IDAHO NATIONAL LABORATORY

FY 2025
NUCLEAR SCIENCE & TECHNOLOGY
RESEARCH IMPACTS

DEAR STAKEHOLDERS AND SUPPORTERS,

As we look ahead to the future of nuclear energy, I'm pleased to share this year's Nuclear Science and Technology (NS&T) Impacts Report, which highlights Idaho National Laboratory's (INL's) accomplishments in advancing the U.S. Department of Energy's (DOE's) mission and supporting the nation's evolving energy landscape.

This Fiscal Year (FY)-25 NS&T Impacts Report comes at a pivotal moment for us. With renewed national focus on energy security, the United States (U.S.) supply chain resilience and advanced reactor deployment, our work is more relevant than ever. The recent executive orders signed in May 2025 bring increased momentum by calling for a whole-of-government approach to quadruple nuclear energy in the U.S. by 2050.

WE ARE AT THE FOREFRONT OF EFFORTS TO ACCELERATE THE DEPLOYMENT OF ADVANCED REACTOR TECHNOLOGIES.

The rapid growth of artificial intelligence (AI) and high-performance computing (HPC) creates an unprecedented demand for reliable, around-the-clock electricity. Nuclear energy is uniquely positioned to meet this challenge, and INL is at the forefront of efforts to accelerate the deployment of advanced reactor technologies.

This year, we made significant progress on multiple fronts in reactor experiments and demonstrations. Fabrication of the Microreactor Applications Research Validation and Evaluation (MARVEL) microreactor is on track, and installation at the Transient Reactor Test (TREAT) Facility is proceeding as planned. The Molten Chloride Reactor Experiment (MCRE), a collaboration between Southern Company and TerraPower, is preparing to establish key technologies for fast-spectrum, liquid-fueled reactors. INL also supports the Department of War's Strategic Capabilities Office with the upcoming deployment of the Pele microreactor.

Through the National Reactor Innovation Center (NRIC), we are building the infrastructure needed to support private-sector demonstrations. We are accelerating the availability of the Demonstration of Microreactor Experiments (DOME) and Laboratory of Operations and Testing in the United States (LOTUS)

test beds to provide secure, flexible environments for testing microreactors and other advanced systems. These platforms are designed to reduce development timelines and costs while maintaining the highest standards of safety and performance.

We also saw strong momentum from our industry partners. Our strong partnership with TerraPower continues to support their deployment of Natrium near Kemmerer, Wyoming. Oklo, Inc., held a ground breaking for its Aurora Powerhouse project, located on the INL site, with INL providing high-assay, low-enriched uranium (HALEU) and fuel-fabrication capabilities. Our work with X-energy progressed toward fuel qualification for its Xe-100 reactor. We also continue to work with companies on innovative fuels, including accident-tolerant fuel irradiations with Westinghouse, GE-Vernova, General Atomics and Framatome, as well as innovative fuel fabrication and testing with Lightbridge and Clean Core Thorium Energy.

INL's leadership extends to space nuclear power. Our strategic report, *Weighing the Future: Strategic Options for U.S. Space Nuclear Leadership*, authored by space community luminaries, catalyzed high-level discussions on nuclear power in space. We are also pleased to have INL staff serve in key leadership roles in the Fission Surface Power Program. These efforts position the lab to deliver first-of-a-kind reactor hardware for defense and space propulsion missions.

We also made important strides in strengthening the domestic fuel cycle. INL completed initial Advanced Test Reactor (ATR) fuel recycling tests at the Material Recovery Pilot Plant and supported DOE in the allocation of HALEU — key steps toward reestablishing a robust U.S. fuel supply chain. In response to the executive orders mentioned above, our staff contributed to DOE Authorization Standard 1271, streamlining approvals for DOE reactors and fuel fabrication facilities.

This report highlights the division's contributions across a broad spectrum of mission areas — from fuel development and materials science to safeguards, modeling and national security. It also showcases the impact of our Laboratory Directed Research and Development (LDRD) investments and the growing recognition of our work in national media.

These accomplishments reflect the dedication of our teams and the strength of our partnerships. Together, we lay the groundwork for a resilient, modern nuclear energy future — one that strengthens American energy dominance, fuels economic growth, and reinforces national security.

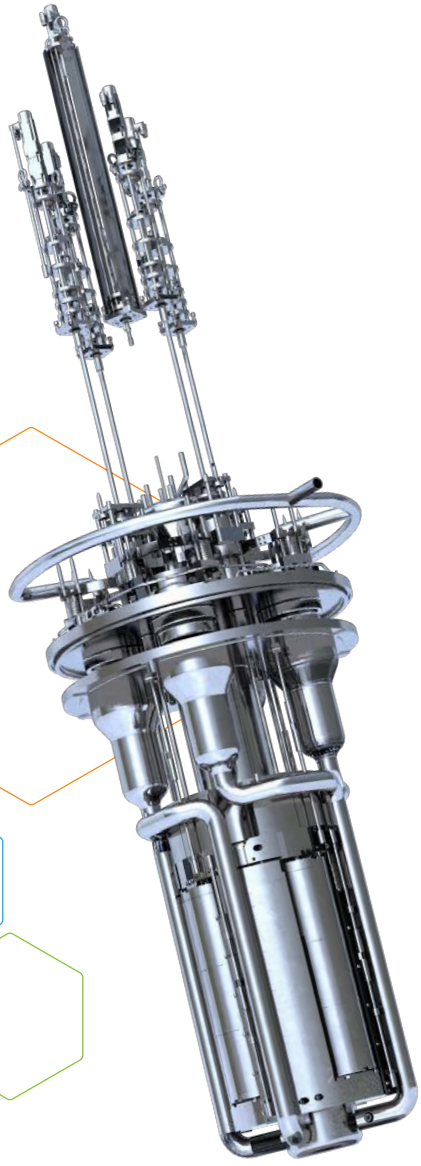
Thank you for your continued support.

Jess C. Gehin, Ph.D.
Associate Laboratory Director,
Nuclear Science and Technology

> *Each of you plays a critical role in the groundbreaking work taking place at the Nuclear Science and Technology directorate. Your dedication and innovation are essential to advancing Idaho National Laboratory's mission — and to realizing Secretary Wright's vision of accelerating transformative technologies like nuclear fusion, high-performance computing, quantum computing, and AI. Together, we are helping ensure America's continued leadership and prosperity."*
> **— Jess Gehin to NS&T staff**

SECTION 1

ADVANCED REACTOR DEVELOPMENT AND TESTING



Design, Demonstrate, and Deploy Advanced Reactors

In FY-25, INL continued to lead the nation in developing and demonstrating advanced nuclear technologies that support national security, energy resilience and commercial innovation. These efforts directly align with President Donald Trump's nuclear executive orders, which promote the development and deployment of advanced nuclear reactors for defense and space applications, and an executive order that emphasizes the protection of critical infrastructure.

THESE EFFORTS DIRECTLY ALIGN WITH THE PRESIDENT'S NUCLEAR EXECUTIVE ORDERS, WHICH PROMOTE THE DEVELOPMENT AND DEPLOYMENT OF ADVANCED NUCLEAR REACTORS.

MARVEL MICROREACTOR

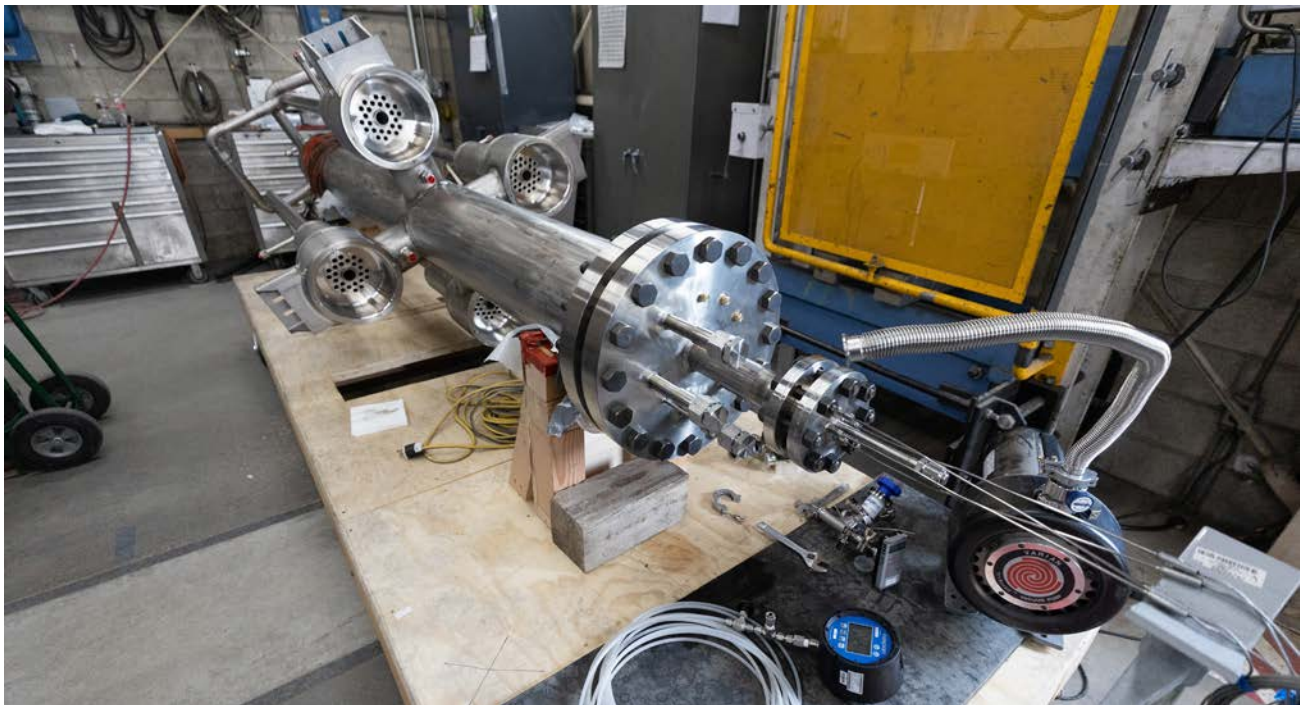
A Year of Validation and Momentum

This year marked a transformative chapter for the Microreactor Applications Research Validation and Evaluation (MARVEL) project at INL. As the team continues to move from design to demonstration, MARVEL made significant progress toward becoming the first operational microreactor of its kind in the U.S.

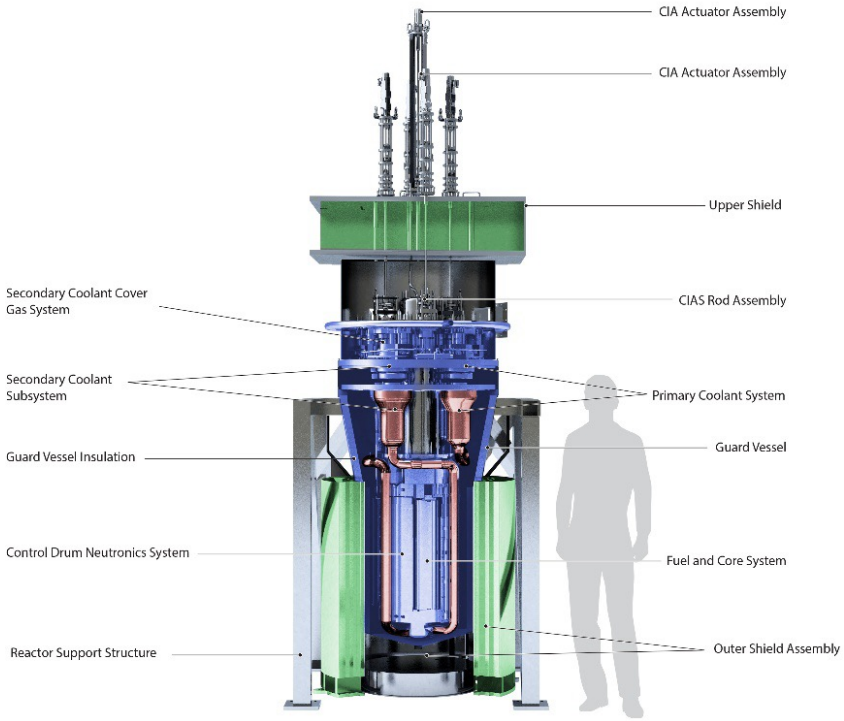
At the heart of this year's success was the completion of testing at the Primary Coolant Apparatus Test (PCAT) — a full-scale, electrically heated, non-nuclear replica of MARVEL's primary coolant loop. Over a rigorous three-month testing campaign, the MARVEL team validated the reactor's natural-circulation primary cooling system, confirming its ability to safely and reliably extract 85 kilowatts of thermal power. The test also verified the performance of key components and modeling tools, including RELAP5-3D, providing confidence in the system's design.

While testing was underway, fabrication of the reactor itself continued to advance. Steady progress was made in component manufacturing. A major milestone was reached in September 2025 with the completion of fabrication of the stainless-steel components in the MARVEL Reactivity Control System — an essential step toward future reactor operations. Fabrication was also kickstarted on the Primary Coolant System (PCS), a key component on the critical path of the project.

Beyond technical progress, MARVEL issued an Expression of Interest (EOI) to industry and research partners, inviting proposals for experiments and demonstrations that could leverage MARVEL's unique capabilities. A wide range of innovative use cases has been received and will be considered for the experimental phase of the use of the MARVEL reactor. This outreach reflects MARVEL's broader mission: to serve not only as a trailblazing reactor, but also as a testbed for advanced nuclear technologies, hybrid energy systems, and novel operational paradigms.



MARVEL Primary Coolant Apparatus Test (PCAT) before shipment offset for MARVEL system testing.



Looking ahead, the project refined its deployment timeline. Next year, the project expects to complete all major fabrications for the reactor system and receive the fuel in-house. Initial criticality is expected to occur shortly thereafter with full power operations planned by 2028. These adjustments reflect a deliberate and data-driven approach to ensuring safety, performance, and long-term impact. This year, MARVEL proved more than just the viability of its design — it demonstrated the power of collaboration, innovation, and persistence in bringing a new generation of nuclear energy to life.

NS ENERGY

Oct. 2024

How INL is advancing nuclear deployment with MARVEL Microreactor

The MARVEL microreactor is on a fast track to development at INL where it will be the point of the spear on advanced microreactor deployment.

https://www.nsenergybusiness.com/analysis/how-idaho-national-laboratory-is-advancing-nuclear-deployment-with-marvel-microreactor/

MSN

July 2025

DOE Invites Experiments for MARVEL Microreactor

DOE is inviting companies to propose experiments using its MARVEL reactor, a testbed scheduled to begin operations in 2028 at INL's TREAT facility.

https://www.msn.com/en-us/technology/biotechnology/doe-invites-experiments-for-marvel-microreactor/ar-AA1HHOcL?ocid=BingNewsVerp

LIFE TECHNOLOGY

July 30, 2025

INL Engineers Develop Microreactor Test Facility

INL engineers launch innovative project to design microreactor test facility, shaping global energy landscape in 2020 spring.

https://www.lifetechnology.com/blogs/life-technology-technology-news/idaho-national-lab-engineers-develop-microreactor-test-facility

PROJECT PELE

Advancing Mobile Nuclear Power for National Defense

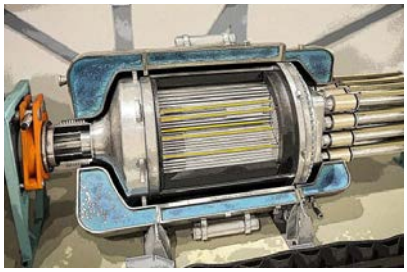
INL continued its leadership in supporting DOW's Project Pele — a mobile, high-temperature gas-cooled test microreactor. The reactor uses HALEU-based Tri-structural isotropic (TRISO) particle fuel, engineered for passive safety and multiyear operation without refueling.

A major milestone was reached on May 31, 2025, when INL and its partners completed fabrication of all TRISO fuel required for Pele operations. This achievement ensures the project is ready for upcoming reactor activities and marks a critical step in fuel preparation.

To safely transport the fuel from BWX Technologies (BWXT) Nuclear Operations Group to INL, engineers developed and tested a specialized transportation configuration. INL identified potential risks, conducted shake table simulations, and evaluated multiple packaging options. The preferred configuration is being shared with the broader advanced reactor community to inform future fuel transportation efforts.

INL also completed the Contractor's Readiness Assessment for receiving TRISO fuel at TREAT, enabling fuel-pin assembly and reactor module loading to proceed. In parallel, the lab collaborated with BWXT and DOE to develop and approve several long-lead equipment procurements. These efforts allowed Project Pele to begin purchasing reactor hardware and assembling the core ahead of the preliminary safety analysis report, accelerating the overall project timeline.

These activities followed the groundbreaking on the Pele reactor at INL in late FY-24, marking a major milestone in national energy-resilience and defense innovation.



Top: Project Pele groundbreaking. Bottom: Rendering of Pele microreactor.

WORLD NUCLEAR NEWS

July 2025

Fabrication of the reactor core for the Project Pele prototype mobile microreactor — the first microreactor to be built and operated in the USA — has begun at BWX Technologies' Innovation Campus in Lynchburg, Virginia.

https://world-nuclear-news.org/articles/work-starts-on-pele-microreactor-core

NRIC Accelerates U.S. Innovation through Completion of Significant Accomplishments and Strategic Industry Collaborations

NRIC advanced its mission to accelerate the commercialization of advanced nuclear technologies by bridging the gap between concept, demonstration, and deployment. A major milestone was the selection of Westinghouse Electric Company and Radiant Industries to conduct the inaugural advanced microreactor experiment tests at the DOME facility at INL, with testing scheduled to begin in spring 2026.

In preparation, both companies completed the Front-End Engineering and Experiment Design phase and are now engaged in Detailed Engineering and Experiment Planning — critical steps for designing, fabricating, constructing, and performing reactor experiments. These collaborations are helping NRIC and its partners reach key milestones toward test authorization at DOME.

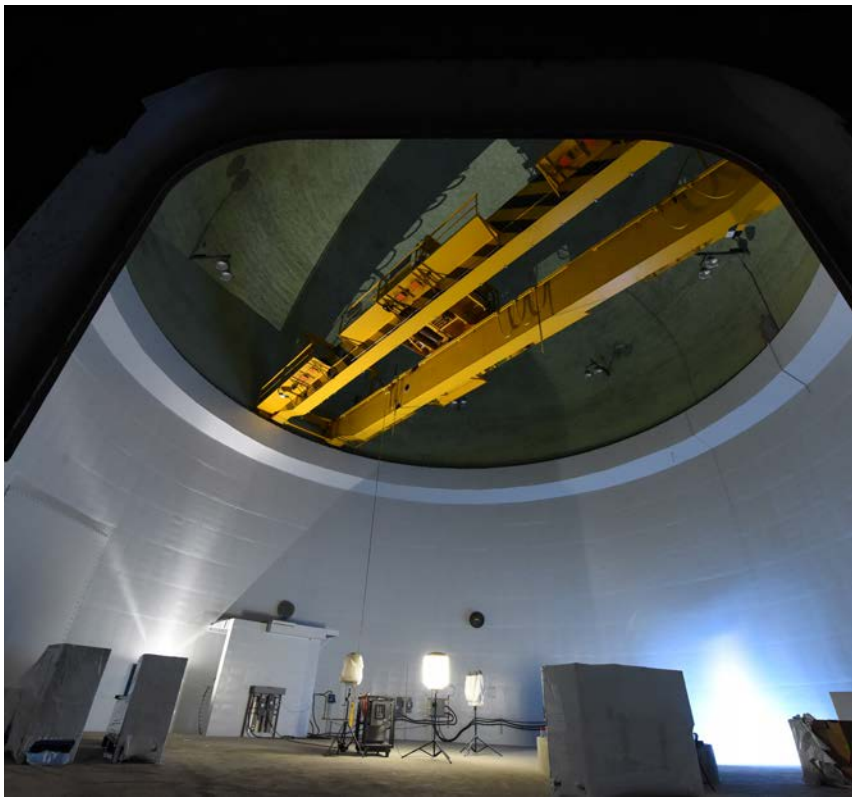
In June 2025, DOE provided a finding of no significant impact for the environmental assessment of the DOME test bed under the National Environmental Policy Act, allowing NRIC to proceed with training and scheduling. INL also received a defense "priority" procurement status for DOME and LOTUS construction, accelerating supply chains. DOME is scheduled to be completed by March 2026 — ten months ahead of schedule — while LOTUS construction is set to begin in FY-26.

NRIC continues to prioritize industry needs. This year's gap assessment, conducted with reactor developers, national technical directors, and laboratories, identified capabilities needed to address high-impact challenges. Recommendations included optimizing DOE and lab facilities, improving fuel and component prototyping, advancing construction methods, and developing tools and guidance to support demonstration and deployment.

NRIC has established the Maritime Nuclear Applications Group (MNAG) to serve as a resource hub and collaboration platform for the maritime and nuclear sectors. MNAG hosts quarterly meetings and working groups to drive progress on research and development (R&D), regulatory, finance, and public acceptance of maritime nuclear technologies.

They have integrated industry insights and Nuclear Regulatory Commission (NRC) feedback to finalize a foundational document that shapes the maritime nuclear regulatory landscape. Additionally, MNAG has developed economic models to highlight the value of deploying maritime nuclear reactors and address public acceptance issues. Separately, NRIC has partnered with the American Bureau of Shipping to tackle challenges in the maritime sector and speed the implementation of advanced nuclear reactor technologies. This aims to offer competitive advantages for U.S. companies involved in designing, building, operating and supporting maritime assets.

The center expanded its Virtual Test Bed, attracting more users and integrating advanced reactor models. It launched the Sodium-cooled Thermal-spectrum Advanced Research Test Reactor (STARTR), building on DOE's MARVEL program, and developed DOME models to simulate temperature and radiation profiles. A new registration page now enhances user access.



POWER MAGAZINE

July 2025

Westinghouse, Radiant Selected for First Fueled Nuclear Microreactor Tests at INL's DOME Facility

Nuclear microreactors developed separately by Westinghouse and Radiant are poised to become the first fueled designs tested at the DOME facility — the world's first dedicated microreactor test bed, slated to open at INL in early 2026. The first fueled experiment is expected to begin as early as spring 2026.

https://www.powermag.com/westinghouse-radiant-selected-for-first-fueled-nuclear-microreactor-tests-at-inls-dome-facility/

Illustration of LOTUS

In July, NRIC installed three creep frames in a shielded enclosure at INL's Sample Preparation Laboratory. These frames test thermal creep in irradiated materials — graphite, metal alloys, and advanced-manufacturing samples — providing essential data for regulatory qualification. A new scheduling app now optimizes frame usage.

GE Hitachi Nuclear, in collaboration with NRIC, successfully tested a modular steel-concrete composite design called "diaphragm plate-steel composite" in the Bowen Laboratory at Purdue University. The tests exceeded expectations and were considered successful in that they showed that this steel-concrete composite design performed in all scenarios at or above design criteria, signifying that it could be used in future projects to build safer and more efficient SMR containment structures. The data from these tests supported GE Hitachi in submitting topical reports to the NRC for this advanced construction technology design while informing GE Hitachi on design decisions for future SMR projects. The overall goal of this collaboration with GE Hitachi is to demonstrate construction technologies that have the potential to reduce nuclear construction costs and schedule, relative to traditional construction techniques and methods.

MSTEC shield hot cell with manipulators and characterization equipment controls for working with irradiated samples.

MSTEC Shielded Hot Cell

The Molten Salt Thermophysical Examination Capability (MSTEC) is a state-of-the-art, shielded argon glovebox for irradiated and nonirradiated actinide materials. 2025 saw substantial progress towards establishing this NRIC capability with installation of the glovebox, shielding, remote manipulators, and mezzanine along with highly specialized experimental infrastructure installed and tested inside the glovebox. Once readiness activities are completed in early FY26, MSTEC will be INLs newest transuranic glovebox that will provide users with characterization equipment, infrastructure, and technical staff necessary to deliver reliable and reproducible data for designing, demonstrating, licensing, and operating molten salt reactors and fuel cycle development.

NUCLEAR ENGINEERING INTERNATIONAL

May 30 2025

INL prioritized to fast-track microreactor test beds

INL has received priority rating authorization by the federal government to expedite the construction of the world's first two microreactor test beds. The new rating follows DOE plans to streamline construction projects across the national laboratories aimed to restore U.S. energy dominance and help spur innovation.

https://www.neimagazine.com/news/inl-prioritised-to-fast-track-microreactor-test-beds/

Oklo groundbreaking event Sept. 22, 2025

INL IS WORKING WITH OKLO TO ESTABLISH THE A3F AT MFC TO FABRICATE THE FUEL FOR THE AURORA POWERHOUSE.

INL and Oklo, Inc. made major strides this year on the Aurora Powerhouse, a fast-spectrum reactor that will be built just south of the Materials and Fuels Complex main entrance. In a significant milestone, the project broke ground in 2025, marking the start of preconstruction activities. Earlier in the year, the project completed site characterization and geotechnical studies. The company also completed the conceptual design of its Aurora Fuel Fabrication Facility, which will be used to fabricate fuel assemblies for the reactor, and received DOE approval for its conceptual safety design report.

The Aurora Powerhouse is founded on technology proven at INL (i.e., EBR-I and EBR-II) using metallic fuel and liquid sodium coolant to generate 75 MWe of electricity. It can operate on either fresh HALEU or recycled nuclear fuel. INL is working with Oklo to establish the Aurora Fuel Fabrication Facility at MFC to fabricate the fuel for the Aurora Powerhouse. Following its participation in the DOE Reactor Pilot Program, the Aurora Powerhouse will transition to an NRC license, becoming the first NRC-licensed, privately developed reactor on a DOE site.

AALO ATOMICS:
Groundbreaking event

INL's collaboration with Aalo Atomics advanced significantly in FY-25, marked by a major milestone: the groundbreaking for the company's Aalo-X microreactor facility near the INL in September 2025. This followed DOE's approval to site the reactor on a 1-acre lot next to MFC. The facility will be the location of the Aalo-X 20-MWth reactor, which uses low-enriched uranium fuel and a thermal-spectrum sodium-cooled design. Aalo Atomics was selected for the DOE Reactor Pilot program and targets having a dry criticality test of Aalo-X by July 4, 2026.

BUSINESSWIRE
Aug. 28, 2025
Aalo Atomics First to Break Ground as Part of President Trump's Nuclear Reactor Pilot Program

Aalo Begins Construction Process Today on Aalo-X Experimental Reactor at Idaho National Laboratory (INL); Aims to Be Operational by July 4th, 2026

https://www.businesswire.com/news/home/20250828289985/en/Aalo-Atomics-First-to-Break-Ground-as-Part-of-President-Trumps-Nuclear-Reactor-Pilot-Program

EAST IDAHO NEWS
Aug. 29, 2025
Company breaks ground on nation's first experimental modular reactor

Two years after the US Department of Energy approved the development of the MARVEL nuclear reactor—ushering in what officials are calling the "second atomic age"—the Idaho National Lab is celebrating another milestone.

https://www.eastidahonews.com/2025/08/inl-breaks-ground-on-nations-first-experimental-modular-reactor/

BUSINESSWIRE
Sept. 22, 2025
Oklo Breaks Ground on First Aurora Powerhouse

Oklo Inc., an advanced nuclear technology company, today holds a groundbreaking ceremony at INL for its first Aurora powerhouse, the Aurora-INL

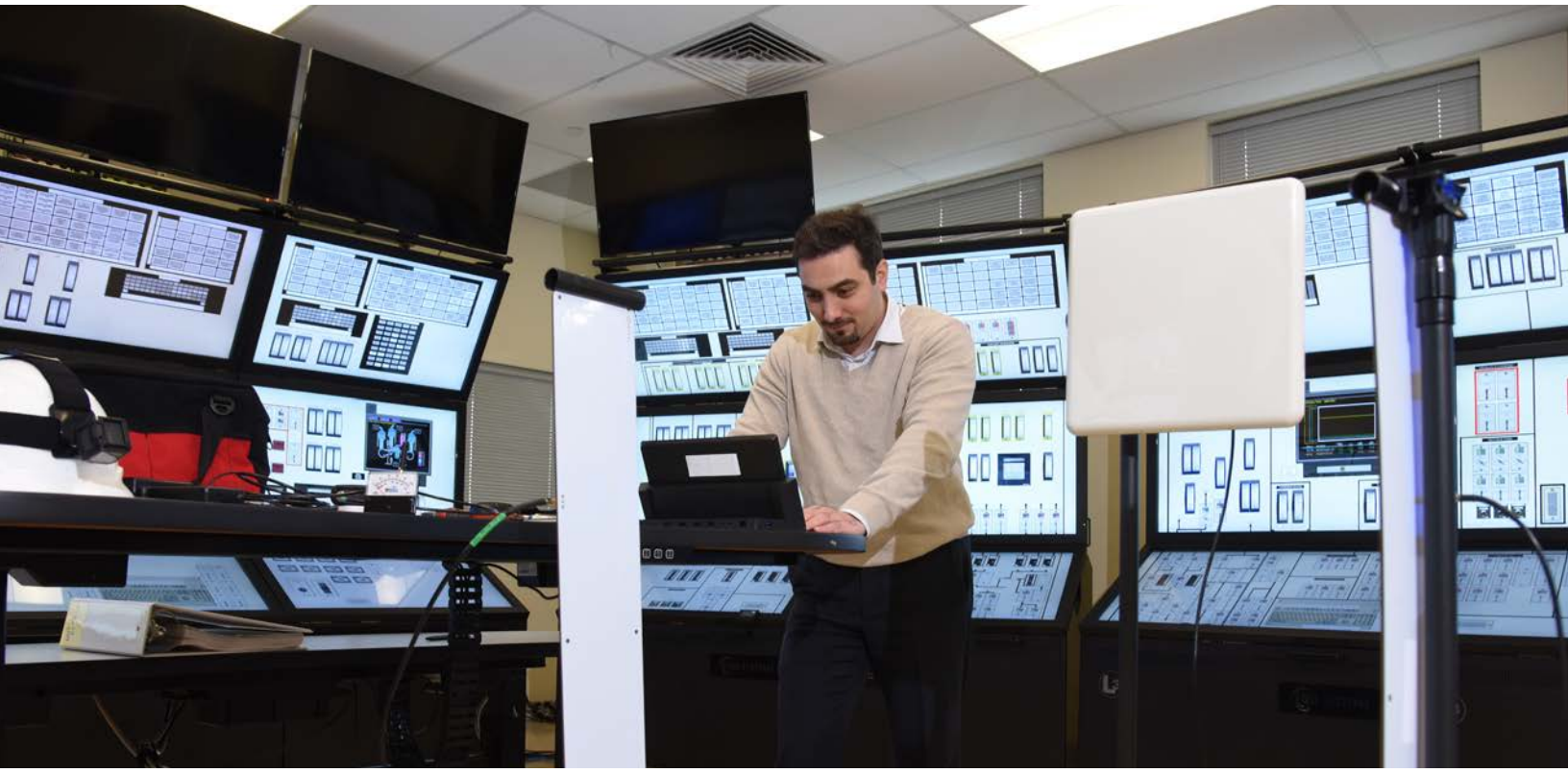
https://www.businesswire.com/news/home/20250922963622/en/Oklo-Breaks-Ground-on-First-Aurora-Powerhouse

SECTION 2

STRENGTHENING NATIONAL ENERGY SECURITY THROUGH THE LIGHT WATER REACTOR FLEET

As the backbone of the U.S. nuclear energy infrastructure, the light water reactor (LWR) fleet plays a vital role in ensuring national energy security and advancing the vision of nuclear abundance. INL, through its leadership in the Light Water Reactor Sustainability (LWRS) program, drives innovation to modernize operations, enhance safety, and unlock new economic opportunities for the existing fleet.

THE FOLLOWING HIGHLIGHTS SHOWCASE INL'S COLLABORATIVE EFFORTS WITH INDUSTRY TO EXTEND THE LIFE, PERFORMANCE, AND VALUE OF LWRS IN SUPPORT OF A RESILIENT AND FLEXIBLE ENERGY FUTURE.



Working in INL's Human Systems Simulation Laboratory, Senior R&D Scientist Ahmad Al Rashdan co-developed the Advanced Remote Monitoring project for the LWRS Program

Automating Operations and Remote Monitoring

Researchers from the LWRS program at INL partnered with the Utilities Service Alliance and six member utilities to modernize nuclear plant operations. This $13 million, five-year collaboration led to advancements in automating operator rounds, transformer health monitoring, process anomaly detection, thermal performance upgrades and fire watch procedures.

The project engaged key industry stakeholders — including other utilities, the Nuclear Energy Institute, and the NRC — to align innovations with regulatory and operational goals.

> *"The Advanced Remote Monitoring Project (ARM) has brought about technological advancements enabling the modernization of many nuclear plant business processes . . . The results made possible include heightened levels of nuclear safety, plant efficiencies and equipment reliability all while strengthening the economic resiliency of nuclear operations." —*
>
> **Clinton Carter, Vice President of Nuclear Innovation and Industry Relations, Utilities Service Alliance**

Optimizing Fuel Use and Reducing Waste

INL researchers addressed fuel efficiency and waste reduction through the Plant Reload Optimization project. Using AI and advanced computational methods, the team developed tools to help utilities design more efficient reactor core fuel-loading patterns — cutting costs while maintaining safety.

> *This R&D is very timely, especially since Constellation Energy is actively planning power uprates for several plants . . . This project focuses on optimal core design and system performance, providing insights and solutions to enable larger-scale power uprates."*
>
> **— Jason Murphy, Vice President of Nuclear Fuels, Constellation Energy**

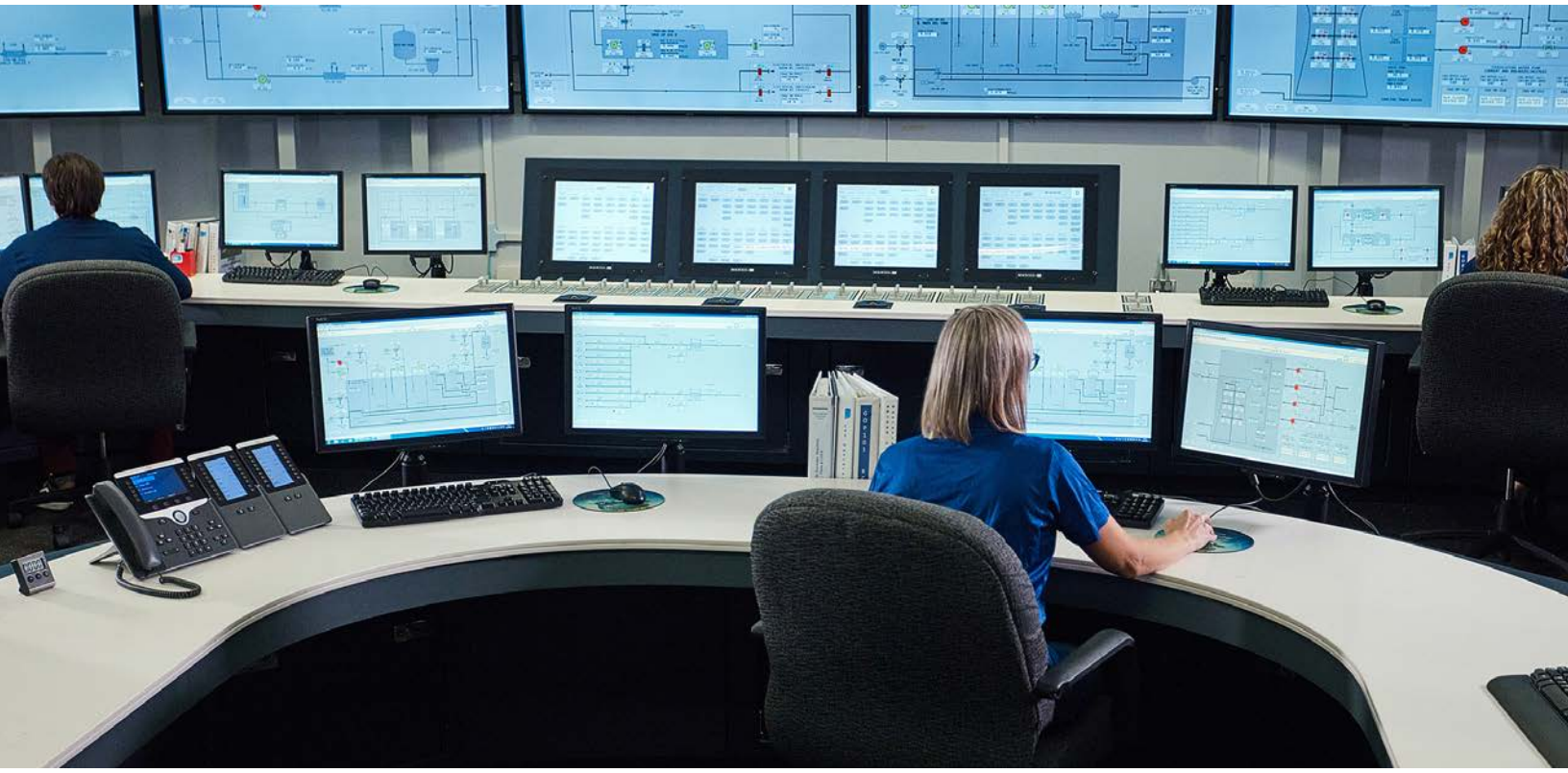
REUTERS

Sept.2024

Nuclear modelling vital as licensing shifts towards performance

Modelling nuclear power stations is essential to reduce costs and streamline development, especially as regulation focuses more on plant performance.

https://www.reuters.com/business/energy/nuclear-modelling-vital-licensing-shifts-towards-performance-2024-09-11/



Simulating New Revenue Streams for Nuclear Plants

INL and Westinghouse Electric Company jointly demonstrated a virtual simulator that models the delivery of steam from nuclear plants for district heating and industrial processes. Observed by NRC and DOE representatives, the simulation showed how operators can manage plant conditions and external steam demands in real time.

> *"This new simulator is made to incorporate all the variables needed to study complex scenarios involving thermal energy production, which can increase profits for nuclear operators . . . We are proud that our long-standing partnership with INL will help utilities identify new revenue streams and improve training capabilities."* **— Luca Oriani, President of Long-Term Operations, Westinghouse Electric Company**

BUSINESSWIRE

Jan. 22 2025

First-of-a-kind Simulator Created by Westinghouse and INL Will Improve Versatility, Profitability of Nuclear Reactors

Enhanced simulation capability allows utilities to validate and train on new uses for thermal energy created by nuclear reactors

https://www.businesswire.com/news/home/20250121476352/en/First-of-a-kind-Simulator-Created-by-Westinghouse-and-Idaho-National-Laboratory-Will-Improve-Versatility-Profitability-of-Nuclear-Reactors

SECTION 3

FUEL CYCLE TECHNOLOGY INNOVATION

Advancing Fuel Cycle Innovation and HALEU Readiness

INL continues to lead the nation in developing and demonstrating next-generation fuel cycle technologies that support a secure, resilient, and scalable energy future. Researchers are advancing innovation across the entire fuel cycle — from advanced fuel testing and material recovery to packaging, transportation, and disposal solutions.

A key milestone in 2025 was the successful allocation of the first batch of HALEU fuel by DOE to five advanced-reactor companies, made possible through the technical and strategic support — spanning technical analysis, contracting, internal coordination, and stakeholder engagement — of INL. This support was instrumental in overcoming logistical barriers and enabled DOE's first HALEU allocation to support a 2026 reactor demonstration. Since then, DOE made a second allocation to three additional companies in August 2025, further accelerating advanced reactor deployments.

INL completed the first two tests using ATR fuel at the Material Recovery Pilot Plant. These tests successfully removed cladding from used fuel, preparing the uranium for in situ downblending from highly enriched uranium (HEU) to near-HALEU levels, followed by conversion to U_3O_8 and recovery — demonstrating a viable pathway for fuel recycling.

> *Quadrant Nuclear Industries (QNI) is working to establish commercial reprocessing technologies to produce High Assay Low Enriched Uranium (HALEU) in support of the emerging Small Modular Reactor (SMR) fuel supply chain. . . . By working closely with INL's world-class scientists and engineers, QNI is able to ground its commercial feasibility assessment in decades of proven research, rigorous testing, and operational excellence. . .We see this collaboration as a model for how private industry and national laboratories can work together to address national security imperatives, strengthen the domestic HALEU supply chain, and ensure the U.S. remains at the forefront of advanced nuclear technology."* **— Dee L. Mewbourne, CEO Quadrant Nuclear Industries**

R-L: Bill Phillips, Jabob Yingling, and Michael Woods

INL Achieves Historic First in Fuel Salt Production for Molten Chloride Reactor

INL reached a historic milestone late this year: scientists have officially begun full-scale production of enriched fuel salt for the MCRE — the first time this type of fuel has ever been produced for a fast-spectrum molten-salt reactor. INL partners with Southern, TerraPower and CorePower on this DOE Advanced Reactor Demonstration program risk-reduction project.

The achievement follows a series of breakthroughs earlier this year, when the team successfully converted uranium metal into uranium chloride fuel salt. In August, it produced the first batch of UCl_3/NaCl fuel, a small "starter" quantity used to validate the process. This batch was to undergo testing to ensure it met safety and performance standards before the team scaled up to a full 9-kilogram production run by September 2025.

This fuel will power MCRE, a next-generation reactor experiment designed to obtain key data for fast-spectrum molten-salt technology. The reactor will be the first experiment hosted at NRIC's LOTUS test bed, with operations scheduled to begin in 2028.

NUCLEAR NEWSWIRE

April 10, 2025

DOE commits to supplying HALEU to five advanced nuclear companies

The DOE has announced its first round of conditional commitments to provide high-assay low-enriched uranium to five U.S. nuclear developers

https://www.ans.org/news/2025-04-10/article-6924/doe-commits-to-supplying-haleu-to-five-advanced-nuclear-companies/

WORLD NUCLEAR NEWS

May 1, 2025

Agreement waiver to enable INL to receive used fuel

The State of Idaho and the U.S. DOE have signed a targeted waiver of the 1995 Settlement Agreement, allowing INL to bring in a high-burnup nuclear fuel cask and limited amounts of used fuel from U.S. university research reactors.

https://www.world-nuclear-news.org/articles/agreement-waiver-to-enable-inl-to-receive-used-fuel

NUCLEAR ENGINEERING INTERNATIONAL

March 2025

INL perfects fuel for molten salt reactor

After five years of research, scientists at the INL believe they have created the perfect recipe to fuel the world's first critical fast-spectrum molten salt reactor

https://www.neimagazine.com/news/inl-perfects-fuel-for-molten-salt-reactor/

L-R: Ruchi Gakhar, Dean Burt and Diego Macias

YOUTUBE

INL developed a new molten salt test loop that will support the development of advanced reactors using molten salts. It will also be used to help support the world's first fast-spectrum, salt-fueled reactor experiment at the lab scheduled to begin in the 2030s.

https://www.youtube.com/watch?v=DNB_VHJx0p8

NUCLEAR NEWSWIRE

April 3, 2025

Molten salt test loop at INL means real-time data on sensors and materials

DOE announced March 31 that a new Molten Salt Flow Loop Test Bed at INL recently went through its inaugural test run.

https://www.ans.org/news/2025-04-03/article-6914/molten-salt-test-loop-at-inl-means-realtime-data-on-sensors-and-materials/

INL Advances Molten Salt Reactor Readiness with Breakthroughs in Fuel, Materials, and Testing Infrastructure

INL is making significant strides in molten salt reactor (MSR) research through multiple, independently funded initiatives that support the broader development of advanced nuclear technologies.

In a first of its kind experiment, researchers completed corrosion analysis from the Molten salt Research Temperature-controlled Irradiation (MRTI) test. This experiment used a high-assay UCl_3-NaCl fuel salt,

> *Recognizing INL's unique and strong nuclear capabilities, Saltfoss Energy is pleased to have formed a research partnership with INL since 2022. During this, INL has performed measurements of thermophysical properties of our fuel salt and are presently expanding studies to assess impact of UF3 (used to control corrosion) as well surrogate fission products."* **— Esben Klinkby, VO R&D Partnering, co-founder Saltfoss**

> *The novel Molten-salt Research Temperature-controlled Irradiation (MRTI) vehicle was designed to address knowledge gaps in irradiating enriched-uranium-bearing salts. ... INL established a fuel salt irradiation capability in the NRAD reactor and created opportunities for fuel salt irradiations in the Advanced Test Reactor (ATR)... "*
> **— Jeff Latkowski, senior vice president TerraPower**

enriched to 93% U-235, and was irradiated in NRAD, achieving a burnup of 0.196 gigawatt-days per metric ton of uranium. The results provide the first direct data on how molten salt interacts with structural materials — specifically, Inconel-625 — under active fission conditions. These insights are critical for designing durable reactor components capable of withstanding the unique chemical and thermal environment of MSRs.

To further support MSR development, INL also commissioned a first-of-its-kind molten salt test loop. This system replicates the high-temperature corrosive conditions found in operating MSRs, allowing researchers to evaluate material performance and system behavior in real time. The loop was developed through INL's LDRD program. It provides a flexible platform for early-stage testing and complements other DOE-NE demonstration efforts.

Molten-salt Research Temperature controlled Irradiation, MRTI at NRAD.

INL Finalizes DOE Standard Canister Design to Support Spent Fuel Road-Readiness and Long-Term Stewardship

INL also finalized the design of the DOE Standard Canister, completing the final design review in accordance with the American Society of Mechanical Engineers' Boiler and Pressure Vessel Code. Unlike earlier R&D-focused projects, this applied-engineering design is a cornerstone of DOE's road-ready spent nuclear fuel demonstration and supports the 1995 Settlement Agreement between DOE, the State of Idaho and the U.S. Navy. It enhances long-term stewardship of DOE-managed used fuel across the national complex.

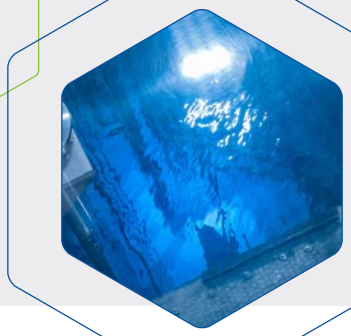
Strengthening the Back End of the Fuel Cycle

In support of national energy security and long-term waste management, the State of Idaho and DOE approved a targeted waiver of the 1995 Settlement Agreement in April 2025. This agreement enables INL to accept a high-burnup research cask in 2027 to support critical research on high-burnup spent fuel from commercial reactors. The data generated will support extended-storage licenses for spent fuel at 54 nuclear power plants across 28 states.

The waiver also allows INL to safely manage small quantities of spent fuel from U.S. university research reactors — preserving essential nuclear science programs and ensuring continued access to research infrastructure for the next generation of nuclear engineers and scientists. This milestone reinforces INL's role in addressing national fuel cycle challenges while honoring Idaho's commitment to environmental stewardship and the original goals of the 1995 Settlement Agreement.

INL–Curio Collaboration: Advancing Nuclear Recycling

In FY25, INL supported Curio's lab-scale demonstration of its proprietary NuCycle® technology—an advanced nuclear fuel recycling process. Conducted across four national laboratories, including INL, this work tested key unit operations and marked a major step toward commercial deployment. The collaboration reinforces INL's role in accelerating innovative fuel cycle solutions that enhance national energy security and reduce nuclear waste.



SECTION 4

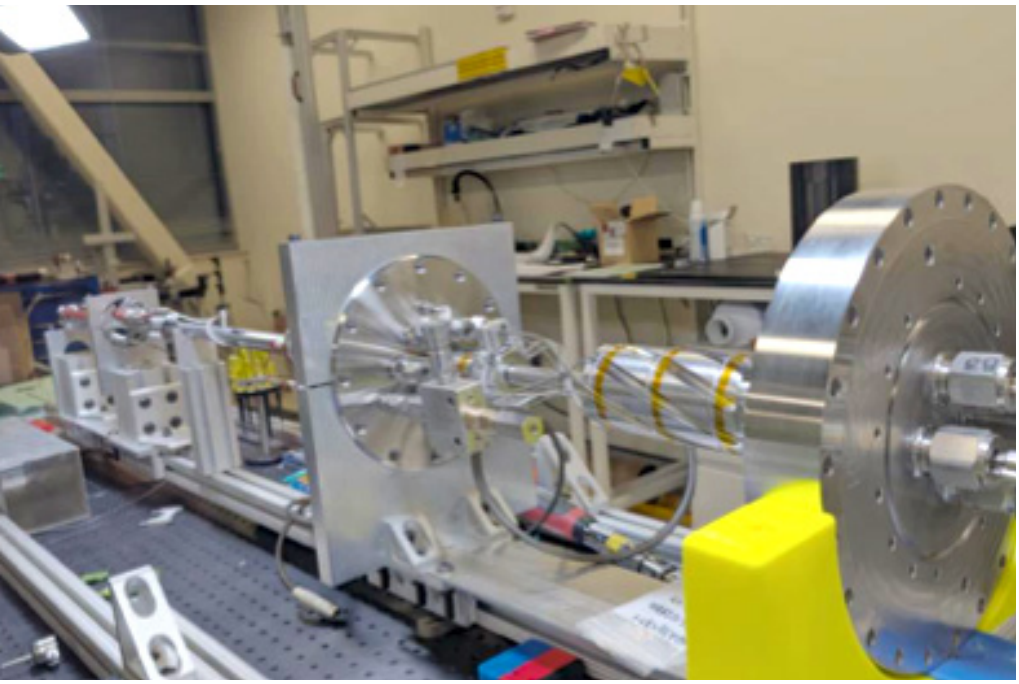
DEVELOPMENT AND TESTING OF INNOVATIVE FUELS AND MATERIALS

Powering the Future with Safer, Smarter Fuels

INL continues to lead the way in developing and testing the fuels and materials that will power tomorrow's nuclear reactors. In FY-25, researchers conducted the first U.S. safety tests in over 25 years on high burnup fast reactor fuels using TREAT. In partnership with the Japan Atomic Energy Agency, the team completed two first-of-their-kind experiments — one on advanced metallic fuel and one on mixed oxide (MOX) fuel. These tests produced critical data to help regulators and developers bring advanced reactors to market faster. The achievement was recognized by the Office of Nuclear Energy as one of the "11 Big Wins for Nuclear" in the Trump administration's first 100 days.

INL also completed the first reactivity-initiated accident test on high-burnup commercial fuel in more than 40 years. The HERA-HBU-1 experiment used a refabricated fuel rod from a commercial LWR to simulate accident conditions. The test collected real-time data using advanced sensors, supporting the licensing of accident-tolerant fuels and extended fuel burnup.

> *Your leadership — together with the world-class facilities and expertise at INL — has been instrumental in advancing the fabrication of our uranium-zirconium alloy samples using highly enriched uranium (to accelerate the burnup), and in setting the stage for the FAST irradiation testing campaign that is planned to begin in the Advanced Test Reactor (ATR) in late 2025 to early 2026."* **— Seth Grae, President & CEO Lightbridge Corporation**



Assembling and instrumenting the HERA-HBU-1 test train in the Measurement Sciences Laboratory.

Strategic Collaborations Advance Fuel Innovation

In addition to in-house innovation, INL is expanding its impact through strategic industry partnerships focused on advanced-fuel development.

INL works with Lightbridge Corporation to support the development of Lightbridge Fuel™ — a next-generation metallic fuel designed to enhance safety, economics, and proliferation resistance in both existing LWRs and emerging SMRs. Lightbridge and Oklo, Inc., are exploring co-location of a fuel fabrication facility within Oklo's proposed advanced fuel manufacturing site to accelerate commercialization. These efforts are supported by long-term framework agreements with INL's operating contractor, DOE GAIN vouchers, and university-led research funded by the DOE Nuclear Energy University Program.

INL also collaborates with Clean Core Thorium Energy to advance thorium-based fuel technologies. This partnership leverages INL's testing infrastructure to evaluate fuel performance and safety, contributing to the broader goal of diversifying and modernizing the U.S. nuclear fuel supply.

NUCLEARNEWSWIRE

Aug. 1, 2025

Lightbridge to test uranium-zirconium fuel alloy in INL's ATR

Lightbridge Corporation has fabricated samples of nuclear fuel materials made of an enriched uranium-zirconium alloy, matching the composition of the alloy that the company intends to use for its future commercial Lightbridge Fuel product.

https://www.ans.org/news/2025-08-01/article-7250/lightbridge-to-test-uraniumzirconium-fuel-alloy-in-inls-atr/

GLOBENEWSWIRE

August 14, 2025

U.S. Firm Achieves Second Thorium Breakthrough at Idaho National Lab's Reactor

CCTE's first-of-its-kind, thorium-based fuel continues to surpass burnup records, paving the way for safer and more sustainable nuclear power

https://www.globenewswire.com/news-release/2025/08/14/3133156/0/en/US-Firm-Achieves-Second-Thorium-Breakthrough-at-Idaho-National-Lab-s-Reactor.html

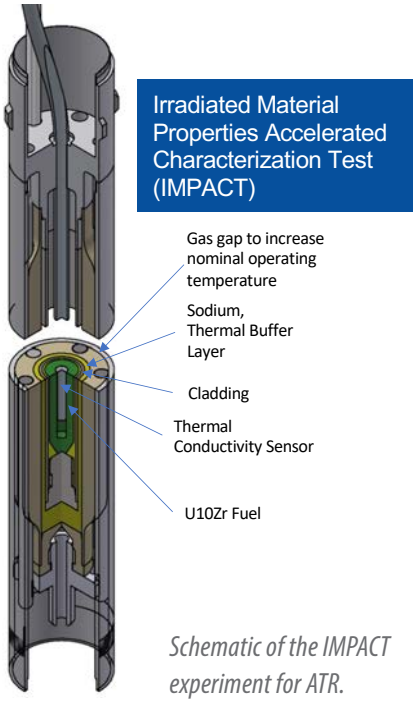
MIT NEWS

Sept. 23, 2025

MIT's work with INL advances America's nuclear industry

The collaboration has led to new fuels and a variety of other projects to enable clean, safe nuclear energy

https://news.mit.edu/2025/mit-work-with-idaho-national-laboratory-advances-america-nuclear-industry-0923



Schematic of the IMPACT experiment for ATR.

Transfer shield plate and shield cylinder, which was installed in ATR in FY2025.

Upgrading Facilities for Advanced Testing

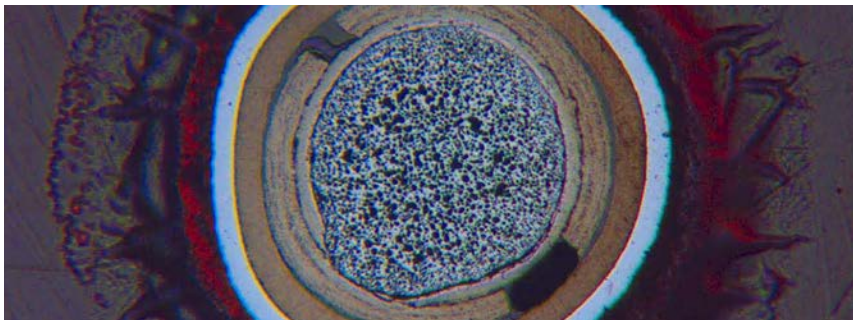
To support future experiments, INL installed a new transfer shield plate and shield cylinder at the ATR. These upgrades provide access to eight new test ports, increasing the lab's capacity to insert and remove experiments efficiently. The new infrastructure will support a growing number of advanced fuel and materials tests.

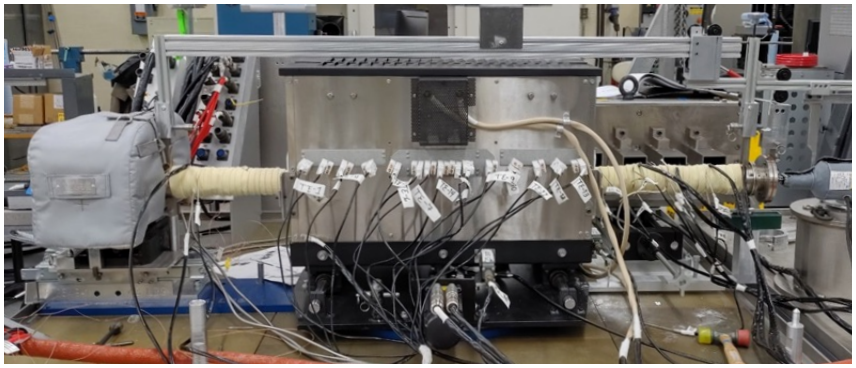
One of the first experiments to use this new capability is the Irradiated Material Properties Accelerated Characterization Test (IMPACT), scheduled to begin irradiation in October 2025. IMPACT will be the first to measure the centerline temperature of a metallic fuel pin in real time during irradiation. It also includes a novel probe to track how fuel conducts heat over time — data that are essential to validate fuel performance models.

THREADS

Two new components for INL's Advanced Test Reactor (ATR) were installed during the current outage. A new 23,000-pound stainless steel shield cylinder and 14,000-pound transfer shield plate will help expand ATR's experimental capabilities for future test cycles.

https://www.threads.com/@idaho_national_lab/post/DJFvhnJTmaU?xmt=AQF0OJVRiqD2G8exR-nBiXW-Jrb4zV0slmpuG2SFsqdB6w





Filling Critical Knowledge Gaps

INL's Air/Moisture Ingress Experiment (AMIX) reached a major milestone this year. After successful operational testing at INL's North Holmes Laboratory in Idaho Falls, AMIX is undergoing remote qualification at the Fuel Conditioning Facility. This experiment will help researchers understand how TRISO fuel behaves during high-temperature air or moisture exposure — an important step toward fuel qualification and safety assurance.

Planning for the Next Generation of Criticality Research

At the request of DOE, INL experts are evaluating the development of a new criticality experiment facility. The proposed System Physics Advanced Reactor Criticality (SPARC) facility will restore U.S. capabilities for large-scale criticality safety research and support zero-power reactor-physics experiments for decades to come. The multi-lab team developed a plan for SPARC and received strong support from national labs, industry, and academic partners.

FORBES

July 26, 2025

NRC Eyes New Accident Tolerant Nuclear Fuels for Commercial Use

Accident tolerant fuels may offer important technological advances to increase the safety of U.S. nuclear power plants

https://www.forbes.com/sites/noelfletcher/2025/07/26/nrc-eyes-new-accident-tolerant-nuclear-fuels-for-commercial-use/?ctpv=searchpage

IDAHO NATIONAL LAB TESTING SALT-FUELED NUCLEAR REACTOR

March 12, 2025

The lab's Molten Chloride Reactor Experiment (MCRE) is testing a reactor design that replaces traditional fuel rods with a liquid mix of uranium and molten salt.

https://www.ktvb.com/article/tech/science/lab-testing-salt-fueled-nuclear-reactor/277-2dcfbecd-6944-478c-9bba-71285afecea6

MINING.COM

August 15, 2025

U.S. startup makes thorium breakthrough at DOE's Idaho Lab

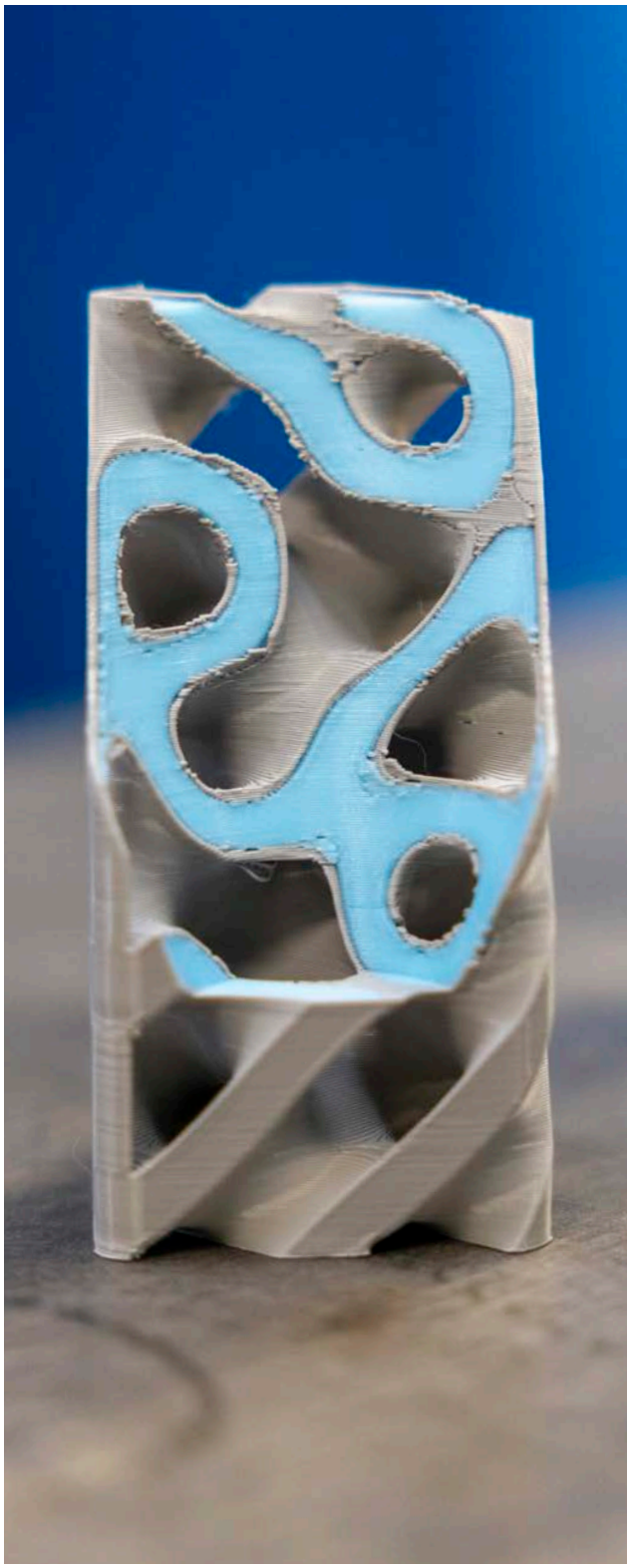
Clean Core Thorium Energy (CCTE) achieved a milestone for its patented Advanced Nuclear Energy for Enriched Life (ANEEL) fuel, which it said has now reached a burnup level of over 45 gigawatt-days per metric ton in the advanced test reactor at the U.S. DOE's INL.

https://www.mining.com/us-startup-makes-thorium-breakthrough-at-department-of-energys-idaho-national-lab/

The Auxiliary Lead-out Experiment (ALE) House is a newly developed experiment cubicle at INL designed to support TRISO fuel testing. Both BWXT's BANR and X-energy will use the ALE House to evaluate different TRISO fuel types as part of their advanced reactor development efforts.

BANR-1:
Supporting Remote and Industrial Applications

INL also completed critical machining for fuel irradiation experiments supporting the BWXT Advanced Nuclear Reactor Experiment-1 (BANR-1), part of the DOE's Advanced Reactor Demonstration program. BANR-1 is a 50 MW thermal high-temperature gas reactor designed as a modular, factory-fabricated microreactor. It uses TRISO coated fuel and passive cooling systems, making it ideal for remote power generation, industrial heat applications, and clean electricity for data centers, municipalities, and campuses.



Multi-material INFLUX demonstration piece showing fuel region (blue) and cladding (grey)

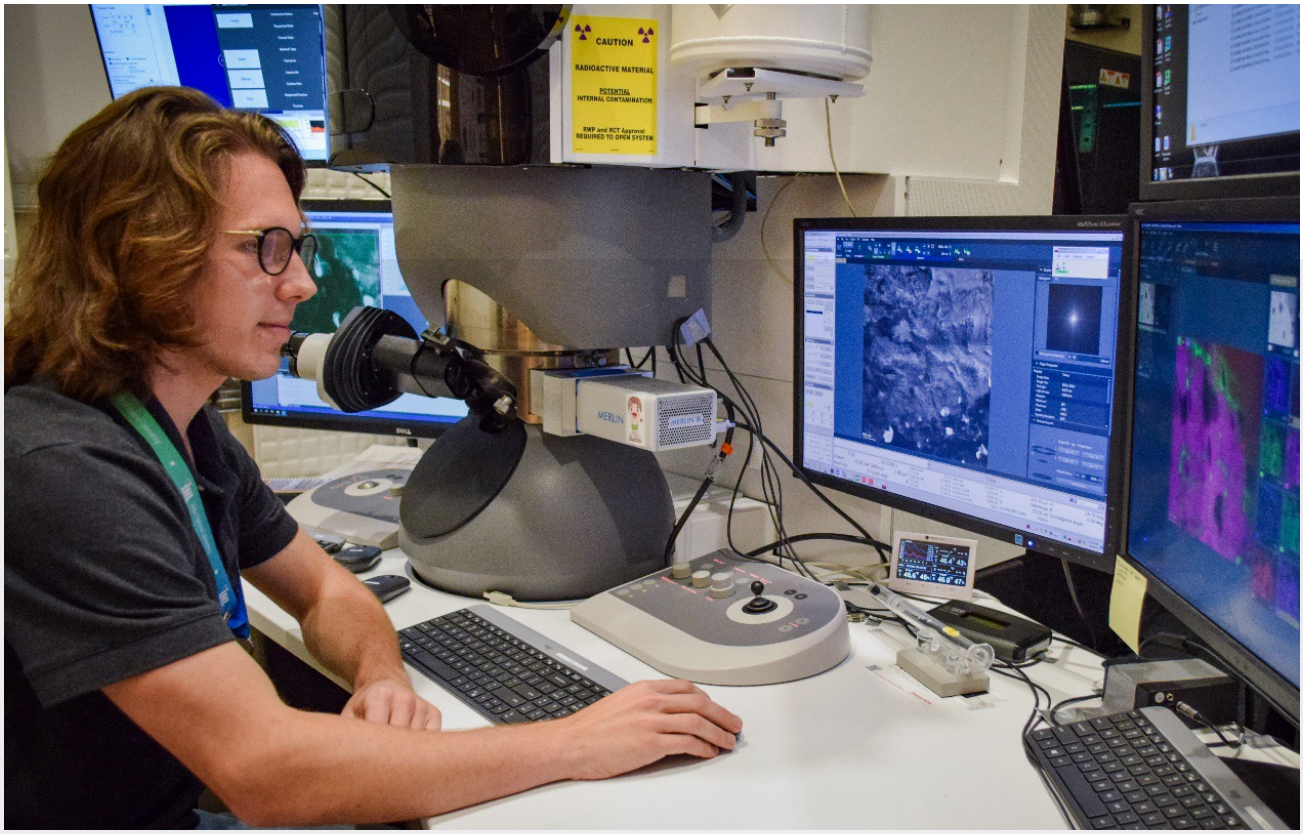
INFLUX: Reimagining Nuclear Fuel with Nature-Inspired Design

Lead researcher: Nick Woolstenhulme

INFLUX is a groundbreaking fuel concept that rethinks the architecture of nuclear reactor cores using advanced additive manufacturing. Departing from traditional rod- or plate-based assemblies, INFLUX employs complex, 3D-printed geometries inspired by nature — such as triply periodic minimal surfaces — to dramatically enhance heat transfer. These innovative lattice structures promise higher power density, improved fuel utilization, greater safety margins, and reduced operational costs. Prototype demonstrations have already been completed, with early design data showing strong potential. INFLUX is currently planned for direct funding in FY-26, pending final budget guidance. The Advanced Fuels Campaign coordinates a multi-lab and industry collaboration to advance development. Additionally, a spin-off effort focused on triple periodic heat exchangers is also slated for FY-26, with direct funding under both the Advanced Manufacturing and Materials Technologies and Microreactor programs.

The Nuclear Science User Facilities (NSUF)

NSUF continues to serve as a cornerstone of collaborative nuclear research, offering unparalleled access to world-class experimental infrastructure and expertise. In FY-25, NSUF-supported research resulted in 177 peer-reviewed publications, with INL researchers contributing to 111 — a 15% increase in total publications and a 40% rise in INL authorship over the previous year.



Ali Montros, a student researcher, studying fuel material structures.

SECTION 5

HIGH PERFORMANCE COMPUTING, MODELING AND SIMULATION, AND ARTIFICIAL INTELLIGENCE

TOOLS TO HELP SCIENTISTS SIMULATE REACTOR BEHAVIOR, STREAMLINE LICENSING, AND UNLOCK NEW REVENUE STREAMS

SMARTER, FASTER, SAFER

How INL Uses Artificial Intelligence and Supercomputing to Power the Nuclear Future

At INL, AI and HPC are transforming how we design, operate, and secure nuclear energy systems. From building digital twins of reactors to automating complex experiments and strengthening the electric grid, INL harnesses the power of data and machine learning to accelerate innovation. These cutting-edge tools help scientists simulate reactor behavior, streamline licensing, and unlock new revenue streams — all while enhancing safety, efficiency, and resilience. Through strategic partnerships with industry leaders like Amazon Web Services and Microsoft, INL ensures that the U.S. remains at the forefront of clean energy innovation in the digital age.

SAWTOOTH AND TETON

Accelerating Discovery Through Advanced Computing

INL's HPC capabilities — anchored by the Sawtooth and Teton supercomputers — continue to drive innovation across the nuclear science and technology landscape. These systems enable researchers to simulate complex physical phenomena, optimize reactor design, and analyze massive datasets with unprecedented speed and precision.

Sawtooth, INL's flagship HPC system, supports multiphysics modeling for advanced reactor concepts, fuel performance, and safety analysis. Its architecture is optimized for large-scale parallel processing, making it ideal to simulate transient behaviors in nuclear systems and validate experimental data from facilities like TREAT and the Nuclear Radiography Reactor (NRAD).

Teton will provide flexible computing resources for rapid prototyping, code development, and smaller-scale simulations. It plays a critical role in support of early-stage research and training the next generation of computational scientists.

Together, Sawtooth and Teton form the computational backbone of INL's modeling and simulation ecosystem. Their integration with the Nuclear Research Data System (NRDS) and other digital infrastructure ensures that simulation outputs are traceable, reproducible, and aligned with DOE's open science principles.

INTERESTING ENGINEERING

July 29, 2025

Idaho National Lab enlists Amazon cloud to build autonomous nuclear reactors

U.S. government lab will use Amazon's AI muscle to design autonomous nuclear reactors and digital twins

https://interestingengineering.com/energy/idaho-lab-amazon-ai-nuclear-reactors

Building Smarter Reactors with Digital Twins

INL is developing digital twins — virtual replicas of physical systems — to simulate and optimize nuclear reactor performance. In collaboration with Westinghouse and AWS, INL is building a digital twin of a small modular reactor. This cloud-based tool uses AI to model reactor behavior, helping researchers test designs, improve safety and explore new energy applications.

Partnering for Impact

INL collaborates with AWS, Microsoft and Atomic Canyon to bring advanced AI and cloud technologies into nuclear energy research. With AWS, INL develops tools that reduce costs and timelines for nuclear facility operations and support autonomous reactor functions. With Microsoft, INL uses Azure AI services to automate the generation of licensing documents, helping accelerate reactor deployment. The collaboration with Atomic Canyon will develop benchmarks to drive the implementation of AI tools for use in nuclear energy.

INL is working with commercial partners such as Microsoft, Amazon Web Services, and NVIDIA to accelerate the deployment of new nuclear plants and reduce their operational costs.

INL Director John Wagner at an INL leadership AI Jam, August 7, 2025.

Automating Insights with AI

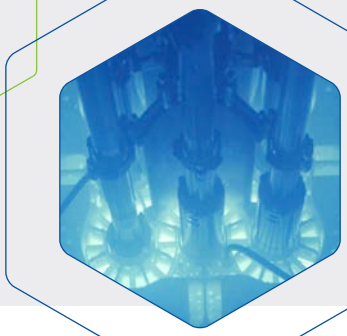
INL's AI strategy focuses on automating reactor experiments and using machine learning to analyze complex data, such as results from post-irradiation testing. These tools reduce testing time, improve accuracy, and support the development of next-generation nuclear fuels. AI also helps streamline the nuclear licensing process and enabling autonomous reactor operations.

Driving National and Global Progress

From autonomous lab platforms to AI-integrated nuclear data centers, INL's work is shaping a future in which nuclear energy and AI work hand in hand. These efforts support national security, energy resilience, and international collaboration — ensuring the U.S. remains at the forefront of clean energy innovation.

Innovation in Modeling and Simulation to Support Advanced Reactor Licensing

In FY-25, INL continued to strengthen the modeling and simulation tools that underpin safe, efficient deployment of advanced reactors. A key milestone was the release of KP-BISON, a specialized version of INL's BISON fuel performance code, developed by Kairos Power in partnership with INL. KP-BISON incorporates enhancements to simulate the unique thermomechanical behavior of TRISO fuel used in Kairos's fluoride salt-cooled high-temperature reactor design. This five-year joint effort resulted in a more robust modeling toolset that supports both INL's national mission and Kairos's commercial licensing efforts, demonstrating the power of public-private collaboration in accelerating innovation.



SECTION 6

STRATEGIC INITIATIVES: FUSION ENERGY AND SPACE NUCLEAR POWER

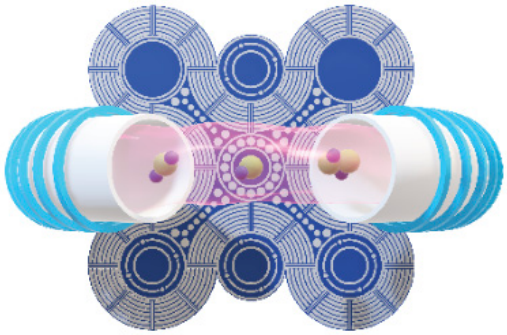
Enabling Fusion Energy

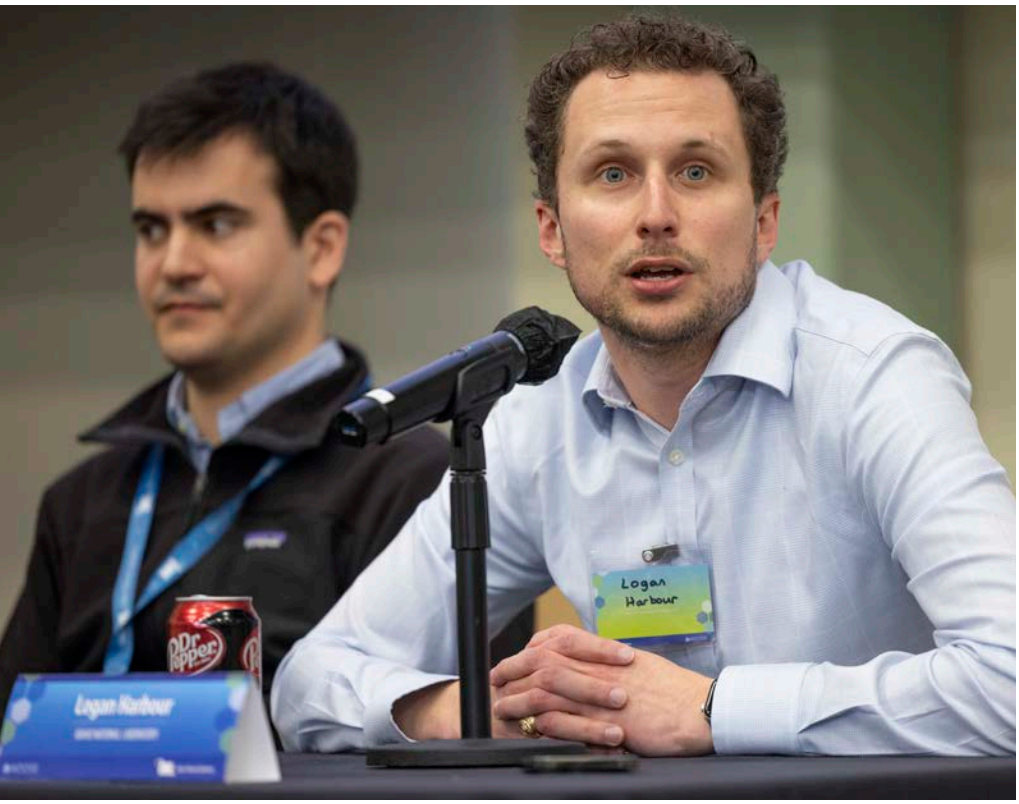
INL helps lead the way in fusion energy. On April 21, 2025, INL launched the Fusion Innovation Research Engine (FIRE), a national collaboration focused on testing materials and systems needed for future fusion power plants.

The Accelerating Fusion Blanket Development through Nuclear Testing (BNT) collaborative is a model of public-private partnership. General Atomics will contribute advanced engineering and computer modeling while Tokamak Energy will help ensure the blanket designs meet commercial needs. These partnerships are essential to building a fusion energy future that is both technically sound and economically viable.

> *Fusion blankets are pivotal to delivering limitless fusion energy to the grid. We're now focused on helping INL and DOE ensure their testing is relevant to private companies as part of a fusion energy future."* — **Aaron Washington of Tokamak Energy**

> *This funding propels two critical components forward that will help carry us closer to achieving a fully operational fusion power plant in the United States."* — **Wayne Solomon, Vice President of Magnetic Fusion Energy at General Atomics.**





MOOSE workshop March 2025

MOOSE Framework Powers Ahead with Smarter, Faster Simulations

This year, INL's Multiphysics Object-Oriented Simulation Environment (MOOSE) made major strides in modeling capabilities for nuclear energy and beyond. New features enable more-precise and efficient modeling of complex geometries.

MOOSE is now optimized for hybrid central processing unit/graphics processing unit computing, leveraging ExaScale technologies to significantly boost performance. These upgrades already help researchers solve more-complex problems faster.

To enhance accessibility, the team began integrating AI tools into the workflow—streamlining user experience and accelerating the design and licensing of advanced reactors. One such tool is an AI-powered assistant that helps users generate accurate input files based on existing examples.

MOOSE continues to support industry partners like Kairos Power, reinforcing its role as a trusted, high-impact platform for national and commercial innovation.

C3

August 2025

Could AI Make Nuclear Permitting Faster?

The Idaho National Laboratory (INL) has teamed up with Microsoft to examine the use of artificial intelligence (AI) in speeding up the time it takes to compile all the documents a nuclear developer needs to obtain permits.

https://c3newsmag.com/nuclear-permitting-ai/

REUTERS EVENTS

July 30, 2025

Trump, Westinghouse target 10 new large reactors

US national laboratory implements AI to accelerate permitting Microsoft and the Idaho National Laboratory (INL) have formed a partnership that will apply artificial intelligence tools to help nuclear companies compile documents to secure licenses for new nuclear power plants.

https://www.reutersevents.com/nuclear/trump-westinghouse-target-10-new-large-reactors-palisades-plant-wins-key-restart-approval

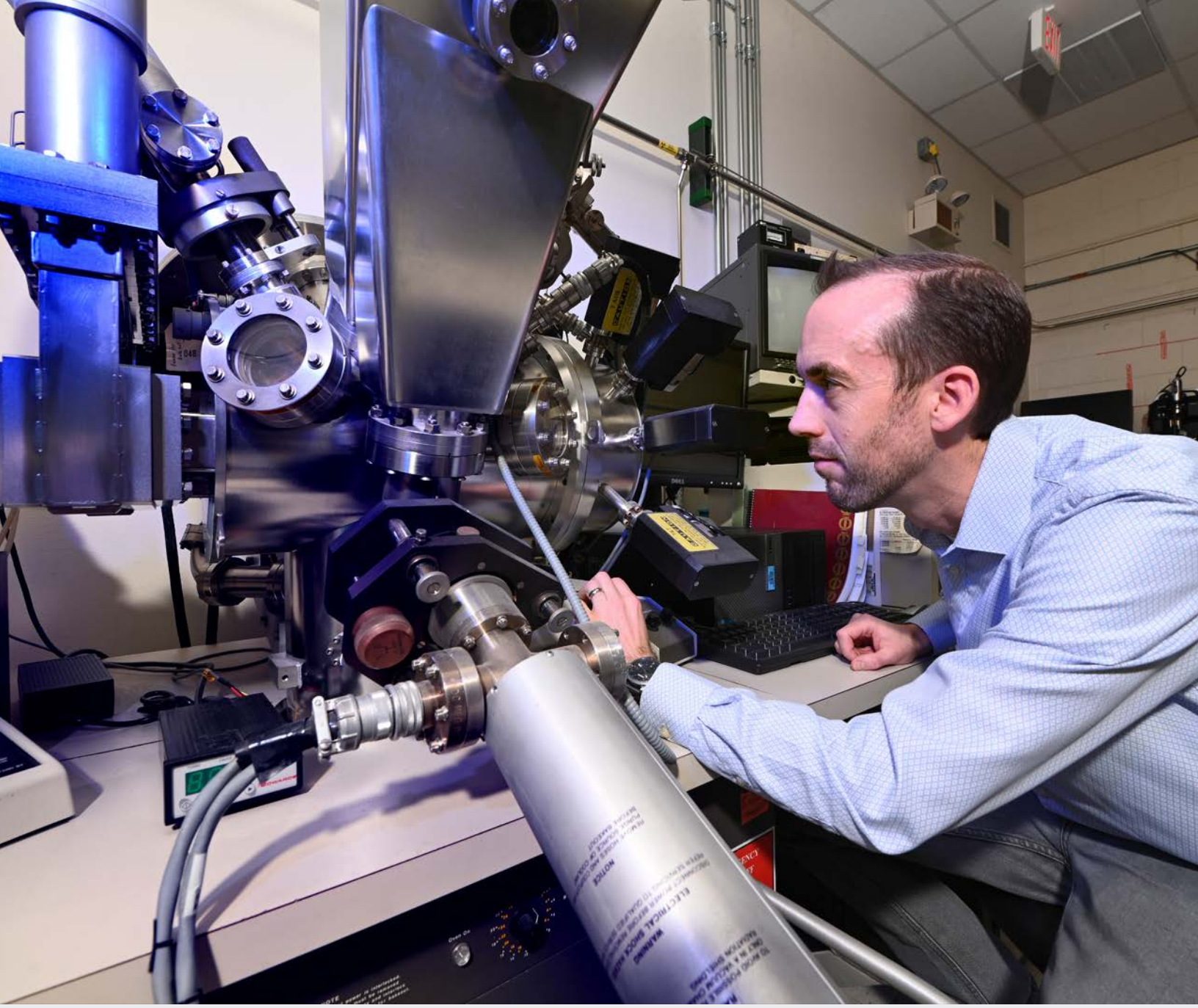
REUTERS

July 16, 2025

Microsoft, US national lab tap AI to speed up nuclear power permitting process

Microsoft and the Idaho National Laboratory (INL) said they will tap Microsoft's AI technology for generating engineering and safety analysis reports that are a standard part of the application process for construction permits and operating licenses for nuclear facilities in the United States.

https://www.reuters.com/business/energy/microsoft-us-national-lab-tap-ai-speed-up-nuclear-power-permitting-process-2025-07-16/



Performance of Solid Breeder Materials Under Neutron Irradiation

For nuclear fusion to succeed, reactors will need to breed tritium as fuel. One concept involves a solid breeder blanket in which neutrons from the fusion reactions are absorbed in a lithium-bearing ceramic to produce tritium. Under this project, solid breeder materials are being irradiated in the NRAD core, then the tritium-release behavior of these materials is being tested at the Safety and Tritium Applied Research facility, to measure such mechanical properties as swelling. The project leverages existing INL capabilities while employing an underutilized reactor capability and a new tritium thermal-desorption spectroscopy system. The enhancement of INL's irradiation and tritium capabilities is poised to lead to increased programmatic and private funding.

Chase Taylor at Safety and Tritium Applied Research Facility, lead researcher for Solid Breeder Materials

FISSION SURFACE POWER

Enabling Sustained Lunar Exploration

INL advanced the Fission Surface Power (FSP) Initiative — a joint effort with the National Aeronautics and Space Administration (NASA) and the DOE — to develop a nuclear reactor for deployment on the Moon by the end of the decade. This compact, scalable power system is designed to support long-duration lunar missions by providing reliable energy for habitats, science payloads and in situ resource utilization in environments where solar power is limited.

INL continued managing Phase 1 of the project, overseeing contracts with three industry teams — Lockheed Martin, Westinghouse, and IX — tasked with delivering initial reactor designs. These designs are being evaluated for performance, manufacturability, and integration with NASA's Artemis program. The lab also supported early-stage testing and infrastructure planning to ensure readiness for future demonstration and deployment.

In August 2025, Interim NASA Administrator Sean Duffy announced a new fission surface power program that supersedes previous programs, seeking to place a 100 kWe reactor on the lunar surface in 2030. This bold new initiative leverages previous work to ensure U.S. leadership in space nuclear technology.

FSP represents a critical step toward establishing a sustainable human presence on the Moon and, eventually, Mars. By leveraging INL's nuclear expertise and test capabilities, the program lays the groundwork for space-based nuclear power systems that will enable exploration far beyond Earth orbit.

THE NEW YORK TIMES

Aug. 6, 2025

NASA Is Getting Fired Up About a Nuclear Reactor on the Moon

Placing an atomic energy source on the lunar surface is "not science fiction," experts say, but does pose technical challenges.

https://www.nytimes.com/2025/08/06/science/nasa-nuclear-reactor-moon.html

FORBES

Aug. 7, 2025

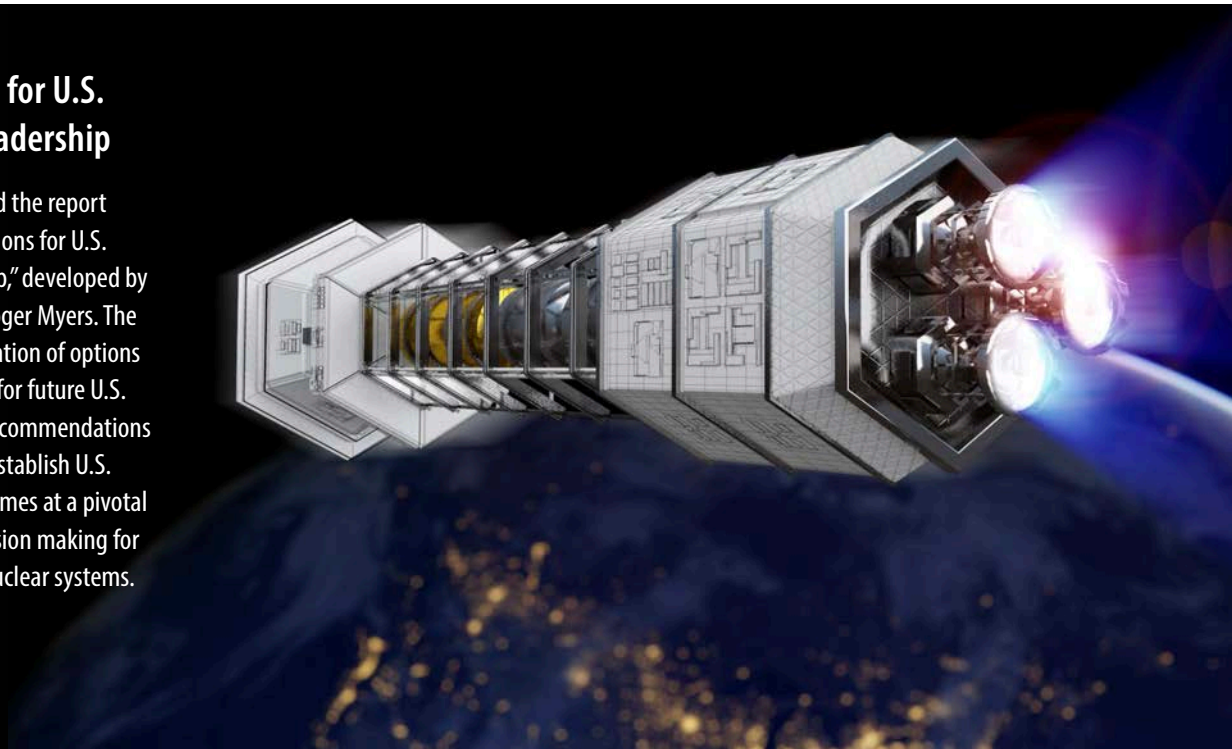
NASA Is Already Prepping To Build Trump A Nuclear Reactor on the Moon

NASA plans to build a nuclear reactor on the moon by the end of the decade to claim lunar real estate and generate electricity.

https://www.forbes.com/sites/christopherhelman/2025/08/07/nasa-is-already-prepping-to-build-trump-a-nuclear-reactor-on-the-moon/

Strategic Options for U.S. Space Nuclear Leadership

In July 2025, INL released the report "Weighing Strategic Options for U.S. Space Nuclear Leadership," developed by Dr. Bhavya Lal and Dr. Roger Myers. The report documents evaluation of options for space nuclear power for future U.S. missions and provides recommendations on the path forward to establish U.S. leadership. The report comes at a pivotal time for the U.S. on decision making for development of space nuclear systems.



SECTION 7

STRATEGIC PARTNERSHIPS AND OUTREACH

Accelerating Nuclear Progress Through GAIN

The Gateway for Accelerated Innovation in Nuclear (GAIN) continues to drive innovation by supporting public-private partnerships and advancing the deployment of next-generation nuclear technologies. Through its voucher program, GAIN awarded $1.8 million in in-kind support to seven companies in FY-25, helping them access national-laboratory expertise to overcome technical and regulatory challenges. FY-25 saw three vouchers awarded to reactor developers, three to supply chain companies, and one to a company working on spent fuel recycling. Historically, vouchers play critical roles in helping companies to advance both reactor designs and fuel strategies as they look to deploy their technologies.

GAIN also released 121 legacy technical documents in FY-25, including 65 from current-year requests and others from prior years. These documents continue to provide critical data to developers.

GAIN AWARDED $1.8 MILLION IN IN-KIND SUPPORT TO SEVEN COMPANIES IN FY-25

Expanding Reach, Empowering States

GAIN supported 11 states through the First Movers Initiative, a coalition of state energy offices exploring nuclear deployment. In partnership with the National Association of State Energy Officials, GAIN delivered customized information packets that include siting data, financial model overviews, and guidance for evaluating project proposals to each state. The team also recommended such strategies to reduce financial risk as leveraging investment tax credits to attract private investment.

John Wagner formalizes a new chapter of collaboration as he signs the Memorandum of Understanding with the State of Utah, reinforcing shared goals in nuclear innovation and partnership.

NUCLEARNEWSWIRE

Jan. 2025

First GAIN vouchers of 2025 go to Curio, Deep Fission, Kairos, and NuCube Energy

Of the four companies receiving awards, three are working on fission reactor designs and one is developing a used fuel recycling process.

https://www.ans.org/news/2025-01-09/article-6674/first-gain-vouchers-of-2025-go-to-curio-deep-fission-kairos-and-nucube-energy/

NEWS WISE

April 2025

Advanced Nuclear First Mover Initiative: Ready, Set, Grow

Eleven governors and their state energy offices are putting out ready-for-business signs to advanced nuclear energy developers under an initiative that taps into experts at the INL.

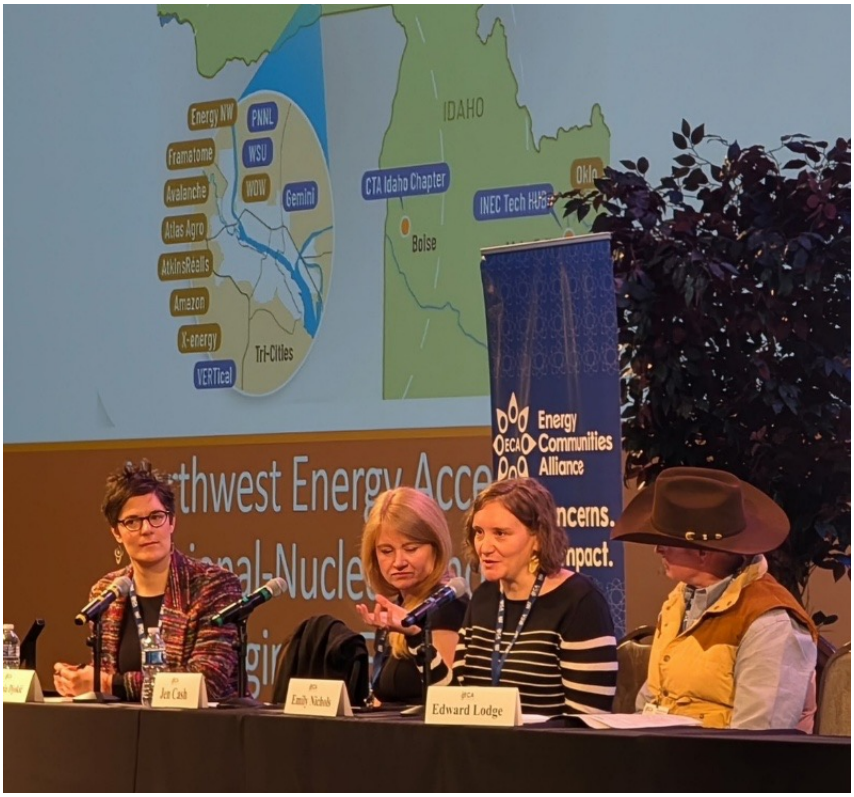
https://www.newswise.com/articles/advanced-nuclear-first-mover-initiative-ready-set-grow

"In just a few months the GAIN office has provided over 30 technical documents to Radiant including important chapters of the Nuclear Systems Materials Handbook (NSMH). The NSMH is a valuable resource as it provides data of the highest quality — considered 'established' data — which helps reduce our testing burden and streamline QA processes." — **Douglas Bernauer, CEO, Radiant**

"We felt like at St. Johns we really had somebody that had some knowledge in our corner . . . GAIN has just been phenomenal working with you guys . . . It's the easiest part of my day working with you guys . . . GAIN has been nothing but a godsend for us to look into the future as what is a possibility." — **Spencer Udall, Mayor of St. Johns and safety supervisor at Salt River Project — about how GAIN has benefitted the community**

"GAIN legacy document support has provided Oklo Inc. with irreplicable data to accelerate our technical development — data that directly informs vital engineering and safety considerations in areas such as equipment and material design, operational experience, and fuel recycling." — **Ross Moore, Senior Director of Regulatory Affairs, Oklo.**

Beyond state engagement, GAIN participated in more than 80 nationwide outreach events, sharing technical resources and highlighting nuclear innovation. In Quarter 1 of FY-25, GAIN completed a third pilot study in Montana, evaluating options for converting the Colstrip coal facility to new energy technologies. The study compared payback timelines for various options — including natural gas as a transitional strategy to nuclear — and will help inform future development decisions at the site.



Emily Nichols, project coordinator for GAIN, speaking at Energy Communities Alliance about GAIN's outreach activities with states.

Singapore-INL SMR Workshop participants at the NRIC DOME.

Australian Shadow Minister for Energy and Emissions Reduction, Dan TEHAN, visits INL Hot Fuels Examination Facility (HFEF) on September 9, 2025.

INL drives global nuclear innovation

In FY-25, INL led strategic meetings with international partners — including the United Kingdom, Republic of Korea, and Japan — to advance collaboration in nuclear fuels, modeling and simulation, safety, AI and workforce development. The lab showcased its nuclear infrastructure and R&D achievements to high-level policymakers and hosted an SMR workshop with Singaporean ministries, sparking collaboration discussions.

INL also delivered technical training to emerging nuclear nations — Peru, Serbia, Vietnam, and Thailand — through the U.S. Department of State's Foundational Infrastructure for Responsible Use of Small Modular Reactor Technology program. At the International Atomic Energy Agency's General Conference, INL joined Argonne and Oak Ridge National Laboratories to spotlight the value of industry partnerships in commercializing advanced nuclear technologies. INL's leadership was further recognized at the Nuclear Energy Agency's Roadmaps to New Nuclear Ministerial, where its experts contributed to four panels on advancing U.S. reactor technologies.

EAST IDAHO NEWS

April 27, 2025

Celebrating a decade of innovation: GAIN

Ten years ago, the U.S. DOE announced a landmark initiative to boost innovation in nuclear energy development by using the technical expertise of the nation's energy laboratories. The department established GAIN to act as the matchmaker that connects nuclear innovators to lab experts and capabilities.

https://www.eastidahonews.com/2025/04/celebrating-a-decade-of-innovation-the-gateway-for-accelerate-innovation-in-nuclear/

IDAHO BUSINESS REVIEW

August 20, 2025

Western states forge alliance with nation's nuclear lab on advanced energy development

The INL is the hub of collaboration among Western states to advance nuclear energy. This effort, anchored in legislative frameworks, strategic investments, collaborations and partnerships, is positioning the region as a leader in nuclear innovation.

https://idahobusinessreview.com/2025/08/20/inl-western-states-nuclear-energy-innovation/

SECTION 8

ORGANIZATIONAL EXCELLENCE AND RECOGNITION

NS&T continues to grow in response to the historic amount of work coming to the directorate. In FY-25, the directorate added 99 new staff members, in addition to internal hires, and welcomed 187 interns.

NS&T staff were recognized with a wide range of honors, awards, and appointments

Presidential Early Career Award for Scientists and Engineers: Five INL nuclear energy researchers, Ahmad Al Rashdan, Andrea Jokissari (former INL), Katya LeBlanc, Alexander D. Lindsay, and Cheng Sun (former INL, current joint appointee), were among nearly 400 recipients.

DOE Appointment: Chris Ritter was named DOE-NE National Technical Director for the Artificial Intelligence for Nuclear Deployment Initiative.

99

NEW STAFF MEMBERS INCLUDING POSTDOCS

187

INTERNS JOINED THE DIRECTORATE

Chris Ritter at the AI Jam on July 8, 2025.

American Nuclear Society (ANS) Awards and Recognitions:

Jess Gehin
Seaborg Medal, Recognition for excellence in nuclear science and engineering

Michael Calley
Robert L. Long Training Excellence Award

Kaushik Banerjee
FCWMD Significant Contributions Award

Ishita Trivedi
Young Member Advancement Award

John Jackson
Untermyer and Cisler Reactor Technology Award

Amy Welty
Mary Jane Oestmann Professional Women's Achievement Award.

Vivek Agarwal
H.M. Hashemian Mid-Career Award and Untermyer and Cister Reactor Medal

Simon Pimblott
Named ANS Fellow

Drew Thomas
Presidential Citation

Abdalla Abou-Jaoude
Early-Career Reactor Physicist Award and ANS 40 Under 40

Ishita Trivedi
Young Member Advancement Award

Samuel Bays
Landis Public Communications and Education Award

Kevin Lyon, Mauricio Edward Tano Retamales and Matt Marzano
40 Under 40

Other Recognitions:

Stephanie Castro Baldivieso
AIChE Best Abstract and Presentation Award

Pierre-Clement Simon
Penn State College of Engineering Early-Career Award

Ahmad Al Rashdan
Appointed lead of the Light Water Reactor Sustainability Program's Plant Modernization Pathway

David Holcomb
Inaugural Meritorious Service Recognition Award at the 10th annual Molten Salt Reactor Workshop

Ron Boring
INL representative in the Oppenheimer Science and Energy Leadership Program (OSELP) Cohort 7

Zach Prince presents the results of a heat pipe microreactor transient simulation at an INL Griffin meeting (Yaqi Wang remotely shown on the screen).

Griffin wins R&D100 Award

Each year, the R&D 100 Awards — often called the "Oscars of Innovation" — recognize the most impactful new technologies from around the world. In FY-25, two INL technologies earned this prestigious distinction, reinforcing the lab's reputation as a global leader in scientific and engineering excellence.

The winning technologies reflect the breadth of INL's mission and the ingenuity of its researchers. **Griffin,** developed in collaboration with Argonne National Laboratory in a team led by **Javier Ortensi** and **Changho Lee**, is a multiphysics simulation tool that models neutron behavior in fusion-reactor environments. Designed to accelerate advanced reactor design and safety analysis, Griffin enables researchers to simulate complex nuclear systems with high fidelity and flexibility. This recognition highlights INL's leadership in computational science and commitment to deliver transformative solutions for the nation's clean energy future.

Publication excellence

In FY-25, INL also made significant contributions to nuclear science and engineering through a wide range of publications. These included peer-reviewed journal articles, conference papers, book chapters, and editorials — reflecting the combined efforts of teams across NS&T, MFC and ATR — 481 publications in total, including:

230
PEER-REVIEWED JOURNAL ARTICLES

222
CONFERENCE PAPERS AND PROCEEDINGS

2
BOOK CHAPTERS

2
EDITORIALS

IDAHO BUSINESS REVIEW

August 27, 2025

INL technologies earn two R&D 100 Awards

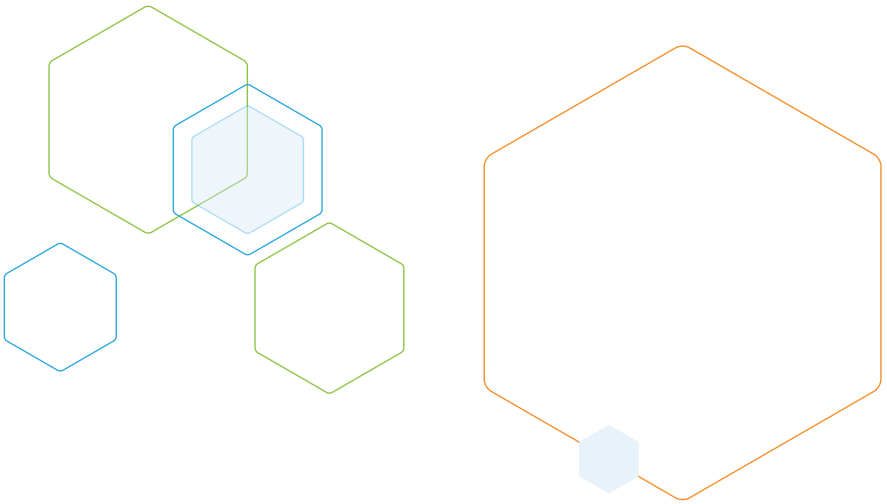
INL wins two 2025 R&D 100 Awards for technology innovation

Storm-DEPART enhances storm prediction and disaster response

Griffin advances nuclear fusion safety through simulation

ReNuFiber named a finalist for sustainable insulation tech

https://idahobusinessreview.com/2025/08/27/inl-wins-2025-rd100-innovation-awards/



Access a digital copy of this report.

For more information, contact donna.kempspangler@inl.gov

Battelle Energy Alliance manages INL for the
U.S. Department of Energy's Office of Nuclear Energy

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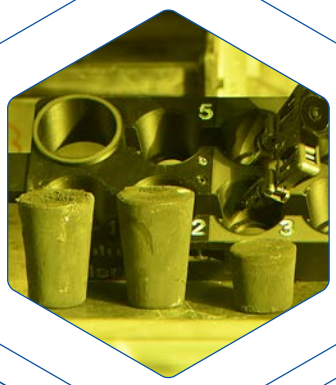

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