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

NEPA Identification: DOE-ID-INL-26-029

Proposed Action Title: Terrestrial Energy Fuel Line Assembly TEFLA-1

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

Proposed Action Description:

PURPOSE AND NEED

Terrestrial Energy is developing the Integral Molten Salt Reactor, which uses uranium mixed with fluoride salts as reactor fuel. The U.S. Department of Energy (DOE) selected Terrestrial Energy for the Fuel Line Pilot Program to develop and demonstrate a process for producing this specialized fuel. Terrestrial Energy needs a limited quantity of qualified fuel salt and fuel pins for its planned Terrestrial Energy Test Reactor Assembly (TETRA) criticality experiment at the National Criticality Experiments Research Center (NCERC) in Nevada.

The purpose of the proposed action is to use Idaho National Laboratory's (INL) existing facilities and expertise to develop and test the fuel-fabrication process, produce less than 50 kilograms of enriched fuel salt and fewer than 50 fuel pins, and ship the completed pins to Nevada. The work will also generate the procedures, data, and operating experience needed to support continued development of the Terrestrial Energy Fuel Line Assembly (TEFLA) process.

PROPOSED ACTIVITIES

Administrative and Technical Support

To support Terrestrial Energy's development of the TETRA test reactor and TEFLA fuel-production process, INL, through the National Reactor Innovation Center (NRIC), will provide the technical expertise, project coordination, and regulatory support needed to advance the designs and prepare for the planned criticality experiment. These administrative and technical support activities will include:

- Providing project management, scheduling, cost tracking, meetings, administrative support, data management, reporting, and approved external communications.
- Providing access to secure digital engineering tools, including computer models, shared databases, and virtual or mixed-reality systems.
- Preparing and reviewing engineering analyses, design information, operating procedures, hazard and accident analyses, and nuclear safety documents.
- Participating in design and readiness reviews and preparing responses to DOE questions.
- Providing technical support related to environmental protection, historic preservation, air and water requirements, waste management, and other applicable requirements.
- Developing and maintaining quality assurance documentation, including working limits, final specifications, procedures, sampling plans, test and inspection results, material and production records, and final reports.
- Reviewing Terrestrial Energy's quality assurance program and planning and scoping the potential qualification of INL as a supplier.

Terrestrial Energy will retain responsibility for its designs, facilities, operations, and quality assurance program. Supplier qualification activities beyond planning and scoping are not included in this proposed action.

Receipt, Transfer, Characterization, and Storage of Uranium Material

INL will receive less than 20 kilograms of uranium tetrafluoride (UF4) enriched to less than 10 percent uranium-235 (U-235) from a qualified supplier for use as feed material in the test-fuel fabrication process. Receipt activities will include accepting and opening the shipment, verifying the contents against shipping records, documenting chain of custody, repackaging the material as needed for handling or storage, and returning or otherwise managing the transport containers.

Following receipt, INL will transport the UF4 to the Materials and Fuels Complex (MFC) or another appropriately authorized INL facility for sampling, characterization, inventory, and storage pending use. Variations in the supplier, shipping route, package configuration, receiving location, and sequence of activities are included in this scope, provided the activities remain within applicable packaging, transportation, security, radiation protection, nuclear material control, and facility requirements.

Materials, Procurement, and Laboratory Process Development

INL will procure, receive, prepare, sample, and store the materials required to develop and perform the fuel salt fabrication process. Maximum project inventories present at one time will include:

- Less than 20 kilograms of enriched UF4 containing less than 10 percent U-235.
- Less than 5 kilograms of depleted uranium metal.
- Less than 10 kilograms of depleted UF4.
- Less than 10 kilograms of sodium fluoride (NaF).
- Less than 10 kilograms of potassium fluoride (KF).
- Less than 3 kilograms of ammonium bifluoride (NH4HF2).
- Argon gas needed to maintain the glovebox atmosphere.
- Aluminum cladding and related fuel-pin components.

The finished fuel salt is accounted for within these source-material inventories and is not an additional material quantity. The total quantity of finished enriched fuel salt will remain below 50 kilograms.

Development and initial testing will occur in the Engineering Development Laboratory in MFC-789, the Water Chemistry Laboratory in MFC-768B, or another appropriately authorized INL facility with equivalent capabilities. INL employees will characterize the starting materials, develop the fabrication process, establish operating procedures, and conduct initial testing with depleted uranium materials before introducing enriched uranium, when practicable. Process-development activities will include preparation and testing of fuel salt, pellets, cladding, sealing methods, and fuel-pin loading procedures.

Fuel Salt and Fuel Pin Fabrication

Major fuel fabrication activities will occur inside the Pyrochemistry Glovebox in the Fuels and Applied Sciences Building, MFC-787. INL will install and configure the research equipment needed to perform the work inside the glovebox. The specific equipment configuration will be established through process development and the applicable facility work-control process.

Sodium fluoride and potassium fluoride salts will be dried in a vacuum oven at approximately 300°C. All salt-processing activities will occur in gloveboxes under an argon atmosphere. The prepared sodium fluoride, potassium fluoride, and UF4 will be combined and heated in a furnace inside the Pyrochemistry Glovebox to temperatures below 1,000°C. Heating and mixing will produce a uniform fuel salt mixture. The resulting material will be processed into powder and pressed into pellets.

Samples will be analyzed in the Analytical Research Laboratory, MFC-752, or another appropriately authorized INL laboratory with equivalent analytical capabilities. Testing will confirm the chemical composition, impurities, density, and other properties needed to determine whether the fuel salt and pellets meet project specifications.

The project will produce less than 50 kilograms of finished enriched fuel salt. Final mixture ratios and batch sizes will be established through the TETRA design and will remain within the maximum material quantities and applicable facility, safety, security, environmental, and nuclear material limits.

INL will procure or receive the metal tubes and related components required to fabricate fewer than 50 fuel pins. Cladding materials will consist of aluminum alloys appropriate for the final fuel-pin design, including Al6061-T6, Al6061-O, and Al5052-O. The components will be inspected and qualified by testing their dimensions, straightness, wall thickness, strength, leak resistance, pressure performance, handling characteristics, and response to heat. Fuel pellets will be loaded into the tubes, sealed, inspected, and assembled as required for quality approval and shipment.

The final number, dimensions, cladding selection, sealing method, and arrangement of the fuel pins will be established as the TETRA design is completed. These design details will remain within the project limit of fewer than 50 fuel pins and all applicable facility and transportation requirements.

Air and Water

All salt-processing activities will occur in gloveboxes under an argon atmosphere. Process off-gases will pass through commercially available scrubbers designed to control hydrogen fluoride before entering the applicable facility exhaust system. No uncontrolled airborne release is proposed, and the project will not require changes to existing facility ventilation, exhaust, or filtration systems.

The project will not use water for processing, equipment cleaning, or decontamination. It will not generate process wastewater or liquid waste, and no liquid discharge is proposed.

Packaging and Transportation

INL will identify, develop, or procure suitable containers and certified shipping packages for the finished fuel pins. INL will coordinate with Terrestrial Energy and Los Alamos National Laboratory (LANL) to establish packaging, sealing, handling, transportation, receiving-site, and delivery requirements.

Following all required approvals, INL will ship fewer than 50 finished fuel pins from INL to NCERC in Nevada. The number of shipments, quantity included in each shipment, transportation route, and package configuration will be established through the transportation-planning task based on the completed fuel design and applicable transportation requirements.

This NEPA review does not evaluate or authorize the return of unused material, test items, or waste from Nevada to INL for storage or disposition. Any future return shipment, receipt, or storage activity will require separate review under NEPA before it occurs.

Waste

Project activities will generate limited quantities of radioactive, hazardous, mixed, chemical, and ordinary industrial waste. The types and quantities of waste will depend on the number of process-development tests, production batches, samples, and fuel pins completed within the material and production limits established above.

Anticipated waste will include:

- Residual and off-specification salts.
- Depleted uranium NaF-KF-UF4 mixtures produced during process development.
- Used filters, wipes, protective clothing, sampling materials, and other disposable laboratory supplies.
- Contaminated or unusable equipment and components.
- The pilot fabrication rig or portions of the rig that cannot be decontaminated or reused.
- Metal pieces, maintenance waste, and empty material or chemical containers.

INL will characterize, collect, package, store, treat, recycle, and dispose of project waste through existing approved INL Waste Generator Services pathways and facilities. The project does not include construction of a new waste-management facility or development of a new treatment or disposal pathway.

Unused feedstock will not be disposed of as project waste. It will remain in appropriately authorized INL storage until needed for continued research or another authorized activity.

Activities involving uranium and hazardous chemicals will occur in appropriately authorized laboratories or processing areas. Controls will include gloveboxes or other enclosed process equipment, ventilation and off-gas controls, radiation and contamination monitoring, spill and fire protection, employee training, personal protective equipment, material inventory controls, and emergency procedures. INL will complete all applicable facility, safety, security, environmental, and work-control reviews before beginning physical work.

Locations and Equipment Installation

Project activities will occur at the following planned locations:

- Development and initial testing work may take place in the Engineering Development Laboratory, MFC-789, and/or the Water Chemistry Laboratory, MFC-768B.
- Major salt-processing and fuel-fabrication activities will be inside the Pyrochemistry Glovebox in the Fuels and Applied Sciences Building, MFC-787.
- Sample analysis will occur in the Analytical Research Laboratory, MFC-752.
- Receipt, inventory, and storage at MFC or another appropriately authorized INL facility.

Equivalent existing INL facilities are included in this scope when they are appropriately authorized for the materials, equipment, and hazards involved and the change in location does not create different environmental impacts.

INL will install and configure research equipment inside the Pyrochemistry Glovebox. The equipment has not been fully selected and will be finalized through process development and facility work control. Equipment installation will not require changes to facility ventilation, exhaust, filtration, utility, or storage systems. The project does not include outdoor work, construction of a new building, expansion of an existing building, exterior construction, or ground disturbance.

ACTIVITIES OUTSIDE THIS SCOPE

This project description does not cover:

- Construction or operation of the TETRA reactor.
- Criticality testing, reactor operation, or irradiation of the fuel pins.
- Construction of new buildings, expansion of existing facilities, exterior construction, outdoor work, or ground disturbance.
- Changes to existing facility ventilation, exhaust, filtration, utility, or storage systems.
- Commercial-scale fuel production.
- Return shipment, receipt, or storage at INL of unused material, test items, or waste from NCERC.

This document does not authorize, and does not commit DOE to authorizing, construction or operation of the TETRA-1 reactor or proposed criticality experiment at NCERC. Those activities are separate actions that will require their own DOE decisions and independent NEPA review before they occur. The scope described above, consisting of fuel-fabrication process development and production of a limited quantity of fuel salt and fuel pins, is one phase of a multi-phase program in which each phase results in an independent decision whether to proceed to the next. It has independent utility and will generate procedures, data, and operating experience of value regardless of whether subsequent phases proceed.

Changes that add an activity outside this scope will require additional NEPA review before the activity begins.

Environmental Aspects and Impacts:

Air Emissions

Powder handling, blending, pulverizing, pellet pressing, sampling, analytical preparation, off-normal releases, and waste handling may generate airborne uranium/fluoride particulate and radiological emissions. The selected purification method may also generate chemical and process-gas emissions, including HF- or hydrogen-related streams where those gases are used. All operations will use engineered containment, gloveboxes/hoods, ventilation, filtration, monitoring, and approved procedures appropriate to the material and process. An Air Permitting Applicability Determination (APAD), including a radionuclide source-term estimate, and confirmation of applicable permit/monitoring requirements are required before installation or operation of an emission source.

Discharging to Surface, Storm, or Ground Water

The current scope does not identify routine process-liquid effluent or outdoor disturbance. Process, analytical, cleaning, and decontamination liquids will be collected and managed as waste unless a discharge is expressly reviewed and authorized. Any proposed sanitary, industrial, stormwater, or reuse discharge; connection to a drinking-water system; or outdoor activity requires PEL review before implementation.

Disturbing Cultural or Biological Resources

No soil/vegetation disturbance, new building footprint, or work outside developed facility areas is included. If facility selection, utility work, outdoor equipment, storage, staging, routing, or construction would disturb land or modify an eligible historic property, project personnel must stop planning that activity and obtain cultural and biological resource review before work.

Generating and Managing Waste

Expected waste streams include nonhazardous industrial waste; unused/off-specification NaF, KF, depleted/natural UF4, enriched UF4, Fuel Salt and pellets; uranium- or fluoride-contaminated PPE, wipes, filters, analytical consumables, crucibles, tooling, equipment, and spill debris; off-gas treatment media; failed or rejected Fuel Pins; hazardous chemical waste; low-level radioactive waste; and mixed waste where radioactive and hazardous characteristics overlap. Quantities are TBD. Each stream must be characterized, profiled, accumulated, treated only under an approved plan where applicable, and dispositioned through an authorized pathway. No new waste treatment, storage, or disposal facility is included.

Releasing Contaminants

NaF, KF, UF4, prepared Fuel Salt, laboratory reagents, cleaning agents, process gases, and enriched uranium could affect air, soil, water, or workers if spilled or released. Work will use compatible containment, secondary containment where appropriate, inventory controls, criticality controls, spill response, emergency procedures, and approved material handling and storage practices.

Using, Reusing, and Conserving Natural Resources

The project will use uranium feedstock, carrier salts, cladding, specialty gases, analytical reagents, electrical power, packaging, and equipment. Process optimization will prioritize material recovery, reuse of qualified material, waste minimization, and avoidance of unnecessary enriched-material losses, consistent with safety, security, quality, and waste requirements.

References:

B1.30 "Transfer actions", B3.6 "Small-scale research and development, laboratory operations, and pilot projects"

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.

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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