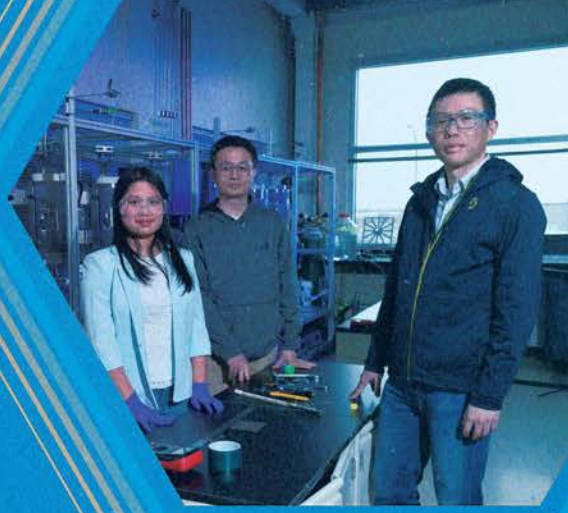
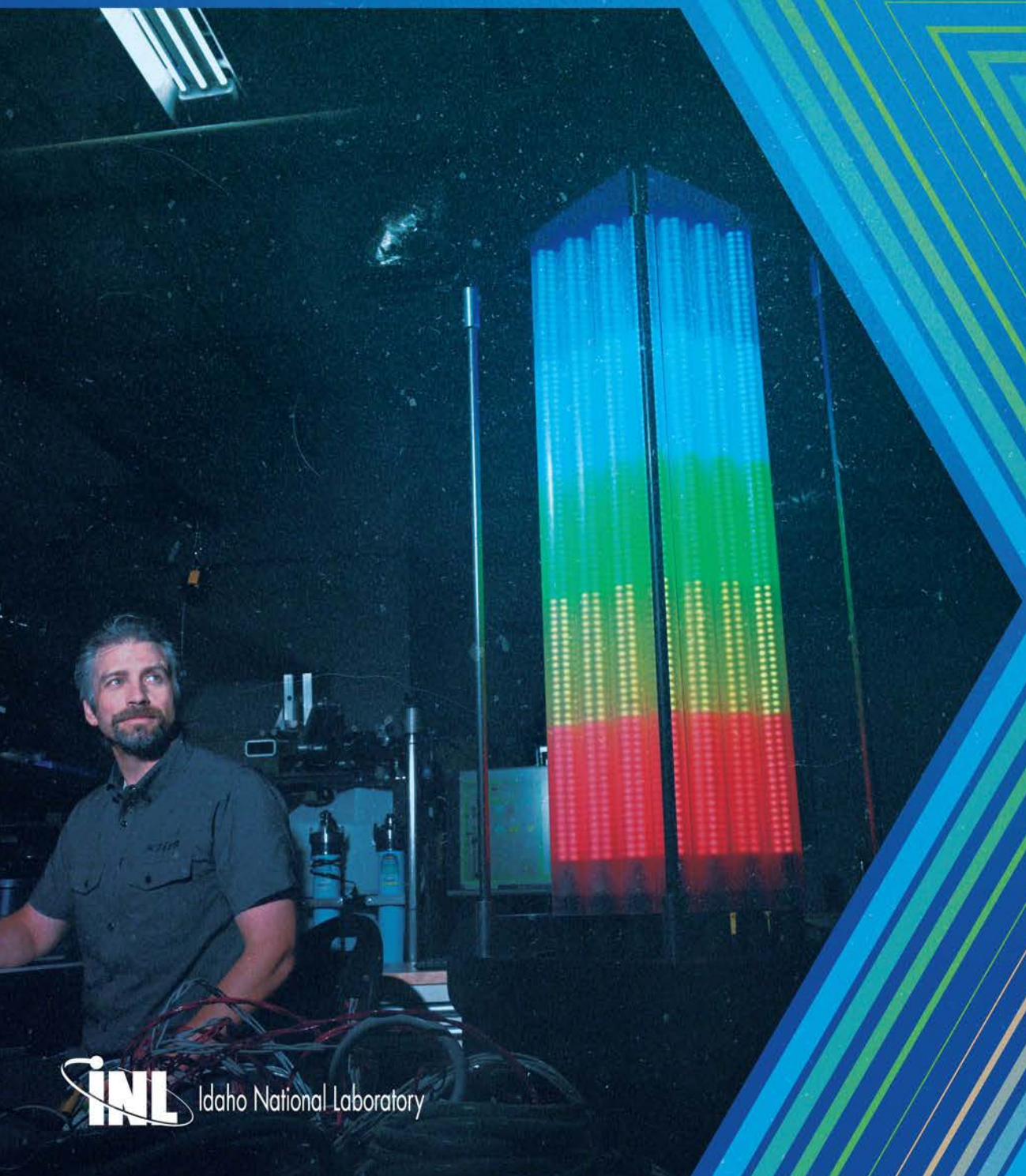
TECHNOLOGY TRANSFER

ANNUAL REPORT





Idaho National Laboratory

2025

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From the Technology Deployment Director

As Director of Technology Deployment at the Idaho National Laboratory (INL), I am honored to share this year's accomplishments and milestones. Fiscal year 2025 was marked by record-setting achievements in intellectual property and commercialization, as well as continued innovation in how Technology Deployment works broadly across the lab to translate INL's research and capabilities to impact.

Technology Deployment's mission is clear: move laboratory technologies into the hands of industry, government and communities where those technologies can make a difference.

Every patent awarded, every license signed and every successful partnership is a step closer to improving lives, strengthening our economy and enhancing national security.

This year, INL innovators broke all-time highs by submitting **99 invention disclosures and 81 software disclosures**. These disclosures are the first step in protecting intellectual property. Combined with **31 U.S. patents** awarded, INL had an outstanding year. These accomplishments highlight both the creativity of our researchers and the diligence of our Technology Deployment and Intellectual Property Legal teams. We ensured that each new invention coming from INL research was carefully assessed, protected and positioned for impact.

Our commercialization successes continue to demonstrate the value of our work and show that the lab's impact is broad and growing. We helped improve energy resiliency in remote locations by licensing the "**Microgrid-in-a-Box**," the first portable microgrid. We are fighting cybersecurity attacks by commercializing **OmniTap** and **Consequence-driven Cyber-Informed Engineering (CCE)** with startup companies. Our flagship nuclear safety and performance codes (**BISON, Griffin, RELAP**) have been globally adopted. And the hard work of our collaborative researchers and INL's Agreements Management team is furthered by strategic partnerships with industry leaders, universities and government. These partnerships include Cooperative Research and Development Agreements (CRADAs) with private nuclear power companies NuScale, Radiant, Oklo and Westinghouse.

We are also using artificial intelligence (AI) to advance how we approach technology transfer. By integrating **AI tools** into **all aspects** of how we work, we have already increased patent grant rates and enabled smarter portfolio decisions. We are using AI to more quickly record and transcribe invention disclosure meetings, which is allowing us to capture valuable insights that improve patent drafting, licensing and commercialization. These operational improvements, though less visible, are essential to sustaining our long-term success.

Equally important is the culture of innovation we foster at the lab. **Our fifth annual Innovation Week** brought together more than 160 INL researchers for workshops, speakers and celebrations of achievement. Keynote speaker Jeff DeGraff challenged us to embrace creativity and use "constructive conflict" as a catalyst for innovation. When we celebrate our inventors and licensees, as we do at Innovation Week, we are fueling the next generation of breakthroughs.

National recognition has followed. INL technologies earned **Research and Development (R&D) 100 Awards** for two technologies: The **Griffin advanced reactor physics tool** makes nuclear reactor design cheaper and safer by predicting how different designs, fuels and materials will perform in real life. And the **Storm-DEPART disaster response platform** helps utilities and industry predict the impacts of major hurricanes.

As we look ahead, we remain committed to strengthening the bridge between scientific discovery and real-world impact. We will continue to expand the use of AI and predictive analytics in our operations, and deploy new types of intellectual property (such as for AI models and datasets). We will deepen partnerships with industry and government, and support our researchers with the tools and resources they need to see their ideas through to deployment.

I am deeply grateful to our researchers, technology transfer and intellectual property professionals, industry partners, and sponsors who make this work possible. Together, we ensure that INL innovations are not confined to the laboratory—they reach the marketplace, create jobs and help solve the pressing challenges of our time.

Jason Stolworthy
Director, Technology Deployment
Idaho National Laboratory

Jason Stolworthy
Director, Technology Deployment

Stefanie Johnston
Manager, Agreements Management

Abstract

The Idaho National Laboratory (INL) is a U.S. Department of Energy (DOE) multiprogram laboratory that conducts research and development in various DOE mission areas. Like all national laboratories, INL is fully committed to making its capabilities and technologies available to federal agencies, state and local governments, universities and industry. Technology transfer is a foundational part of the lab's purpose.

To fulfill this mission, INL encourages its researchers and engineers to disclose new inventions and intellectual property to ensure they are captured, protected and made available to others who might benefit from them. The lab then licenses the intellectual property to industrial partners, who commercialize the technologies, supporting job creation and delivering the benefits of federally funded technology to consumers. INL's unique capabilities are made available to other federal agencies, international organizations, domestic and foreign commercial entities or small businesses to solve specific technical challenges.

INL employees work with researchers and technical staff members from the university and industrial sectors to develop emerging technologies. In this global economy, INL helps develop the next generation of engineers and scientists by licensing software to educational institutions throughout the world.

This report is a catalog of select INL technology transfer activities executed during the past year. These activities included commercialization transactions and research agreements. Because of the breadth of INL's work, this report focuses on transactions specifically authorized by technology transfer legislation (and corresponding contractual provisions) or that involve the transfer of legal rights to technology to other parties. This report was compiled from primary records that were readily available to INL's Technology Deployment and Agreement Management offices. Accomplishments cataloged in this report reflect the achievements and creativity of INL's researchers, technicians, support staff and operators.

Prepared for the U.S. Department of Energy Under DOE Idaho Operations Office Contract DE-AC07-05ID14517.

Intellectual Property

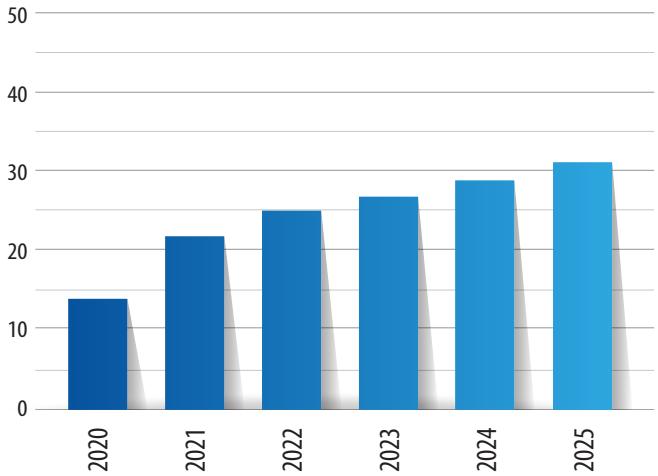
INL's intellectual property portfolio includes invention disclosure records, patent applications, issued patents and copyright assertions. This portfolio provides a basis for collaboration with commercial enterprises, academia and other parties domestic and international. INL's science, engineering and technical intellectual property portfolios provide the laboratory with an opportunity to deploy its creative, meaningful research.

Technology Deployment works closely with INL leaders and researchers to identify and pursue opportunities for technology commercialization and business development.

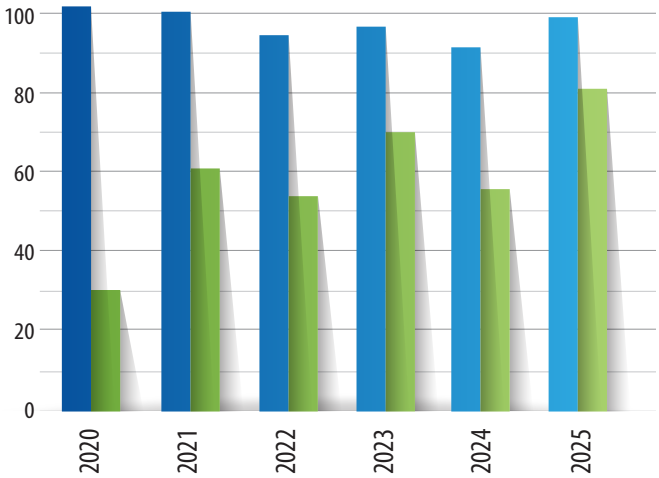
In fiscal year (FY) 2025, INL innovators submitted 99 invention disclosure records and 81 software disclosures to Battelle Energy Alliance LLC (BEA).

In FY-25, 31 U.S. patents were issued to either INL or DOE based on the inventions of INL scientists and researchers.

U.S. PATENTS ISSUED FY 2020–2025



DISCLOSURE RECORDS RECEIVED FY 2020–2025

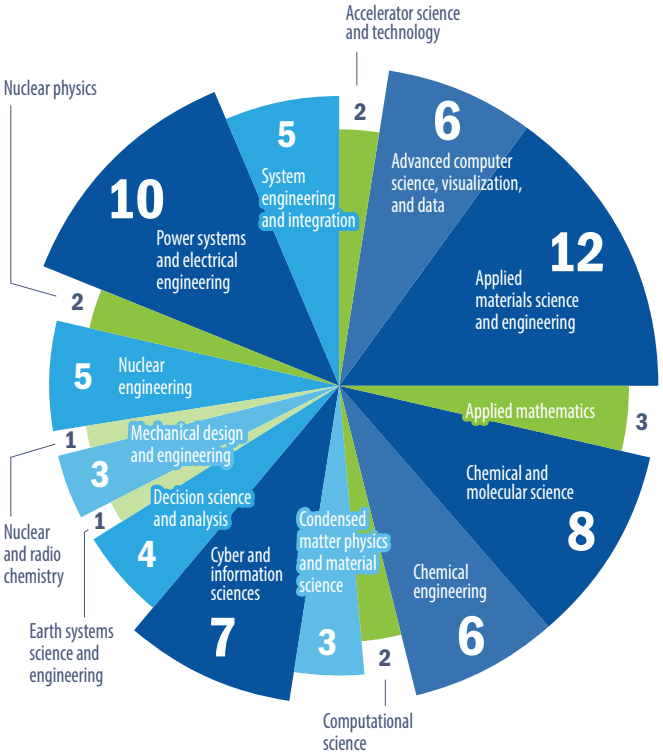


Since the commencement of BEA's contract to manage INL in 2004, laboratory researchers have submitted close to 2,000 disclosures, resulting in more than 650 issued U.S. patents. The lab has executed more than 2,250 licenses during this period.

BEA has intellectual property ownership rights under its contract with DOE and can retain title to inventions and seek patent protection, subject to some exceptions. The decision to seek patent protection is based on market and technical assessments of the technology and its subsequent programmatic value.

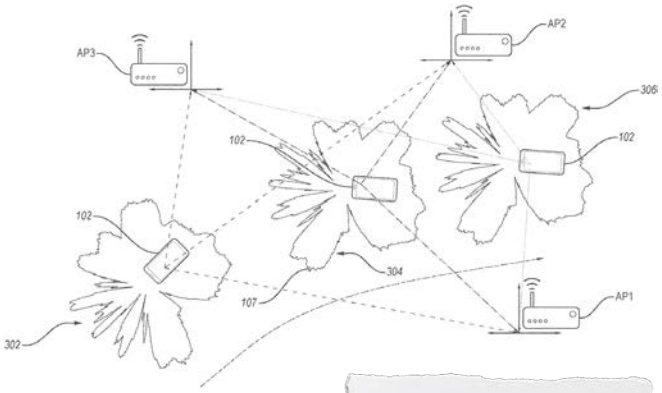
Technology assessments inform a recommendation presented to a committee composed of department or project managers, an assistant laboratory director or designee, market analysts, commercialization managers and a patent attorney. The Technology Deployment director makes a final decision to elect or decline the technology for patent protection. Generally, potential inventions judged to be commercially valuable, crucial to a primary mission or valuable in terms of motivating further research funding are elected.

CORE COMPETENCIES ASSOCIATED WITH FY GRANTED PATENTS



- Accelerator science and technology
- Advanced computer science, visualization and data*
- Applied materials science and engineering*
- Applied mathematics
- Biological and bioprocess engineering*
- Biological systems science
- Chemical and molecular science**
- Chemical engineering*
- Computational science**
- Condensed matter physics and materials science**
- Cyber and information sciences*
- Decision science and analysis*
- Earth and energy systems and infrastructure analysis and engineering
- Earth, environmental and atmospheric science*
- Isotope science and engineering*
- Large-scale user facilities/ R&D facilities/advanced instrumentation*
- Mechanical design and engineering*
- Microelectronics
- Nuclear and radio chemistry*
- Nuclear engineering*
- Nuclear physics
- Particle physics
- Plasma and future energy sciences*
- Power systems and electrical engineering*
- Systems engineering and integration*

*Acknowledged ** Emerging



Patent 12,120,109

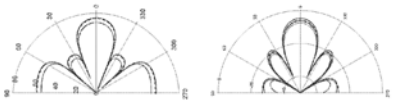


FIG. 2A FIG. 2B

FIG. 2C FIG. 2D

Patents

Methods Of Forming Alloys By Reducing Metal Oxides

A method of forming an alloy includes disposing a first metal oxide and a second metal oxide in a molten salt. The molten salt is in contact with a working electrode and a counter electrode. An electrical potential is applied between the counter electrode and the working electrode to co-reduce the first metal oxide and the second metal oxide to form a first metal and a second metal, respectively.

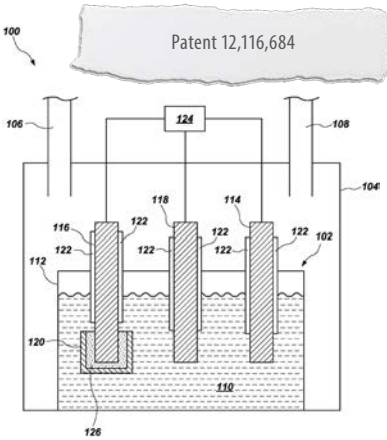
Patent No. 12,116,684 granted October 15, 2024, Prabhat Tripathy

Systems, Devices, And Methods For Authenticating Millimeter Wave Devices

Systems, devices, and methods are described for millimeter wave device authentication. An authentication system may include one or more access points. Each access point of the one or more access points is configured to extract from one or more beam patterns generated via a client device, a beam feature associated with the client device. Each access point may also be configured to transmit the beam feature. The authentication system may also include a server communicatively coupled to one or more access points and including a database for storing known beam features. The authentication server may be configured to receive the beam feature associated with the client device from at least one access point of the one or more access points. Also, the authentication server may be configured to authenticate the client device in response to the received beam feature matching a known beam feature stored in the at least one database.

Patent No. 12,120,109 granted October 15, 2024, Arupjyoti Bhuyan, Zhi Sun, Sarankumar Balakrishnan

Patent 12,116,684



Spread Spectrum Communication, And Associated Devices, Systems, And Methods

Various embodiments relate to spread spectrum communication. A communication system may include a base station and a user equipment. The base station may be configured to: add a cyclic prefix (CP) to each block of a number of blocks of a first direct sequence spread spectrum (DSSS) signal to generate a first cyclic prefix-direct sequence spread spectrum (CP-DSSS) signal; add artificial noise to the first CP-DSSS signal; and transmit, via a channel, the first CP-DSSS signal. The user equipment is configured to receive the first CP-DSSS signal. Associated methods and communications systems are also disclosed.

Patent No. 12,126,374 granted October 22, 2024, Arslan J. Majid, Hussein Moradi, Behrouz Farhang

Methods, Systems And Apparatuses for Treating Fluids Using Thermal Gradient Osmosis

A method of treating a fluid comprises introducing a feed fluid stream comprising multiple materials to first side of a semi-permeable membrane. A draw fluid stream having a higher temperature than the feed fluid stream is introduced to second, opposing side of the semi-permeable membrane to form a thermal gradient across the semi-permeable membrane. One or more of the multiple materials of the feed fluid stream is drawn through the semi-permeable membrane and into the draw fluid stream via thermal gradient osmosis. A fluid treatment system and a thermal gradient osmosis apparatus are also described.

Patent No. 12,128,358 granted October 29, 2024, Aaron D. Wilson, Christopher J. Orme, John R. Klaehn, Birendra Adhikari, Frederick F. Stewart, Seth W. Snyder

Methods Of Forming Articles Including Microchannels Therein, And Related Articles

A method of forming an article comprises forming a feed material around one or more shapeholders and sintering the feed material and the one or more shapeholders to form a sintered article comprising the one or more shapeholders in a base material. The sintered article is exposed to a solvent to remove the one or more shapeholders from the base material. Additional methods are disclosed, as well as articles including one or more microchannels exhibiting a diameter of from about 5 μm to about 10 mm.

Patent No. 12,138,687 granted November 12, 2024, Donna P. Guillen, Robert V. Fox, Dennis S. Tucker, Troy B. Holland

Methods of Hydrogenating Carbon Dioxide Using Electrochemical Cells Comprising Tunable Catalysts

A method of hydrogenating carbon dioxide comprises forming a tunable catalyst comprising at least one metal comprising a size within a range of from a single atom to about 999 nanometers and formulated to produce one or more carbon-containing compounds. An electrochemical cell comprising a positive electrode, a negative electrode comprising the tunable catalyst, and an electrolyte between the positive electrode and the negative electrode is formed. Carbon dioxide is introduced to the negative electrode of the electrochemical cell and a potential difference is applied between the positive electrode and the negative electrode to selectively hydrogenate the carbon dioxide. The hydrogen ions are diffused through the electrochemical cell. The carbon dioxide at the negative electrode is hydrogenated to selectively form carbon monoxide, methane, or a desired ratio of carbon monoxide and methane. An electrochemical cell and a carbon dioxide hydrogenation system are also disclosed.

Patent No. 12,146,233 granted November 19, 2024, Meng Li, Bin Hua, Dong Ding

Flow-through Liquid Metal Cooled Molten Salt Reactors

A liquid metal cooled molten salt reactor having a liquid metal vessel connected to a gas chamber that is connected to a molten salt chamber that is connected with a hot liquid metal vessel. A fuel salt that is withdrawn from the fuel salt tank through a feeding tube into the molten salt chamber from which the fuel salt is withdrawn into a salt separator. A purging gas is inserted into the gas chamber and withdrawn. A liquid metal coolant is dispensed from the liquid metal vessel through a plurality of dispensing nozzles into the molten salt chamber. The liquid metal coolant flows through the molten salt into a hot liquid metal vessel and then through a liquid metal filter into a liquid metal pump. The liquid metal coolant flows through a thermal exchanger subsequently returning to the liquid metal vessel.

Patent No. 12,148, 537 granted November 19, 2024, Junhua Jiang

Techniques For Incorporating Sensors Into Apparatuses And Systems (BA-1102)

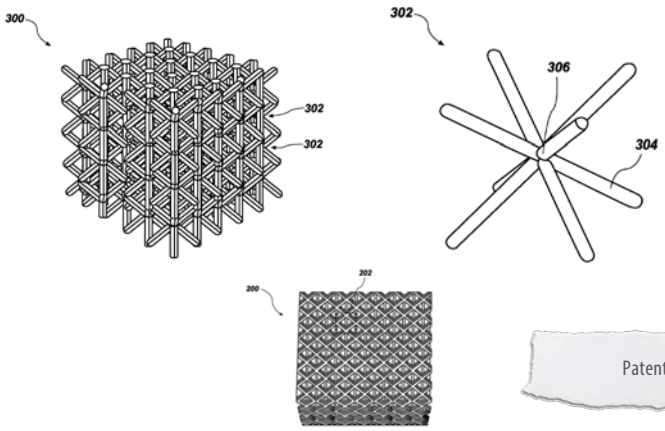
Methods of placing sensors in structures may involve placing first particles including a first material of the structure on or above a support surface. Second particles, including a second, different material may be dispersed among the first particles at least within a transition region of the structure proximate to a location where a sensor is to be supported by the structure. A sensor may be placed in the location. The first particles of the first material may be fused to one another and to the second particles of the second material to form the structure with the sensor supported by the structure.

Patent No. 12,148,538 granted November 19, 2024, Isabelle J. Van Rooyen, Piyush Sabharwall.

Active Electromagnetic Shielding For High Power Dynamic Wireless Charging And Related Systems, Methods, And Devices

Active electromagnetic shielding for dynamic, high-power wireless charging and related electrified roadway systems, method, and wireless power transmitters is disclosed. A wireless power transmitter includes a first canceling coil offset from a power transmission coil, a second canceling coil offset from the power transmission coil, and circuitry electrically connected to the first canceling coil and the second canceling coil. The circuitry is configured to deliver canceling currents to the first canceling coil and the second canceling coil to destructively interfere with portions of electromagnetic fields generated by the power transmission coil.

Patent No. 12,149,096 granted November 19, 2024, Bo Zhang



Test Capsules For Measuring A Change In At Least One Property Of A Material, And Related Methods

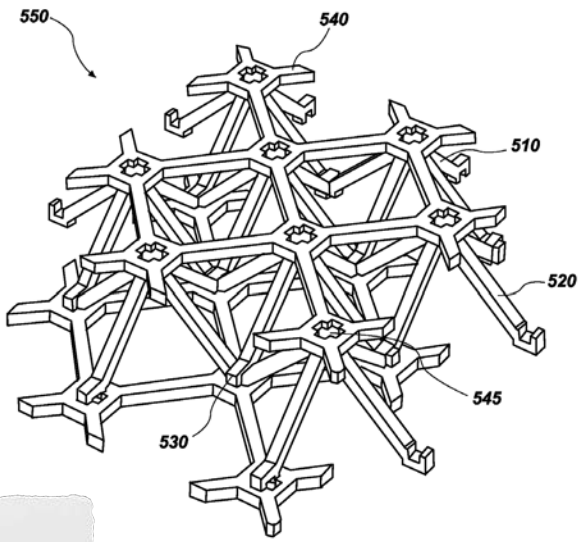
A test capsule for measuring at least one property of a material exposed to nuclear radiation comprises a lattice structure configured to exhibit a change in at least one property responsive to exposure to nuclear radiation. The lattice structure comprises a first strut and a second strut connected to the first strut at a node. Related test capsules and methods are also described.

Patent No. 12,181,421 granted December 31, 2024, Robert A. Roach, Andrea M. Jokisaari, Michael D. McMurtrey, Geoffrey L. Beausoleil, Carolyn L. Seepersad

Systems And Methods For Control System Security

A resilient security agent determines a cyber and/or physical health of a control system by, inter alia, communicating cyber-physical key data through cyber-physical control paths of the system and determining error introduced by the communication. The resilient security agent may be further configured to verify the integrity of acquired cyber-physical state information. The cyber health of the control system may be evaluated by comparing the acquired cyber state information to one or more cyber state profiles. The physical health of the control system may be evaluated by comparing the acquired physical state information to one or more physical state profiles.

Patent No. 12,189,778 granted January 7, 2025, Craig G. Rieger, Timothy R. McJunkin, Milos Manic, Kasun Amarasinghe



Patent 12,181,421

Laser Ablation Methods For Producing Feedstock Powder Suitable For Laser-Based Additive Manufacturing

Methods and systems for producing feedstock powders, suitable for use in laser-based additive manufacturing, use laser ablation to vaporize a source material, which may be in bulk solid or solid coarse grain form. The source material is vaporized by a laser (or other focused energy source) in a vaporization chamber that is temperature controlled to provide a vertical thermal gradient. The vertical thermal gradient may be controlled to, in turn, control the nucleation, coagulation, and agglomeration of the vaporized molecules, enabling formation of microparticles that may then be used as feedstock powders in laser-based additive manufacturing. The produced feedstock powder particles may be of uniform composition, of uniform shape (e.g., substantially spherical), and of uniform phase or homogeneously mixed phases.

Patent No. 12,202,046 granted January 21, 2025, Robert C. O'Brien, Owen O. Abe

Sensor Assemblies And Nuclear Reactor Systems Comprising Doped Solid-State Lasing Media For Use In Determining An Operating Characteristic Of A Nuclear Reactor, And Related Methods

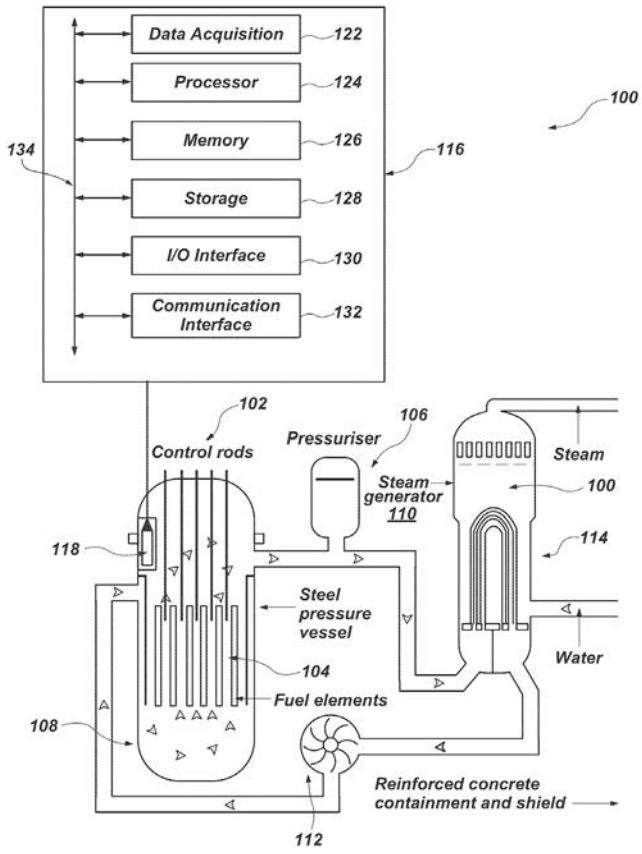
A sensor assembly for determining an operating characteristic of a nuclear reactor. The sensor assembly includes a solid-state lasing media and an optical fiber. The solid-state lasing media is doped with a fissile species. The solid-state lasing media is disposable within a core of the nuclear reactor and is configured to generate laser light. An output of the laser light is based at least in part by the fissile species. The optical fiber is operably coupled to the solid-state lasing media and configured to receive the laser light generated by the solid-state lasing media. The optical fiber is configured to extend out of the core of the nuclear reactor to a control system of the nuclear reactor.

Patent No. 12,205,729 granted January 21, 2025, Robert C. O'Brien, Andy Beasley

Processing Flows And Related Systems And Methods Are Disclosed

Processing flows and related systems and methods are disclosed. A computing system includes one or more data interfaces, one or more other components, and a controller. The one or more data interfaces are configured to provide an interface to a data source. The one or more other components include one or more controller plugins, one or more processing nodes, or both the one or more controller plugins and the one or more processing nodes. The controller is configured to manage interactions between the one or more data interfaces and the one or more other components and enable a user to chain together the one or more data interfaces and the one or more other components according to one or more flows. The one or more controller plugins are configured to provide results of the one or more flows to one of a user interface and a system interface.

Patent No. 12,219,667 granted February 4, 2025, Aniqua Z. Baset, Christopher D. Becker, Samuel Ramirez, Sneha K. Kasera, Kurt W. Derr



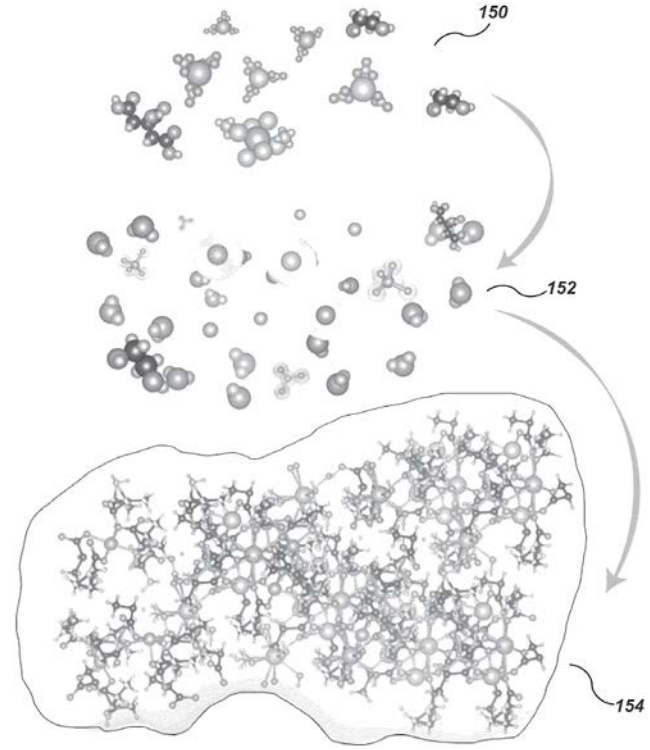
Patent 12,205,729

Methods Of Forming Metal Nanomaterials

A method of forming a metal nanomaterial comprises forming a precursor solution comprising a metal precursor and a metal oxide precursor. A complexing agent is added to the precursor solution, and the metal precursor and the metal oxide precursor are hydrolyzed to form a sol. The sol is heated to form a gel, which is calcined to incorporate metal cations from the metal precursor into a metal oxide lattice from the metal oxide precursor. The calcined gel is exposed to a reducing agent to exsolve the metal from the metal oxide lattice and to form a metal nanomaterial comprising a metal and a metal oxide is formed. Additional methods of forming a metal nanomaterial are also disclosed.

Patent No. 12,226,835 granted February 18, 2025, Bin Hua, Meng Li, Dong Ding

Patent 12,226,835



Methods Of Removing Contaminants From A Solution, And Related Systems

A method of removing contaminants from a solution comprises passing a solution including one or more contaminants through a first cell comprising a first anode chamber and a first cathode chamber, passing a slurry comprising a flowing electrode material through the first anode chamber and the first cathode chamber while applying an electric potential between the first anode chamber and the first cathode chamber to transport anions from the solution to the first anode chamber and to transport cations from the solution to the first cathode chamber, the flowing electrode material comprising a MXene material, wherein M is a metal and X is one or both of carbon and nitrogen, and passing the slurry through a second cell to desorb the anions and cations from the flowing electrode material. Related systems for removing contaminants from a solution, and related methods are disclosed.

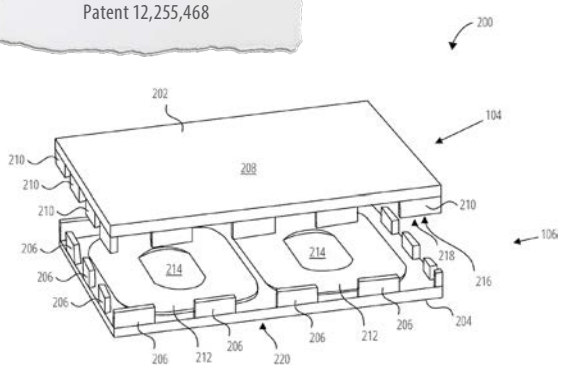
Patent No. 12,252,420 granted March 18, 2025, Tedd E. Lister, Luis A. Diaz Aldana, Naqsh E. Mansoor, David Estrada

Electromagnetic Shield Designs For High Power Wireless Charging Of Electric Vehicles And Related Shields, Vehicles, Systems, And Methods

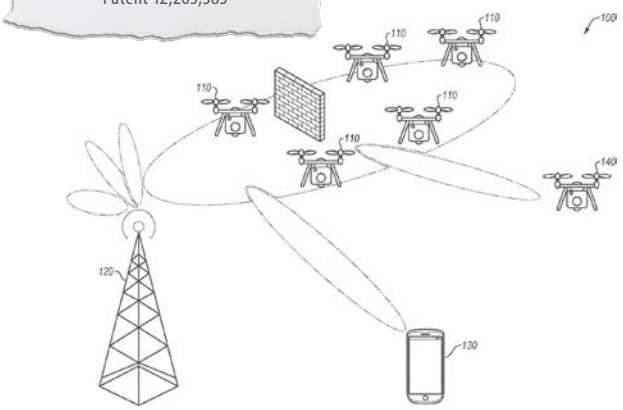
Electromagnetic shields, vehicles, wireless charging systems, and related methods are disclosed. An electromagnetic shield includes a shield member including a coil side to face one or more inductive coils. The electromagnetic shield also includes one or more perimeter shield members configured in a loop proximate to a perimeter of the coil side of the shield member. The shield member and the one or more perimeter shield members are configured to shield electromagnetic radiation emitted by the one or more inductive coils.

Patent No. 12,255,468 granted March 18, 2025, Bo Zhang, Richard Barney Carlson

Patent 12,255,468



Patent 12,265,385



Systems, Devices, And Methods For Millimeter Wave Communication For Unmanned Aerial Vehicles

Systems, devices and methods are described for controlling and communicating with unmanned aerial vehicles (UAVs) over a millimeter wave (mmWave) communication network established between a base station and the UAVs. A communication system may include one or more unmanned aerial vehicles (UAVs). The communication system may further include one or more base stations including millimeter wave (mmWave) antennas configured to generate control signals to the one or more UAVs over an mmWave communication network.

Patent No. 12,265,385 granted April 1, 2025, Arupjyoti Bhuyan, Ismail Guvenc, Huaiyu Dai

Systems and Methods For Binary Code Analysis

Human-readable (HR) code may be derived from a binary. The HR code may be configured to have statistical properties suitable for machine-learned (ML) translation. The HR code may comprise source code, intermediate code, assembly code, or the like. A machine-learned translator may be configured to translate the HR code into labels comprising semantic information pertaining to respective functions of the binary, such as a function name, role, or the like. Execution of the binary may be blocked in response to translating the HR code to a label associated with malware, such as cryptocurrency mining malware or the like. Conversely, the binary may be permitted to proceed to execution in response to determining that the translation is free from labels indicative of malware.

Patent No. 12,265,615 granted April 1, 2025, Matthew W. Anderson, Matthew R. Sgambati, Brandon S. Biggs

Sorting of Dark Colored And Black Plastics

Systems and methods for classifying and sorting of dark colored and/or black-colored plastic materials utilizing a vision system or one or more sensor systems implemented with one or more medium wavelength infrared cameras whereby the captured image data is process within a machine learning system in order to identify or classify each of the materials, which may then be sorted into separate groups based on such an identification or classification.

Patent No. 12,290,842 granted May 6, 2025, Jeffrey A. Lacey, Lorenzo J. Vega Montoto, Nalin Kumar, Gerado Manual Garcia, Isha K. Maun

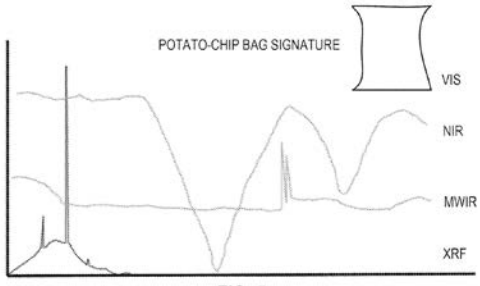


FIG. 5

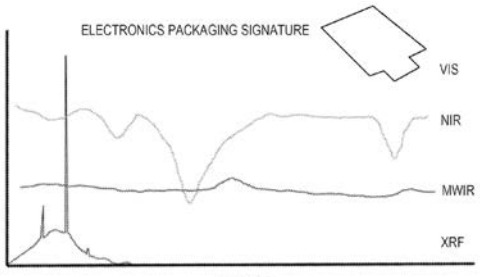
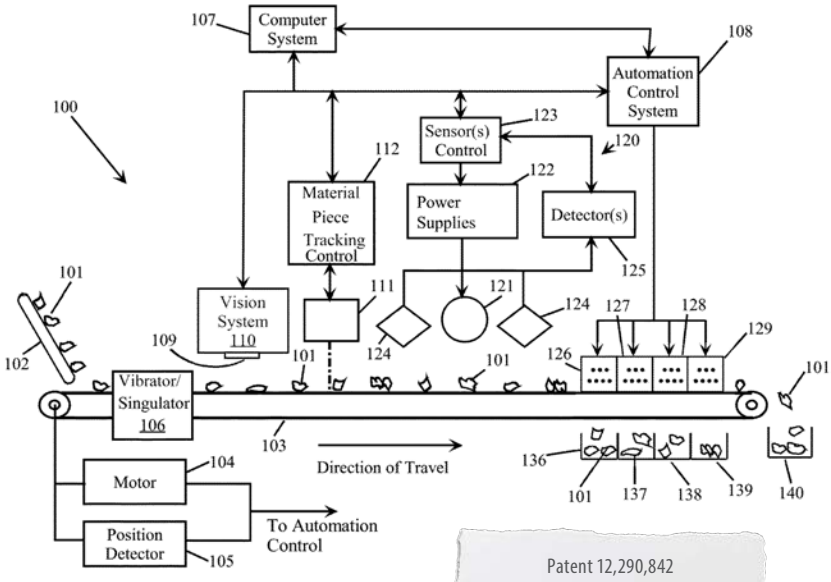


FIG. 6



Patent 12,290,842

Energy Production Devices And Associated Components, And Related Heat Transfer Devices And Methods

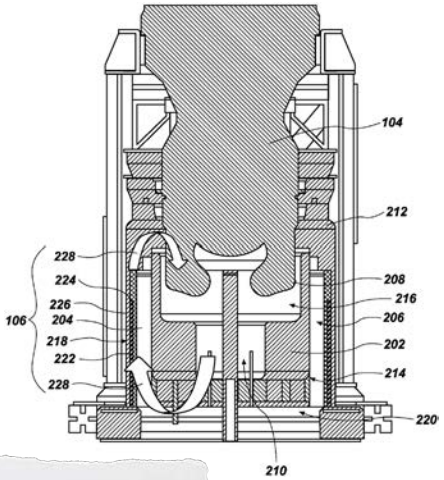
An energy production device may include a core configured to heat a heat transmission fluid, an energy harnessing device configured to convert heat into electrical energy and a heat transfer device positioned over the core configured to receive the heat transmission fluid and transfer the heat to the energy harnessing device. The energy production device may further include a vibration isolator positioned between the energy harnessing device and the heat transfer device. The vibration isolator may be configured to secure the energy harnessing device to the heat transfer device and substantially prevent the transmission of motion from the energy harnessing device to the heat transfer device.

Patent No. 12,300,397 granted May 13, 2025, Yasir Arafat, Carlo Parisi, Carl E. Baily, Blair K. Grover, Douglas C. Crawford, Allen Peterson

Electrochemical Cells Comprising Three-Dimensional (3D) Electrodes Including A 3D Architectured Material, Related Systems, And Related Methods Of Forming Hydrogen

An electrochemical cell comprising a three-dimensional (3D) electrode, another electrode, and an electrolyte. The 3D electrode comprises a 3D architectured material. Methods of forming the 3D architectured material are also disclosed, as are methods of using the 3D architectured material in methods of forming hydrogen.

Patent No. 12,308,483 granted May 20, 2025, Wei Wu, Dong Ding, Ting He



Patent 12,300,397

Nuclear Reactor And Associated Components, Systems, And Methods

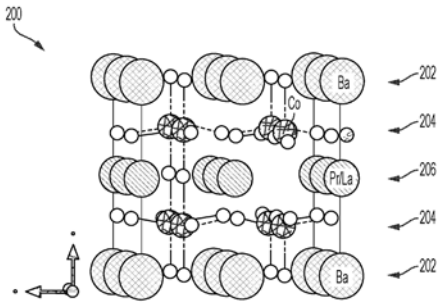
A method of operating a nuclear power system includes generating heat in a nuclear reactor core, transmitting the heat to a heat engine, generating electricity with a generator operatively coupled to the heat engine. The method further includes detecting a no-load condition, and stopping the heat engine. The method also includes transferring heat from an outer surface of the nuclear reactor to the environment through a heat transfer system if a temperature of the nuclear reactor rises above a threshold temperature. The method further includes preventing heat from transferring from the outer surface of the nuclear reactor to the environment through the heat transfer system if the temperature of the nuclear reactor is below the threshold temperature. Nuclear power systems and nuclear reactors are also disclosed.

Patent No. 12,345,240 granted July 1, 2025, Abderrafi M. Ougouag, Ramazan Sonat Sen, George W. Griffith, Yasir Arafat

Electrochemical Cells For Hydrogen Gas Production And Electricity Generation, And Related Systems And Methods

An electrochemical cell comprises a first electrode, a second electrode, and a proton-conducting membrane between the first electrode and the second electrode. The first electrode comprises a layered perovskite having the general formula: $DAB_2O_{5+\delta}$, wherein D consists of two or more lanthanide elements; A consists of one or more of Sr and Ba; B consists of one or more of Co, Fe, Ni, Cu, Zn, Mn, Cr, and Nd; and δ is an oxygen deficit. The second electrode comprises a cermet material including at least one metal and at least one perovskite. Related structures, apparatuses, systems, and methods are also described.

Patent No. 12,359,327 granted July 15, 2025, Dong Ding, Hanping Ding, Wei Wu, Chao Jiang



Patent 12,359,327

Metal-coated Articles Comprising A Transition Metal Region And A Platinum-Group Metal Region And Related Methods

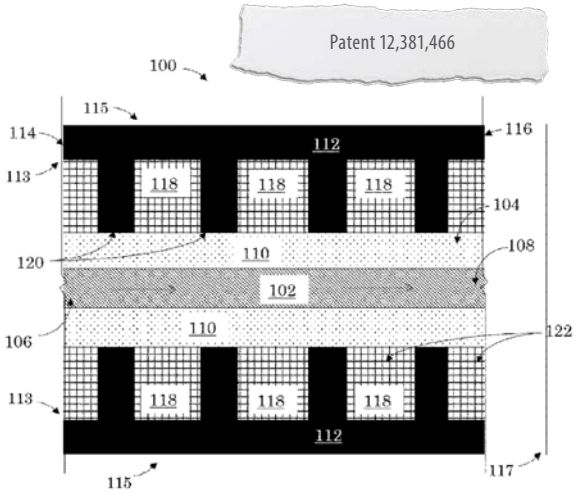
A metal-coated article that comprises a substrate, a transition metal region adjacent to the substrate, and a platinum-group metal region adjacent to the transition metal region. The transition metal region comprises a transition metal carbide layer adjacent to the substrate. The platinum-group metal region comprises a transition metal/platinum-group metal layer that is adjacent to the transition metal region and a platinum-group metal layer adjacent to the transition metal/platinum-group metal layer. Related methods are also disclosed.

Patent No. 12,359,333 granted July 15, 2025, Prabhat Kumar Tripathy

Compact Annular Linear Induction Pump

The compact annular linear pump has a duct, with an inlet and an outlet, positioned to surround an inner core. The duct has a fluid with paramagnetic properties disposed within it. Surrounding the duct is a stator having a first end and a second end. The stator has a plurality of slots that is divisible by three. There is a tooth at each end of the stator and between each slot. There is an electromagnetic circuit with three conductors wired in series disposed within the stator. Within each slot is a coil. Each of the three conductors travel through the stator by alternating through pairs of slots, each coil belonging to a single conductor and alternating conductors every third coil pair. The fluid travels from the inlet to the outlet by application of a current generator to the electromagnetic circuit creating a magnetic flux.

Patent No. 12,381,466 granted August 5, 2025, Bryce D. Kelly



Methods Of Recovering Active Materials from Rechargeable Batteries, And Related Apparatuses

A method of recovering active materials from a rechargeable battery comprises placing an active material of a rechargeable battery in a cathode chamber comprising a cathode of an electrochemical cell comprising the cathode chamber, an anode chamber comprising an anode, and a membrane separating the cathode chamber from the anode chamber, contacting the active material in the cathode chamber with an electrolyte comprising an acid, ferric ions, and ferrous ions, and dissolving at least one of lithium and cobalt from the active material into the electrolyte. Related apparatuses for recovering metals from active materials of rechargeable batteries are also disclosed.

Patent No. 12,388,123 granted August 12, 2025, Joshua S. McNally, Luis A. Diaz Aldana, John R. Klaehn, Tedd E. Lister, David W. Reed

Smart Network Switching Systems And Related Methods

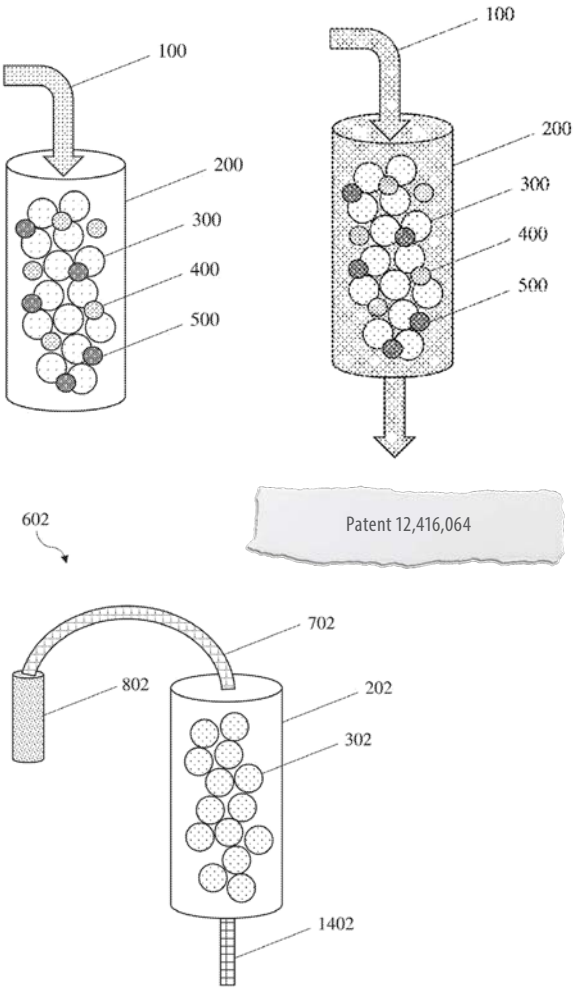
A method of monitoring and controlling network traffic within an industrial control system including receiving one or more data packets at a smart network switching system operating software-defined networking, analyzing the one or more data packets at a protocol level within a control plane of the software-defined networking, based on the analysis, determining whether the one or more data packets are authorized data packets, and forwarding a data packet of the one or more data packets to a destination device within a data plane of the software-defined networking upon determining that the data packet is an authorized data packet. The method further includes providing information related to the analysis of the one or more data packets to an out-of-band monitoring and control system for display to a user, and receiving a response communication from the out-of-band monitoring and control system indicating whether the one or more data packets are authorized data packets.

Patent No. 12,407,650 granted September 2, 2025, Briam E. Johnson, Michael V. McCarty, Rishi R. Chatterjee, Kristopher Watts

Ion Exchange IN Non-Aqueous Fluid For Separation Of Mixtures (BA-1232)

Systems and methods for selectively recovering a target metal from an ion exchange resin are generally described. In certain embodiments, such methods and systems can be employed for metal purification and enrichment of target metal species from mixtures containing contaminating or non-target metals. In some embodiments, ion exchange is accomplished in the presence of one or more species that facilitate the recovery of a metal from a composition further comprising one or more other metals. The recovered metal-containing composition may contain the recovered metal at relatively high purity and/or in relatively large amounts. In some embodiments, the conditions present during ion exchange are varied in a manner that facilitates the enrichment of a metal from an initial (e.g. sample) composition further comprising one or more other metals to result in a product that contains the enriched metal at relatively high purity and/or in relatively large amounts.

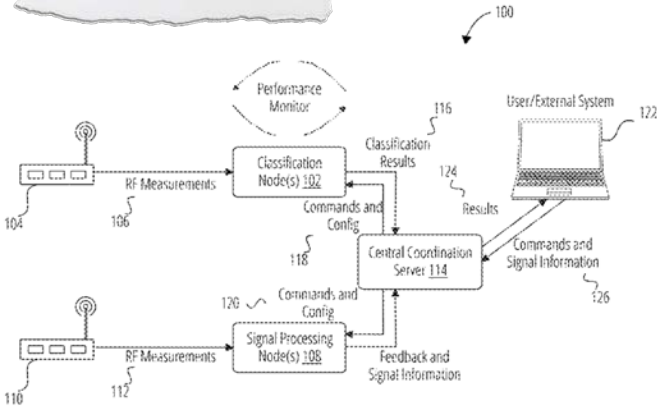
Patent No. 12,416,064 granted September 16, 2025, Mary E. Case, Robert Vincent Fox, Laura Sinclair, John N. Moses, Jessica Sweeney



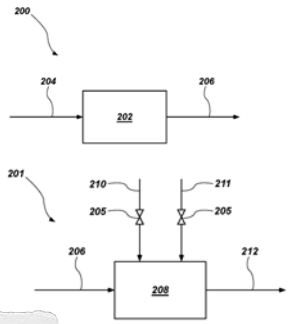
Spectrum Monitoring And Analysis, And Related Methods, Systems, And Devices

Wireless signal class 12,189,778 ifiers and systems that incorporate the same may include an energy based detector configured to analyze an entire set of measurements and generate a first single classification result, a cyclostationary-based detector configured to analyze less than the entire set of measurements and generate a second signal classification result; and a classification merger configured to merge the first signal classification result and the second signal classification result. Ensemble wireless signal classification and systems and devices the incorporate the same are disclosed. Some ensemble wireless signal classification may include energy-based classification processes and machine learning-based classification processes. In some embodiments, incremental machine learning techniques may be incorporated to add new machine learning-based classifiers to a system or update existing machine learning-based classifiers.

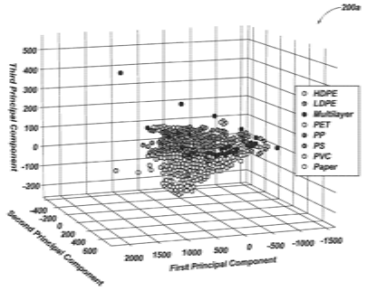
Patent No. 12,418,349 granted September 16, 2025, Kurt W. Derr, Samuel Ramirez, Sneha K. Kasera, Christopher D. Becker, Aniqua Z. Baset



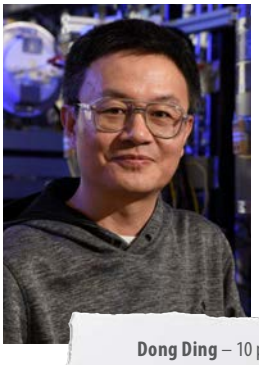
FY-25 Patent Hall of Fame

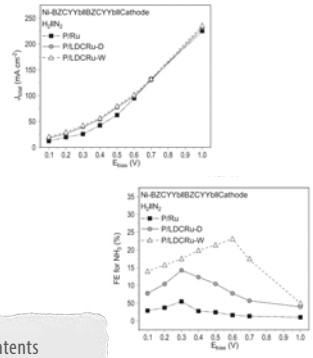


Robert Vincent Fox – 20 patents

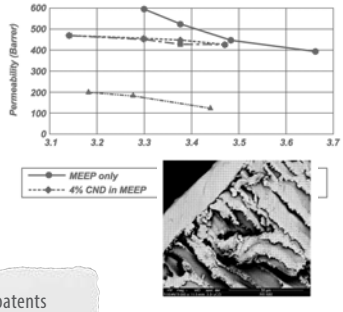


Jeffrey A. Lacey – 20 patents

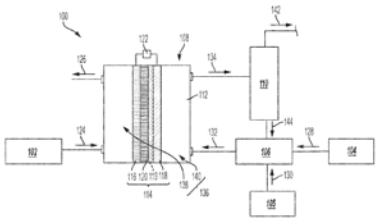




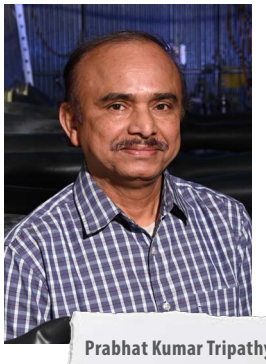
Dong Ding – 10 patents

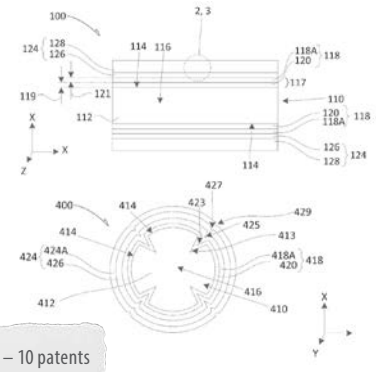


John R. Klaehn – 10 patents

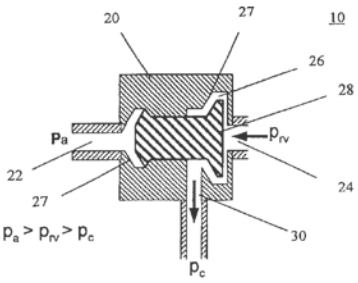


Tedd E. Lister – 10 patents

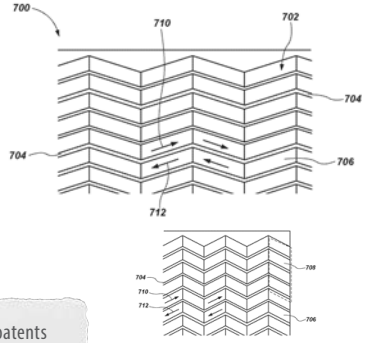




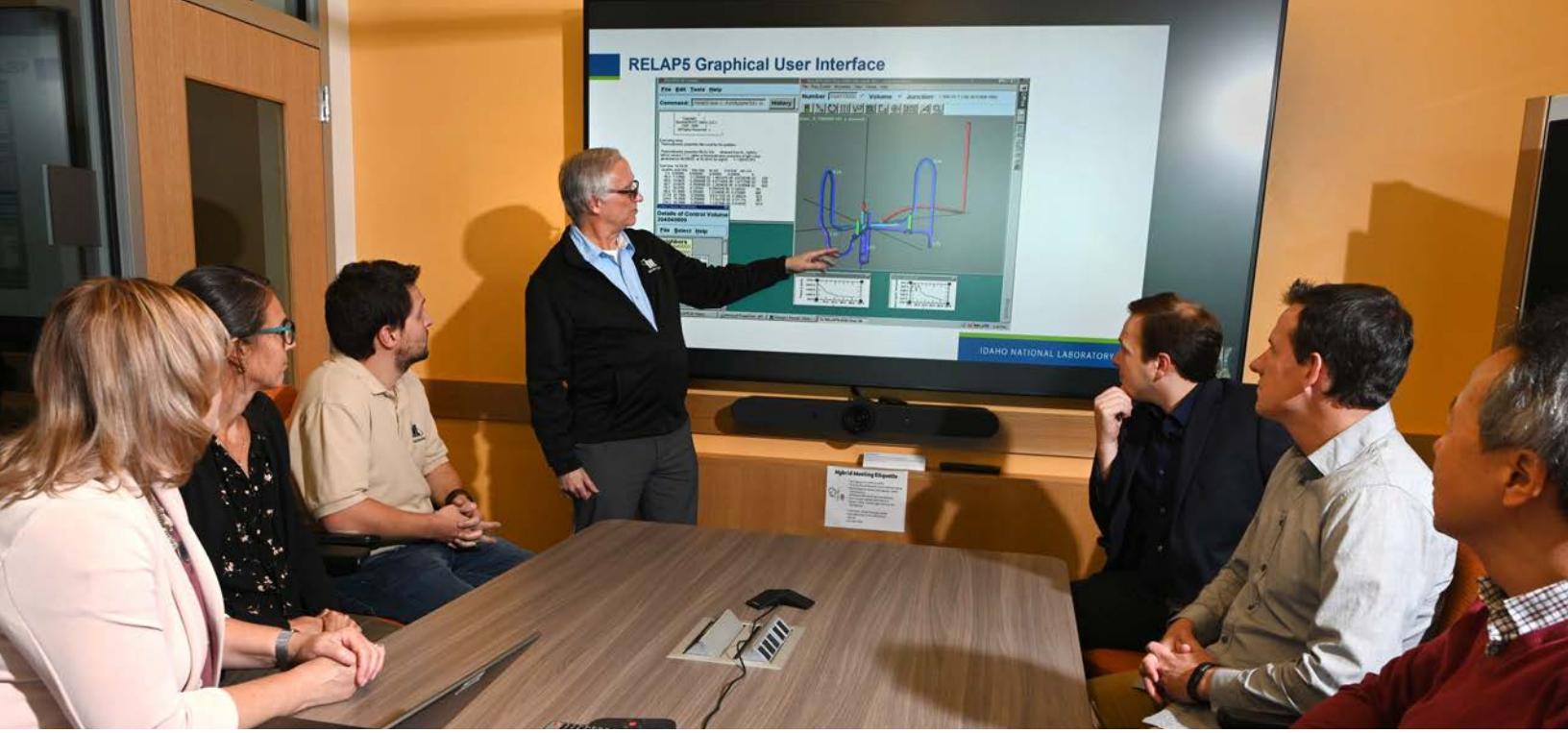
Prabhat Kumar Tripathy – 10 patents



Abderrafi M. Ougouag – 5 patents



Piyush Sabharwall – 5 patents



RELAP5-3D team.

Copyright Assertion Highlights

Copyright is a legal right that grants the creators of an original work, such as software, exclusive rights for its use and distribution. INL employees assign such rights to the company as a condition of employment. In accordance with BEA's contract with DOE, all rights are assigned to DOE unless BEA specifically requests authority to assert copyright. BEA requests permission to assert copyright on software it intends to license via open source and traditional agreements.

During FY-25, INL received permission from DOE to assert copyright protection on 15 software programs. Since 2005, INL has been authorized to assert copyright protection on 214 pieces of software.

The following are a subset of the copyright assertions for the year.

Intermediate RELAP5-3D Training Workshop Materials

The RELAP5-3D Intermediate Training Workshop covers how to use the computer program RELAP5-3D, the premier nuclear power plant safety systems code in the world. The materials are meant for users who already took the Basic Training workshop or who have already had classroom or work experience using the code. The materials consist of PowerPoint presentations and RELAP5-3D input files.

Seismic Contingency Auto Generator

This code takes in premade earthquake scenario XML files from USGS and converts them into a contingency file (.con file) that can be used by power grid solvers. Within the .con file is a number (defined by the user) of contingencies that have randomly failed power transformers based on their likelihood of failure (as determined by the voltage class and severity of the earthquake through finite element modeling).

Interplays in the Rare Earth Element Value Chain

The proposed tool enables examination of the rare earth element (REE) value chain and how different stages of the value chain affect one another. For instance, if an end-use application is looking for an REE to use, the model helps determine which input form of REE (intermediate, oxide, or metal) would be most suitable. The information provided by the tool gives forecasted market size, pricing data, and potential supply information in response to new application deployments.

Optimizing Energy for Delivery Drones – A Comprehensive Tool Set for Drone Energy Calculation and Drone Fleet Optimization

This software optimizes delivery by processing drone-related information. It calculates the energy consumption and flight time for drone operations and includes features for optimizing the drone fleet to ensure efficient deliveries.

Sentinel

The Sentinel software provides intrusion and anomaly detection for network traffic. This incremental update release provides a scrollable network map and updated detection weights.

Fully Homomorphic Encryption

The purpose of this code is to instantiate a cryptosystem suitable for real-time, linear time-invariant digital systems, including digital control systems, digital filters and digital state estimators. The code provides functions to generate public and secret keys with respect to a chosen dynamic range related to a fixed-point representation of the digital system. The code provides functions to encrypt and decrypt digital system parameters and signals. Additionally, the code enables the capability to add and multiply the encrypted values. Using these functions and capabilities, a digital system designer can create a cryptosystem to encrypt their system and signals during transmission and computation.

Modified Data Collection And Analysis Codes Of Using TCM (Thermal Conductivity Microscope) to Measure Thermal Conductivity And Diffusivity

Data collection will collect the thermal wave phase and amplitude profiles, and data analysis will compare these collected profiles with the prediction from an analytical model and extract the best-fit thermal conductivity, thermal diffusivity, interface thermal resistance and other parameters.

Smart Planning for Radioactive Source Transport: Advanced Tools for Safety and Efficiency

Efficient end-of-life (EOL) management of high-activity radioactive sources is a critical global challenge, requiring precision, safety and collaborative planning. Visualization plays a pivotal role in addressing the complexities of source recovery operations, including navigating spatial constraints, mitigating risks and ensuring regulatory compliance. This software provides a novel visualization-driven framework tailored to radioactive source recovery. It integrates advanced features that enable precise spatial analysis and intelligent planning with novel virtual tools. This software introduces advanced visualization capabilities to enhance spatial planning and operational workflows, offering intelligent solutions for site-specific challenges. By integrating real-time tools and adaptive functionalities, it enables precise decision-making, improves collaboration and enhances safety across complex environments. With its focus on efficiency and adaptability, this software sets a new standard for managing intricate planning and execution processes in dynamic scenarios.

Open-Source Software Release Highlights

INL has expanded efforts to release open-source software. This software is freely available to the public and open to collaboration directly with researchers and engineers outside of the laboratory. INL seeks to foster its widespread adoption by industry and research organizations. INL's Technology Deployment group is defining and refining an overarching strategy to capitalize on the strengths of both open-source software and commercial releases. INL's open-source software can be acquired cost-free at the following web pages:

https://github.com/idaholab
https://github.com/idaholabresearch
https://github.com/idaholabUnsupported
https://inlsoftware.inl.gov

CIEBAT

Cyber-Informed Engineering Battery Analysis Tool (CIEBAT) is a tool that can inform engineering and traditional cybersecurity mitigations to make Battery Energy Storage Systems (BESS) more resilient to cyberattack from concept to operations.

ALFRED

The All Particle in Fission Reactor - Energy Deposition (ALFRED) code helps analysts determine the energy deposited in specimens during experiments at the Transient Reactor Test (TREAT) facility. The novelty introduced in this software is the capability to track all particles involved during a fission event (fission products, neutrons, gammas) and evaluate their energy deposition in the core and specimen in a time-dependent fashion.

Datum

Datum is an application designed to help catalog and make scientific data that is stored in network storage, searchable and actionable by data scientists. It is a web-based application that enables users to ingest data, process metadata and then make that data searchable and actionable across scientific data types and domains.

Node RED

The Node-RED code was designed for running, monitoring and controlling hydrogen production systems at INL facilities. The software is flexible and can be easily modified for different setups, not just hydrogen facilities. The web interface enables easy remote access and management, which is helpful for distributed systems. Unlike traditional programmable logic controllers (PLCs) that need direct connections or special software, this code makes remote troubleshooting easier. The open-source community regularly updates the software, adds new features and provides support, improving the system without high upgrade costs.

New Structural Analysis Modeling Tool

This new software program facilitates interoperability between Building Information Modeling (BIM) software and structural analysis software. This program converts 3D building models from architectural design tools, such as Revit, ArchiCAD and AVEVA E3D, to structural analysis formats compatible with tools like SAP2000. By using the IFC file format, the software transforms architectural entities into structural analysis entities, adjusts their connectivity and exports them back as IFC files. Structural engineers will benefit from reduced preprocessing time, eliminating the need to recreate models from scratch in structural analysis software. This open-source solution stands out due to its use of open-file formats and vendor-neutral approach, contrasting the existing proprietary and often costly alternatives.

SALAMANDER

The Software for Advanced Large-scale Analysis of MAgnetic confinement for Numerical Design, Engineering and Research (SALAMANDER) is an open-source, multiphysics, multiscale framework designed for high-fidelity modeling of magnetic confinement fusion systems. SALAMANDER facilitates 3D simulations to understand component degradation and operational impacts in extreme environments, supporting design, safety, engineering and research projects. This tool is expected to greatly benefit fusion energy and technology research groups at INL, other national laboratories, universities and commercial enterprises globally, enabling them to perform sophisticated simulations that are crucial for advancing fusion energy technology.

HELP

The HELP software is designed to estimate the density of bioburden (microbial contamination) and the total number of colony-forming units using Hierarchical Bayesian methods. This process helps predict the likelihood of contamination based on prior data. It is part of the U.S. National Aeronautics and Space Administration's (NASA) Planetary Protection Bioburden Assessment Tool and is used in risk assessments for the Europa Clipper mission.

MOUSE

MOUSE (Microreactor Optimization Using Simulation and Economics) is a tool that helps design small nuclear reactors and estimates the costs to build and run them. It uses computer models to simulate how the reactor works.

MoltenSaltPropnet

MoltenSaltPropnet is a physics-informed machine learning framework that rapidly predicts key thermophysical properties of molten salt mixtures, enabling researchers to evaluate reactor-relevant salt systems with accuracy and efficiency. By transforming critically evaluated data into user-friendly, real-time models, the framework supports safer, more efficient design and operations of next-generation molten salt reactors.

GNN Model Software

GNN Model Software uses machine learning to detect anomalies in network traffic that may indicate malicious or unusual activity. The Graph Neural Network applies a graph-based view of network logs and uses that to identifies anomalous traffic within its local graph context. This work supports applications in cybersecurity and network monitoring.

Scout

Scout is an analyst support tool that automates cyber threat-report generation by applying natural language processing for entity extraction. It integrates classifications from the Attack Chain Estimator (ACE) and leverages large language models to produce comprehensive reports. It streamlines the collections, analysis and reporting of cyberattack information, improving efficiency and consistency in threat analysis workflows.

P-Gems

P-Gems is a model that looks at how the supply, demand and price of Platinum Group Metals (PGMs) could change as demand for gasoline cars declines and hydrogen technologies grows. It shows that the PGM market may drop in the late 2020s but is likely to recover in the 2030s as demand from hydrogen fuel cells increases.

Licensing Activities and Highlights

In FY 2025, Technology Deployment modified or entered into 130 new licensing agreements. At the end of the fiscal year, INL had more than 500 active licenses on technologies with patents, copyright assertions or open-source rights held by its researchers. Licensees include domestic and foreign businesses, universities, laboratories, governments and other industry partners.

Pack Energy Licenses INL's Microgrid Systems

Pack Energy—a Laramie, Wyoming, based energy intelligence platform and developer of microgrid solutions—has executed a non-exclusive license to manufacture and deploy the Relocatable Resiliency Alternative Power Improvement Distribution (RAPID) Microgrid In-A-Box (MIB) system developed at INL. RAPID-MIB is a portable, self-contained grid system that enables the integration of multiple energy sources. It is designed to provide resilient and reliable power to remote locations or during power outages. Pack Energy has executed a separate umbrella Strategic Partnership Project (SPP) agreement to secure INL's technical support as the MIB is customized for specific applications. One of the intended applications for RAPID-MIB is to replace carbon-intensive diesel generators operating in remote, off-grid locations such as military installations, remote communities and oil-field operations.

Pure Atom LLC, Licenses INL's Sample Containers

Pure Atom LLC was founded in early 2024 as a spin-out of INL technology. They are a small company supplying sample prep/storage containers to industry, university and government research organizations.

La Brea Technologies, Inc. Licenses INL's OmniTap

Operational technology company Psymetis attempted to commercialize INL's OmniTAP technology but abandoned those efforts due to internal funding issues. Seeing the commercial potential of the technology, Psymetis' Chief Technology Officer went on to found startup company, La Brea Technologies, Inc., to commercialize the technology instead. INL's OmniTAP technology is currently protected by a U.S. patent application and licensed to La Brea Technologies. The company plans to further develop OmniTap in collaboration with INL and leverage the DOE TCF funding awarded for the commercialization effort.

Idaho Office of Emergency Management – Idaho Military Division Licenses INL's AHA

The Idaho Office of Emergency Management – Idaho Military Division has non-exclusively licensed the INL copyright protected software, All Hazards Analysis (AHA), for state emergency management applications.

Cumulys Energy Services, Inc. Licenses INL's Cirrus

Cumulys Energy Services is a boutique cloud storage company offering a full suite of business solutions for the energy services sector. They are licensing INL's Cirrus software, a cutting-edge cloud feasibility assessment tool that will guide their clients as they are navigating the complexities of cloud integration, enhancing operational resilience and efficiency in the electric grid sector.

Ridgetop Group, Inc. Licenses INL's AEM

Tucson, Arizona–based Ridgetop Group, Inc. has executed an exclusive license with BEA to commercialize the R&D Award–winning Advanced Electrolyte Model (AEM). As part of the agreement, Ridgetop has accelerated AEM's commercialization by introducing new product features and implementing a secure software licensing management platform that automatically authenticates end users and enforces license terms. The integrated platform also supports a limited-capability trial version of AEM, enabling prospective customers to evaluate the software prior to licensing.

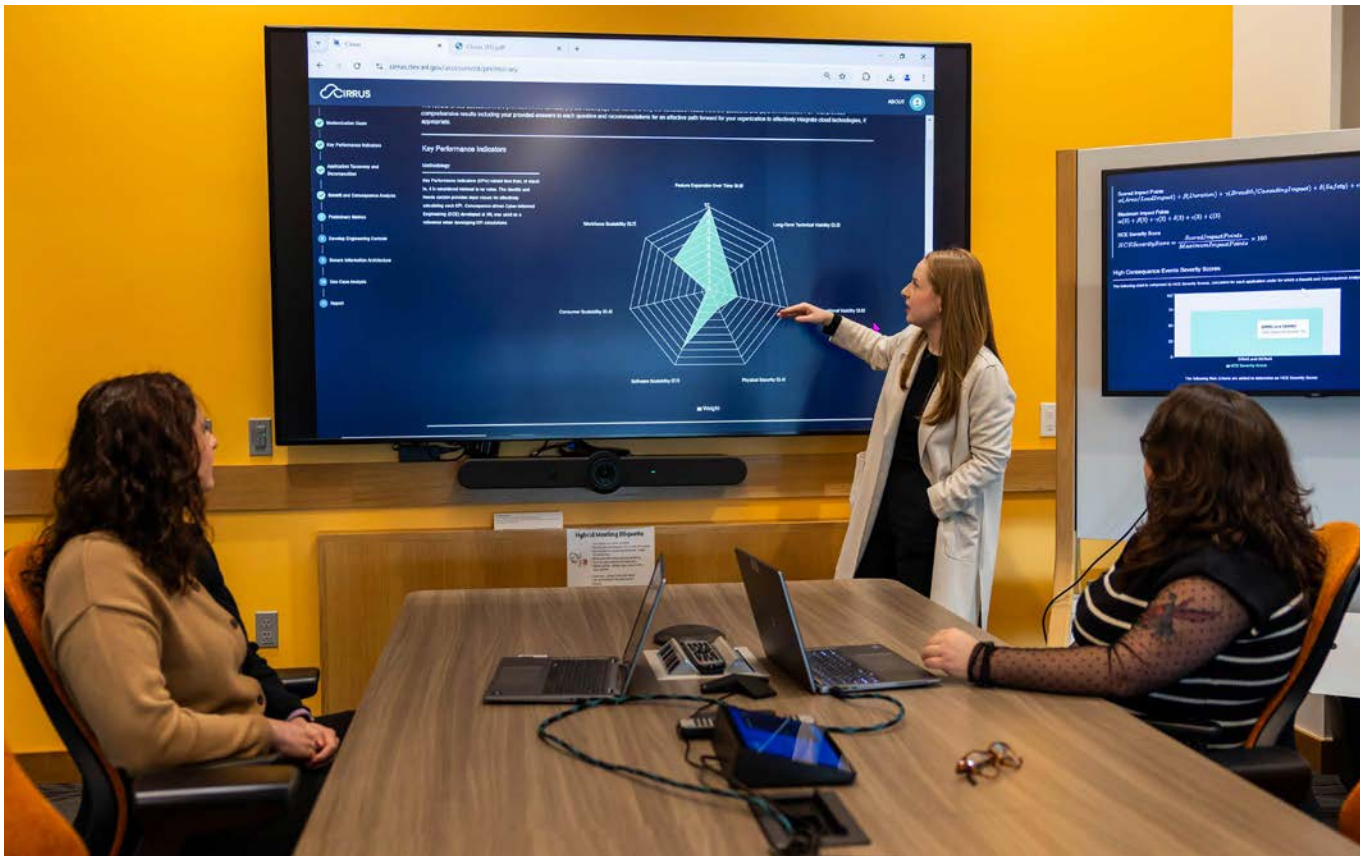
This longstanding partnership was recently recognized with the 2024 Licensing Executives Society Deal of Distinction Award, and has streamlined access to AEM for both new and returning users by leveraging Ridgetop's customer support infrastructure and global network of technical sales representatives. Through this collaboration, Ridgetop and INL are expanding the reach of AEM and accelerating the adoption of advanced modeling and diagnostic tools across the battery energy storage research community.

PNNL Licenses INL's Lessons Learned AI Search Tool

Under a government use agreement, Pacific Northwest National Laboratory (PNNL) has licensed INL's lessons learned AI search tool. This tool uses AI technology to search and retrieve pertinent data from DOE's lessons learned database. The tool allows almost instantaneous retrieval of information that would take humans 10s or 100s of hours to complete. It is hoped that all national laboratories will implement the solution to improve their safety culture.

Alpitronic Americas Licenses INL's Cerberus EV Charging Security Technology

Alpitronic Americas executed an exploratory license to perform testing and evaluation of INL's Cerberus technology. Cerberus is a hardware and software solution that can detect and prevent cyberattacks on EV charging equipment. Alpitronic designs and sells EV charging equipment and has partnerships with EV OEMs.



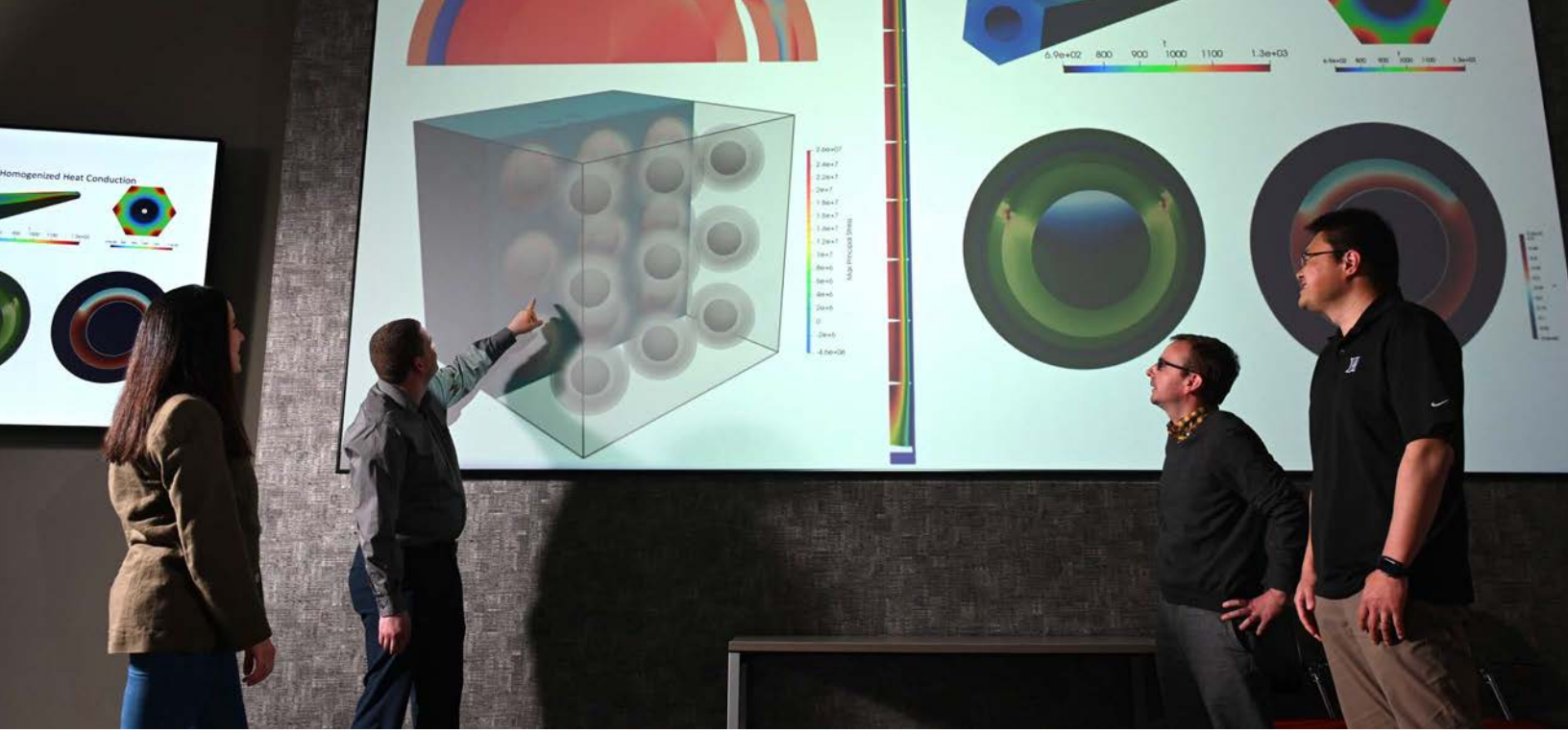
CIRRUS Software Demo.

Rook Armor Licenses INL's Refractory Metal Borides by Electric Field Assisted Sintering

Texas-based Rook Armor executed a non-exclusive option agreement with BEA to reserve rights in a tungsten tetraboride (WB4) material synthesis technology based on INL Electric Field Assisted Sintering capabilities. Rook is interested in collaborating with INL researchers to work on proposals to advance the technology for commercial use. If successful, this could lead to a new method to commercially produce the WB4 material at scale for a range of applications, including armor, wear plates, cutting tools and others.

STP Nuclear Operating Company Licenses INLs NuH2

STP Nuclear Operating Company has executed a non-exclusive software license agreement to license the Nuclear Power Uprate Hydrogen Production Tool. This tool is implemented in Microsoft Office's Excel. It can be used by utilities to understand the business implications of investments in power uprates (including corresponding tax benefits) and to assess the potential added profits associated with hydrogen production. The company operates nuclear power facilities in South Texas and actively seeks to identify, evaluate and adopt technologies and tools that will help further its efforts to produce carbon-free electricity for two million Texas homes.



BISON visualization team.

Nuclear Modeling and Simulation Codes

INL's modeling and simulation codes are globally recognized for their leading role in nuclear reactor design, safety and operations. The following is a summary of new code licenses in FY-25 and how they are used, along with a list of entities to which they are licensed.

BISON

BISON is a nuclear fuel performance code that can model light water reactor fuel rods, TRISO particle fuel, metallic rod and plate fuel and other fuel forms. It solves thermos-mechanics and diffusion equations for various geometries, describing temperature properties, fission product swelling and other material aspects. Licensees:

- **Imperial College London:** Fuel modeling and large strain clad ballooning studies.
- **Veracity Nuclear LLC:** Nuclear reactor simulation and engineering analysis.
- **Ghana Atomic Energy Commission:** Fuel performance analysis for advanced reactors.
- **University of Ontario:** Performance and safety analysis of pebble bed reactor technologies.
- **University of Michigan:** Coupled neutronics and heat transfer calculations.
- **University of Saskatchewan:** Modeling fuel rods and TRISO particle fuel.
- **Seaborg Technologies:** Molten salt reactor development.
- **Lightbridge Corporation:** Development of next-generation nuclear fuel technology.
- **UK National Nuclear Laboratory, LTD:** Development of coated particle fuel performance code.
- **University of Illinois:** Modeling light water reactor accident tolerant fuel and high-temperature gas-cooled reactor TRISO fuel.
- **Bangor University:** Investigate theoretical properties of accident-tolerant fuels.
- **NuCube Energy:** Understand the evolution of fuel operating conditions of TRISO fueled microreactors.
- **Aalo Atomics:** Develop mass-manufactured nuclear power plants.
- **MPR Associates:** Internal comparison with existing fuel analysis.
- **Standard Nuclear:** Development, analysis and commercial use of proprietary TRISO nuclear fuel forms.
- **Egyptian Atomic Energy Authority (EAEA):** National R&D efforts in Egypt.
- **Jozef Stefan Institute:** Research and education centered around modeling the thermal and structural performance of fuel types.
- **Institute of Nuclear Safety System, Inc.:** Multiphysics simulation.
- **Abilene Christian University:** Coupled neutronics calculations.

Griffin

Griffin is a reactor multiphysics application suitable for steady-state and time-dependent coupled neutronics calculations leveraging multiple MOOSE-based thermal-fluids applications (Pronghorn, RELAP-7, Sockeye, etc.) and a fuel performance application (BISON). Licensees:

- **Jimmy Energy:** Sensibility analysis on HTR reactors.
- **North Carolina State University:** Reactor multiphysics application.
- **Texas A&M University:** Analysis of various reactor types.
- **Abilene Christian University:** Coupled neutronics calculations.
- **Institute of Nuclear Safety System, Inc.:** Multiphysics simulation.
- **Pacific Northwest National Laboratory:** Develop and use as part of DOE and National Nuclear Security Agency.
- **University of Illinois:** Heat pipe behavior analysis in microreactors.
- **University of Ontario:** Performance and safety analysis of pebble bed reactor technologies.
- **University of Chicago Argonne LLC:** Multiphysics simulation capabilities.
- **Jozef Stefan Institute:** Research and education centered around modeling the thermal and structural performance of fuel types.

RELAP5-3D

RELAP5-3D is a software code that aids in the analysis of transients and accidents in water-cooled nuclear power plants and related systems. It offers fully integrated and multi-dimensional thermal-hydraulic and kinetic modeling capabilities. Licensees:

- **Information Systems Laboratories, Inc.:** Support for Naval Nuclear Laboratory and INL to support the development of NUPAC, which involves the merging of new features and bug fixes from RELAP5-3D to NUPAC, and vice versa.
- **U.S. Geological Survey:** Thermal-hydraulic analysis of reactor core.
- **Brookhaven Science Associates LLC:** Cybersecurity assessment.
- **Ansaldo Nucleare SpA:** Development of lead-cooled fast reactor.
- **FPoliSolutions LLC:** A feasibility study to support a commercialization path for RAVEN.
- **Last Energy, Inc.:** Analysis of small modular reactor design.
- **University of Florida:** Multiphysics modeling.
- **Los Alamos National Laboratory:** Multi-physics modeling of molten salt reactors.

RELAP5-3D is widely used for reactor safety analysis, design, operator training, and non-nuclear modeling and simulation.

- **University of Maryland:** Analysis of transients and accidents in nuclear power plants.
- **Belgium Nuclear Research Center:** Thermal-hydraulic and safety analysis for licensing of the MYRRHA plant.
- **Aristotle University of Thessaloniki:** Contribute to international research on nuclear safety systems.
- **Curtiss-Wright Flow Control Service Corp., Scientech:** Development of a simulation code for a sodium-cooled fast reactor.
- **Aalo Atomics:** Run safety analysis on sodium-cooled microreactors.
- **Virginia Commonwealth University:** Expand engineering education abilities such as using it for capstone senior design projects.
- **National Institute of Standards and Technology:** Provide valuable benchmarks with existing National Bureau Standards reactor models.
- **University of New Mexico:** Analyze the safety analysis of light water and advanced reactors.
- **Studsvik Scandpower, Inc.:** Improving reactor performance.
- **University of Natural Resources and Life Sciences, Vienna:** Education and research center for renewable resources.
- **Rolls Royce SMR Ltd., England:** Support the SMR licensing/regulatory process.
- **Newcleo Spa:** Design, build and operate Gen-IV Advanced Modular Reactors.
- **NIER Ingegneria S.p.A. Societa Benefit:** Achieve integral sustainability within the fields of systems engineering.
- **Tokyo Institute of Technology:** Multi-dimensional thermal-hydraulic and kinetic modeling capabilities.
- **National Atomic Research Institute:** Nuclear safety, radiation applications and new energy.

RELAP5-RT

RELAP5-RT is a real-time version of the RELAP5 code developed for use in nuclear plant training simulators and control system testing. It prioritizes computational speed and stability to accurately represent reactor system behavior within the time constraints of real-world operations. Licensee:

- **Curtiss-Wright Flow Control Service Corp.:** Nuclear power plant simulators.

Relap7

RELAP7 is a next-generation nuclear systems safety analysis code designed to model the behavior of reactor coolant systems during steady-state and transient conditions. It builds on modern numerical methods and the MOOSE framework to provide improved accuracy, flexibility and computational efficiency compared to legacy codes. Licensees:

- **Los Alamos National Laboratory:** Space reactor designs
- **Abilene Christian University:** Coupled neutronics calculations.

Grizzly

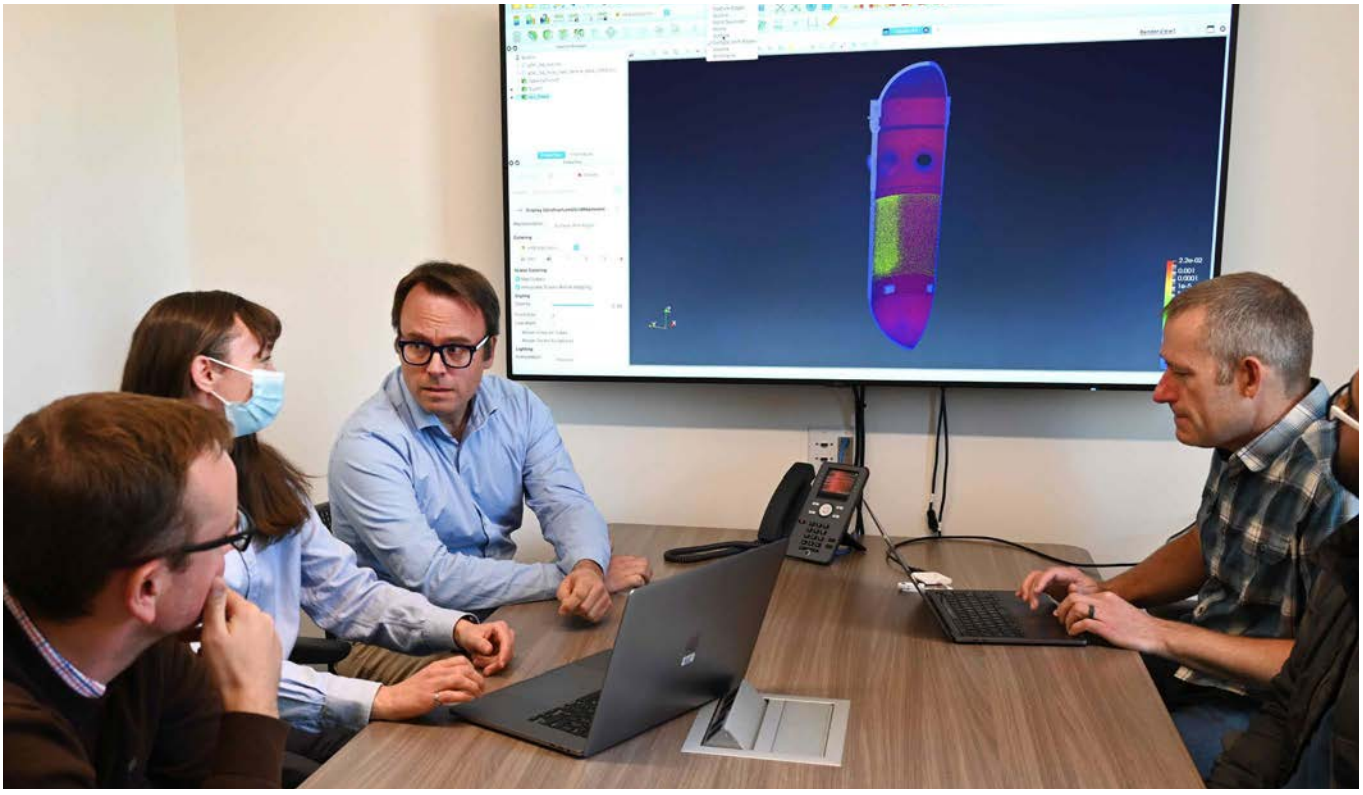
Grizzly code simulates aging and degradation in nuclear power plant components. It is primarily used to assess material performance, structural integrity and long-term safety under operating and environmental stressors. Licensees:

- **Australia's Nuclear Science and Technology Organization:** Analysis of advanced reactor systems.
- **University of Chicago Argonne, LLC:** Microreactor performance simulations.

Sockeye

Sockeye is a heat pipe simulator and analysis tool that can accurately predict heat transfer in heat-pipe-cooled microreactors and other heat pipe applications. Licensees:

- **NuCube Energy:** Heat pipe simulator for microreactors.
- **North Carolina State University:** Simulation tools for nuclear reactor analysis.
- **University of Illinois:** Heats pipe behavior analysis in microreactors.
- **University of California, Berkeley:** Heats transfer prediction for microreactors.
- **Canadian Nuclear Laboratories:** Analyze heat-pipe cooled nuclear microreactors.



Grizzly modeling and simulation.

Pronghorn

Pronghorn is a thermal hydraulics code used for the optimization of nuclear reactor fuel pin cell shapes and advancements in Gen IV reactor design. Licensees:

- **North Carolina State University:** Optimization of nuclear reactor fuel pin cell shapes.
- **Seaborg Technologies:** Advancements in Gen IV reactor design.
- **University of Ontario:** Performance and safety analysis of pebble bed reactor technologies.
- **Pacific Northwest National Laboratory:** Develops and uses as part of DOE and National Nuclear Security Agency.
- **SoftInWay Inc.:** Explores compatibility with SoftInWay's AxSTREAM software application.

DireWolf

DireWolf is a code suite developed to analyze heat-pipe cooled nuclear microreactors, comprising several software applications for studying nuclear microreactors physics, reactor physics, radiation transport, nuclear fuel performance, heat pipe thermal hydraulics, power generation and structural mechanics. Licensees:

- **North Carolina State University:** Simulation tools for nuclear reactor analysis.
- **Canadian Nuclear Laboratories:** Analyze heat-pipe-cooled nuclear microreactors.
- **University of Chicago Argonne LLC:** Microreactor performance simulations.

BlueCRAB

BlueCRAB is a generic reactor simulator. It can be used to analyze proposed advanced reactor designs (such as molten salt reactors, fluoride salt-cooled high-temperature reactors and microreactors). BlueCRAB can also be used to model lightwater reactors. It links to current U.S. Nuclear Regulatory Commission tools. Licensee:

- **University of Ontario:** Performance and safety analysis of pebble bed reactor technologies.

MARMOT

MARMOT is a mesoscale fuel performance code. It can predict the evolution of the microstructure and material properties of fuels and claddings due to stress, temperature and irradiation damage. MARMOT can supply microstructure-based materials models to other codes that work on a larger scale, e.g., Bison. MARMOT solves equations involving solid mechanics and heat conduction using the finite element method. Licensee:

- **University of Ontario:** Performance and safety analysis of pebble bed reactor technologies.
- **University of Saskatchewan:** Modeling fuel rods and TRISO particle fuel.

SABERTOOTH

SABERTOOTH is a high-fidelity, full reactor simulator application focused on light water reactors, boiling water reactors and other reactors containing multiphase coolants (e.g., water). It couples in the MOOSE-based two-phase modeling application, RELAP-7, along with fuels performance, neutronics and thermo-mechanics. It has been applied to light water reactor problems, as well as to NASA's nuclear thermal propulsion reactor.

- **Abilene Christian University:** Coupled neutronics calculations.

MARMOT software team.

Royalty, Technology Commercialization Fund and Innovation Development Fund Highlights

Royalties

From fiscal year 2005 to the present, INL has issued more than 2,200 new licenses to commercialize technologies developed at the laboratory. License agreements generate royalties, and the lab has earned more than $25 million in royalties since the inception of BEA's contract in FY-05. During FY-25, the lab earned more than $1 million in royalties.

Royalties are one indicator that laboratory innovations are meeting market needs. The lab encourages innovation and reinvesting a significant portion of royalty revenues to promote the development of promising early-stage technologies.

Federal regulations govern royalty spending, which must support technology transfer activities. Roughly 30% of INL royalty funds go to inventors of licenses technologies. Additional spending goes to employees who have supported technology transfer activities throughout the laboratory, independent of a specific technology having commercial application. The remaining royalties are reinvested into two funds: the Science and Technology Strategic Investments Fund and the Innovation Development Fund.

The Science and Technology Strategic Investments Fund supports research and development capabilities that lead to new technology development and increase INL's ability to generate new business. A key to the success of these investments is the lab's ability to attract industry partners that are essential to advancing future INL technologies.

The Innovation Development Fund supports the advancement of technologies and intellectual property developed at INL. Specifically, funding is used to help with the maturation of technologies and provide support to researchers by funding education, training, licensing and patent costs, etc., that could increase the licensing of INL technologies.

Technology Commercialization Funds

INL technologies and projects won more than $1.4 million from the DOE Technology Commercialization Fund (TCF) program. TCF is a highly competitive program that supports the commercialization of DOE national laboratory plant and site technologies and buildout of the national laboratory commercialization ecosystem. The funding, which includes an additional cost share of $800,000, will help further the INL's groundbreaking work in grid resilience, nuclear power plant reliability, and modeling and simulation.

The following INL projects received TCF funding:

- **The Self-Healing Power Systems Toolbox (SHePS)** (principal investigators: Becca Avery, Michael Ropp [Sandia National Laboratory]), which could help microgrids maintain power availability in case of an outage or attack.
- **The Visualization for Predictive Maintenance Reminder (VIPER) tool** (principal investigator: Vivek Agarwal), which presents nuclear power plant engineers and analysts with system health diagnostics, metrics and actionable recommendations.
- **A self-guided training platform for the MOOSE multiphysics modeling and simulation platform and its associated codes** (principal investigator: Kyle Gamble).

Kyle Gamble leading training.

Technology-based Economic Development

INL is a vital and fervent partner in Idaho's economic development at all levels. Not only does the lab employ more than 6,000 people, but BEA also aided in job creation and workforce development over the past year.

Technical Assistance Program

The Technical Assistance Program (TAP) provides organizations with access to the laboratory's world-class expertise, state-of-the-art facilities and advanced research capabilities.

TAP offers a range of resources to support technical needs and foster innovation for entrepreneurs, small businesses, local governments and municipalities.

In this program, INL scientists and engineers provide assistance that is not normally available to a community or small business with the aim of promoting national competitiveness. TAP provides this assistance without fees and helps in areas where organizations may find their problems too complex or technical to solve on their own.

The lab partnered with multiple businesses and government entities through this program. In FY-25, INL provided 562 hours of work, representing a 69% increase from the previous year, INL also assisted multiple small businesses and government entities in multiple different projects. Here are a few highlights from FY-25 projects:

GeoBitmine, an eastern Idaho startup company, is leveraging waste heat from server farms to support hydroponic greenhouse farming, land use optimization and opoprtunities for new revenue streams. With assistance from TAP, GeoBitmine received expert guidance on balancing water and energy use to maximize their impact on the regional energy landscape. INL's senior researcher, Kara Cafferty, provided valuable insights that helped GeoBitmine enhance their business plan, leading to job creation in IT and agriculture while supporting local food production.

The collaboration between **Vaulted Deep** and INL under the TAP has led to significant advancements in organic waste disposal technology. Vaulted Deep, a Houston-based startup company, aims to use fibrous byproducts from nut agriculture to create a slurry for safe subsurface disposal of organic waste. INL's Technology Deployment team, particularly biomass researcher Luke Williams, assisted Vaulted Deep in optimizing milling techniques to achieve the desired particle size for their proprietary process. This partnership has provided Vaulted Deep with valuable data and recommendations, accelerating their efforts to commercialize this innovative waste management solution.

Agreement Management

The Agreement Management organization is responsible for several functions, including the following:

- Preparing, negotiating and executing all funds coming to INL through collaboration agreements with industry, academia and other government agencies to advance INL's mission objectives.
- Leading the process to determine appropriate agreement mechanisms.
- Managing expectations of technical leads, principal investigators, managerial staff members and sponsors related to implementing sound contracting practices.

Agreement Management Summary

Agreement	Agreement Customer Name	Agreement Title
SPP	Jet Propulsion Laboratory	Extreme Environment Advanced Material Studies for Deep Space Survivability
SPP	Antares Nuclear, Inc.	Defense and Space Power Antares
SPP	Nano Nuclear Energy Inc.	Radiation stability of molten nitrate salt mixtures
SPP	The Board of Regents of the University of Wisconsin System	University of Wisconsin - Development of an in-situ thermal conductivity measurement system in ion-beam accelerator at University of Wisconsin Madison
SPP	University of Utah	INL Support to Utah FORGE project
SPP	Chevron Technical Center, a Division of Chevron U.S.A, Inc. a Pennsylvania Corporation	Solvent Fractionation of Wet Algal Biomass
SPP	Antares Nuclear, Inc.	Antares Microreactor Testing Project – Front End Engineering & Experiment Design
SPP	Radiation Monitoring Devices, Inc.	RMD - Dual-mode Non-hygroscopic Ceramic Scintillators for Material Accounting
SPP	Qualtech Systems, Inc.	Digital Twin driven Actionable Decision Support for Plant Monitoring and Maintenance
SPP	Chevron Technical Center, a Division of Chevron U.S.A, Inc. a Pennsylvania Corporation	Chevron - Phase 2-Eastern Snake River Plain Basalt Carbon Mineralization Feasibility and Pilot Demonstration
SPP	Quanterion Solutions Incorporated	SBIR SPP for Project DoD SBIR 22.2, SBIR/STTR FY 2022 Phase II
SPP	Shell International Exploration and Production, Inc.	Tasks 1 and 2 for 24SPU14
SPP	Theia Scientific, LLC	A Scalable Platform for Real-Time Microscopy Image Analysis Using Artificial Intelligence and Machine Learning
SPP	J. R. Simplot Company	Simplot SPP
SPP	NuclearATC	Cost-Effective Light Water Reactor In-Pile Testing
SPP	Chevron Technical Center, a Division of Chevron U.S.A, Inc. a Pennsylvania Corporation	Chevron - INTENSIFIED CO2 CO-ELECTROLYSIS (ICC). Phase 3
SPP	Antares Nuclear, Inc.	Antares Engineering Support of Safety Documentation and Instrumentation and Controls
SPP	University of Wisconsin-Madison	U of Wisconsin (VIFF) - Converting Inconsistent and Heterogenous Biomass and Municipal Solid Wastes into Demineralized and Uniform Feedstocks for Thermal-Catalytic Processing to Low Carbon Fuels, Chemicals, and Materials
SPP	Enexor Energy, LLC	Enexor - Modular Biomass Preprocessing System Development
SPP	State of Florida	State of Florida Operational Technology Resilience against Threats (FORT) – Locks and Levees
SPP	University of Utah	U of U - Measure thermal diffusivity of aluminum nitride-epoxy composites
SPP	University of Alaska Fairbanks	Measurement of Environmental Samples for University of Alaska

Agreement	Agreement Customer Name	Agreement Title
SPP	X-Wave Innovations, Inc.	(XII) A Non-Contact, Wireless Sensor System for Remote and Long-Term Monitoring of Internal Conditions of Spent Nuclear Fuel Dry-Storage Canisters
CRADA	Curtiss-Wright Flow Control Service Corp., Scientech	Autonomous Control for Reactor Technologies
CRADA	POET, LLC	POET - Novel Omniphobic Membrane Distillation Process Development for Low-Carbon Ethanol Extraction Using Waste Heat
CRADA	Radiant Industries Incorporated	Radiant DOME phase 2 PTS
CRADA	Westinghouse Electric Company LLC	WEC DOME Test Bed Detailed Engineering and Experiment Design
CRADA	Aalo Holdings, Inc.	(Aalo) INDEPENDENT CODE-TO-CODE VERIFICATION OF AALO-1 FUEL AND CORE PERFORMANCE
CRADA	FirstIgnite LTD	FirstIgnite - AI Technology Licensing Accelerator Solution (ATLAS)
CRADA	Oklo, Inc.	Oklo CRADA PTS3
CRADA	Westinghouse Electric Company LLC	Elevating the State of Validation and Uncertainty Quantification in the Bison Fuel Performance Code for Commercialization and Licensing
CRADA	DTC Communications, Inc	INL Eagle Video Surveillance Radio Commercialization with DTC
CRADA	X-Energy, LLC	X-energy Advanced Reactor Demonstration Project Xe-100 Post-Irradiation Examination Preparation Tasks
CRADA	Westinghouse Electric Company LLC	(WEC) eVinci NTR Design for DOME PTS
CRADA	CENTROID PIC Corp dba Centroid Lab	Initial FRI3D Commercial Usage Assistance
CRADA	Westinghouse Electric Company LLC	Westinghouse PIE CRADA
CRADA	Aalo Atomics, Inc.	Aalo CRADA 24CRU20 PTS-1
CRADA	Antares Nuclear, Inc.	Antares Reactor Siting Support
CRADA	Nano Nuclear Energy Inc.	NANO Nuclear Energy Inc. Umbrella CRADA
CRADA	Radiant Industries Incorporated	Radiant ATR Fuel Test
CRADA	Antares Nuclear, Inc.	ANTARES R1 DEMONSTRATION PROJECT
CRADA	Bloom Energy Corporation	Inspection and Shipping of Bloom Energy Modular 1.8 MWe High Temperature Electrolysis System
CRADA	General Atomics	Metal “Film” Pump for Direct Internal Recycling of Fusion Fuel
CRADA	Oklo, Inc.	Oklo CRADA PTS4
CRADA	Deep Fission, Inc.	GAIN Voucher for Independent Verification and Benchmark of Deep Fission’s Deep Borehole Microreactor Thermal Hydraulic System Behavior
CRADA	NuCube Energy, Inc.	NuCube - Heat Exchanger Evaluation for NuCube
CRADA	La Brea Technologies, Inc.	OmniTap Commercialization with La Brea Technologies, Inc.2
CRADA	Korea Atomic Energy Research Institute (KAERI)	Building Cybersecurity Capabilities - PTS 1
CRADA	Bloom Energy Corporation	Bloom Electrolyzer Umbrella CRADA
CRADA	Kyoto Fusioneering America Ltd.	INFUSE Public-Private Research Partnership Program FY 2024 Request for Assistance (RFA)
CRADA	Michigan Technological University	(MTU) From Sorted MSW to Clean Syngas via Solvent Targeted Recovery and Precipitation (STRAP)
CRADA	Radiant Industries Incorporated	Developing fuel specification and fuel manufacturability for Radiant using Natural Uranium
CRADA	MobileNuclear Energy LLC	MobileNuclear Umbrella CRADA
CRADA	Deep Isolation US LLC Oklo, Inc. UChicago Argonne, LLC - ANL	Enabling the near-term commercialization of an electrorefining facility to close the metal fuel cycle
CRADA	GridWrap Inc.	Testing GridWrap’s Composite WiRe Wrap to Mechanically Strengthen the Conductors and Increase the Power Capacity of the Grid
CRADA	Abraham Solar	Abraham Solar - Industrialization and Advancement of the INL RAPID-Microgrid-in-a-Box, Relocatable/Resiliency Alternative Power Improvement for Distribution – Microgrid

Agreement	Agreement Customer Name	Agreement Title
CRADA	Aalo Atomics, Inc.	Aalo Umbrella CRADA
CRADA	GE Research	GE – Scaled Solid Oxide Co-Electrolysis for low-cost syngas synthesis from nuclear energy-INL
CRADA	AMP Robotics Corporation	AMP Robotics - Cellulose 2.0™: Repurposing Non-recyclable Municipal Solid Waste, through Diversion and Up-cycling Methods
CRADA	National Renewable Energy Laboratory The Regents of the University of California - Lawrence Berkeley National Laboratory VERDE	FCIC CRADA VERDE Nanomaterials
CRADA	RhinoCorps	TCF - Optimization of Physical Security Protection through Combined Simulation
CRADA	Casale SA	C02 Hydrogenation via Agile Methanol Production (CHAMP) Supporting DE-FOA-0002997
CRADA	Korea Atomic Energy Research Institute (KAERI)	Building Cybersecurity Capabilities With KAERI
CRADA	Continuous Composites, Inc.	CCI - Baselining Densification of Carbon-Carbon Composites using EFAS (24CRU17 - PTS01)
SPP	Standard Nuclear, Inc.	Support for CAT II Authorization for Office of Nuclear Energy Fuel Line
SPP	Ridgeline Elements, LLC	Ridgeline Elements Co leaching from Cu-Co concentrated oxide ores
SPP	DTE Materials	DTE - Hemicellulose Removal from Wood Chips to Produce a Biobased Concrete Additive
SPP	Wave Motion Launch Corporation	Wave Motion JET GUN FIRING TEST
SPP	Antares Nuclear, Inc.	Antares Reactor Support
SPP	Atomic Canyon, Inc.	Atomic Canyon- Benchmark Suite for Evaluating Retrieval-Augmented Generation (RAG) and Large Language Models (LLMs)
SPP	X-Wave Innovations, Inc.	X-Wave Ultrasonic Multipoint Waveguide Temperature Sensor for Divertor Diagnostics in Fusion Power Plants
SPP	Exostellar, Inc.	Exostellar- Exostellar Application to Project Alexandria
SPP	Quadrant Nuclear Industries	Quadrant Nuclear Industries
SPP	SRC Manufacturing Consortium Corporation	SMART USA Institute - SMART Backbone PTS
SPP	SRC Manufacturing Consortium Corporation	SMART USA Institute - Project Task Statement
SPP	The Johns Hopkins University Applied Physics Laboratory	JHUAPL NNS Ceramic Radome Processing
SPP	State of Florida Department of Management Services	State of Florida Operational Technology Resilience against Threats (FORT) – Battery Infrastructure Phase I
SPP	Antares Nuclear, Inc.	PTS #1- Start Design on Modification to Proposed Buildings
SPP	GE Hitachi Nuclear Energy Americas, LLC	GE Hitachi Reference Data Library and Common Data Environment
SPP	Mercury Mission Systems, LLC	Mercury Inc Raman Microscopy Analysis
SPP	Tokamak Energy Inc.	ST-E1: PRELIMINARY DESIGN REVIEW FOR A FUSION PILOT PLANT
SPP	SRC Manufacturing Consortium Corporation	SMART USA Institute - Digital and Technical Scope
SPP	Entergy Services	Storm-DEPART (Damage Estimate Prediction and Recovery Tool) Development
SPP	Ceres Power Limited	Electrolyzer Testing for Ceres
SPP	University of Montana McGill Hall, Dept. of HHP	(UM) Development of a Digital Twin Model Applied to Human Physiology through Physics-Informed Deep Neural Networks (PIDNNs).
SPP	General Matter, Inc.	General Matter Agreement
SPP	GE Vernova Operations, LLC, d/b/a GE Vernova Advance Research Center	GE Vernova CyPR

2025 Publications

Org	Peer-Reviewed Journal Articles	Books and Chapters	Conference Abstracts, Papers, Posters, Proceedings	Editorial	Total by Org
Energy & Environment Science & Technology	154	7	40	1	202
Nuclear Science & Technology	221	2	206	2	431
National & Homeland Security	20	1	38	-	59
Advanced Test Reactor	-	-	-	-	-
Materials & Fuels Complex	61	-	6	-	67
Other	7	-	3	-	10
Total	**463**	**10**	**293**	**3**	**769**

Marketing

Fiscal year 2025 saw Technology Deployment continue applying AI to its marketing activities. By continuing to integrate tools like ChatGPT and FirstIgnite, the team streamlined content creation and targeted lead generation. These efforts resulted in engaging a wider and more targeted audience. The team achieved 22 total industry agreements in FY-25, representing a 175% increase from FY-24. This total included 3 licenses, along with proposals, CRADAs and sponsorships, reflecting both strong licensing activity and broader industry collaboration. Technology Deployment also maintained a 17.1% lead-to-deal ratio, indicating that outreach efforts were efficient and effectively targeted the right partners and industries.

This progress shows how AI enhances the team's marketing abilities and sets the stage for the Artificial Intelligence Technology Licensing Accelerator Solution (ATLAS) project in FY-25. ATLAS — a two-year project funded by the U.S. Department of Energy's Technology Commercialization Fund — will demonstrate the application of AI in technology transfer.

INL's Technology Deployment and Industry Engagement teams also market the laboratory's facilities to prospective industry partners. The goal is to create long-term partnerships between industry and facilities, resulting in lab revenue and growth.

OUTREACH AND ENGAGEMENT BASELINE METRICS

	FY-24 YTD	FY-25 YTD
Outbound Leads	1196	**246**
Inbound Leads	134	**121**
Intro Discussions Held	79	**65**
Licences Executed	6	**3**
Summaries Created	112	**56**
Other Agreements (e.g., CRADAs, SPPs and sponsorships)		**22**

Challenges faced by marketing

- Lack of technical knowledge in certain capabilities led to delays or needing a researcher present for meetings, delaying meetings/communications.
- Restriction of AI tools in creating effective communication has been a challenge.
- Funding in government and private sectors has tightened, reducing industry's willingness to invest in lab technologies.
- Change in industry trends and government priorities has made a few technologies more difficult to market (e.g., renewables, bioenergy)

Opportunities for improvement

- Outbound emails pitching to companies needs to be refined. In the latter months of FY-25, emails became significantly more effective.
- Find efficiencies to best optimize marketing efforts.
- Find effective marketing research capability with which to provide Commercialization managers for IP evaluation. Prospective licensees are more frequently asking about the market demand of a technology, increasing the need to understand demand to help sell the technology.

OmniTap at Cybercore.

Notable Technology Deployment Activity Highlights

Enhancing technology transfer

Technology transfer is crucial at INL because it bridges the gap between groundbreaking research and real-world applications. By transferring technology, INL ensures that innovative solutions developed in the lab can be deployed to address critical challenges in energy, security and environmental sustainability. INL's Technology Deployment group worked through FY-24 to increase participation in the technology transfer programs and find new opportunities.

First Technology Demonstration Projects Approved

The OmniTap technology was developed by INL under the Laboratory Directed Research and Development program. It enables the creation of a universal hardware device that can be connected to any Industrial Control System network to translate traffic (data packets) to an Ethernet format that existing cybersecurity tools and appliances can use. OmniTap will enable real-time cybersecurity monitoring of process controllers within critical infrastructure, enhancing the opportunity to stop attackers prior to observable symptoms of compromise and resulting damage/consequences. This capability will enable a dramatic shift away from Defense in Depth to a more proactive approach for defending critical process control networks that is necessary to protect infrastructure that allows our nation to function.

INL funding will be used to assemble an OmniTap prototype device for demonstration. This will be done as rapidly and economically as possible by leveraging several COTS hardware development kits and migrating the software decode algorithms previously developed for the LDRD. Although the demonstration device will have some limitations, such as a cumbersome form-factor, it will prove that a scaled-down OmniTap device works in simulated environments such as CELR and others found at INL.

A separate project made use of INL's electric field assisted sintering (EFAS) capabilities to bond dissimilar metals, forming a bimetallic component. Traditionally, the method of forming bimetallic components is explosion bonding, which has several drawbacks, including the high-level technical knowledge required, security concerns and the large amount of real estate required to perform such activities. Electrification of this technology using EFAS enables much more facile manufacturing, reduced cost and electrification of the processing method. INL plans to use the demonstration samples to showcase the method at a conference and in white papers that can be distributed to potential industry partners.

Cradle to Commerce Summit 2025

Technology Deployment Director Jason Stolworthy and commercialization manager Ryan Bills attended the Cradle to Commerce Summit (C2C) held at Lawrence Berkeley National Laboratory on September 11-12, 2025. Stolworthy participated as a panelist in the plenary session that explored the critical role of the national laboratories in driving innovation and shaping a resilient future. Panelists discussed how the national laboratories are the critical component for accelerating energy breakthroughs in partnership with industry, entrepreneurs, investors and philanthropies.

Technology Transfer Working Group – Leadership in AI

Commercialization managers Toussaint Myricks and Ryan Bills led a discussion for the TTWG Software Licensing Forum. The topic was AI-related risks in software licensing. Myricks and Bills shared their experiences and various licensing provisions that can be used to reduce the risk of licensees using AI to undermine lab tech transfer objectives.

Technology Deployment Participates in University of Chicago's Lab to Launch Program

Lab to Launch is an applied commercialization class at the University of Chicago Booth School Of Business that is focused on commercializing hard science (cleantech, energy, life science and biotech). Cross-functional student teams composed of 4-5 MBA/Masters/Ph.D. students were paired up with select INL technologies to assess market viability, determine the best use case(s) and develop an R&D roadmap and commercialization plan. The final deliverable was a business plan, with all the underpinning to start a business. Student research helped identify new market opportunities and licensees.

DOE Technology Transfer Working Group Executive Board Meeting

Commercialization manager Jon Cook chaired the working group for the Technology Transfer Wroking Group (TTWG) of DOE's Office of Technology Transitions (OTT). DOE hosted the TTWG Executive Board meeting on January 28-29 to discuss current technology transfer topics and ways for DOE and laboratory organizations to work together effectively to advance the technology transfer mission across the laboratories and DOE.

STEM and My Amazing Future

Danielle Ferreira led a STEM education workshop at INL's "My Amazing Future" program on April 9-10 at the INL Meeting Center. As a STEM ambassador, Ferreira supports INL's K-12 education program, encouraging young people to develop their STEM identity by introducing them to physics through exciting demonstrations. This initiative helps students envision themselves as future scientists, engineers, technicians and operators, preparing them for potential careers at the laboratory.

AI-Powered Business Model Canvas Tool

INL successfully executed a license with InnovationWithin to use their AI-powered business model canvas tool. The tool will be leveraged by Technology Deployment staff to identify potential markets and customer segments. Subscription will also be provided to INL's Energy I-Corps lite participants this fall.

Fostering INL's innovation

Innovation is key to elevating the lab to the next level and achieving its mission to discover, demonstrate and secure innovative nuclear energy solutions, other clean energy options and critical infrastructure. Throughout FY-25, Technology Deployment fostered the laboratory's innovation through a series of events, programs and initiatives.

ETHOS-2 Analyzed the Lab's Innovation Culture

Idaho National Laboratory (INL) participated in ETHOS-2, a multi-lab project funded by DOE that assessed the lab's innovation culture according to 12 key drivers across the national laboratory ecosystem. ETHOS-2 revealed a decline in INL's innovation scores compared to the ETHOS-1 initiative in 2021, with all categories scoring below previous levels.

Jason Stolworthy and continuous improvement specialist Paige Price analyzed data from 2019 to 2025 to understand what has shifted innovation culture at INL. Six years ago, the ETHOS-1 study showed that labs with higher "innovation culture" scores achieve up to 30% better results across key DOE metrics. Innovation Culture scores have dropped significantly since 2019, with the lowest scores in 2025.

Stolworthy and Price met with Deputy Lab Director Todd Combs, Institutional Planning and Programs Director Mitchell Kerman and Research Excellence Programs Director Giselle Sandi-Tapia to raise awareness of the dramatic shift in culture and provide recommendations on key actions the lab could take to improve culture. The group identified next steps to increase the innovation culture at INL with a specific focus on the needs of researchers.

Innovation One LLC also visited INL in July to present the survey results and share recommendations for stimulating and increasing a culture within INL in which taking innovative approaches is encouraged. The final ETHOS-2 report outlines 18 strategic recommendations aimed at strengthening leadership, knowledge management, technology transfer, and innovation processes.

Fifth Annual Innovation Week Held

Technology Deployment organized INL's fifth annual Innovation Week in June to celebrate and reinforce the lab's commitment to developing an innovative culture at the lab for researchers, engineers and support staff. The week included a speed networking event for researchers (facilitated 400+ connections), a discussion on how leveraging AI augments INL's ability to innovate and a presentation on developing a culture of continuous improvement and innovation. More than 250 employees across the lab participated in the "innovation pause" designed to help them think about failure as an innovation engine.

INL also welcomed keynote speaker, Jeff DeGraff, a motivational speaker known for jumpstarting creativity and empowering innovation culture at more than half of the Fortune 500 companies. DeGraff discussed

Pre-production design mock-up of the INL Innovations wall display.

successful experiences in spurring innovation and how constructive conflict leads to more innovation. He helped INL employees understand how their complementary strengths and personalities contribute to an overall culture that stimulates innovation.

Laboratory Innovators Celebrated

The culmination of Innovation Week 2025 was the Innovation Celebration. More than 160 INL researchers were invited to celebrate their successes in receiving patents, filing copyrights, and submitting open-source software disclosures. The celebration included food, a congratulatory video from DOE Technology Commercialization Office Director Anthony Pugliese and a special encore message from keynote speaker Jeff DeGraff.

Innovation Workshops Emphasize Customer-Centric Approach and Effective Pitching

Technology Deployment hosted the University of Idaho's Entrepreneurs Director George Tanner on August 14. Professor Tanner hosted two important workshops aimed at promoting the adoption of INL-developed technologies and solutions.

In workshop 1, Professor Tanner emphasized the importance of using a customer-centric approach in developing solutions. While organizations such as DOE and the U.S. Department of Homeland Security provide funding, it is the end-users who will ultimately adopt INL-developed technologies and solutions. Focusing on end-users helps ensure that INL's work will result in impact. Participants learned how to validate needs of prospective users, how to develop a compelling value proposition how to identify the right questions to ask, and how to determine the appropriate stakeholders to engage with.

In workshop 2 Professor Tanner demonstrated effective pitching, which is essential for gaining support and advancing innovations that contribute to INL's mission. He covered best practices for crafting and delivering a persuasive pitch. Participants had the opportunity to practice their pitches and receive feedback through multiple rounds.

Piloted Proactive Innovation Workshops

Solving today's toughest challenges requires more than incremental thinking. INL held pilot proactive innovation workshops in September that used a structured, facilitator-led process to spark bold, transformative concepts with a focus on nuclear energy system construction needs. Technology Deployment engaged with the LDRD office to identify technical areas needing support. The goal was to explore solutions for supporting factory-based modular construction methods and how reactor components are connected or made to achieve significant cost and build time reductions while enabling reliable connections.

The proactive innovation workshops at INL successfully generated a range of innovative opportunities for changing the build paradigm for nuclear energy systems. The pilot workshops demonstrated significant value in promoting idea generation and cross-disciplinary collaboration.

Innovation Development Resources for Managers

Technology Deployment developed resources specifically for managers setting goals related to innovation. These resources include guidance on how to drive innovation within teams and how to foster a culture of creativity and problem-solving. The resources were designed to help managers develop a call to action with innovation priorities, enhance team members' critical innovation skills and improve competencies to become better sponsors of innovation. INL's performance review system encourages managers to select goals to develop key skills and capabilities.

New Innovation Wall Display

To celebrate more than 75 years of innovation at INL, Technology Deployment commissioned a new display for the Engineering Research Office Building on the Idaho Falls campus. The display celebrates the spirit of technical innovation that has made the lab a cornerstone of energy and national security.

Energy iCorps

INL regularly sends teams to participate in Energy I-Corps, a technology-to-market program through DOE's Office of Technology Transitions. The program pairs teams of researchers with industry mentors for an intensive two-month training in which the researchers define technology value propositions, conduct customer discovery interviews, and develop viable market pathways for their technologies. Researchers return to the lab with a framework for industry engagement to guide future research and inform a culture of market awareness within the labs.

Technology Deployment engaged in several activities this year to support this program and INL's researcher teams:

INL Ties Own Record for Number of Energy I-Corps Teams Selected

DOE's Office of Technology Transitions selected four INL teams to participate in DOE's Energy I-Corps Cohort 20 program (Spring 2025). Sending five teams in a single run of the program ties INL's record for participation, set 9 years ago in 2016 (Cohort 4). Each team received $100k to participate in the program. The following teams that were selected:

- The Hydropower Technology Catalog (HTC) – Connecting Innovators with End Users
- Visualization for Predictive Maintenance Recommendation (VIPER)
- Relocatable/Resiliency Alternative Power Improvement Distribution (RAPID) – Microgrid-in-a-Box (MIB)
- Technology, Organization, and Person of Interest Graph Extraction, Analysis, and Reporting (TOP GEAR)
- Physical and Cyber-Secure Master State Awareness Estimator

All five teams successfully completed the program and presented about their experiences during the Energy I-Corps graduation week in Washington, D.C., on June 27-30. The teams conducted between 75 and 103 customer discovery interviews during the 10-week intensive entrepreneurial training.

Participants said that the experience helped them better understand the potential market fit for their technologies and helped to demystify technology transition. They said their mentors helped them set clear and achievable goals and gave them guidance for critical aspects of the commercialization process. They said that Energy I-Corps helped them improve their communication and conversation skills.

Energy I-Corps Lite Helps Revitalize Participation in Energy I-Corps

Thi five participant teams this year bring the total number of INL teams that have participated in Energy I-Corps to 39 over the 10-year program tenure. When DOE's Energy I-Corps program began in 2015, INL had sent an average of two teams to participate in each cohort. However, participation had taken a dip in recent years

INL's success this year signals a reemergence in INL's interest and participation in the program. Interest has rebounded, in part, thanks to James Keating's Energy I-Corps lite program, which serves as a pipeline development program for interested researchers. Energy I-Corps lite directly inspired eight of the most recently selected teams to apply for the full program.

Anniversary Celebration Dinner for Energy I-Corps Alumni

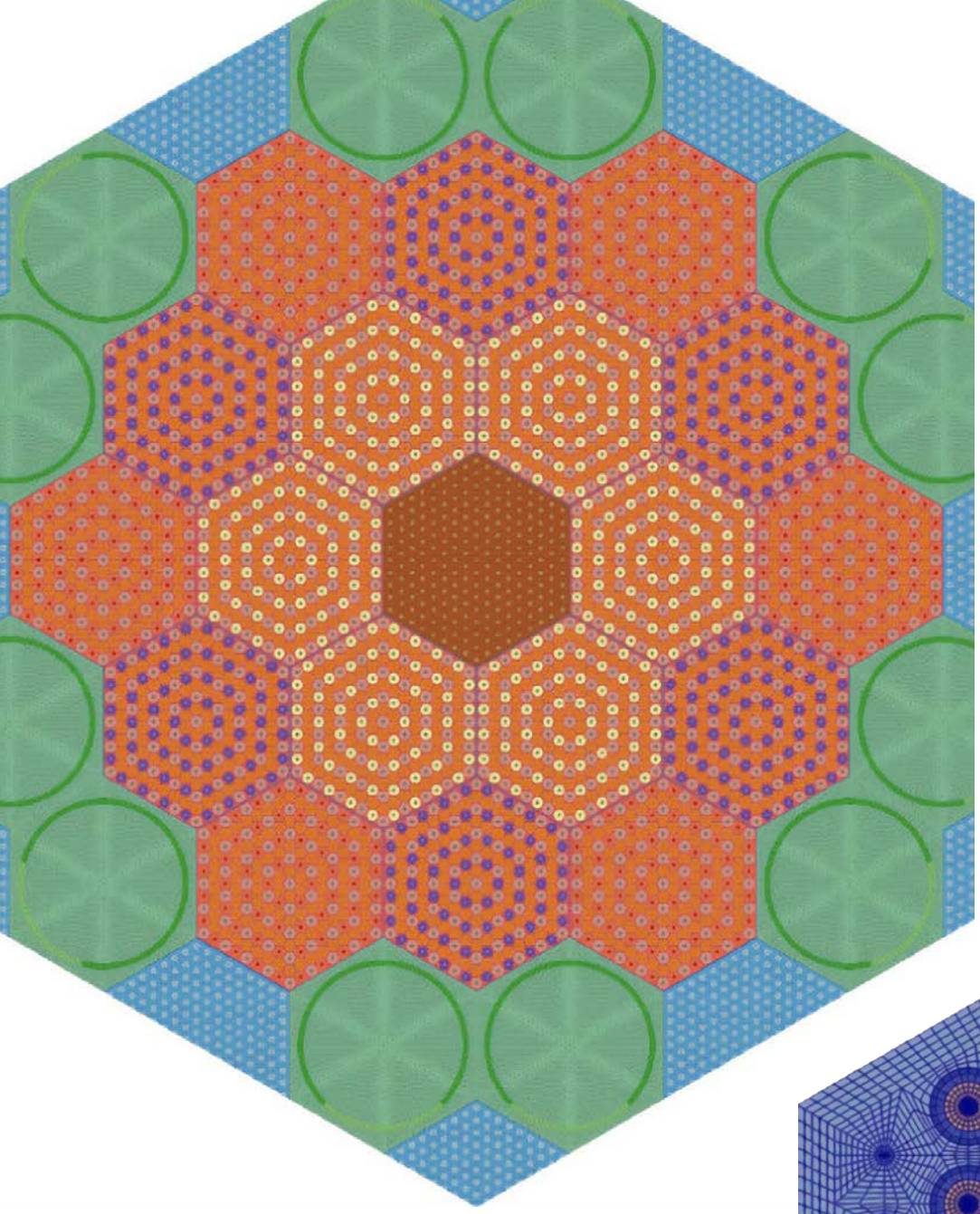
INL held a 10th anniversary celebration dinner for their 80 Energy I-Corps alumni, managers and local industry mentors. The event demonstrated Technology Deployments' appreciation of the time and energy that INL's alumni have dedicated to commercialization. The event highlighted three Energy I-Corps experiences and served as a networking session between the alumni, their managers, partners and mentees.

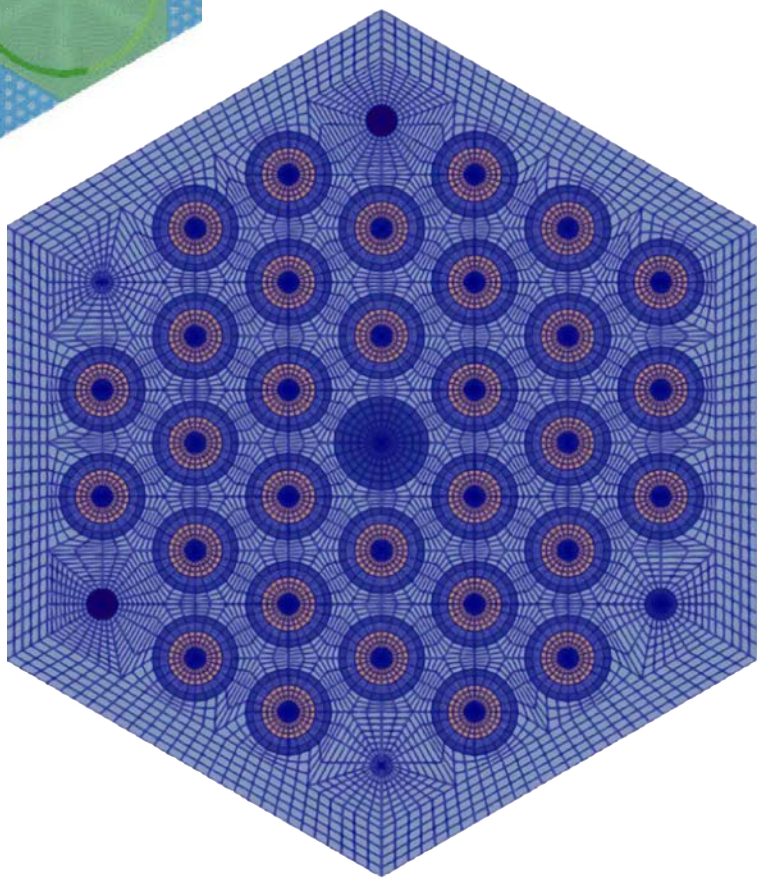
Participants Win Early Career Researcher Association Poster Session

INL's Khaldoon Al Dawood and Mahesh Acharya, both Energy I-Corps participants in FY-25, were selected as INL's Early Career Researcher Association's poster session winners. Acharya graduated from EIC Topic 2 Cohort 20- on June 30, while Khaldoon participated in EIC Topic 1 Cohort 6 at INL.

Energy I-Corps: Cohort 21

On April 3, Jim Keating and Danielle Ferreira hosted an informational session to address researchers' questions about their technologies and how the Energy I-Corp program can help them transform their technologies into market-ready solutions. The session also focused on helping researchers enhance their communication skills so they can develop substantially stronger proposals.





Awards and Recognition

R&D 100 Winner

Griffin

The Griffin reactor physics tool for multiphysics modeling and simulation makes advanced nuclear reactor design cheaper and safer by predicting how different reactor designs, fuels and materials will perform in real life. Used by nuclear energy researchers, regulators and industry, Griffin is a cornerstone of the nation's advanced-reactor development.

Researchers: *Javier Ortensi (principal investigator), Changho Lee (Argonne National Laboratory; principal investigator), Yaqi Wang, Namjae Choi, Olin Calvin, Logan Harbour, Jackson Harter, Joshua Hanophy, Zachary Prince*

R&D 100 Winner

STORM-Depart

Hurricanes, ice storms and other severe weather events are incredibly destructive to the power grid, but efficient, targeted planning for response and recovery can dramatically mitigate much of the damage that follows in their wake. Storm-DEPART is an incident-tested, data-driven tool designed to improve decision-making when preparing for major tropical and ice weather disasters and to focus restoration resources where the need is anticipated once they happen.

Researchers: *Mary Klett (principal investigator), Ollie Gagnon*

ReNuFiber's thermal insulation is made from non-recyclable plastics, textiles and wood.

R&D 100 Award Runner Up

ReNuFiber

ReNuFiber addresses a major environmental challenge by turning non-recyclable plastics, textiles and wood into high-quality thermal insulation for residential and commercial buildings. It diverts waste from landfills and creates new business opportunities for recycling centers.

Researchers: *Kristan Egan (principal investigator), Zachary Smith*

Technology Transfer Working Group Awards

Two INL Technology Deployment staff members were recognized with best-in-class awards at the Technology Transfer Working Group meeting in May. Dani Ferreira and Ryan Bills both won TTWG best-in-class awards for their exemplary work in innovator outreach and excellence in licensing, respectively.

AEM Licensing Agreement Earns Deal of Distinction Honor at LES

The Licensing Executives Society (LES) selected the Advanced Electrolyte Modeling (AEM) licensing agreement between INL and Ridgetop Group as its Physical Sciences Sector Deal of Distinction for 2024. The license was a breakthrough in transitioning AEM from a niche research tool to a software product that is gaining traction as a "must have" for battery developers around the world. The LES Deals of Distinction Award (DDA) is an annual industry sector award program of LES (USA and Canada), which aspires to recognize worthy licensing deals and promote creative and innovative solutions to business issues involving contracts.

Inventor of the Year

Dong Ding was selected as Idaho National Laboratory's 2024 Inventor of the Year

Distinguished staff scientist Dr. Dong Ding was named INL's 2024 inventor of the year. Ding is a distinguished staff scientist whose research supports advanced design manufacturing and integrated energy systems. His work advances the lab's capabilities in hydrogen production through high-temperature water electrolysis, along with natural gas upgrading, ammonia electrosynthesis, advanced manufacturing of solid oxide cells/stacks, fuel cells and electrocatalysis – key areas in promoting the nation's energy abundance and resilience.

Ding's dedication to INL values has been evident in numerous award wins during his career at INL, including the Lab Director Exceptional Scientific Achievement Award (2022), the EES&T Leadership Award (2021) and the Asian American Most Promising Engineering of the Year (2020).

2025

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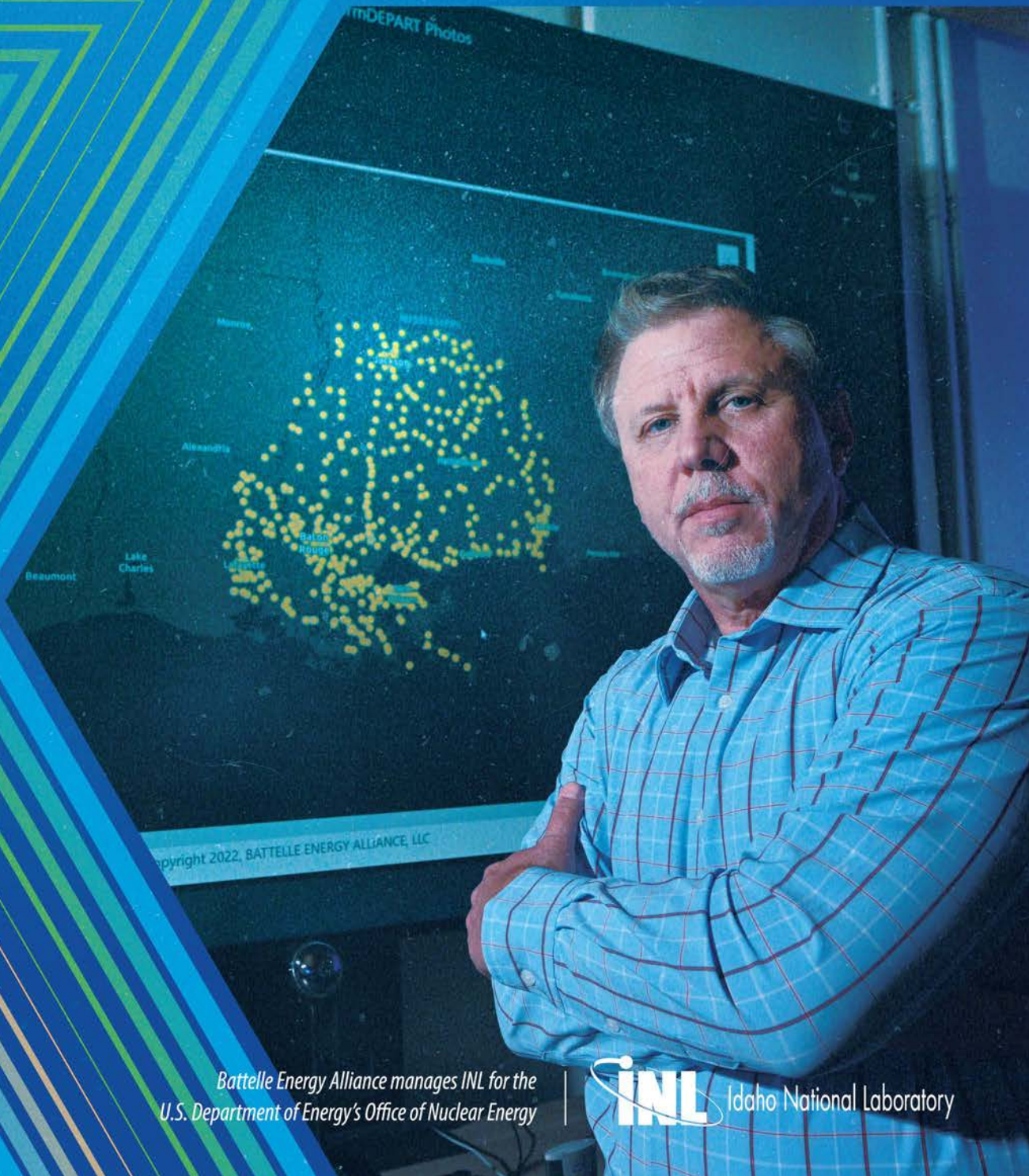

Battelle Energy Alliance manages INL for the U.S. Department of Energy's Office of Nuclear Energy

INL Idaho National Laboratory