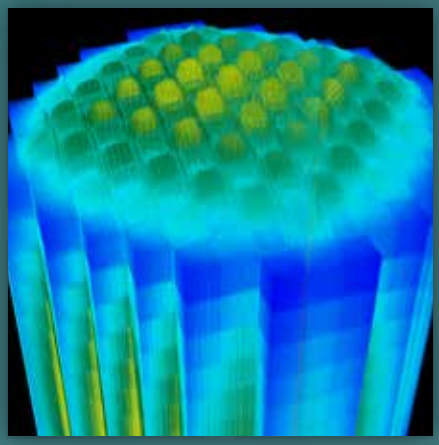
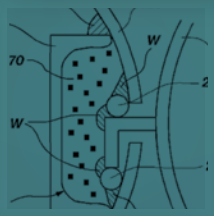
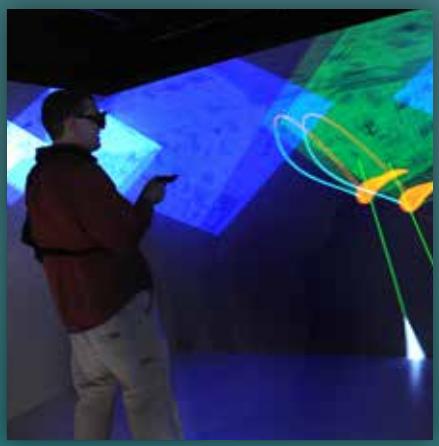
Technology Deployment

Annual Report 2014

December







Idaho National Laboratory

Prepared for the
U.S. Department of Energy
Under DOE Idaho Operations Office

Contract DE-AC07-05ID14517

Abstract

Idaho National Laboratory (INL) is a Department of Energy (DOE) multi-program national laboratory that conducts research and development in all DOE mission areas. Like all other federal laboratories, INL has a statutory, technology transfer mission to make its capabilities and technologies available to all federal agencies, to state and local governments, and to universities and industry. To fulfill this mission, INL encourages its scientific, engineering, and technical staff to disclose new inventions and creations to ensure the resulting intellectual property is captured, protected, and made available to others who might benefit from it.

As part of the mission, intellectual property is licensed to industrial partners for commercialization, creating jobs and delivering the benefits of federally funded technology to consumers. In other cases, unique capabilities are made available to other federal agencies or to regional small businesses to solve specific technical challenges. INL employees also work cooperatively with researchers and technical staff from the university and industrial sectors to further develop emerging technologies. In our multinational global economy, INL is contributing to the development of the next generation of engineers and scientists by licensing software to educational instiutitons throughout the world.

This report is a catalog of selected INL technology transfer and commercialization transactions during this past year. The size and diversity of INL technical resources, coupled with the large number of relationships with other organizations, virtually ensures that a report of this nature will fail to capture all interactions. Recognizing this limitation, this report focuses on transactions that are specifically authorized by technology transfer legislation (and corresponding contractual provisions) or involve the transfer of legal rights to technology to other parties.

This report was compiled from primary records, which were readily available to the INL's Office of Technology Deployment. However, the accomplishments cataloged in the report reflect the achievements and creativity of the researchers, technicians, support staff, and operators of the INL workforce.

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From the Laboratory Director

Fiscal Year 2014 has been a year of adding more capabilities and new facilities at Idaho National Laboratory (INL). In April, we dedicated the Energy Innovation Laboratory (EIL), which significantly enables our ability to deliver on our vision for the nation's nuclear energy research and multi-mission laboratory. Key members of the U.S. Senate and House of Representatives, along with our customers from the Department of Energy, joined us in celebrating the addition of this important research facility.

At the dedication, DOE Assistant Secretary for Nuclear Energy Pete Lyons said, "The Department of Energy is invested in the future of Idaho National Lab," which will "in turn provide for the energy needs of the Nation."

DOE Assistant Secretary for Energy Efficiency and Renewable Energy David Danielson noted the expanding partnership with DOE's Nuclear Energy division saying, "This collaborative, customizable space (EIL) will enable lab researchers, industry, and academic partners to accelerate clean energy innovations and environmentally sustainable technologies that can help tackle today's energy challenges."

INL's Technology Deployment (TD) organization cooperates with INL's research directorates to deploy technologies that support the Nation's 'all of the above' energy policy and advance its competitiveness. During the past decade, INL has signed 697 new technology license agreements, executed 145 Cooperative Research and Development Agreements (CRADAs) and completed 417 Work for Other (WFO) agreements worth nearly $1.4 billion.

In addition, INL researchers are publishing a large number of articles in 'peer-reviewed' journals and presenting to major research forums around the world. To complete the expanding technology deployment calculus, our researchers and staff have made extraordinary efforts to influence the education and training of tomorrow's work force. This includes work to emphasize the importance of science, technology, engineering and math (STEM) subjects in educational institutions ranging from elementary to graduate programs.

This expanded view of deploying technology from INL is reflected in our collaborative efforts with academia, government and industry organizations. During 2014, we expanded work under our ongoing agreements with industry, including those with TerraPower, Cogent Energy Systems, Chester Engineers, Environmental Alternatives, NanoSteel, and Alstom Grid.

"The Department of Energy is invested in the future of Idaho National Lab," which will "in turn provide for the energy needs of the Nation."

Pete Lyons

DOE Assistant Secretary for Nuclear Energy

The past ten years of investing in research and intellectual property management at INL is paying dividends as well. During 2014, INL received significant Royalty revenues from our technology licensing efforts. This year INL's Royalty revenues exceeded $3.32 million, more than double our earnings in 2013. This year, INL was issued 33 new patents, offering the prospect of reaping future licensing royalties. INL reinvests royalties into our researchers' efforts at maturing promising new technologies and expanding research capabilities so productive years like FY14 are important and provide resources to help support future R&D outcomes.

INL earned special recognition this year as our researchers earned our 49th and 50th R&D 100 awards since 1986. The Multiphysics Object Oriented Simulation Environment (MOOSE) development team won for software that has transformed approaches to predictive simulation. Quicker, adaptable and more accessible, MOOSE is used in many disciplines, including nuclear engineering, material science and geology.

Dr. Kevin Gering won the R&D 100 Award for his Advanced Electrolyte Model (AEM), which offers a genome-level investigation of electrolytes for battery design, water processing, medical research, energy systems, and corrosion chemistry. Dow Chemical's engineer said, AEM "saved us a lot of time" and the president of a battery design company noted AEM "has simplified the design process for lithium-ion batteries" that can be used in aerospace, military, autos and consumer electronics.

This annual summary offers details about INL expertise in deploying technology, conducting research and executing work. We are proud that INL continues to deliver a worthy return to the nation for the American taxpayer's investment in Idaho National Laboratory.

John Grossenbacher

Director, Idaho National Laboratory

From the Technology Deployment Director

INL promotes a broad approach to Technology Deployment, reflecting how R&D efforts provide value to industry, our government sponsors, our academic partners and the U.S. taxpayer. FY2014 was especially rewarding for INL and deployment of technologies as we continue to mature our approaches to deploying the exceptional discoveries, inventions and innovations made by our researchers.

The licensing of intellectual properties and a robust portfolio of various work agreements, including Cooperative Research and Development Agreements (CRADAs), Work for Other (WFO) agreements, Agreements for Commercializing Technology (ACT), and User Facility Agreements (UFA) remain very important to deploying technology. Through its various deployment mechanisms, INL shares 'world class' capabilities that include data, knowledge, user facilities, technical expertise and intellectual property in the form of patented inventions and copyrighted software. INL's TD department provides IP licensing and management services, while INL's new Contract Management department supports with research agreement execution and management services.

More deployment mechanisms have emerged in INL's maturing deployment strategy. While industry relevant work agreements continue to be extremely important, publishing and publicizing work in scientific journals, trade journals and other public media have grown in importance for sharing knowledge and deploying technology. Support for education partnerships, ranging from elementary to graduate research programs, has enhanced INL's reputation, while promoting the value of access to laboratory research capabilities.

It is quite apparent that 'the sum of the parts is greater than the whole' as an old adage extols. Expanding deployment mechanisms yields greater impact by collectively pursuing these activities – managing intellectual property portfolios, negotiating work agreements, publishing and publicizing research, cementing valuable educational partnerships and making user facilities available. INL also supports deployment activities through the Center for Advanced Energy Studies (CAES) with its member collaborators – Boise State University, Idaho State University, University of Idaho and University of Wyoming.

In 2014, INL successfully licensed open-sourced software, including Sophia which is used in monitoring and protecting infrastructure networks. An industrial control system and computer network fingerprinting tool, Sophia was beta tested by more than 70 enterprises. NexDefense, Inc., a startup software company based in Atlanta, GA, signed a license to commercialize Sophia, which operates as a passive monitoring system for infrastructure networks and reports anomalies to operators for investigation. The company intends to provide comprehensive software maintenance and support, while developing complementary products. Sophia's appearance on the market offers an important suite of tools to companies involved in electric generation, transmission, and distribution systems, as well as to other critical market sectors.

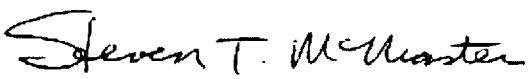
"Through its various deployment mechanisms, INL shares 'world class' capabilities that include data, knowledge, user facilities, technical expertise and intellectual property in the form of patented inventions and copyrighted software."

Steven T. McMaster,
Director, Technology Deployment

This annual report details select efforts to deploy technologies during FY2014. During FY2014, U.S. businesses sold more than $138 million in products and processes which are based on INL patented technologies. Since 2005, INL has:

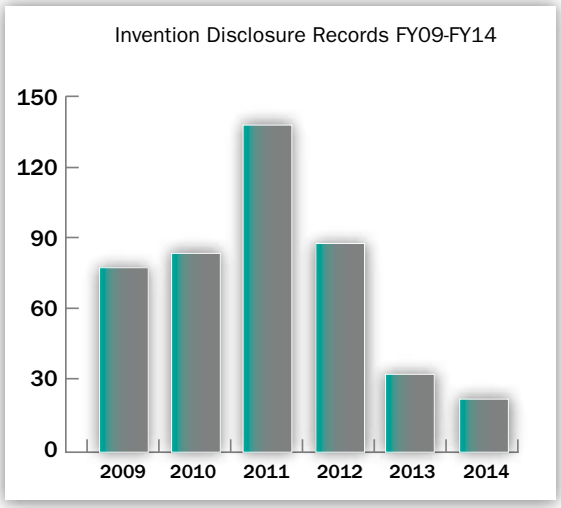
- Generated 832 invention disclosure records, filed 424 patent applications and received 391 issued patents.
  - In FY2014, 24 Invention Disclosure Records were submitted and 33 patents were issued to INL.
- Earned more than $14.4 million in royalties from 697 licensed technologies, including $3.32 million dollars during 2014, more than double 2013 (and INL's 5 year average for royalty revenue).
  - In FY2014, 42 licenses were executed; including 5 new and 13 modified patent licenses, 27 new RELAP licenses and 15 other software copyright licenses.
- Signed 145 new Cooperative Research and Development Agreements (CRADAs) valued at nearly $345 million.
  - During FY2014, 13 new CRADAs were signed and 19 were modified at a value of about $44.4 million.
- Attracted 417 projects representing nearly $1.4 billion in our contracted non-DOE Work For Others (WFO) programs.
  - In FY2014, nearly 41 new projects were added and more than 300 projects were modified at a value of about $90 million.

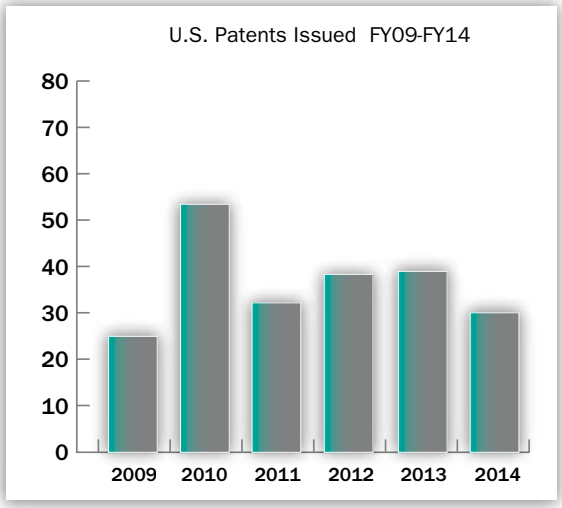
FY2014 revealed positive trends for a busy INL, including an expansion of deployment activities, an impressive doubling of royalty income, the first licensing of an open-sourced software suite, and a better understanding of deployment mechanisms. All of these activities are aimed at deploying INL technologies and capabilities for use in academia, industry and among government agencies. We are looking forward to an even more productive and successful 2015.

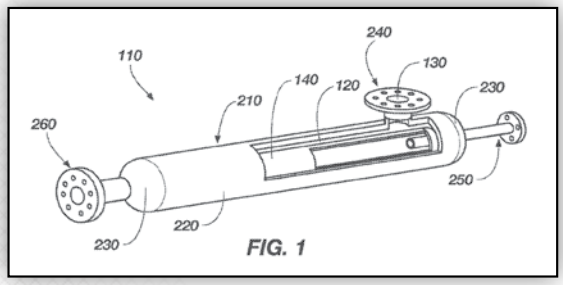


Steven T. McMaster

Director, Technology Deployment







Intellectual Property

The Intellectual Property (IP) portfolio for Idaho National Laboratory includes requested and granted copyrights, as well as filed patent applications and issued patents. These intellectual properties provide a basis for conducting work with national laboratories and federal agencies, commercial enterprises, academia and other parties. The extent of INL's science, engineering and technical IP portfolios provides the basis for the Laboratory to do creative, meaningful research. Technology Deployment (TD) works closely with INL management and researchers to identify and pursue opportunities for technology commercialization and business development.

In 2014 24 Invention Disclosures Records (IDRs) were submitted to Battelle Energy Alliance (BEA) by INL inventors. These include 8 from Energy and Environment Science and Technology (EEST), 9 from Nuclear Science and Technology (NST), and 7 from National and Homeland Security (NHS).

Thirty-three U.S. patents were issued either to INL or DOE based on the inventions of INL scientists and researchers. These included 21 from EEST, and 4 from NST and 8 from NHS.

In addition, TD filed 29 new patent applications, including 16 from EEST, 2 from NST and 11 from NHS.

During the past ten years, INL researchers have generated 832 IDRs, filed nearly 424 patent applications and received nearly 391 issued patents.

BEA has the right under its contract, subject to some exceptions, to take title to inventions and seek patent protection. The decision of whether or not to take title and seek patent protection is based on market and technical assessments of the technology and its subsequent programmatic value. Market assessments are performed and a recommendation is presented to a committee comprised of department or project managers, assistant lab director or designee, market analysts, commercialization managers, and patent attorneys. These recommendations are presented before the team and then a final decision is made to elect or decline the technology for patent protection by TD's director. Generally, if the invention is judged as commercially valuable, crucial to a primary mission, or valuable in terms of motivating further research funding, it is elected. If BEA decides to decline title, DOE decides on whether to seek patent protection in its own name. If DOE decides not to seek patent protection, the inventor(s) may petition to have title waived to them by DOE with the expectation that they will pursue patent protection using their own resources.

A brief description of the 33 patents issued to INL inventors during FY 2014 is provided on the following pages.

Methods of Conveying Fluids and Methods of Sublimating Solid Particles

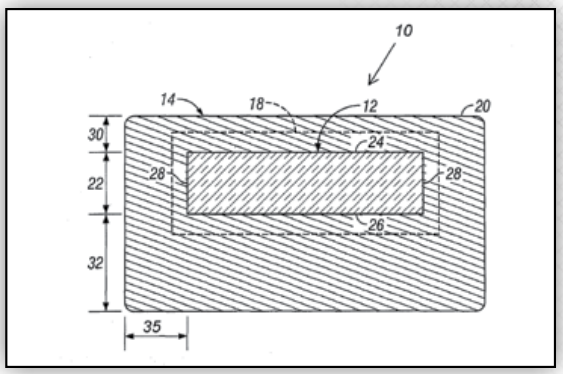
A patent was issued for this invention to Terry Turner and Bruce Wilding which describes a method for sublimating particles of carbon dioxide (CO2) out of a natural gas stream using a hydrocyclone and heat exchanger. Natural gas is super cooled as part of the process of making liquefied natural gas (LNG) and this novel method captures CO2 as a slurry because it solidifies before other gases, purifying the LNG production.

Patent Number: 8,544,295 Issued: Oct. 1, 2013

Armor Systems, including Coated Core Materials

This patent was issued to Henry Chu, Thomas Lillo, Kevin McHugh. It describes a method and design for an armor that is comprised of similar materials on the inside and outside with a ceramic core. This configuration is especially beneficial when the outside coatings are metal because the metal encapsulates the ceramic allowing it to withstand multiple impacts with better effectiveness.

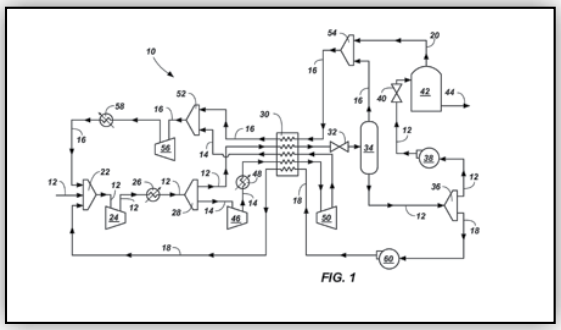
Patent Number: 8,551,607 Issued: Oct. 8, 2013



Complete Liquefaction Methods and Apparatus

Granted to Terry Turner and Bruce Wilding, this patent describes a method and design for a natural gas liquefier that uses the pressure of a pipeline to drive the process of making liquefied natural gas (LNG).

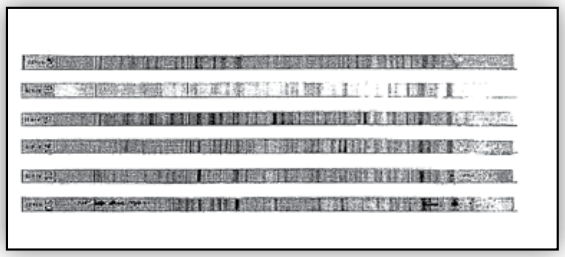
Patent Number: 8,555,672 Issued: Oct. 15, 2013



Rapid Classification of Biological Components

This patent was re-examined and issued to Vicki Thompson, Karen Barrett, and Diane Key. It describes a novel antibody profiling analysis technique that allows for forensic samples to be quickly profiled and for detecting an analyte. One way to use this invention is to set the analyte as a selected drug (e.g. marijuana, cocaine - crystalline tropane alkaloid, methamphetamine, methyltestosterone), and test a sample using a simple drug test. Another contemplated embodiment of the invention is to use antibody profiling to positively correlate a persons identity to an 'identity' profile in a database.

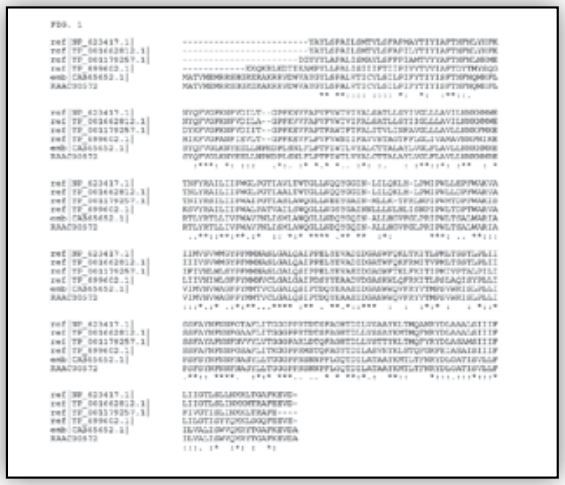
Patent Number: RE44,539 E Issued: Oct. 15, 2013



Thermophilic and Thermoacidophilic Biopolymer-degrading Genes and Enzymes from Alicyclobacillus Acidocaldarius and Related Organisms, Methods

This patent was granted to David Thompson, William Apel, Vicki Thompson, David Reed, and Jeffrey Lacey. It describes certain gene sequences of Alicyclobacillus acidocaldarius and related organisms.

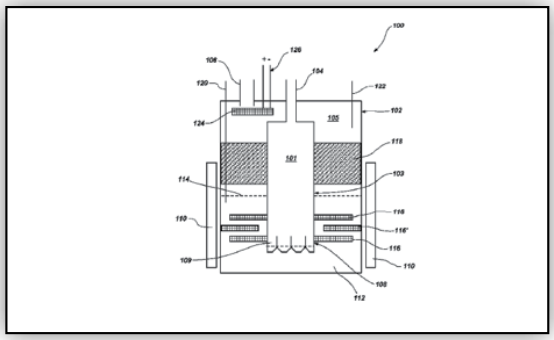
Patent Number: 8,557,557 Issued: Oct. 15, 2013



Genetic Elements, Proteins, and Associated Methods Including Application of Additional Genetic Information To Gram (+) Thermoacidophiles

This patent was granted to Brady Lee, Deborah Newby, Jeffrey Lacey, David Thompson, Vicki Thompson, William Apel, Francisco Roberto, and David Reed. It describes nucleotide sequences and polypeptide encoding sequences related to Alicyclobacillus acidocaldarius and related organisms.

Patent Number: 8,569,030 Issued: Oct. 29, 2013



Molten Metal Reactors

Issued to Dennis Bingham, Kerry Klingler, Terry Turner and Bruce Wilding, this patent describes a reactor design used to convert a carbon-based material into a stream of synthesis gas. The configuration includes an inner and an outer crucible and the exterior crucible contains a molten alkaline metal compound.

Patent Number: 8,574,327 Issued: Nov. 5, 2013

Thermophilic and Thermoacidophilic Sugar Transporter Genes and Enzymes from Alicyclobacillus Acidocaldarius and Related Organisms, Methods

This patent was issued to David Thompson, William Apel, Vicki Thompson, David Reed, and Jeffrey Lacey. It describes sugar transporting across cell membranes using polypeptides and nucleid acid sequences from Alicyclobacillus acidocaldarious.

Patent Number: 8,575,323 Issued: Nov. 5, 2013

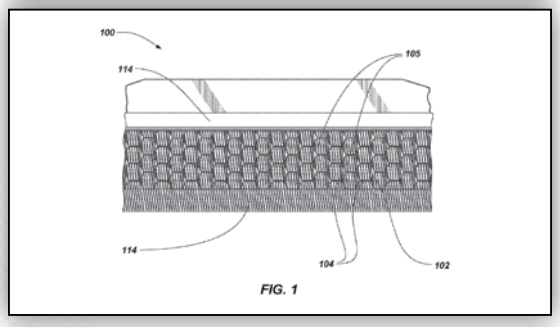
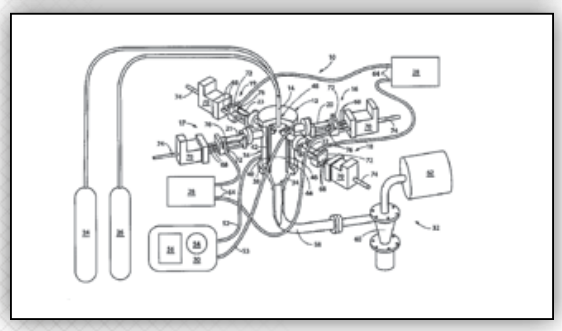


FIG. 1

Dissipative Structures and Related Methods

Granted to Benjamin Langhorst and Henry Chu, this patent describes a design for effective blast mitigation. Explosive forces and high pressure shock pulses caused by an explosive device may cause substantial damage, injuries, and death. Blast mitigation structures are becoming more important for use in protecting people and assets.

Patent Number: 8,573,571 Issued: Nov. 5, 2013



Combustion Flame Plasma Hybrid Reactor Systems, and Chemical Reactant Sources

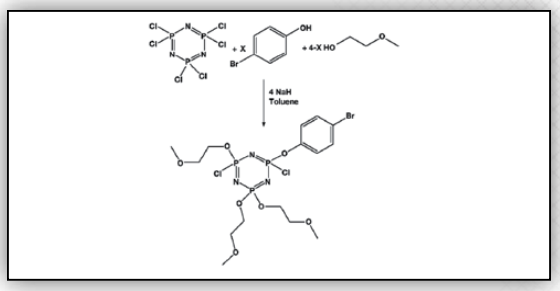
Issued to Peter Kong, this patent describes unique design for a hybrid plasma reactor. Plasma reactors are used for converting chemicals and precursors into more valuable end products.

Patent Number: 8,591,821 Issued: Nov. 26, 2013

Phosphazene Additives

This patent was granted to Mason Harrup and Harry Rollins. Phosphazene compounds have been used to reduce flammability of polymeric substrates, such as wood or textiles. The phosphazene compound is mixed or blended with the polymeric substrate to improve wood flammability resistance and to provide other useful advantages, including greater resistance to ultraviolet light decomposition and biological deterioration.

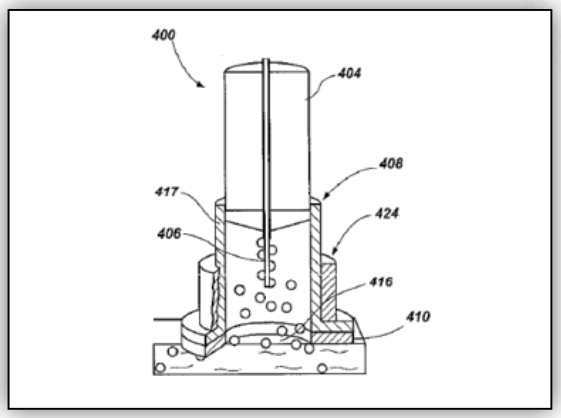
Patent Number: 8,592,628 Issued: Nov. 26, 2013



Device for Collecting Chemical Compounds

A patent was granted to Jill Scott and Gary Groenewold. It describes a device that will aid in detecting the presence of a chemical or chemicals. This device is specifically meant to be used with a portable vacuum extraction device to aid in detecting chemicals that are toxic and determining the level of contamination within an the area being surveyed.

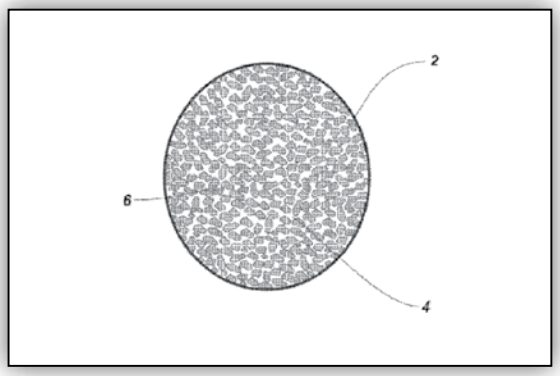
Patent Number: 8,613,233 Issued: Dec. 24, 2013



Methods of Producing Metal Oxides, a Method of Producing Adsorption Media, including the Same, and a Precursor of an Active component, including the Metal Oxide

Issued to Nicholas Mann and Rhonda Tranter (for Troy Tranter), this patent describes methods of producing a metal oxide by dissolving a metal salt in a reaction solvent. The metal oxide is precipitated and recovered. Also disclosed is a method of producing adsorption media from the metal oxide, along with a precursor of an active component that includes particles of a metal oxide.

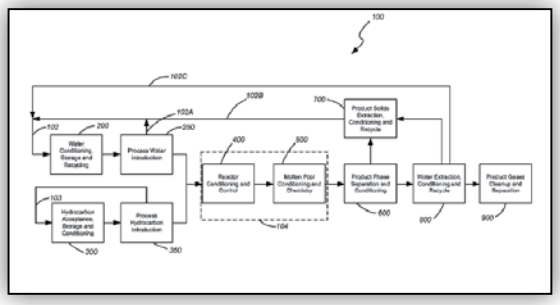
Patent Number: 8,664,150 Issued: March 4, 2014



System and Process for the Production of Syngas and Fuel Gasses

This patent was issued to Dennis Bingham, Kerry Klingler, Terry Turner, Bruce Wilding, and Bradley Benefiel. It describes systems and methods for the production of syngas and fuel gasses, including the production of hydrogen. In one embodiment the system includes a reactor having a molten pool of a material comprising sodium carbonate. A supply of conditioned water and carbon containing material are in communication with the reactor. When the water, carbon source and molten pool are introduced into the reactor, they may be homogenously mixed to produce hydrogen and other gasses.

Patent Number: 8,685,281 Issued: April 1, 2014



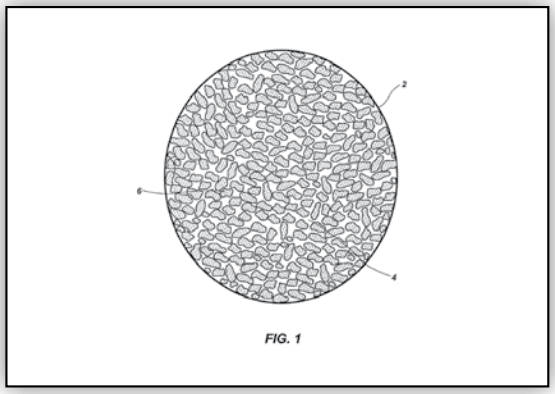


FIG. 1

A Composite Media for Fluid Stream Processing, a Method of Forming the Composite Media, and a Related Method of Processing a Fluid Stream

Granted to Troy Garn, Jack Law, and Mitchell Greenhalgh, this patent describes a method of forming a composite media that includes at least one crystalline aluminosilicate material in polyacrylonitrile. The method comprises dissolving polyacrylonitrile in an organic solvent to form a matrix solution. At least one crystalline aluminosilicate material is combined with the matrix solution to form a composite media solution. The organic solvent present in the composite media solution is diluted and the composite media solution is solidified. In addition, a method of processing a fluid stream is disclosed, which provides beads of a composite media that includes at least one crystalline aluminosilicate material dispersed in a polyacrylonitrile matrix. This method removes at least one constituent from the fluid stream.

Patent Number: 8,686,083 Issued: April 1, 2014

Since 2005, INL has received 391 issued patents

Methods of Combined Bioprocessing and Related Microorganisms, Thermophilic and/or Acidophilic Enzymes, and Nucleic Acids Encoding Said Enzymes

This patent was issued to David Thompson, William Apel, Vicki Thompson, and Thomas Ward. A genetically modified organism comprising: at least one nucleic acid sequence and/or at least one recombinant nucleic acid isolated from Alicyclobacillus acidocaldarius and encoding a polypeptide involved in at least partially degrading, cleaving, transporting, metabolizing, or removing polysaccharides, cellulose, lignocellulose, hemicellulose, lignin, starch, sugars, sugar oligomers, carbohydrates, complex carbohydrates, chitin, heteroxylans, glycosides, xylan-, glucan-, galactan-, or mannan-decorating groups; and at least one nucleic acid sequence and/or at least one recombinant nucleic acid encoding a polypeptide involved in fermenting sugar molecules to a product. The extracts are used to convert biomass into a product.

Patent Number: 8,691,525 Issued: April 8, 2014

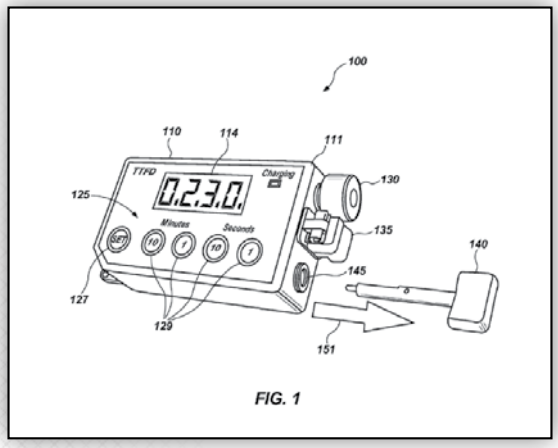


FIG. 1

Apparatus, System, and Method for Synchronizing a Timer Key

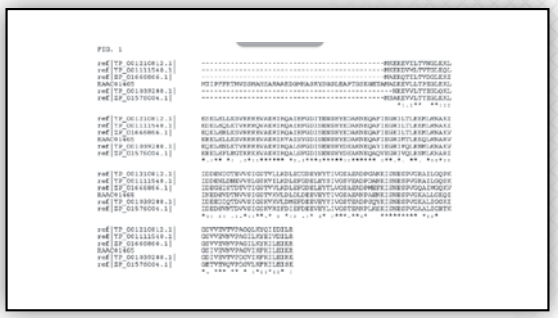
This patent was granted to Reston Condit, Michael Daniels, Gregory Clemens, Eric Tomberlin, and Joel Johnson. This invention is a timer key that controls the countdown time of an electronic fireset initiation device (electronic fuse). The user turns the fireset on or off by pressing the "Set" and a "Minutes or Seconds" button simultaneously. Once turned on, the user sets the countdown time on the fireset by simultaneously pressing the "Set" button and one of the other four buttons corresponding to a unit of time. Once the key is removed the fireset display begins to count down, unless re-inserted. When the countdown timer reaches "00:00", the fireset will initiate either a shock tube or electrical blasting cap.

Patent Number: 8,701,560 Issued: April 22, 2014

Transcriptional Control in Alicyclobacillus Acidocaldarius and Associated Genes, Proteins, and Methods

This patent was issued to Brady Lee, David Thompson, William Apel, Vicki Thompson, David Reed, and Jeffrey Lacey, for this invention which teaches methods for transcriptional control of a thermoacidophilic organism which may be used for the economic production of biofuels and chemicals.

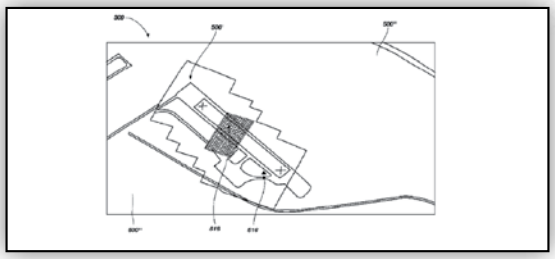
Patent Number: 8,716,011 Issued: May 6, 2014



Methods and Systems Relating to an Augmented Virtuality Environment

This patent was issued to Curtis Nielsen, Matthew Anderson, Mark McKay, Derek Wadsworth, Jodie Boyce, Ryan Hruska, John Koudelka, Jonathon Whetten, and David Bruemmer, which describes a system and method using an three dimensional virtual environment to control multiple assets (e.g. robots) positioned within a real-world environment.

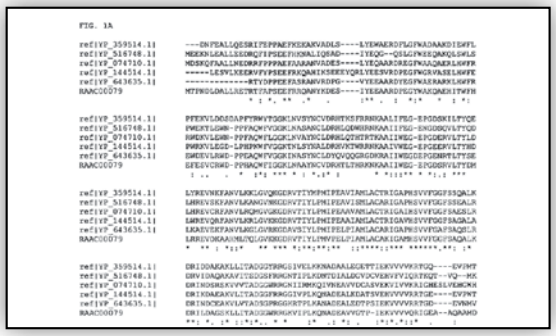
Patent Number: 8,732,592 Issued: May 20, 2014



Thermophilic and Thermoacidophilic Metabolism Genes and Enzymes from Alicyclobacillus Acidocaldarius and Related Organisms, Methods

This patent was issued to Vicki Thompson, William Apel, David Reed, Brady Lee, David Thompson, Francisco Roberto, and Jeffrey Lacey for an invention which teaches methods for altering the cell metabolism of heat tolerant organisms to produce enzymes for economic production of biofuels and chemicals

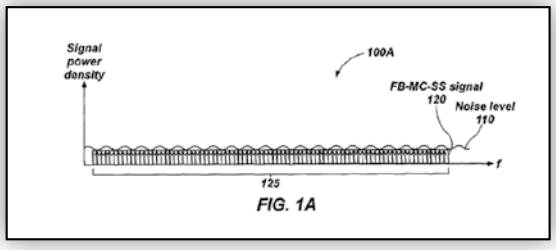
Patent Number: 8,728,803 Issued: May 20, 2014

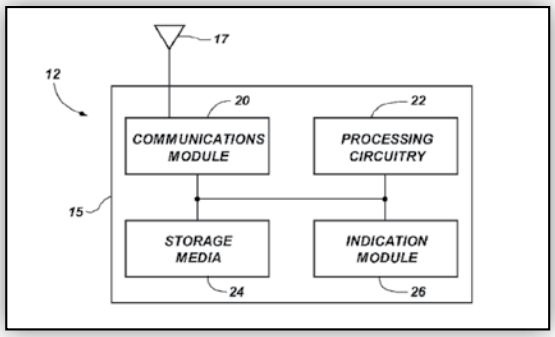


Methods and Apparatuses Using Filter Banks for Multi-carrier Spread Spectrum Signals

Granted to Hussein Moradi, Behrouz Farhang, and Carl Kutsche, this patent describes the "receiving side" of a method known as "WSComm." Hard to detect, intercept or exploit, WSComm includes apparatuses and methods for generating and receiving multi-carrier spread-spectrum signals that carry information at a very low power level distributed over the frequency spectrum. These signals may exist in the apparent noise level of other conventional communication signals that operate at higher power levels. With a low probability of detection and interception, WSComm is able to operate under harsh radio frequency (RF) environments and/or jamming conditions, while posing little or no taxation on the frequency spectrum.

Patent Number: 8,731,027 Issued: May 20, 2014

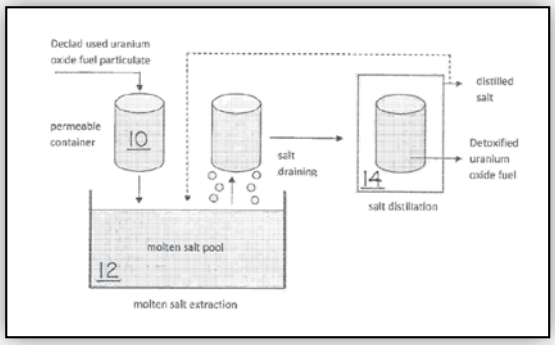




Wireless Device Monitoring Systems and Monitoring Devices, and Associated Methods

Granted to Steven McCown, Kurt Derr, and Kenneth Rohde, this patent describes devices created that are capable of receiving a wireless communication and determining whether the signal originated from an authorized or unauthorized device based on the identification information of the source. They also are capable of detecting the presence and identity of almost any other wireless device regardless of the radio frequency (RF) spectrum it is using. This invention is licensed to RFinity Corporation.

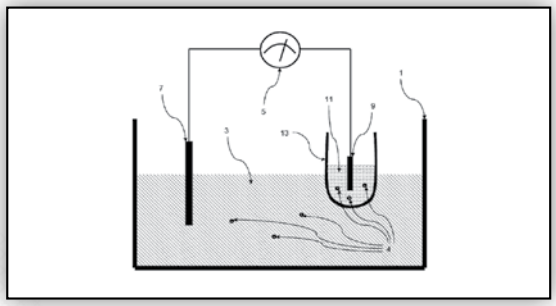
Patent Number: 8,737,965 Issued: May 27, 2014



Molten Salt Extraction of Reactive Fission Products from Irradiated Uranium Oxide Fuel

Granted to Steven Herrmann, this patent describes the detoxification of used uranium oxide fuel by extracting transuranic and reactive fission products into molten salt. By contacting declad and crushed used uranium oxide fuel with a molten halide salt containing a minor fraction of the respective uranium trihalide, transuranic and reactive fission products partition from the fuel to the molten salt phase. This occurs while uranium oxide and non-reactive, or noble metal, fission products remain in an insoluble solid phase. The salt is then separated from the fuel via draining and distillation. By this method, the bulk of the decay heat, fission poisoning capacity, and radiotoxicity are removed from the used fuel. The remaining radioactivity from the noble metal fission products in the detoxified fuel is primarily limited to soft beta emitters. The extracted transuranic and reactive fission products are amenable to existing technologies for group uranium/transuranic product recovery and fission product immobilization in engineered waste forms.

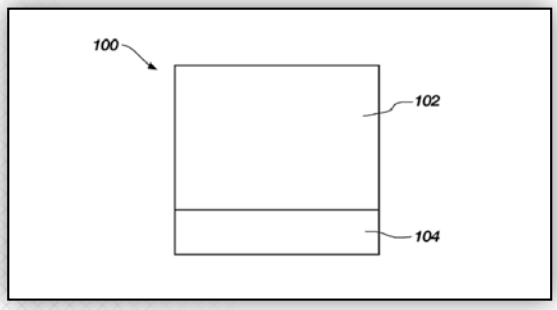
Patent Number: 8,734,738 Issued: May 27, 2014



Actinide Ion Sensor for Pyroprocess Monitoring

Issued to Jan-fong Jue and Shelly Li, this patent describes an apparatus for real-time, in-situ monitoring of actinide ion concentrations and is comprised of a working electrode, a reference electrode, a container, a working electrolyte, a separator, a reference electrolyte, and a voltmeter. The unique configuration detailed in this patent is used in monitoring during pyroprocesses.

Patent Number: 8,741,119 Issued: June 3, 2014



Methods for Recovering a Solvent from a Fluid Volume and Methods of Removing at Least One Compound from a Nonpolar Solvent

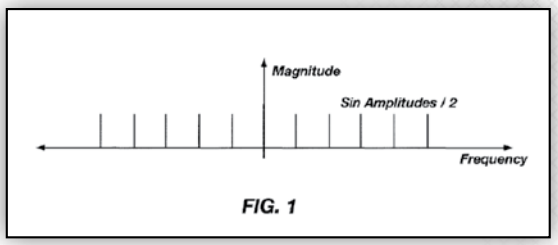
Issued to Daniel Ginosar, Daniel Wendt, and Lucia Petkovic, this invention enables low cost production of biodiesel from low quality feedstocks having high free fatty acid (FFA) concentration. This is achieved by isolating FFA with an expanded gas solvent extraction process.

Patent Number: 8,747,673 Issued: June 10, 2014

Crosstalk Compensation in Analysis of Energy Storage Devices

This patent was issued to Jon Christophersen, John Morrison, William Morrison, Chester Motloch, and David Rose. This invention enables rapid impedance spectra measurements that can be used to assess the state of health of energy storage devices.

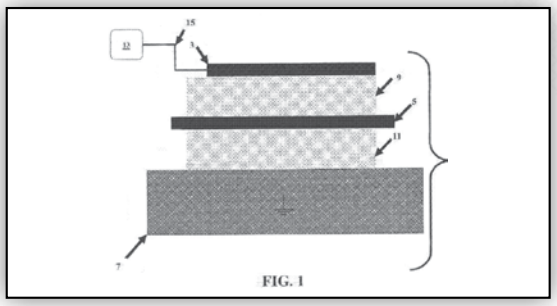
Patent Number: 8,762,109 Issued: June 24, 2014



Electrically-Floating, Near-Vertical Incidence, Skywave Antenna

Issued to Allen Anderson, Timothy Kaser, Paul Tremblay, and Randall Mays, this patent describes how an antenna, a floating ground element, and a grounding element are uniquely configured. At least part of the floating ground element is positioned between the antenna and the ground. Electrical insulators separate the floating ground element, the ground and the antenna.

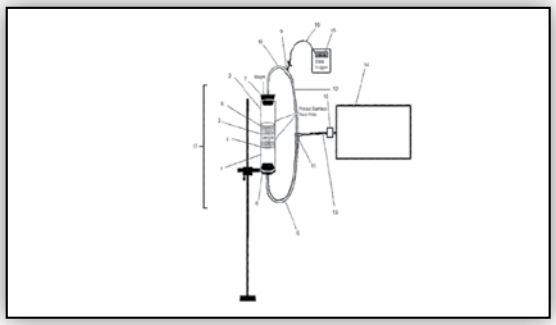
Patent Number: 8,774,866 Issued: July 8, 2014



Laboratory Ambient Flux Measurement

This patent was granted to Joel Hubbell and relates to a new laboratory apparatus for measuring the unsaturated hydraulic conductivity at a single water potential. One or more embodiments of the invented apparatus can be used over a wide range of water potential values within the tensiometric range, requires minimal laboratory preparation, and operates unattended for extended periods with minimal supervision.

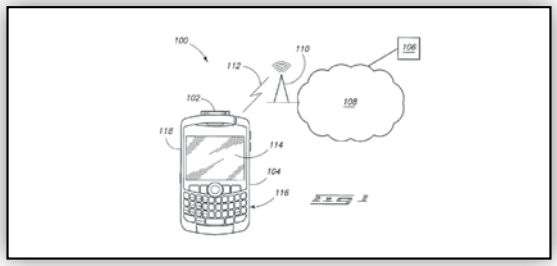
Patent Number: 8,806,954 Issued: Aug. 19, 2014

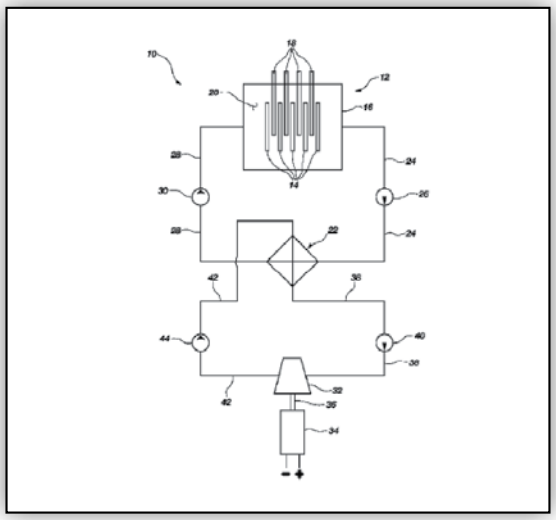


Processing Module Operating Methods, Processing Modules, and Communications Systems

Granted to Steven McCown, Kurt Derr, and Troy Moore, this invention is a processing module operating method includes using a processing module physically connected to a wireless communications device that can retrieve authorized encrypted codes from a web site for comparison to an encrypted code from the wireless communications device. Failure to meet code requirements enables the system to prevent the wireless communications device from accessing the decrypted code or operating in the system environment.

Patent Number: 8,831,220 Issued: Sep. 9, 2014

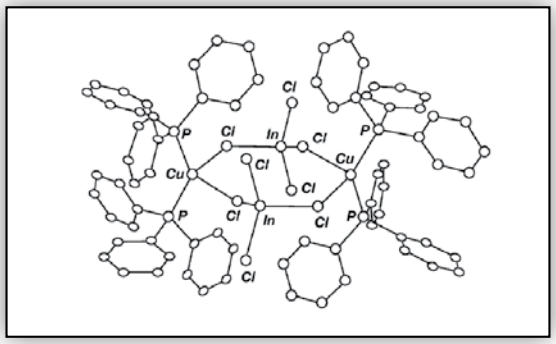




Zirconium-Based Alloys, Nuclear Fuel Rods and Nuclear Reactors, including such Alloys, and Related Methods

Granted to Robert Mariani, this patent describes that material added to zirconium (Zr)-based alloys for Light Water Reactor cladding applications can guard against hydrogen embrittlement and stabilize the grain size, or inhibit grain growth to increase cladding lifetime. The specific materials for addition are based on a thermodynamic and transport model that relies upon phase diagrams, experimental data and prior modeling experience. Niobium (Nb), tantalum or vanadium can be added at levels sufficient to increase hydrogen permeability with decreasing temperatures, mitigating hydride precipitation. At least part of the added Nb resides on the grain boundaries to promote hydrogen transport. Other additives may be used, such as molybdenum (Mo), which has a low solubility in Zr, to induce phase-segregation of Nb from the bulk Zr. This promotes co-precipitation of the Mo and Nb on the grain boundaries. A third additive, such as yttrium oxide may be used to help control grain-size and prevent substantive microstructural changes to the cladding during temperature changes that affect the cladding.

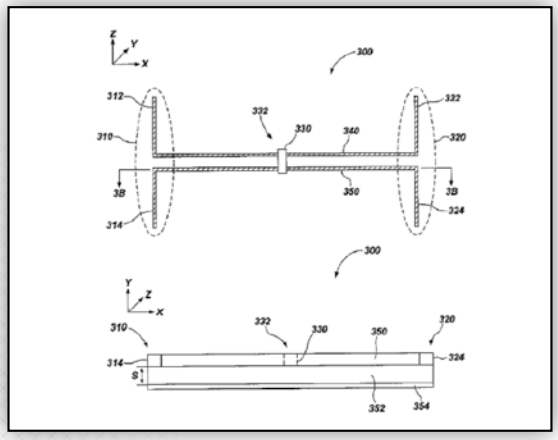
Patent Number: 8,831,166 Issued: Sep. 9, 2014



Methods of Forming Single Source Precursors, Methods of Forming Polymeric Single Source Precursors, and Single Source Precursors Formed

Granted to Robert Fox, Rene Rodriguez, Joshua Pak, Chivin Sun, Kelsey Margulieux, and Andrew Holland, this invention teaches methods for the formation of organo-metallic single-source precursors for use in the production of semiconductor nanomaterials. The semiconductor nanomaterials formed from this method are useful for the manufacture of solar photovoltaic devices, solid-state light emitting diodes, sensors, solid-state lasers, and energy-efficient integrated circuits.

Patent Number: 8,829,217 Issued: Sep. 9, 2014



Apparatuses and Method for Converting Electromagnetic Radiation to Direct Current

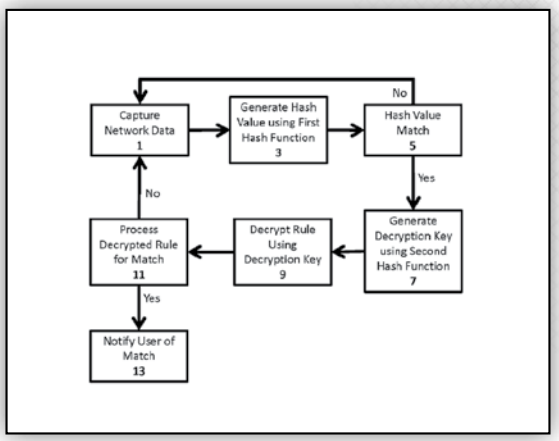
Granted to Dale Kotter and Steven Novack, this patent is an energy conversion device that may include a first antenna and a second antenna configured to generate an alternating current responsive to incident radiation, coupled with a rectifier. The energy conversion device may also include an array of nanoantennas configured to generate an alternating current in response to receiving incident radiation. Each nanoantenna of the array includes a pair of resonant elements and a shared rectifier operably coupled to the pair of resonant elements with the shared rectifier configured to convert the alternating current to a direct current. This invention has been licensed by Red Wave, Inc.

Patent Number: 8,847,824 Issued: Sep. 30, 2014

Intrusion Detection Using Secure Signatures

Granted to Trent Nelson and Jedediah Haile, this patent is for a method and device to detect intrusions in an industrial control computer system using secure signatures that capture network data. A search value, employing at least one one-way function, is generated from the captured network data. The presence of a search value match in a secure signature table, comprising search hash values and an encryption rule, is determined. A decryption key is then generated from the captured network data using a second hash function. One or more of the encryption rules of the secure signatures table having a hash value equal to the generated search value are then decrypted using the generated decryption key. Then, decrypted secure signature rules are processed for a match and one or more user notifications are deployed, if a match is identified indicating a possible computer network intrusion.

Patent Number: 8,850,583 Issued: Sep. 30, 2014

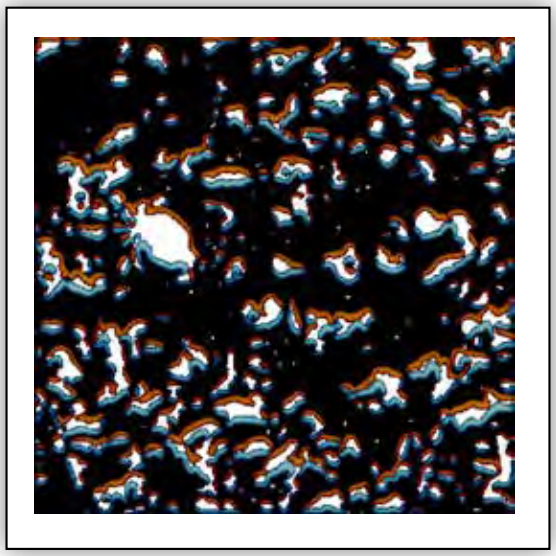


Granted Copyrights

During 2014, INL received permission to assert copyright for two newly developed software programs, both for Nuclear Science and Technology.

Phase-Field Snow Microstructure Model (PIKA)

Pika is a MOOSE-based application for modeling micro-structure evolution of seasonal snow by implementing three equations: the phase-field equation for tracking the evolution of ice-air interface within seasonal snow at the grain-scale; the heat equation for computing the temperature of both the ice and air within the snow; and the mass transport equation for monitoring the diffusion of the water vapor in the pore space of the snow. Designed to offer a completely new approach to modeling snow, PIKA can build a myriad of different, open-source simulation tools for modeling phenomenon such as snow micro-structure evolution for avalanche and albedo prediction and/or in-homogeneous snow hydrology for better run-off prediction. With MOOSE as a common framework, coupling between models and co-development are inherent.



Risk Analysis Virtual ENvironment (RAVEN)

RAVEN is a software code that provides a graphical user interface for three principal applications. These include the pre- and post-processing of the RELAP-7 input and output, a capability to model nuclear power plants control logic for RELAP-7 code and dynamic control of the accident scenario evolution, and a general environment to perform probability risk analysis for RELAP-7, RELAP-5 and any generic MOOSE-based applications. This software tool will provide new capabilities to U.S. industries.

Royalties

During 2014, INL experienced a major increase in royalties earning approximately $3.4 million, which is more than double the FY2013 amount of $1.58 million. The dramatic increase in INL royalties reflects a legacy of strong innovation in years past resulting in the execution of multiple licenses.

Royalties are an important signal that INL innovations are meeting market needs. However, it needs to be noted that it takes time and persistence for inventions to mature into products that generate royalties. For this reason, INL continues to encourage innovation and to reinvest a significant portion of our royalty revenues into further development of promising new 'early stage' technologies emerging from INL's ongoing research and development programs.

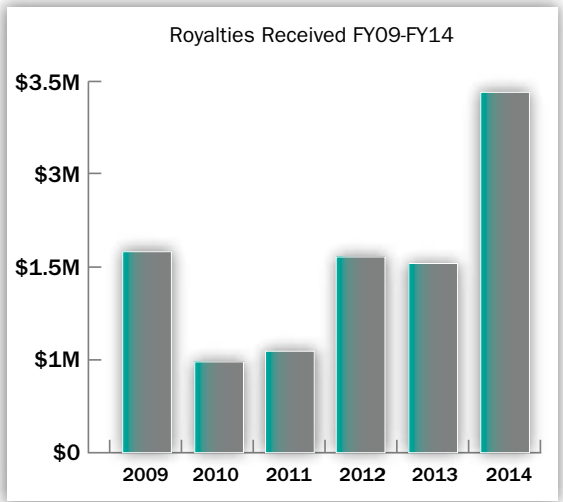
This report also shares information about some of those promising technology maturation projects. A key to the success of these maturation investments will be INL's ability to engage others whose own resources and expertise are essential in advancing future generations of INL technologies.

During the past ten years INL has earned more than $14.43 million in royalties, a robust return by any measure. It also reflects a strong, expanding portfolio of intellectual property, as well as increased attention to commercialization of INL discoveries, inventions and current intellectual properties.

During FY 2014, U.S. businesses sold more than $138 million in products, processes and innovations based on INL patented technologies. Use of INL technologies in domestic and global markets has created jobs and increased U.S. global competitiveness.

Commercial markets have been very accepting of INL-developed technologies. From FY2005 to FY2014, INL has signed 697 licenses to commercialize technologies developed within the laboratory. This success comes from excellent research and strong laboratory support based on strategies that provide investments where they are needed most. These investments have been made with licensing income and focused on funding more mission-related research and development, plus recognition and reward for laboratory employees who are contributing significantly to the transfer and commercialization of INL technologies. Other investments are made based on value related to the research and development mission and those activities that could significantly increase the licensing potential of INL technologies.

INL's Innovation Development Fund and Technology Strategic Investment Opportunities are mechanisms that are used for these reinvestment strategies and have advanced the transfer of laboratory-developed technologies to nonfederal parties as required by technology transfer legislation. IDF projects have permitted development of stronger relationships in various markets, yielding exceptional return on investment to the U.S. public from INL research. Focusing on commercial results has helped create IDF's success.



Technology Deployment used Royalty funds to aid in maturing a number of promising technologies during FY2014 and a selected summary of some projects is provided:

Integrated Waste Screening System (IWSS) (Oil and Gas Radioactive Waste Characterization, Segregation, Documentation)	Douglas Akers
Silicon Carbide via Spark Plasma Sintering (Fabrication of tiles for Armor applications)	Michael Bakas, Henry Chu
Noble Gas Standard (Device for measuring radioactive gases)	Nick Mann
SDR Radios (Self-generating Fault-tolerant Encryption Key)	Hussein Moradi
Active Measurement Cancelation Device (in-situ device that measures resistances in active circuits)	David Jamison
MorphoHawk Software (Supports packaging of software, developing operation manual)	Michael Glazoff
AEM/CellSage GUI Development (Develop graphic user interfaces for battery models/software)	Kevin Gering
Cold Crucible Induction Melter (Develop methods and mechanisms for draining)	Brad Benefil, Clark Scott
Phosphazene Wood Treatment (Validate patent claims related to phosphazene behavior with resin/cellulose)	Harry Rollins, Mason Harrup, Fred Stewart

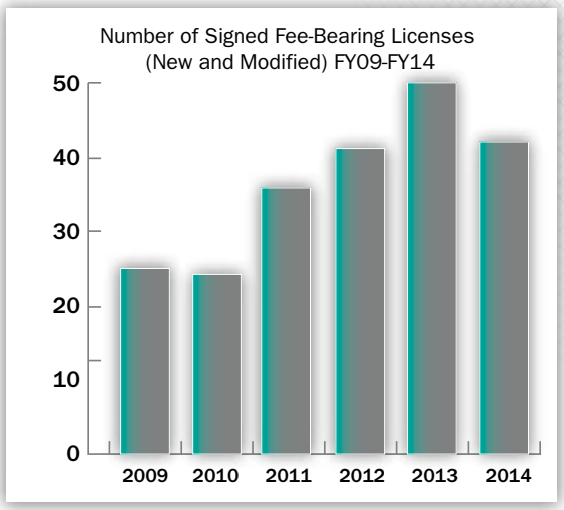
License Highlights

INL negotiates license agreements with businesses or other organizations, which allows them to reproduce, manufacture, sell, or use intellectual property owned by the Laboratory. Dedicated to commercializing INL-developed intellectual properties, these inventions are available as detailed by specific regulations for license by U.S. and foreign companies, as well as other organizations. INL licenses its intellectual property on much the same terms as universities, and other research organizations and industrials firms.

During the past ten years, INL has signed 699 licenses that have earned more than $14.43 million in royalty fees. These include 56 patent licenses, 37 license option agreements, 88 copyright licenses with fees and 516 copyright licenses without fees.

For FY 2014, INL signed a total of 44 new licensing agreements, including 7 patent licenses, 3 license option agreements, 3 copyright licenses with fees and 31 copyright licenses without fees.

Interest in licensing INL software technologies continues to grow. During FY 2014, licensing for new, renewed, fee-bearing and non-fee bearing software included 33 for RELAP, 9 for MOOSE, 3 for RAVEN, 2 for Phisics and 7 for other software licensing.



Below is a selected summary of patent licenses, license options and copyright licenses.

Licensee	Technology
Environmental Alternatives, Inc. (EAI)	Rad-Release Chemical Decontamination Technology (RAD Release)
Chester LNG, LLC	Liquefied Natural Gas Methods
Chester LNG, LLC	Compact/Liquefied Natural Gas Methods
Cogent Analysis Group, LLC	Plasma Process for Waste Destruction
NexDefense, Inc.	Sophia
Advanced Packet Concepts, LLC	OglNet

The following summarizes selected license agreements for patented technologies and copyrighted software:

NexDefense, Inc. Signs Patent and Copyright Licenses for Sophia

NexDefense, Inc., a startup software company from Atlanta, Georgia, signed a "Patent and Copyright License Agreement' to use Sophia, an industrial control system computer network fingerprinting tool. Sophia is a passive monitoring system for infrastructure networks that reports anomalies to operators for investigation. After extensive beta testing involving more than 40 enterprises, NexDefense sought the license with the intention of providing maintenance and support 24/7/365 with complementary products. The commercial software product released in November 2014 offers wide scale product distribution throughout the electric generation, transmission, and distribution systems, as well as to other critical market sectors.

Advanced Packet Concepts, LLC (APC) Signs a Copyright License to the OglNet Software

OglNet, the display component of the Sophia software licensed by NexDefense, Inc., has applications in non-competing fields of use, all fields except computer network security for industrial control systems. APC intends to exploit applications of OglNet in computer gaming and other fields.

Environmental Alternatives, Inc. (EAI) Executes a License to Deploy Radionuclide Decontamination Foam Technology, "RAD Release"

EAI, Inc. executed a new license for INL's RAD Release, an effective decontamination foam technology that aids in radioactive clean up operations, which was developed and tested at INL. This license replaces a previous agreement with EAI, Inc. and permits the company to license RAD Release to enterprises in foreign markets.

Chester LNG, LLC Executes License Agreements for Compact LNG Liquefaction and LNG/CNG Refueling Technologies

Chester LNG, LLC, a subsidiary of Chester Engineers, executed agreements to license two suites of patented inventions related to the natural gas liquefaction processes and the liquefied compact natural gas (L-CNG) refueling processes. Granted non-exclusive rights to these technologies, Chester plans to design, engineer, fabricate, deploy and service natural gas liquefaction plants and L-CNG refueling plants based on the licensed patents in the U.S. as well as global markets.

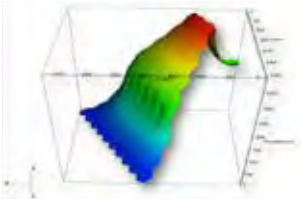
Cogent Energy Systems, LLC Executes License for Waste to Energy Technology

Cogent Energy Systems, LLC has signed an agreement granting non-exclusive rights to a thermal plasma gasification technology developed at INL, which makes use of a variety of feedstocks. INL's 'waste-to-energy' technology processes wastes that includes municipal waste to generate synthesis gas. Cogent also is funding further development of this technology using a Work For Others agreement in support of this license. The company plans to develop the technology to deploy it to micro-grid and more isolated applications.

The NanoSteel Company Signs Modified License Agreement for Metallic Materials and Coatings Technology

The NanoSteel Company of Idaho Falls, Idaho executed a modification to a long standing license agreement related to metallic coatings technologies developed at INL. The new agreement transfers responsibility for maintenance and prosecution of licensed patents from BEA to NanoSteel. It also provides additional flexibility for sublicensing activities, which will allow the company to more readily expand into foreign markets.

Parallel and Highly Innovative Simulation for INL Code System Signs Licenses



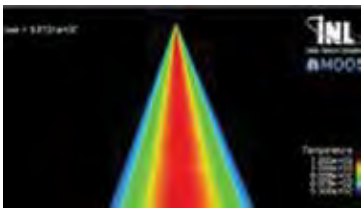
Parallel and Highly Innovative Simulation for INL Code System, called PHISICS, is a software package intended to provide a modern analysis tool for reactor physics investigation. Designed to maximize accuracy for a given availability of computational resources, this is achieved by using several algorithms and meshing options to optimize computational resources and desired accuracy levels.

PHISICS is available to users as a stand-alone version or coupled with RELAP5-3D precompiled libraries. It can be compiled on MAC, LINUX, and Windows, which makes it more flexible and portable than competing software packages. PHISICS also is modular in structure, which facilitates simple and independent modification to its various algorithms, enabling rapid implementation of new calculation schemes. Licenses during 2014, included:

- University of Pennsylvania
- University of Bologna, DIENCA Dept., Montecuccolino Laboratory

Multiphysics Object Oriented Simulation Environment (MOOSE) Advances INL's Nuclear Mission by Making INL-developed Software Available to Industry, Academia, and National Laboratories

During 2014, INL signed five multi-year, non-exclusive licenses for INL's MOOSE software prior to making MOOSE available through open source software (OSS) licensing. Since launching the OSS, our website has had greater than 3,600 unique viewers and approximately 28,000 page views. Designed as a framework for the development of complex multi-dimensional engineering analysis applications using the finite element method, MOOSE provides a clean, extensible interface for scientists to develop analysis applications by accepting weak forms for the mathematical models that govern the behavior of the physical system being modeled. This software was created using funding from the INL's Laboratory Directed Research and Development (LDRD) and during FY2014 has been licensed to:



- The Chancellor, Masters and Scholars of the University of Oxford
- University of California, Berkeley
- Technical Research Centre of Finland
- Boise State University
- TerraPower, LLC

NREL Executes License for Access to Biomass User Facility Modeling

National Renewable Energy Laboratory (NREL) has signed an agreement with INL to collaborate on a project funded by the Bioenergy Technologies Office for the characterization of various biomass feedstocks and feedstock blends. Some work at INL will use near infrared spectroscopy and projection to examine latent structures multivariate analysis (NIR/PLS) models developed at NREL. Execution of this Government use license, will allow for the transfer and use of these models at INL.

Reactor Excursion and Leak Analysis Program (RELAP5-3D) Licensing Continues to Grow

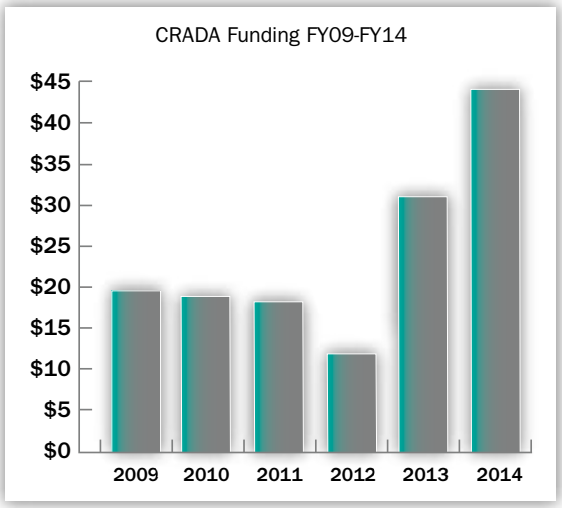
RELAP is widely used in the international nuclear community to support research and nuclear studies, safety analysis and evaluation of innovations. As it has for decades, INL continues to cooperate with the International RELAP Users Group (IRUG) and last year released the latest in the RELAP5-3D code series to analyze transients and accidents in water-cooled nuclear power plants and related systems. Immediately prior to this year's annual IRUG meeting in Idaho Falls, thirty-one individuals participated in an advanced training class conducted by BEA. This training assists utilities and other companies using RELAP5-3D in performing systems safety analyses. INL signed 31 new licenses in FY 2014 and current licensees include:

- Mitsubishi Nuclear Energy Systems, Inc.
- Pennsylvania State University
- Industrial Leak Detection Inc.
- Institute for Advanced Studies – IEAv
- Babcock & Wilcox Nuclear Energy, Inc.
- Ansaldo Nucleare SpA
- NuScale Power, LLC
- Studiecentrum Voor Kernenergie Centre D'Etude De L'Energie Nucleaire
- Karlsruher Institut für Technologie (KIT)
- University of Florida
- Universitat Politecnica de Catalunya
- Nuclear Safety Associates, Inc.
- University of New Mexico
- Applied Programming Technology, Inc.
- Warsaw University of Technology
- TerraPower, LLC
- Ustav jaderného vyzkumu Rez, a.s (UJV Rez a.s.)
- Arizona Public Service
- Nuclear Regulation Authority, Japan
- University of Maryland
- Applied Programming Technology, Inc.
- Department of Nuclear Safety, Taiwan Power Company
- Institute of Nuclear Safety System, Inc.
- North-West University
- X-Energy, Inc.
- Colorado School of Mines
- Bel V

Cooperative Research and Development Agreement Highlights

During the past ten years, INL's successful Cooperative Research and Development Agreements (CRADAs) program has signed 145 new CRADAs representing $344 million of research work. During FY 2014, 13 new CRADAs were signed and 19 modifications to existing CRADAs were executed. The total CRADA value during the year was more than $44.4 million, including about $30.4 million of funds-in, $11.6 million of in-kind contributions from participants, and about $2.4 million in government contributions.

CRADAs may be for short periods of time or may extend several years depending on the objectives of the collaboration. The number of transactions and the corresponding resource commitments vary considerably from year to year based on the technologies available at INL, the readiness of participants to invest in collaborations, and INL's ability to identify the right participants and negotiate satisfactory business relationships.



Summaries of selected CRADAs in FY2014 are provided below:

Korea Atomic Energy Research Institute (KAERI) Signs CRADA

KAERI has initiated the Ki Jang Research Reactor (KJRR) project to construct a new dedicated radioisotope production facility in the Ki Jang province of South Korea. KAERI has signed an agreement for INL to develop and qualify a new low-enriched uranium dispersion fuel for the KJRR. This leverages the unique capabilities at the Advanced Test Reactor (ATR) for irradiation, the Material Fuels Complex (MFC) for post-irradiation examination and INL expertise in LEU fuel development. The project will produce a nuclear quality data package that supports KAERI's licensing submittal to the Korean regulator.

TerraPower Executes Additional Cooperative Research Agreeements

TerraPower has signed several Cooperative Research and Development Agreements (CRADAs) for INL to continue to perform research on fuel performance, fuel fabrication, control room design and even hybrid energy systems. TerraPower may use some of this research to help them develop their nuclear energy system is known as a traveling wave reactor (TWR).

Porifera, Inc. Executes a Research Agreement and License Option to Advance Switchable Polarity Solvent Forward Osmosis Technology

Porifera, Inc., a developer of membrane and wastewater treatment technologies, received a Small Business Innovation Research (SBIR) award to explore the feasibility using INL's award winning Switchable Polarity Solvent Forward Osmosis (SPS-FO) technology in a waste water treatment and carbon capture process. Porifera also executed a CRADA with INL to support this work, which has potential to improve water treatment capabilities across many applications.

Three Industrial Control Systems manufacturers sign CRADAs in support of the DOE Office of Electricity Delivery and Energy Reliability (DOE-OE) Pilot RENDER Program

Alstom Grid, Inc., Siemens Energy, Inc., and Telvent USA (a Division of Schneider Electric, U.S.), each signed an agreement for INL to conduct a risk evaluation and vulnerability assessment of their Industrial Control Systems (ICS) software to reduce the exploitation of energy sector control systems. These software programs provide network operators' needs for supervisory control, asset monitoring, modeling, operations scheduling and a wide variety of other tasks. These agreements support the DOE pilot program called Risk Evaluation Nexus for Digital Age Energy Reliability, or RENDER.The goal is to identify areas for improvement in critical infrastructure management.

Virent, Inc. Executes an Agreement for Biomass Experiments

Virent, Inc. is pursuing a hydrothermal liquefaction process in combination with traditional catalytic conversion technologies to produce "drop-in" distillate hydrocarbons (gasoline, diesel, jet fuel, etc.). This collaborative research project is to evaluate mechanical and chemical preconversion factors to minimize ash content for designated feedstocks. The outcome has potential to reduce feedstock transportation costs and improve catalyst efficiency.

Colorado School of Mines Signs CRADA for Non-Proliferation Research

The Colorado School of Mines signed an agreement to collaborate with INL on fuel cycle safeguards analysis that will help understand and minimize the risk of nuclear proliferation. The central challenge and opportunity of this effort is to provide a useful tool to combine and propagate uncertainties from varying measurement techniques of different parameters (some local, some global) as different parts of a fuel cycle, taken at different times. Then for a given safeguard threat or scenario, efforts would be to estimate how much of the uncertainty of detection in the diversion scenario stems from each measurement, while also determining the impact the quality of measurement has in those scenarios.

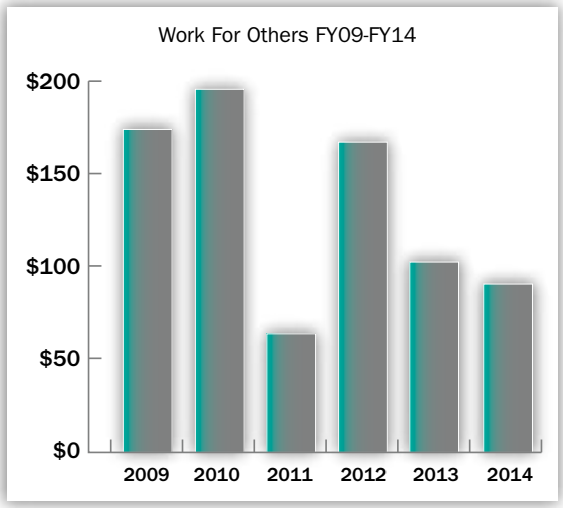
Image Insight, Inc. signs CRADA to Collaborate on Using Cameras to Detect Radiation

The use of mobile devices as radiation detectors is a new technology that provides extended radiological detection capability to areas not currently covered by dedicated radiological detection devices or grids. "Off the Shelf" mobile devices with cameras can detect gamma radiation with only the addition of a Mobile Application Software Package. INL is combining its expertise in mobile device software development, nuclear physics, data communications and cloud processing systems, and radiological test and calibration with the expertise of Image Insight, Inc. The company uses image sensors for the detection and quantitative measurement of ionizing radiation using digital cameras and the development of security and safety systems based on that expertise.

Work for Others Highlights

INL's Work for Others (WFO) program allows other agencies and the private sector to leverage INL capabilities and intellectual knowledge on a full cost recovery basis. Since 2005, BEA has contracted for 417 new WFO Projects that represent nearly $1.4 billion of work.

In FY 2014, 11 new federal WFO agreements and 268 modifications to existing agreements were executed, the value of those agreements reached $91.8 million. The non-federal (private sector) WFO agreements included 30 new projects (14 for EEST, 8 for NST, 8 for NHS) with another 39 modified. The value of those 69 agreement actions exceeded $4.9 million. Since 2002, non-federal WFO agreements have been responsible for nearly $55 million in funding at the INL. The total WFO value during FY 2014, including both federal and non-federal agreements, was about $97 million.



Some of INL's significant WFO projects include:

U.S. Environmental Protection Agency (EPA) Signs Agreement for Designing and Installing a Water Security Test Bed (WSTB) at INL

EPA signed an agreement for INL to design and install an above ground water piping system to function as a Water Security Test Bed (WSTB). The WSTB will be used to test water systems for improving security at municipal water infrastructures in the U.S., advance designs to create more resilient systems to guard again intentional and natural damage, and to evaluate water system contamination detection and decontamination technologies.

GE Hitachi Nuclear Energy Americas, LLC Signs Agreement to Re-establish the Capability to Use the GE-2000 Shipping Cask at ATR to Ship Cobalt Targets

GE-Hitachi signed an agreement for work to re-establish the capability to use the GE-2000 shipping container to ship high specific activity cobalt-60 targets. Following some target shipment failures, the company needs to design, fabricate and certify new containers for future shipments. Work includes reviews of all drawings and material certifications, execute visual, gamma spectroscopy, and X-ray fluorescence examinations, perform neutronic, thermal and structural analysis, develop an experiment safety assurance package, ensure compliance with ATR Safety Analysis Report requirements, and train ATR staff on inspection, handling, loading, and shipment of cobalt targets.

NuScale Modifies Work Agreents

NuScale Power is designing a Small Modular Reactor. INL is assisting in the modifications to the RELAP5-3D thermal hydraulics code to accommodate specific features in the NuScale reactor design. NuScale requested Nuclear Regulatory Commission Appendix K models that deal with critical flow and critical heat flux correlations be added to RELAP5-3D, along with NuScale's new correlations that specifically address helical coil heat transfer issues.

Babcock and Wilcox mPower, Inc. Requests Assistance in License Review

mPower™ is a small, scalable, modular nuclear power system being designed by Babcock and Wilcox's mPower, Inc. INL is providing assistance to B&W in the preparation of a license application to the Nuclear Regulatory Commission. Using RELAP5-3D, INL performed a detailed review of B&W's existing documentation and prepared formal documentation on the adequacy of the existing design as it relates to established scaling procedures. B&W Scaling Analysis, Test Matrix, and Data Handling Procedure, were studied and the results of the study were documented. INL also reviewed the RELAP5-3D code, quality assurance documentation, and manuals against current standards.

Eastern Idaho Technical College (EITC) Signs Agreement for Firefighting and Emergency Training

EITC signed an agreement for INL to provide access to INL's Firefighting and Training Facility to evaluate and certify firefighter professional competencies using live fire interior structures. This training will approximate actual fire conditions normally encountered by firefighters to included Class A (normal combustibles) storage rack fire, Class K (fryer oil) kitchen fire, Class C (electrical) power panel fire, and several other specified training sequences. Because of this unique facility, INL has trained a large number of first responders in the Intermountain Region.

AMETEK, Inc. Executed an Agreement for South Korean Army Portable Isotopic Neutron Spectroscopy (PINS) Training

AMETEK, Inc. signed an agreement for training in the use of PINS equipment, which supports on-site analysis of actual or suspect chemical warfare munitions. This training was provided to AMETEK and the South Korean Army in order to use this innovative, transportable and field-worthy version of the PINS system. Since 1992, PINS has been used around the world to reliably identify thousands of recovered chemical weapons, stockpile munitions, and other suspect containers of hazardous chemicals, all without the need to open or even touch the item under test.

Energy Storage and Transportation Systems Completes the Conductive Charging Test of the 15A and 30A Bosch Electric Vehicle Supply Equipment (EVSE)

INL executed an agreement to test Bosch's EVSE system, which provides the transfer of electrical energy from the utility outlet to an electric vehicle. The apparatus uses a Level 2 charging system meaning that it employs a 240 volt AC input, which is the primary and preferred method for charging vehicles in residential and commercial facilities. This work was carried out under the Advanced Vehicle Testing program under DOE's Vehicle Testing Office. Results are published at http://avt.inel.gov.

Idaho Power Executes an Agreement to Install transmission line monitoring systems and Determine Feasibility of Dynamic Operations

Idaho Power Company signed an agreement to have INL install a Power Line Monitoring System for wind and other data parameters along specified electrical transmission corridors. This real-time and historical data will be used for modeling, validation, and to support dynamic transmission operations. Data gathered may support the need for partial upgrades to certain areas/sections or determine the need for full line upgrades or new transmission lines.

The Institute for Energy Technology (IFE) in Norway Executes an Agreement for Petroleum Human Reliability Analysis

The Institute for Energy Technology (IFE; Norwegian: Institutt for Energiteknikk) is a private international research institution for energy and nuclear technology based in Norway. IFE is working on a project financed by the Research Council of Norway and Statoil, a major Norwegian petroleum company, to investigate human reliability factors. Called "Analysis of Human Action as Barriers in Major Accidents in the Petroleum Industry: Applicability of Human Reliability Analysis Methods," which details human intercations and safety analsyis to prevent accidents. The sharing of significant accident prevention knowledge held by the oil industry could prove to be crucial to the modernization of the U.S. nuclear fleet's power generation.

U.S. Department of Justice Modifies Agreements to include Wireless Spectrum Communications Video/Audio Surveillance Applications Platform R&D

DOJ has signed a modification to earlier agreements to use emerging wireless spectrum technologies at INL. This agreement will contribute to improved national security, while augmenting INL's National Security Technology Development and Demonstration, and Critical Infrastructure Protection mission in Wireless Communications.

Northrop Grumman Information Systems Contracts Work for EWCC MEPC II Project

INL is performing software maintenance for the Northrop Grumman's Electronic Warfare Common Component (EWCC) MEPC II Project, which provides a specific system requirement required by the U.S. Government. Specifically, this project supports mission planning objectives for unique planning components within the Joint Mission Planning Systems (JMPS) Enterprise. INL contributes to the maintenance of the legacy EWCC capabilities and documentation of its software.

Defense Nuclear Facilities Safety Board (DNFSB) Signs Agreement for Risk Assessment Training

DNFSB has signed an agreement for INL to assist in development of a risk assessment training curriculum and program. Aware of how the Nuclear Regulatory Commission (NRC) is using risk assessment information to prioritize resources and inspection activities, DNFSB ha sengaged the Laboratory to determine the appropriate training it needs from INL's library of more than 25 different risk assessment training courses used by the NRC on an annual basis.

J.R. Simplot Company Signs an Agreement to Develop an Early Warning Crop Stress Detection Support System

J.R. Simplot Company has signed an agreement with INL to develop a complete decision support solution for early detection of plant stress using hyperspectral sensors, near-earth aerial platforms, and Geographic Information System (GIS). selected INL because of its combined expertise in the areas of Unmanned Aircraft Systems, GIS and remote sensing expertise.

Sulphur Springs Valley Electric Cooperative Signs an Agreement for Two Propagation Studies

Sulphur Springs Valley Electric Cooperative (SSVEC) has signed agreements for INL to conduct two radio frequency propagation studies as part of a Smart Grid Investment Grant (SGIG) project. These studies will determine impact of wireless communications infrastructure and compliance with FCC requirements on or around the U.S.–Mexico border areas near Sonoita, Arizona.

Vergent Products, Inc. Signs an Agreement for Cellular SCADA Testing

Vergent Products signed an agreement for INL to test and evaluate newly developed supervisory control and data acquisition technology called the Universal Dynamic Controller (UDC). In an effort to update cell phone infrastructure, UDC enables remote, real-time monitoring and control of critical subsystems supporting cell towers. INL will use wireless testing capabilities to evaluate this innovation, which purports to convert a standard cell tower site to an active, remotely monitored and controlled "smart tower site."

AMETEK, Inc. Signs an Agreement for PINS Simulant Chemicals

AMETEK, Inc. signed a contract for INL to manufacture simulant chemicals that would be used in training operators of Portable Isotopic Neutron Spectroscopy (PINS) equipment. INL's PINS is a unique system developed specifically for on-site analysis of actual or suspected chemical warfare munitions. The contract provides for the design of PINS simulant chemicals that mimic the elemental signature of hazardous chemicals without the inherent danger.

Clemens Testing, Inc. Executes an Agreement for Testing of Entry Barriers

Greg Clemens signed a contract for the explosive testing of entry barriers that provide protection from multiple types of threats. INL will provide explosive testing data that can be used to determine the strength of barriers. Analysis of test data will provide an independent technical evaluation, results, and recommendation to improve the protection of facilities.

Technology-Based Economic Development Highlights

INL's Technology-Based Economic Development (TBED) Program strives to create and accelerate new tech-related industries, while also applying technology in traditional industries. The overarching goal is to stimulate a competitive Idaho, region and U.S.

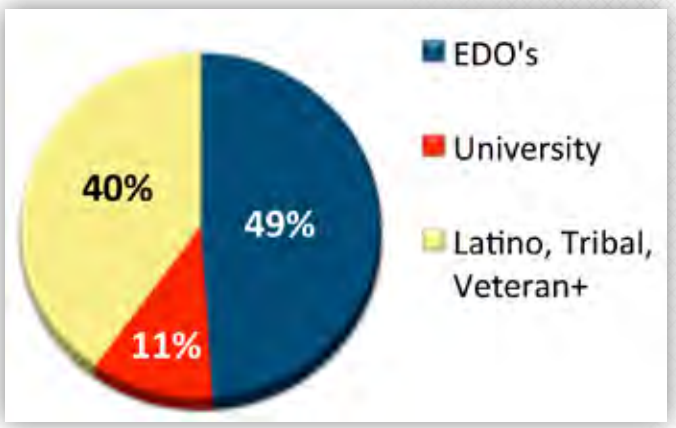
TBED efforts are having an impact. For INL in FY2014, Battelle Energy Alliance (BEA) corporate funding was leveraged to inspire entrepreneurship, innovation, economic development and technology-based economic development throughout the region. BEA corporate funding aided key activities for economic development organizations in communities, colleges and universities, as well as economic development in rural areas and for Latino, Tribal and Veteran based organizations in the region.

Stephanie Cook, INL's Technology-Based Economic Development Program Manager, emphasized the progress using BEA funding saying, "We invest in economic development organizations because they are front and center in creating good paying jobs in our area."

Citing benefits to the southern Idaho region, she noted "Three organizations rolled up their sleeves and went to work. Southern Idaho Economic Development in cooperation with the College of Southern Idaho and Business Plus pulled together a powerful regional program that delivered $800 million dollars in capital investment and created 5,000 jobs."

"It's their success, but we're happy to have played a part in making it a reality," she added.

In addition, for every dollar BEA contributes in charitable giving, almost $19 was returned to Idaho's communities, which is equivalent to leveraging nearly $2.3 million.



Each year Battelle Energy Alliance corporate funding contributes significantly to the region. In FY2014, 49 percent of the funding supported regional economic development organizations, 11 percent enabled university and college connections, and 40 percent benefited rural communities, Latino, Tribal, and Veterans.

Success Distinguished FY2014

Some selected successes supported by TBED grants, include:

- Boise State University's Tec Center received an INL TBED grant for a Shared Advanced Manufacturing laboratory. Funding provided equipment, including a 3D printer to support startups, entrepreneurs and small manufacturers in the Boise area.
- The Nez Perce Tribe, Department of Technology Services, received a small INL TBED grant to purchase 2,500 feet of fiber optic cable, which was used to connect their emerging startup business center to the broadband network in North Central Idaho.

- "Land. Here." INL is participating with the State of Idaho in a variety of activities to highlight a growing Unmanned Aerial Systems (UAS) industry cluster in the state. TBED collaborated with the Department of Commerce and two eastern Idaho economic development organizations to attract research to the region. INL's UAS expert attended the 2014 Autonomous Unmanned Vehicle Systems International (AUVSI) conference with the Idaho team to promote research capabilities and resources, including sensors and data collection, battery research and advanced modeling and simulation. UAS systems have application within agricultural communities for crop management, emergency first responders, land and herd management, and more.

Chadd VanKomen with Boise-based start-up Chase Innovations uses the Shared Advanced Manufacturing laboratory 3-D printer at Boise State University's Tec Center to print ABS plastic circuit board cases. INL's Technology-Based Economic Development grant purchased the 3-D printer for the lab.

Dr. Todd Allen

Approximately one-third of the Wyakin Warriors are studying science, technology, engineering and math, commonly referred to as STEM related subjects.

- INL's Deputy Laboratory Director, Dr. Todd Allen provided the keynote address to more than 250 community and business leaders in northern Idaho during the Jobs Plus annual meeting at the Coeur d'Alene Resort in March. Dr. Allen shared the mission of INL and shared details about having a national laboratory in Idaho as a regional asset. Jobs Plus is the economic development organization chartered with recruiting and retaining jobs in the Coeur d'Alene northern Idaho area. Jobs Plus highlighted the successful creation of nearly 200 jobs, the recruitment of Alliance Data, and the expansion of Kootenai Health systems during the past year. The emergence of an aerospace industry cluster along with a focus on technology and innovation based startups are an evolving emphasis area for Kootenai County's growth strategy.
- A TBED grant was awarded to the Wyakin Warrior Foundation, enabling 27 wounded or injured veterans to seize an opportunity to transition from serving their country on the battlefield to pursuing their college degrees. The Wyakin Warrior Foundation motto is "Battle Tested. Business Ready." With a 100 percent placement rate, the multi-faceted mentoring program is built on a foundation of service to community, professional training and business networks and positions Wyakin Warriors for success as business and community leaders.
- Since 2000, thirty-two rural communities with populations below 10,000 have participated in Idaho Rural Partnership's, Community Review Program. During FY2014, the communities of Sandpoint, Aberdeen and Rigby in Idaho completed reviews that provided observations, recommendations and resources to improve local economies and develop community assets. Communities use the Community Review recommendations to help develop strategic plans, obtain funding for infrastructure, downtown revitalization and to address concerns related to job creation and economic development.

The 2014 BIG contest featured more than $5,000 in prizes for winners in two tracks, collegiate and community. The semi-finals were held April 3 at the Idaho State University (ISU) College of Technology and the finals were held April 4 at the ISU College of Business.

"It has been a wonderful collaboration among Idaho National Lab, Idaho State University and our other sponsors," said Howard Grimes, ISU Vice President for Research and Economic Development. "We doubled the number of competitors this year and many of these technologies will have tremendous impact in our region and beyond."

Since 2000, the Idaho Rural Partnership has completed thirty-two community reviews across the state in cities with populations with fewer than 10,000 people.

Technical Assistance Program (TAP)

INL's Technical Assistance program (TAP) enabled the sharing of knowledge and specialized equipment to promote U.S. competitiveness.

During FY2014, the TAP program:

- Provided assistance that is not commercially available in the region,
- Supported with up to 40 hours of INL technical assistance without charge to the recipient,
- Assisted tech-based businesses in overcoming difficulty barriers, and
- Provided 216 hours of support to nine requesters.

Between 2005 and 2014, TAP has sponsored 8,556 hours of assistance to entrepreneurs, small businesses and rural communities. In FY2014, nine TAPs with 216 hours of assistance were provided.

Continuing to adapt the program, TAP funding supported innovative approaches to speed technologies to market, including:

- INL's Sophia "System and Method for Monitoring Communications on a Network" software was licensed to a startup, NexDefense in the cyber security space. TAP funding supported the transfer of knowledge between INL and the NexDefense programming teams. The next iteration software may soon be used to protect our nation's critical infrastructure.
- INL staff characterized and tested samples of nano materials relevant to research and development for a future armor concept that may one day be used to protect our troops.

INL's Technical Assistance Program provided funding for testing the rapid energetic reaction of a future armor concept under ballistic impact.

Each year, Business + Innovation + Growth, known as BIG, hosts an entrepreneurial startup educational competition. The 2014 winners are left to right, Larry Teckmeyer and Craig Jorgensen won the Community Track. Hye Joon Lee and Brent Singley won the Collegiate Track. Photos courtesy of ISU Photographic Services.

Brigham Young University- Idaho students competed in an aerospace design contest to design, build and test a remote airplane using funds provided by INL's TBED grant.

An eastern Idaho startup company accessed INL's capabilities in order to characterize silicon carbide fibers and perform data analytics on a patent-pending continuous manufacturing process. The lighter, stronger silicon carbide fibers could be used in the transportation, energy and defense market sectors.

- INL's TBED program sponsored the Idaho Economic Development Association's (IEDA) Fall conference. Collaborating with IEDA and Idaho Power, INL joined in hosting the International Economic Development Council's (IEDC) president and CEO, Jeffrey Finkle. IEDC is the world's largest membership organization serving the economic development profession with a mission to create more high-quality jobs, develop vibrant communities and improve the quality of life in the region. Finkle shared his knowledge and expertise with the group of seventy professionals from around the region and talked about fostering economic, workforce development and national trends.

Advancing nuclear fuels research using INL's Technical Assistance Program, Idaho State University obtained glass blowing expertise for an experiment to develop a method to manufacture depleted uranium microspheres for basic materials science research. This process required the drip-casting of an alginate (sea weed extract) slurry containing uranium oxide, which produced a hardening solution. To advance this project, a tumble drying technique required the isolation of the drying spheres within a vented, rotating glass cylinder.

International Economic Development Council's (IEDC) president and CEO, Jeffrey Finkle addresses more than seventy economic development professionals from around the region during the Idaho Economic Development Association's (IEDA) Fall conference.

INTERNATIONAL ECONOMIC DEVELOPMENT COUNCIL

The Power of Knowledge and Leadership

INL delivers successful, award-winning year

By Keith Arterburn

Idaho National Laboratory had a highly productive year marked with record-setting earnings in royalties, successful deployment of innovative technologies and several award-winning performances.

Deployment of INL technologies was underscored by earnings in excess of $3.4 million, which is more than double the earnings from the previous year. This increase in royalties reflects a legacy of strong innovation during the past decade and signals a healthy return on investment for the American taxpayer's investment in Idaho National Laboratory.

The availability and pilot testing of a couple of INL technologies demonstrated successful deployment strategies. Sophia is an INL-developed Industrial Control System Fingerprinting Software Tool, which passively monitors infrastructure and informs management about anomalies for further investigation or protective actions. This innovative technology was developed at INL and was made available commercially after extensive beta-testing by dozens of enterprises.

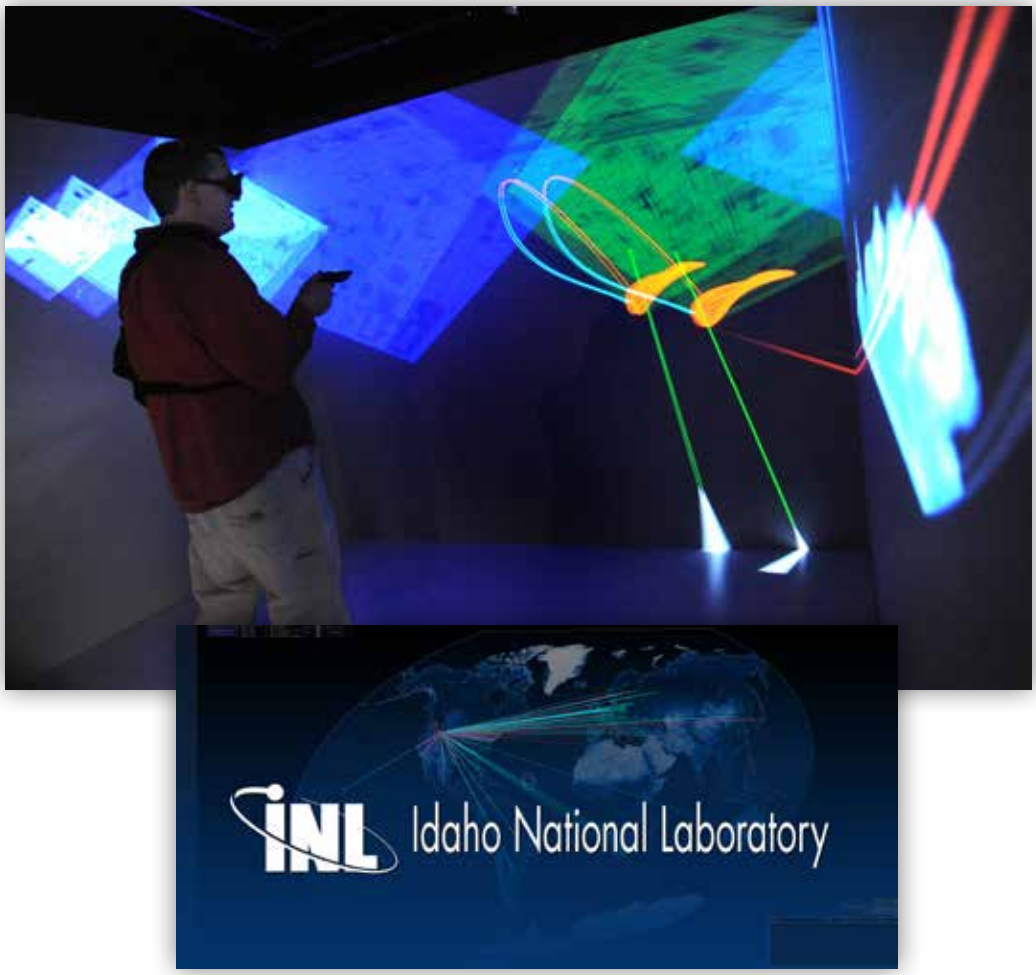
"Licensing of industrial control system cyber security software, a niche application in a relatively large market, has been an exceptional challenge," said INL Senior Commercialization Manager Mark Kaczor. "With Sophia, our successful Alpha and Beta test programs enabled our Licensee to launch a commercial version, with customers, in a fraction of the time that it usually takes to transition from lab to market. As a result of the combined efforts, INL and the company are becoming nationally recognized for special contributions to protecting America's critical infrastructure."

In support of efforts to commercialize Sophia, INL successfully defended the licensed intellectual property through infringement litigation. This permitted licensing of Sophia to NexDefense, Inc., a start-up company based in Atlanta, GA. NexDefense has recently announced the commercial availability of Sophia as an Industrial Network Anomaly Detection System (http://www.prweb.com/releases/2014/11/prweb12336338.htm).

In their announcement, Michael Assante, NexDefense's co-founder and chief security strategist said, "The emerging cyber threats to our nations' critical infrastructure – such as power plants, oil refineries and defense facilities –have the extraordinary capacity to negatively impact millions of people and commerce, all at once, and for prolonged periods of time."

"All companies whose day-to-day operations are powered by automation or control systems will benefit from Sophia's intuitiveness, flexibility and proactivity in uncovering anomalies that might signify intrusion or loss of control," Assante emphasized.

NexDefense's Technical Director Tim Conway, added, "In recent years control systems professionals have seen a significant spike in reported vulnerabilities and attacks that have the potential to impact operations. With NexDefense's commercial release of Sophia, operators of our nations' most critical infrastructure gain the capacity to proactively detect and respond to abnormal behavior within their control system environments, and integrate that situational awareness information into real time system operation decision making."



Another INL technology, the Transmission Line Monitor (TLM), has been licensed by Lindsey Manufacturing Inc. and successfully deployed as Lindsey's Transmission Line Monitor (TLM) product. Lindsey has started its most current pilot project on ENMAX Corporation power lines near Calgary, Canada. This is in addition to several other locations where Lindsey has installed the TLM pilot projects that include Salt River Project, Buck Eye AZ; San Diego Gas & Electric, Escondido CA; Southern Company , Rome GA; Southern California Edison, Lancaster CA; and Los Angeles Department of Water and Power, Los Angeles CA. (www.lindsey-usa.com).

In announcing the recent pilot project, Lindsey Vice President Philip Spillane said, "The Lindsey TLM device and Endpoint data gateway have enjoyed a broad geographical deployment for Dynamic Line Rating and Conductor Clearance pilot projects in both private and public utilities in the United States and Canada. The device has performed flawlessly from day one, with rock solid engineering, design, and manufacture from the INL team."

Deployment of technologies also includes competing for recognition among some of the best innovations and discoveries in the world. During 2014, INL researchers won their 49th and 50th prestigious international R&D 100 Awards.

INL's Multiphysics Object Oriented Simulation Environment won the 2014 R&D 100 Award by offering a framework that makes it easier for scientists to predict phenomena ranging from nuclear fuel and reactor performance to groundwater and chemical movement. Called MOOSE, it speeds the pace of scientific discovery that traditionally required more computing resources than most scientists and engineers could readily access. MOOSE has spawned a large number of other research tools addressing nuclear reactor design, microscopic response of nuclear fuel to irradiation, chemicals flowing through bedrock, as well as water and heat flow in geothermal reservoirs. (Video at www.inl.gov/moosevideo.)

The development and deployment of MOOSE also involved extensive efforts to commercialize the software simulation, earning a prestigious award from the Federal Laboratory Consortium.

Senior Commercialization Manager Gary Smith said, "We are very pleased with the recognition by Federal Laboratory Consortium (Far West) for our efforts here at INL to commercialize MOOSE."

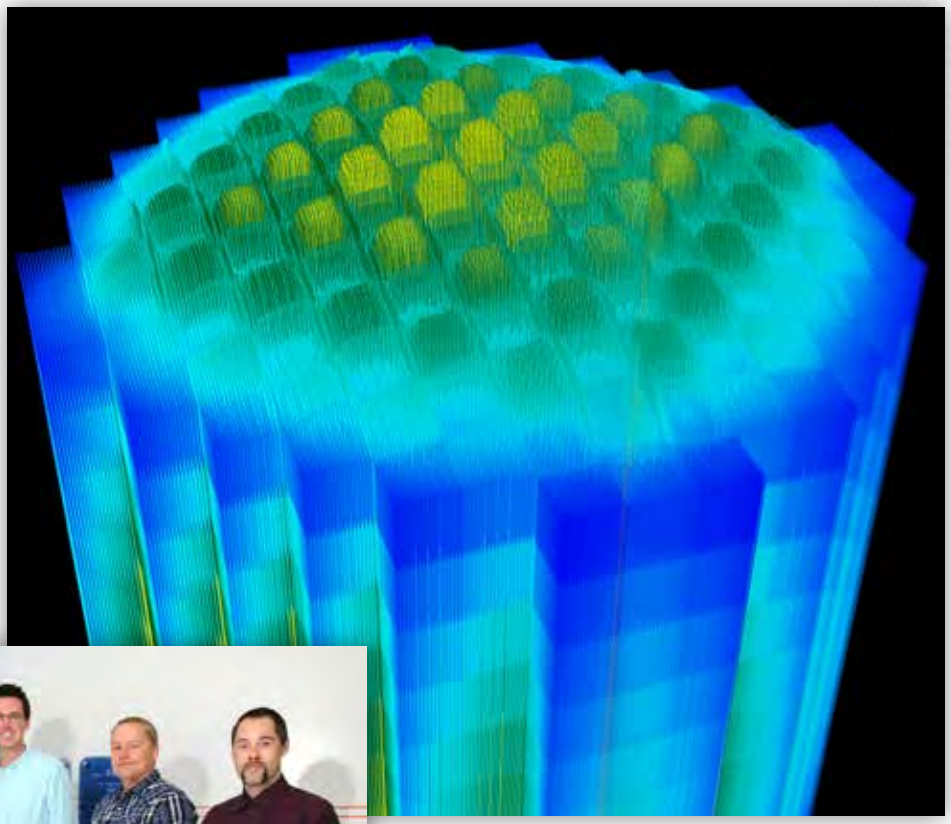
Created by a dedicated team of highly skilled modeling and simulation code developers at INL, MOOSE has evolved very rapidly. A select group of companies and universities were licensed by INL to help beta test and improve upon the original code. Then, INL began deploying this software through traditional royalty-free copyright license agreements to a core group of national laboratories, universities and commercial users.

In 2014, INL had 50 active license agreements, including 17 domestic laboratories and commercial users, 25 domestic universities, 3 international commercial users, and 5 international universities.

With a goal of delivering free worldwide distribution of MOOSE, INL decided for the first time to pursue an open source software (OSS) licensing strategy. In Feb. 2014, DOE approved use of the OSS model to distribute MOOSE using Free Software Foundation, Inc.'s LGPL Version 2.1.

As of the end of FY2014, more than 3,600 unique users have visited the MOOSE website for a total page visits exceeding 28,000. OSS licensing therefore represents a potential 50-fold increase in total users during a five month period. By using OSS licensing, MOOSE is helping accelerate the pace of scientific discovery and engineering innovation.

"It is extremely important that national laboratories deliver a return on investment from the American taxpayer," Smith added. "MOOSE expedites research, reduces costs and advances our pursuit for solutions to key problems."



Multiphysics Object Oriented Simulation Environment team members Left to right: David Andrs, Cody Permann, Andrew Slaughter, Richard Martineau, Derek Gaston (Principal Investigator), JW Peterson, Jason Miller.

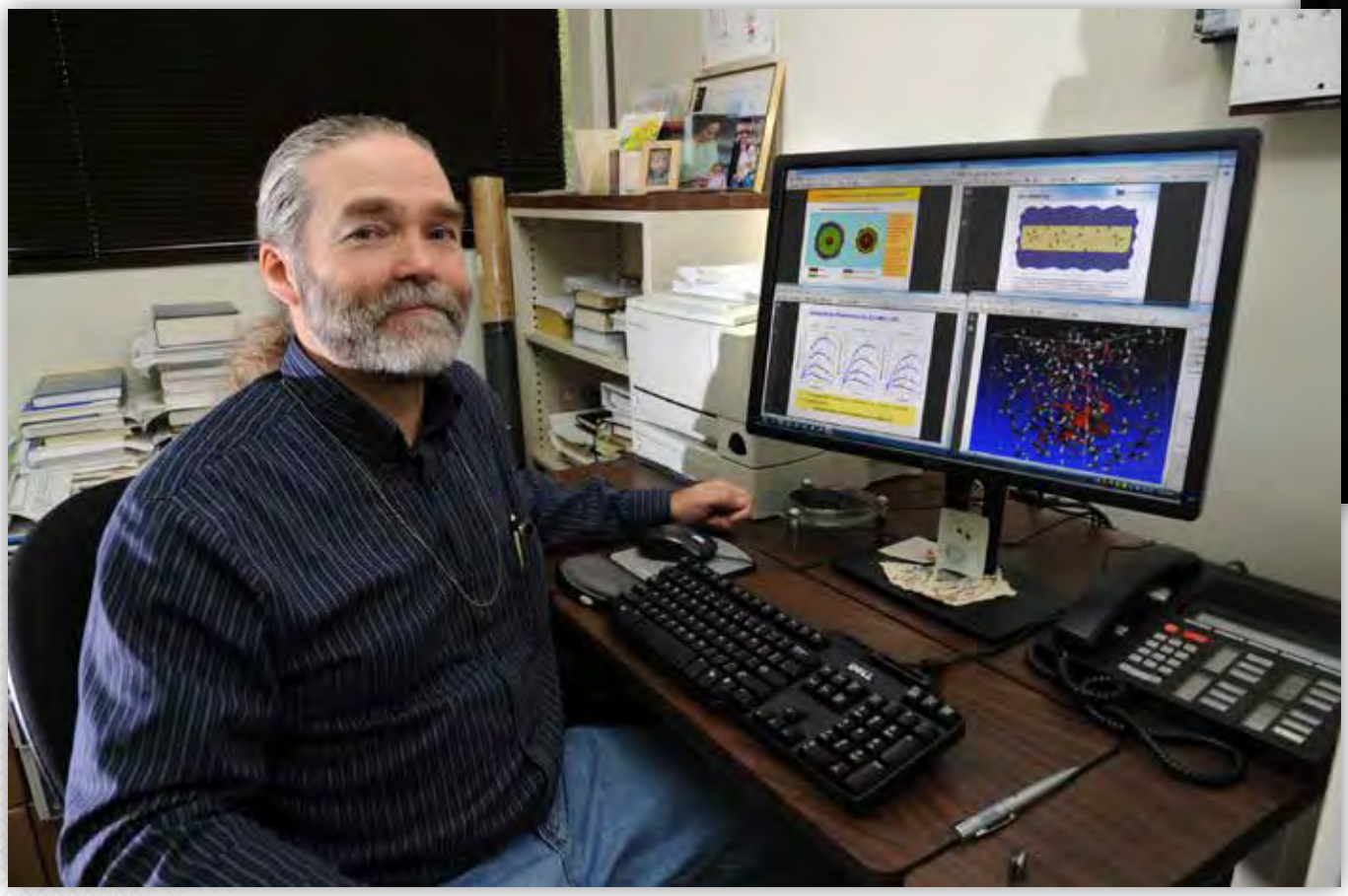
INL's other 2014 R&D 100 Award winner also is a modeling software called Advanced Electrolyte Model (AEM). A 'disruptive, virtual scientific simulation tool,' AEM delivers to industry a DNA-like investigation of electrolytes.

Developed by INL researcher Dr. Kevin Gering, AEM pulled off a trifecta winning two additional awards during 2014 earning recognition from the Federal Laboratory Consortium (Far West) and the Idaho Innovation Award competition. It is a copyrighted, molecular-based, scientifically proven simulation tool. It revolutionizes electrolyte selection, optimizing material combinations and key design elements to make battery design and experimentation quick, accurate and responsive to specific needs. AEM predicts and catalogs electrolyte metrics, evaluating and comparing more than 35 parameters to recommend optimal solutions.

Gering's AEM proved its value in aiding the Dow Chemical Company in developing a new battery electrolyte. Dow's Doug Brune said, "The (AEM) narrowed down our choices and identified solvents we hadn't considered" and "the model saved us a lot of time" (e.g. conducted 300 experiments instead of 1,000).

Battery Design Studio President Robert Spotnitz said AEM "has simplified the design process for lithium-ion batteries which are used in many markets, including consumer, aerospace, military and automotive."

A genome-level investigation that delivers massive amounts of information to evaluate electrolytes, AEM simulates, diagnoses and predicts electrolyte behaviors and interactions, and the properties that emanate from them. (Video at www.inl.gov/aem)



INL is one of the U.S. Department of Energy's Multiprogram national laboratories and is managed by Battelle Energy Alliance, LLC.

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