoboard experiment to gather valuable neutronics performance measurements of metal hydride moderators.

INL will review and validation of use cases, a technical report, along with modeling and simulation. No waste or air emissions will be associated with this project. The INL portion of the Year 1 task will take at IF-654.

This ECP covers funded tasks in Year 1 only, not including equipment purchases. A revision of this ECP will be required for equipment purchases if a decision from the Go/No-Criteria is to move forward to Year 2 tasks.

Tasks in Years 2 and 3 will require a review/revision of this ECP, prior to funding these tasks.

Year 1 Scope of Work:

- Analysis of use cases, this includes creating an integrated product team (IPT) to collect use cases. The IPT team participates in structured wargaming exercises to validate the use cases. Modeling and simulation include high-fidelity predictive modeling of temperature extremes, cooling, stress/strain on components, and nuclear safety at various power levels during normal and off-normal operating environments of the reactor design.
- Designing a modified version of the kilowatt-class reactor to meet requirements, and
- Material selection (This does not include acquisition, this will require a revision of this ECP prior to purchase).

Year 1 Tasks:

Task 1.1: Project Team collects, analyzes, and facilitates review and approval by independent expert reviewers of use cases for:

- size, weight, and power limits
- timescales for mobilization and demobilization
- risk and vulnerability against selected external threats
- specialist workforce availability at remote locations.

Task 1.2: Project Team develops a modified design of the kilowatt class reactor that meets the needs and presents results in the form a breadboard-level design document including:

- Results of modeling and simulations
- Initial plan for the reactor physics experiment

- National Environmental Policy Act (NEPA) and authorization strategy for the VALKRE experiment

Task 1.3: Project Team finalizes selection of materials and initiates critical material procurement schedules and cost estimates for the reactor protoboard experiment documented in a fabrication plan independently reviewed by experts.

Task 1.4: Project Team will document Year 1 activities in an annual report.

Year 1 Go/No-Go Criteria:

Successful completion of independently reviewed and approved Year 1 tasks

- Delivery of annual technical report
- Determination of favorable feasibility and risk profile of the design solution based on results of Tasks 1.1, 1.2, and 1.3
- Years 2 and 3 (not covered by this ECP) will focus on the procurement, testing and start-up for a reactor that will be located at the INL facility, Demonstration and Operation of Microreactor Experiments (DOME) Test Bed.

All off-site partners will comply with their local procedures and state/federal regulations as identified in contract agreements.

Environmental Aspects and Impacts:

Air Emissions

Radionuclide and other potential HAP emissions are expected.

Discharging to Surface, Storm, or Ground Water

N/A

Disturbing Cultural or Biological Resources

CULTURAL: A Section 106 review was completed under CRMO project number (BEA-26-047R1) and resulted in No Historic Properties Affected. Please refer to Holds Points and Project Specific Instructions.

Generating and Managing Waste

Polychlorinated Biphenyl (PCB) waste could be generated when performing maintenance on, replacing, or performing D&D on equipment manufactured before 1982. Such equipment and associated materials include but are not limited to capacitors, lubricants/dielectric fluids, transformers and bushings, light fixtures, electric motors, pumps, voltage regulators, other equipment/components that contain oil, and oil associated with electrical conduit/cable.

Polychlorinated Biphenyl (PCB) waste could be generated when work activities involve structures or buildings built before 1982 (e.g., painted surfaces, caulking, adhesives, rubber gaskets, joint sealer, cable/wire insulation, ventilation duct gaskets or insulation).

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.

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References:

B5.26 "Advanced Nuclear Reactors"

For Categorical Exclusion Determinations:

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.

NEPA Compliance Officer

Signed by: Jason L Anderson, NEPA Compliance Officer

Date Signed: 10/21/2026