

**U.S. Department of Energy-Idaho Operations Office
National Environmental Policy Act
Categorical Exclusion Determination**

Project Title: Deployable Energy Zero Power Criticality

Project Description and Purpose:

Deployable Energy proposes to conduct a zero-power criticality test of its Unity microreactor core at Idaho National Laboratory (INL), Materials and Fuels Complex (MFC). The test will be performed inside an existing below-grade room within the Neutron Radiography Reactor (NRAD) facility.

The purpose of the activity is to experimentally confirm predicted neutronic performance of the Unity core design. The test will measure neutron multiplication as the system approaches criticality under controlled conditions. The activity is limited to zero-power operation and will not generate electricity, thermal energy for use, or sustained reactor power. The test is research-scale and is intended to validate modeling assumptions prior to any future demonstration activities. Table 1 below highlights the operational parameters of the Deployable Energy zero-power criticality test.

Table 1: Operational Parameters of proposed Deployable Energy zero-power criticality test.

Parameter	Definition	Bounding Condition
Thermal Output	Maximum thermal power generated by reactor.	0 MWth (zero-power operation only).
Electrical Output	Estimate of maximum electric generator output from reactor.	0 kWe (no power generation during test).
Fuel Type	Reactor Fuel type.	Low-Enriched Uranium (LEU) UO2 fuel; annular pellet design; Zircaloy cladding.
Fuel Enrichment	Extent to which fuel has been enriched.	4.95% U-235 (LEU)
Fuel Amount	Amount of fuel to be used over the operational life of the reactor.	= 536 kg
Commissioning Time	Maximum time to be spent commissioning the reactor.	Short-duration installation and readiness activities conducted prior to the criticality test campaign (anticipated to occur within the overall project schedule year).
Operational Time	Maximum time to be spent with reactor operational.	Limited to short-duration zero-power criticality testing (less than 12 months). No sustained power operations are planned.
Decommissioning Time	Maximum time to be spent decommissioning and disassembling the reactor.	Temporary test hardware will be removed following completion of testing. Activities are expected to be short term and limited to disassembly and removal within the existing facility.
Cooldown Time	Maximum time that the reactor will sit for on-site cool down prior to defueling.	No significant cooldown required; fuel not significantly irradiated; stored post-test.
Heat Transfer	Medium and mechanism used for transfer of reactor core heat to heat sink.	Not applicable for zero-power test; no active heat transfer system.

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Heat Sink	Medium and mechanism used for conversion and/or dissipation of reactor core heat.	Not applicable; zero-power operation.
Water Consumption	Amount of water facility is capable of delivering .	Light water will be used as a moderator within a contained test vessel. Total volume will be limited to the capacity of the temporary test tank. Water will be drained and managed through existing facility systems following testing.

Technology Overview

The Unity core is a compact microreactor design intended for future deployment as a modular 1-megawatt electric unit (see image below). The core design incorporates commercially established light water reactor fuel technology, helium cooling in its full configuration, and a physically separate water moderator.

The proposed test configuration includes only the reactor core and associated support hardware. The helium coolant system, turbine generator, power conversion equipment, and other balance-of-plant systems are not included in this activity.

The core uses low-enriched uranium fuel containing 4.95 percent uranium-235 in the form of uranium dioxide ceramic pellets. The fuel pellets are enclosed in Zircaloy cladding and supported by stainless steel structural components. The enrichment level remains below 5 percent and does not involve high-assay low-enriched uranium. Fuel materials are consistent with established commercial light water reactor fuel supply chains.

Approximately 536 kilograms of uranium dioxide fuel enriched to 4.95 percent will be shipped to INL in a certified transportation package. Fuel assemblies will be constructed onsite within the existing NRAD facility prior to testing.



Test Configuration and Operations

The zero-power criticality test will be conducted using a temporary, vertically oriented water tank test fixture installed within an existing underground NRAD room.

The test fixture consists of:

- An upper reaction vessel that houses the core lattice
- A lower drain tank that functions as a moderator reservoir

The core will be assembled in a regular lattice geometry within the upper vessel. Initial configurations will include stainless steel rods occupying lattice positions. These rods will be incrementally replaced with fuel rods as part of the controlled approach-to-critical sequence.

Water will serve as the neutron moderator. The moderator will remain unpressurized and near ambient temperature throughout the test. No pressurized coolant system will be used. Water will be added in controlled increments while neutron flux is continuously monitored using installed instrumentation and established critical experiment practices.

The approach-to-critical sequence will include:

- Assembly of a confirmed subcritical configuration.
- Incremental fuel loading and moderator addition.
- Measurement of neutron multiplication after each adjustment.
- Controlled increase of reactivity until criticality ($k_{eff} = 1$) is achieved.
- Confirmation measurements at zero power.
- Drainage of moderator to terminate the reaction.

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Reactivity control during the test is achieved through geometry control and moderator level management. Removal of moderator water returns the configuration to a deeply subcritical state. Because the system operates at essentially zero thermal power, no meaningful heat generation or fuel burnup will occur.

Upon completion of testing, the moderator will be drained to the lower tank, fuel assemblies will be disassembled, and fuel will be placed in approved storage at MFC for future use. The test fixture will then be removed.

Facility and Site Use

All activities will occur within an existing, below-grade NRAD room at MFC. The room is constructed of reinforced concrete and is shielded by substantial structural material and earth. Access is controlled and consistent with current nuclear research operations.

The test fixture is comparable in size to two stacked 55-gallon drums and will be lowered into position through an existing ceiling hatch using facility lifting equipment. A vertical pit beneath the room floor will accommodate the drain tank, allowing the reaction vessel to remain accessible at floor level.

The activity does not require:

- Construction of new buildings
- Modification of site boundaries
- Excavation or ground disturbance
- Installation of permanent infrastructure

All work will occur within previously developed and continuously used research space.

Utilities and Support Systems

The activity will rely on existing facility electrical systems for instrumentation, data acquisition, and control equipment.

Moderator water will be supplied through controlled fill lines and maintained at atmospheric pressure. Following each test sequence, moderator water will be drained to the lower tank and managed through existing facility systems as appropriate. All industrial wastewater generated by this process will be contained and completely characterized prior to disposal. Waste Generator Services (WGS) and the Water TPOC will use this information to approve the disposal pathway.

No new permanent utility extensions or upgrades are required.

Materials and Waste Streams

Radiological Materials

The only radioactive material involved is low-enriched uranium fuel enriched to 4.95 percent uranium-235. Because the test will be conducted at zero power and of short duration, fuel irradiation will be negligible. No significant fission product inventory will be generated.

No spent fuel will be produced as part of this activity. Following completion of that experiment, the pins will be stored at NRAD and subsequently used in additional zero-power critical testing. While the exact scope of these follow-on tests is still being finalized, the test continues to characterize the Unity Nuclear Battery reactor core.

Low-Level Radioactive Waste

There is anticipated to be low level radioactive waste associated with daily radiation control tasks such as PPE, survey items (smears, wipes, particulate monitoring filter papers, individual plastic bags associated with fuel packaging). Other waste would be also controlled as low level radioactive waste due to the installation happening in a radiological buffer area. These wastes would come from installation in the NRS and would consist of packaging materials from the individual components being shipped to INL as well as waste associated with field installation of various instrumentation and controls systems (copper wire, conduit, and packaging).

All of the waste would enter the Hot Fuels Examination Facility (HFEF) low level waste collection points (rad trash cans).

Liquid Materials

The primary liquid used is clean water serving as neutron moderator. Water will remain contained within the test system. All industrial wastewater generated by this process will be contained and completely characterized prior to disposal. WGS and the Water TPOC will use this information to approve the disposal pathway. Any drainage will be managed through existing facility systems. No routine radioactive liquid discharge is anticipated.

Solid Waste

Solid waste generation is expected to be limited and consistent with small-scale experimental activities. Potential waste streams include:

- Fuel transportation packaging
- Minor installation materials
- Temporary shielding materials, if required

Waste volumes are expected to be small and will be managed using existing INL waste handling processes.

Fuel Storage

Battelle Energy Alliance (BEA), the Management and Operating Contractor at INL, will receive, verify, secure storage, and test use of a Deployable-owned ~0.43 μg Cf-252 neutron source at the INL NRAD facility. Activities include coordinating shipments, offloading and inspecting the source, applying tamper-indication devices, and storing the source in its certified Model 50240 Type A Shipping Container in accordance with DOE, INL, radiological control, criticality safety, and nuclear safety requirements. BEA will perform all necessary safety basis reviews, including updates to criticality safety analyses, facility Safety Analysis Reports, Technical Safety Requirements, and operating procedures to ensure compliant handling and consolidation of the neutron source throughout the period of performance.

This evaluation also encompasses BEA's support during the UNITY Zero-Power Criticality Experiment, including controlled movement of the neutron source, integration into the test setup, radiological surveys, hazard analyses, and subsequent removal and return to approved storage. Following testing, and at the end of the project or upon Deployable request, the source will be dispositioned—returned to the manufacturer, transferred to NRAD for reuse, or retained under extended storage. BEA will coordinate all compliant packaging, transportation, and documentation activities associated with this final disposition while the Deployable retains ownership of the neutron source throughout.

Air Emissions

The activity does not involve combustion or chemical processing. The reactor will operate at zero power and is not expected to produce measurable airborne radioactive releases. Ventilation will utilize existing NRAD systems.

Safety Characteristics

The activity incorporates conservative design and operational features:

- The fuel is low enriched uranium oxide below 5% enrichment
- The critical assembly is at atmospheric temperature and pressure during the criticality test due to the open vessel configuration that prevents pressure buildup
- The reactivity control is geometry based reliant on fuel rod position and pitch
- Positive reactivity insertion is terminated by a high-capacity moderator drainage system
- The zero-power operation of the critical assembly results in an insignificant long-lived fission production inventory since the low-power condition limits activation and radioactive inventory
- The test will be performed in a shielded underground facility designed for nuclear research activities

There is no substantial radiological release in the reactivity insertion accident. A peer reviewed analysis calculates the dose consequence to the off-site public as 3.47E-03 rem. DOE has established a policy (DOE P 420.2) stating that the design goal for new nuclear facilities is that the worst-case design basis accident will be 5 rem at the facility's public access boundary which this project meets.

Project Duration and Removal

Fuel delivery is anticipated prior to mid-2026, with testing targeted for completion by July 4, 2026.

The active test period will be approximately 20 days. Following completion:

- Moderator water will be drained
- Fuel assemblies will be disassembled
- Fuel will be placed into approved storage
- The temporary test fixture will be removed

No permanent reactor installation will remain in the NRAD facility.

Relationship to Future Activities

This activity is a discrete, research-scale physics test intended to confirm core neutronic behavior prior to any full-power or commercial demonstration. It does not involve electricity production, long-term operation, construction of a new reactor facility, or deployment of a commercial unit.

The activity uses commercially available low-enriched uranium fuel, established materials, and an existing DOE research facility. The scope is limited to temporary installation and short-duration zero-power testing within an already developed nuclear research environment.

Environmental Aspects or Potential Sources of Impact:

Air Emissions

The proposed zero-power criticality test would occur indoors within an existing NRAD facility and would not involve combustion processes or the installation of new air emission sources. Because the reactor would operate at zero power, no significant heat or operational air emissions are expected. Minor, short-term emissions could occur from routine equipment use and vehicle traffic during installation and removal of the temporary test fixture, but these would be limited in duration and consistent with normal facility activities. Radiological air emissions are not expected. Overall, no measurable impacts to air quality are anticipated.

Discharging to Surface-, Storm-, or Ground Water

The proposed activity would not involve any discharge to surface waters or groundwater. The zero-power test would occur indoors within an existing facility, and water used as a moderator would be contained within the test system and drained to existing, permitted facility wastewater systems following completion of testing. All industrial wastewater generated by this process will be contained and completely characterized prior to disposal. WGS and the Water TPOC will use this information to approve the disposal pathway. No new discharge points, infiltration to soil, or releases to nearby water bodies are planned. As a result, no impacts to surface water or groundwater resources are expected.

Disturbing Cultural or Biological Resources

The proposed activity would occur entirely within an existing indoor facility and would not involve ground disturbance, vegetation removal, or expansion of the current building footprint. No previously undisturbed land would be affected. Because all work would take place within developed and previously disturbed areas at the NRAD facility, no impacts to cultural resources, historic properties, or biological resources are expected.

Pursuant to 2023 Programmatic Agreement as amended in 2025, this federal undertaking is excluded from project-specific Section 106 consultation. The proposed activity results in no historic properties affected.

Generating and Managing Waste

The proposed zero-power criticality test would generate only small amounts of waste, primarily consisting of routine materials such as packaging, disposable protective equipment, and minor maintenance-related debris. Water used as a moderator would be contained within the system and managed through existing facility wastewater processes. All industrial wastewater generated by this process will be contained and completely characterized prior to disposal. WGS and the Water TPOC will use this information to approve the disposal pathway. The nuclear fuel would not be significantly irradiated and would be removed and stored for future use following the test. Any wastes generated would be handled in accordance with established INL procedures. No new or unusual waste streams are anticipated.

Releasing Contaminants

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

The proposed zero-power criticality test would not involve intentional release of contaminants to the environment. The activity would be conducted indoors within an existing, controlled facility designed for radiological work. The reactor would operate at zero power, and the fuel would not be significantly irradiated, the potential radiological releases are well below the evaluation guidelines as discussed above. Water used during the test would remain contained within the system and managed through existing facility processes. With established engineering controls and administrative procedures in place, no releases of chemical or radiological contaminants to the environment are expected.

Using, Reusing, and Conserving Natural Resources

The proposed activity would involve limited use of natural resources. The test would occur within an existing facility and would not require new land, raw material extraction, or permanent infrastructure. Water used as a moderator would be contained within the test system and managed through existing facility processes, and electrical demand would be minimal due to zero-power operation. The nuclear fuel would be retained for future use following the test. Overall, the activity represents a short-term, small-scale use of resources with no substantial impact on long-term resource availability.

Determination

References: B5.26 "Advanced Nuclear Reactors"

Justification:

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 waste, 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.

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;

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(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: 4/15/2026