

Technology Deployment

Annual Report FY 2012



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 institutions 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.

Disclaimer

This information was prepared as an account of work sponsored by an agency of the U.S. Government. Neither the U.S. government nor any agency thereof, nor any of their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness, of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. References herein to any specific commercial product, process, or service by trade name, trade mark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the U.S. government or any agency thereof.

Contents

From the Laboratory Director.....	2
From the Technology Deployment Director	3
Intellectual Property	4
The Impact of Technology Deployment.....	14
Granted Copyrights.....	16
Royalties and Licenses	17
Cooperative Research and Development Agreements.....	22
Work For Others.....	25
Technology-Based Economic Development.....	28
Technical Assistance Program	31
New Faces in Technology Deployment	31
INL's WSComm wins 2012 R&D 100 Award, more recognition.....	32

From the Laboratory Director



During the past eight years that Battelle Energy Alliance (BEA) has managed Idaho National Laboratory (INL), excellent progress has been made in pursuing the vision as the nation's nuclear energy research and multi-mission laboratory. INL has gained significant capabilities in nuclear science and technology, national and homeland security, and energy and environment research. We have added skilled researchers in many important areas, erected new laboratory facilities, expanded test platforms,

and explored innovative approaches to our multiple missions.

Accompanying these research advancements, Technology Deployment (TD) has improved internal business efficiencies and accelerated relationship building with industry, academia and other national laboratories. By engaging in both strategic and tactical reviews of how we process work agreements, including Collaborative Research and Development Agreements (CRADAs) and Work for Others (WFOs) agreements with our government and industry collaborators, TD helped INL significantly improve agreement turnaround times. As a result, INL now maintains best-in-class CRADA and WFO agreement review processes, when ranked against other Department of Energy (DOE) national laboratories.

During FY2012, TD had an impressive year supporting INL in establishing 46 impactful strategic industry relationships, some with very recognizable names such as Curtiss-Wright, Babcock and Wilcox, Electric Power Research Institute, TerraPower, Westinghouse, and Exxon. In addition to building business relationships under CRADAs and WFOs, TD also transferred INL intellectual property through more than 130 executed licenses, an increase of more than 175 percent above INL's three year average.

From the business perspective, the agreements TD helped the Lab put in place more than doubled the total funds received during FY2011 and far surpassed DOE's 2012 performance goals for the use of research matching funds. Royalties earned from INL's licensed intellectual property were up as well, exceeding FY2011 by more than 40 percent and nearly reaching INL's record year established in FY2009. In addition, federal WFO funding doubled from FY2011, achieving \$126 million funds-in for FY2012.

At the heart of process streamlining efforts were several TD led innovative programs that yielded major improvements for DOE technology transfer efforts. These included a fast-track project to streamline CRADA approvals, implementation of policies and procedures to enable INL to participate under the pilot of DOE's new Agreements to Commercialize Technology (ACT) program, innovations through DOE's Technology Transfer Working Group (TTWG), Battelle Commercialization Council initiatives, creating statement of work drafting guidance, and testing the execution of a new online licensing process for 30 agreements.

"INL now maintains best-in-class CRADA and WFO agreement review processes, when ranked against other DOE national laboratories."

John J. Grossenbacher
Director, Idaho National Laboratory

These relationship, business and process accomplishments demonstrate that INL researchers, business managers, and staff successfully compete globally. TD's proactive engagement across the DOE complex attests to the impact of its aggressive operational review and improvement regimen. The overall impact on INL's contribution to DOE's technology deployment mission has been significant.

The work from FY2012 also resulted in important external recognition. INL researchers earned another R&D 100 award this year, raising INL's total to 47 R&D 100 Awards since 1986. INL's Wireless Spectrum Communications (WSCComm) technology offers solutions to expanding the use and availability of the radio frequency spectrum that connects emergency and routine mobile phone service. The WSCComm research and TD team were also selected for a Federal Laboratory Consortium – Far West (FLC FW) award for outstanding technology development and were finalists for the regional Idaho Innovation Award in the same category. Additionally, the FLC FW selected two individuals from our TD staff for recognition this year for their efforts in technology transfer. You'll find more details about these awards in this report.

Regionally, INL continues to make major contributions to the entrepreneurial ecosystem, working in collaboration with Idaho TechConnect to help start-up companies obtain more than \$37 million in financing during the past several years. TD's Technology-Based Economic Development sponsored 24 Kickstand business networking events, supported 20 teams of university students and innovators in the ninth edition of TechLaunch, and aided 142 small businesses in seeking federal funding.

Our researchers generated 88 Invention Disclosure Records and were issued 38 patents during the year, which helped our eight year total reach nearly 330 issued patents. Since 2005, INL has filed nearly 375 patent applications.

This annual summary contains interesting details about INL's deployment of technology, intellectual property management and capability to attract and negotiate work. This snapshot of FY2012 gives some excellent insight on the return to America's taxpayer for their investment in the Idaho National Laboratory and its exceptional researchers.

A handwritten signature in black ink, appearing to read "John J. Grossenbacher". The signature is fluid and cursive.

John Grossenbacher
Director, Idaho National Laboratory

From the Technology Deployment Director



During the past three years, Technology Deployment (TD) management and staff have completed more than 80 strategic initiatives and specific actions to make impactful improvements in our operational support for INL missions. This is a significant accomplishment, which required TD to accept greater responsibilities and exceed normal work expectations.

Key to our abilities to make these improvements has been a focused, coordinated strategic approach, along with careful listening to direc-

tors, managers, and researchers in research directorates. Integrating their programmatic planning for retention and expansion with our responsibilities to facilitate work agreements and commercialize the resulting intellectual property has been challenging.

The credit for these improvements goes to the TD staff members who have worked diligently to evaluate processes, leverage technology and innovate with better practices to respond to the concerns of our research directorate teams. Successful efforts during FY2012 helped TD to finalize our strategic path and solidify new relationships to make even greater contributions to INL missions. Our focus continues to be to **Increase Value to INL Missions, Improve Operations, and Implement a Performance-Based Culture.**

FY2012 was a strong year for successful performances, key achievements and some much appreciated recognition for TD. For example, during 2012 INL negotiated a half dozen license agreements under the aegis of DOE's Start Up America program, which was announced last year by Secretary of Energy Steven Chu. Commercialization Manager Lisa Nate worked on four agreements in this program, three of which were signed by Idaho's Premier Technology, Inc. of Blackfoot.

Also during FY2012, TD continued sponsoring a six-seminar series presented by Technology Ventures Corporation on the business processes for deploying technologies. Taught at the graduate level, the seminar series has offered nearly a hundred INL researchers and staff the benefit of insights from accomplished professionals. Through this seminar and other efforts, TD is committed to creating an even stronger innovative and entrepreneurial eco-culture.

The Federal Laboratory Consortium – Far West recognized TD for its contributions to the Laboratory's missions. Lisa Nate was honored for developing a successful partnership in industry with Lindsey Manufacturing to advance an INL technology to protect high-voltage transmission lines from sabotage. Wireless expert Hussein Moradi and Senior Commercialization Manager Mark Kaczor earned their outstanding early stage technology award for the Wireless Spectrum Communications. My deputy, Jason Stolworthy, was selected as Technology Transfer Professional of the Year for a long list of contributions within the commercialization community.

“Now, we are focused on the future with a strategic plan for 2013 and beyond.”

Steven T. McMaster,
Director, Technology Deployment

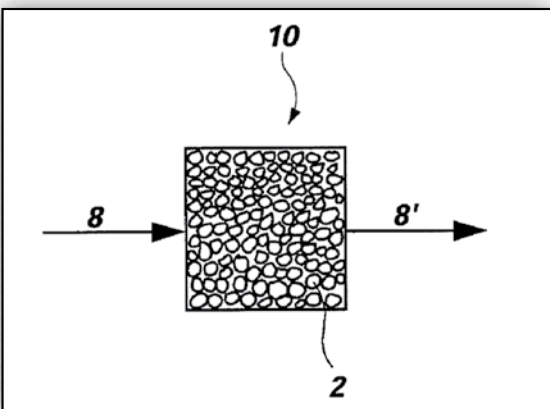
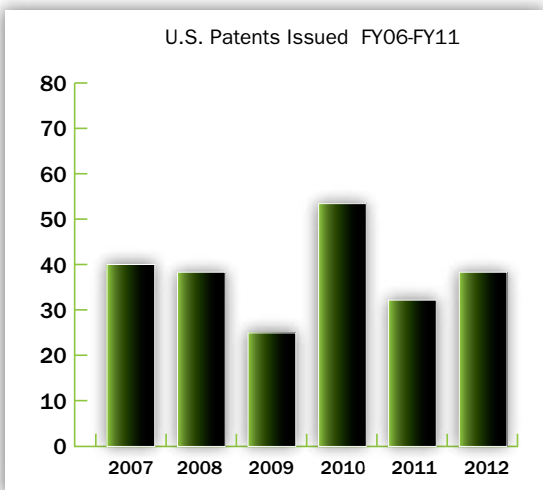
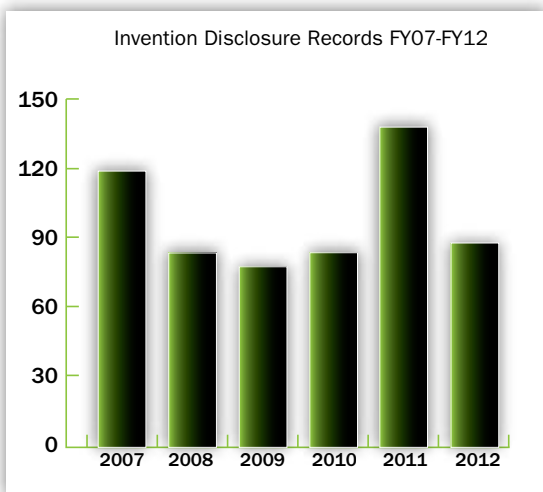
Also during FY2012, TD hired two new talented commercialization managers – Ryan Bills and Aaron Sauer. Ryan supports Energy and Environment commercialization efforts, while Aaron assists in Nuclear Science and Technology.

Our annual report details efforts to deploy technologies during FY2012 and includes some key performance statistics that reveal the impact of INL's enterprise-wide efforts. During this past year, U.S. businesses sold more than \$46 million in products and processes that are based on INL patented technologies. Since 2005, INL has:

- Generated 776 invention disclosure records, filed nearly 375 patent applications and received nearly 330 issued patents.
 - In FY2012, 88 Invention Disclosure Records were submitted and 38 patents were issued to INL.
- Earned more than \$9 million in royalties from nearly 730 licensed technologies, including \$1.58 million dollars during 2012.
 - In FY2012, 132 licenses were negotiated including 4 new and 12 modified patent licenses, 61 RELAP licenses and 55 software copyright licenses.
- Signed 141 Cooperative Research and Development Agreements (CRADAs) worth nearly \$253 million.
 - During FY2012, 18 new CRADAs were signed and 12 were modified at a value of \$45.27 million.
- Attracted 384 projects, representing nearly \$1.246 billion in our contracted Work For Others (WFOs other than DOE).
 - In FY2012, nearly 38 new projects were added and more than 284 projects were modified at a value of \$130 million.
- Assisted more than 720 high technology enterprises in making inquiries into federal funding opportunities.
 - Technology-Based Economic Development assisted 142 individuals and companies in FY2012.

Now, we are focused on the future with a strategic plan for 2013 and beyond that clearly articulates how TD can make contributions to INL's 2020 strategy. As has been stated many times before, innovation at INL and our ability to effectively deploy technologies are essential for the growth and prosperity of America, INL and its many collaborative partners.

Steven T. McMaster
Director, Technology Deployment



Intellectual Property

Idaho National Laboratory's portfolio of Intellectual Property (IP) includes requested and granted copyrights, filed patent applications and issued patents. These are a basis for working with national laboratories and federal agencies, commercial enterprises, academia and other parties. IP portfolios are a key measure of the institution's ability to do creative, meaningful research.

Technology Deployment (TD) works closely with researchers and management of INL's directorates to identify and pursue technology commercialization and business development opportunities.

In 2012, 88 Invention Disclosures Records (IDRs) were submitted to Battelle Energy Alliance (BEA) by INL inventors. These include 38 from Energy and Environment Science and Technology (EEST), 26 from Nuclear Science and Technology (NST), 19 from National and Homeland Security Science and Technology (NHS) and 5 from other INL departments.

Thirty-eight U.S. patents were issued either to INL or DOE, based on the inventions of INL scientists and researchers. These included 19 from EEST, and 10 from NST and 9 NHS.

In addition, TD filed 26 new patent applications (20 from EEST, 4 from NHS, and 2 from NST).

During the past eight years, INL researchers have generated 776 IDRs, filed nearly 375 patent applications and received nearly 330 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 title to the technology for patent protection with the final funding decision made 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 38 patents issued to INL inventors during FY2012 is provided on the following pages.

Methods of Using Adsorption Media for Separating or Removing Constituents

A patent was issued for this invention to Nicholas Mann, Scott Herbst, Terry Todd, and Troy Tranter. Trace amounts of arsenic can cause bladder and lung cancer. Arsenic in drinking water affects millions of people around the world, including more than 4,000 municipal water supplies and potentially tens of thousands of private drinking water supplies in the U.S. Derived from INL's decades of nuclear fuel expertise, this 2006 R&D 100 award winning invention is a low cost ion exchange resin that reduces arsenic contamination to safe levels and licensed to Water Technologies, Inc.

Patent Number: 8,043,586

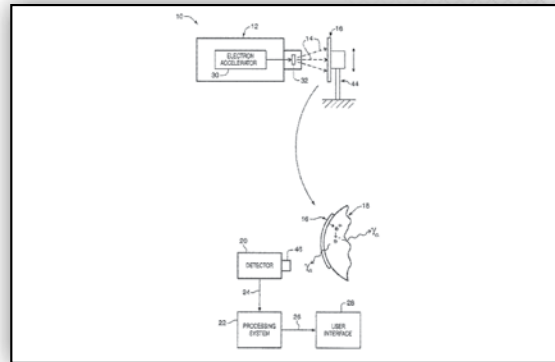
Issued: Oct. 25, 2011

Non-Destructive Testing Method and Apparatus

This patent was issued to Doug Akers. To assess the remaining life of components such as aircraft engines, nuclear reactor fuels and battery materials, it's important to be able to detect material damage that may not be visible to the eye. This invention induces short-lived radioactive materials that produce positrons, which interact with the material's atomic structure and yield critical information about damage up to 2 inches inside the component. These data are critical for assessing the safety of components and developing new materials and improved component designs.

Patent Number: 8,031,825

Issued: Oct. 4, 2011

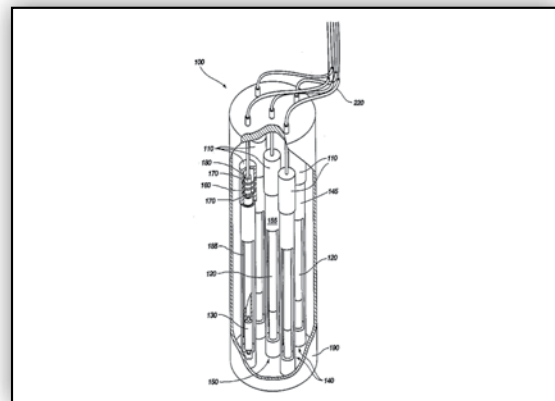


Apparatus and Systems for Measuring Elongation of Objects, Methods of Measuring, and Reactor

This patent was issued to Carl Stoots, Darrell Knudson, Joshua Daw, Joy Rempe, and Keith Condie. Some materials elongate when exposed to high temperatures or loads. This behavior differs when they are also exposed to radiation. A new method enables real-time elongation measurements from within high-temperature irradiation test capsules containing inert gases. The approach eliminates costs and errors that can arise when samples are irradiated for a period of time, removed and measured, then returned to the reactor for multiple cycles.

Patent Number: 8,065,810

Issued: Nov. 29, 2011

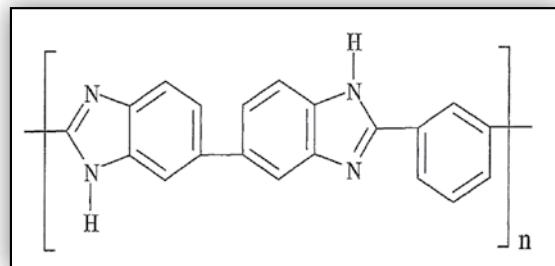


Polybenzimidazole (PBI) Compounds

This patent was issued to Alan Wertsching, Christopher Orme, Eric Peterson, John Klaehn, Michael Jones, Tammy Trowbridge, and Thomas Luther for an invention that provides an improved method to make Polybenzimidazole (PBI). PBI is used in many commercial products, including ink-jet printing, lithography, organic transistors and fuel cells. It also is useful for gas separation, chromatography, ion-affinity, filtration, flame-retardants, and waveguides.

Patent Number: 8,063,174

Issued: Nov. 22, 2011

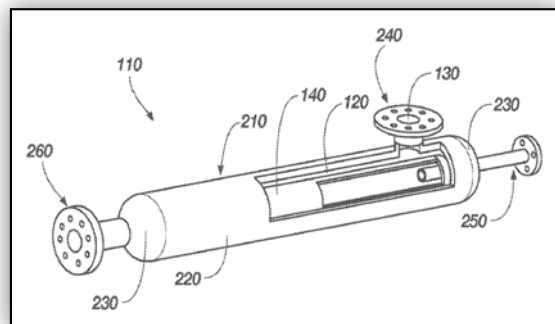


Heat Exchangers Comprising at least One Porous Member Positioned within a Casing

This patent was issued to Bruce Wilding and Terry Turner for an innovative method and device that addresses the difficulties in industry of managing solid carbon dioxide in natural gas. This patented device was one among a suite supporting INL's Compact Liquefied Natural Gas technologies, which won a 2006 R&D 100 Award

Patent Number: 8,061,413

Issued: Nov. 22, 2011



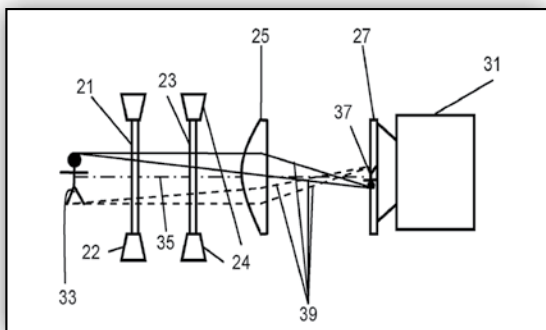


Sequential Injection Gas Guns for Accelerating Projectiles

This patent was issued to Henry Chu, Jeffrey Lacy, and Stephen Novascone. This invention enables investigation of dynamic material properties in a laboratory setting without the use of explosives. This scalable multi-stage gas gun provides feedback control of the projectile velocity and can accelerate projectiles at very precise velocities into targets.

Patent Number: 8,056,462

Issued: Nov. 15, 2011

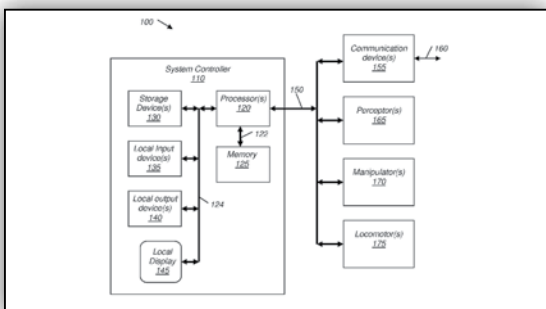


Device for Imaging Scenes with Very Large Ranges of Intensity

This patent was issued to Vance Deason. A number of industrial and scientific imaging tasks need to resolve both very bright and relatively dim regions simultaneously. Examples include weld vision, plasma torches, lamp filaments, laser beams or solar flares, which involve wide ranges of light intensity that make imaging difficult. This invention addresses the problem and allows viewing of arc welding operations by a camera in a radiation field.

Patent Number: 8,058,608

Issued: Nov. 15, 2011

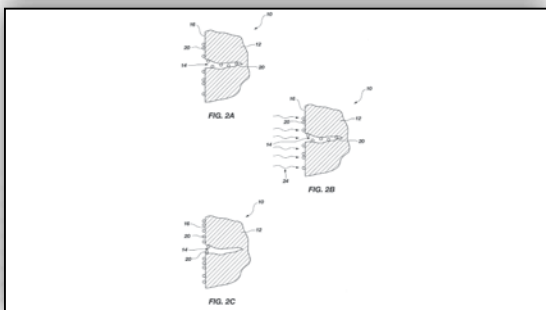


Multi-Robot Control Interface

This patent was issued to David Bruemmer and Miles Walton for INL's Multi-Robot Control Interface, which allows all team members, including robots and humans, to maintain awareness of the environment and cooperatively pursue mission objectives. While most remote robotic systems currently use multiple operators to control a single robot, a major advantage of this interface is that it permits one operator to monitor and task multiple robots efficiently.

Patent Number: 8,073,564

Issued: Dec. 6, 2011

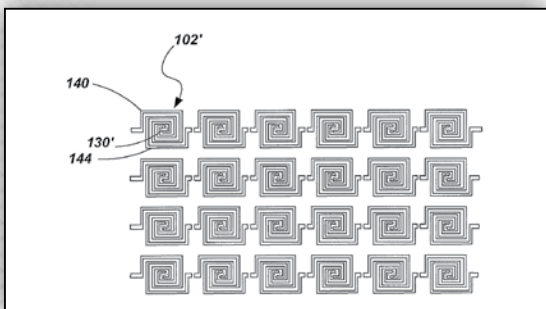


Systems and Strippable Coatings for Decontaminating Structures that Include Porous Material

This patent was issued to Gary Groenewold, Recep Avci and Robert Fox. Metals and radionuclides absorbed into porous solid materials can be difficult to remove. This new invention uses a laser to re-distribute the contamination to the surface for easier removal by the laser or a decontamination mechanism.

Patent Number: 8,070,881

Issued: Dec. 6, 2011



Structures, Systems and Methods for Harvesting Energy from Electromagnetic Radiation

This patent was issued to Dale Kotter, Patrick Pinhero and Steven Novack. One alternative to silicon-based electromagnetic energy conversion may be inexpensive nano-antennae that can be printed on flexible substrates. They can convert low frequency heat radiation and higher frequency visible light into electricity. This technology is licensed to Red Wave Energy, Inc. for further development.

Patent Number: 8,071,931

Issued: Dec. 6, 2011

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

This patent was issued to David Thompson, David Reed, Jeffrey Lacey, Vicki Thompson, and William Apel. Certain heat-resistant organisms make proteins that could enhance economical production of biofuels and chemicals. This invention describes a method for using the organisms to produce such enzymes, which have significant promise in biomass conversion applications

Patent Number: 8,071,748

Issued: Dec. 6, 2011

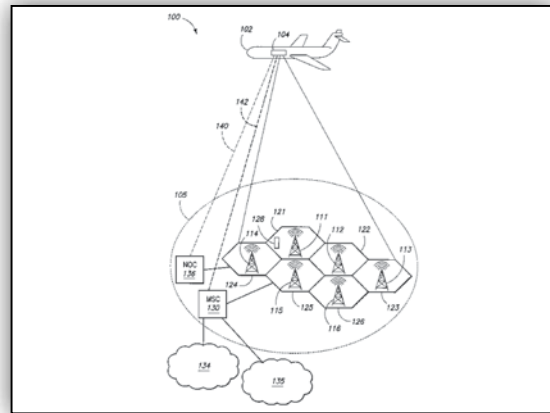


Airborne Wireless Communication Systems, Airborne Communications Methods, and Communication Methods

This patent was issued to Juan Deaton, Michael Schmitt and Warren Jones. In the event of large-scale natural or man-made disasters, access to reliable wireless communication systems can be disrupted due to the widespread destruction of terrestrial infrastructure. Without these capabilities, search, rescue, and recovery operations can be debilitated. This invention provides the capability for restoring emergency wireless communication using an airborne platform to support emergency answering service and emergency responder communications.

Patent Number: 8,078,162

Issued: Dec. 13, 2011

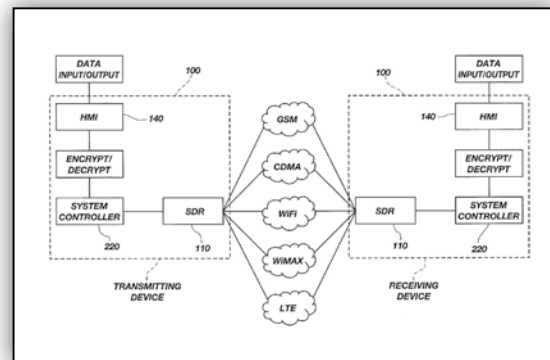


Communication Devices for Network-Hopping Communications and Methods of Network-Hopping Communications

This patent was issued to John Buttles for this invention, which offers a new type of secure wireless communication. It combines traditional encryption methods with a process for changing, in real time, which wireless technology is used when transmitting both voice and data information. This technique prevents the compromise of secure communication by disrupting anyone trying to detect which wireless technology is being used.

Patent Number: 8,081,624

Issued: Dec. 20, 2011

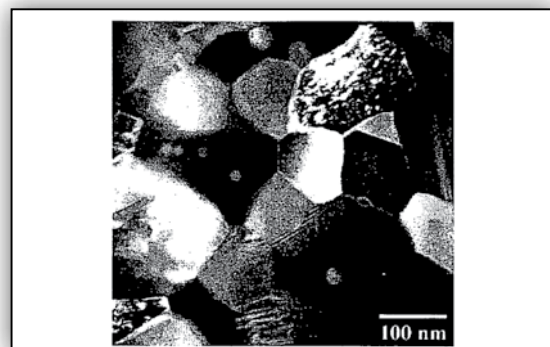


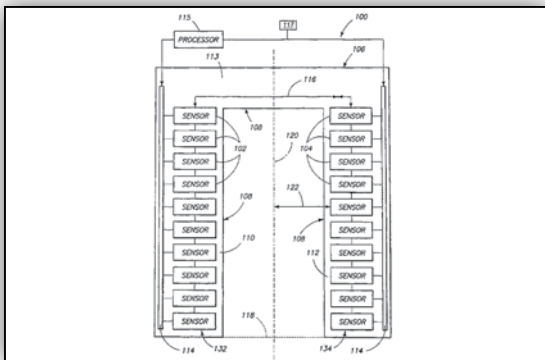
Hardfacing Material

This patent was issued to former INL employee Daniel Branagan of NanoSteel for Hardfacing Material, which is one among a large suite of super-hard steel patents. It employs the ingredients of standard stainless steel to form a very hard and corrosion resistant amorphous metal by powdering the metal and rapidly cooling through a spraying process.

Patent Number: 8,097,095

Issued: Jan. 17, 2012



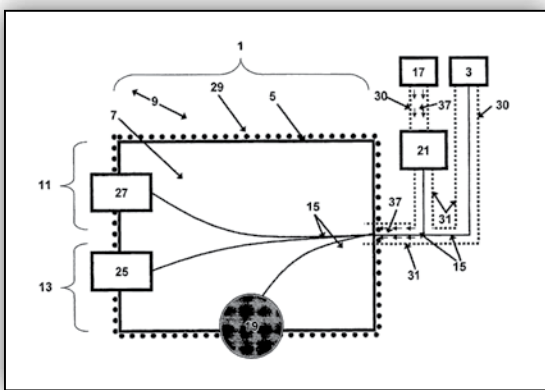


Methods, Systems, and Devices for Detecting Threatening Objects and for Classifying Magnetic Data

A patent was issued to Dale Kotter, David Spencer, David Rohrbaugh and Lyle Roybal for this invention, which uses quantitative anomaly detectors and physics-based discrimination schemes to improve the performance of passive magnetic metal detector ports. Fewer false alarms result thereby increasing the throughput and acceptability of metal detector ports.

Patent Number: 8,102,260

Issued: Jan. 24, 2012

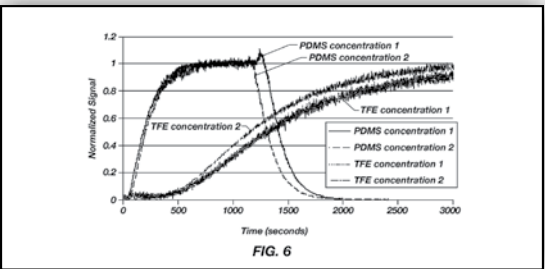


Explosion Proof Vehicle for Tank Inspection

This patent was issued to Scott Bauer, Kerry Klingler and Thor Zollinger. This invention represents multiple advances to INL's Petroleum Tank Inspection Robot. These include improvements to the attachment for directly inspecting the tank floor adjacent to a wall; an emergency submerged robot recovery system; a submerged robot self-righting system; a unique sonar camera system for dynamically mapping obstacles during tank inspection; an explosion-proof internal lighting system; a methodology for operating stepper motors from a long distance and in an explosive environment; and a cleaning brush attachment for use in an explosive environment.

Patent Number: 8,122,780

Issued: Feb. 28, 2012

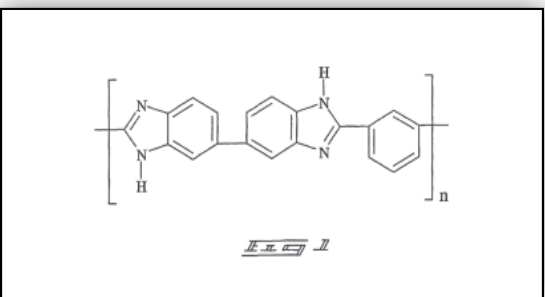


Taggants, Method for Forming a Taggant and a Method for Detecting an Object

A patent was issued to Frederick Stewart, Mark Stone, and Mason Har-rup for this invention, which teaches the controlled release of fluorinated molecules from microspheres for covert marking, tracking, tagging and locating of a wide variety of inanimate objects.

Patent Number: 8,124,414

Issued: Feb. 28, 2012



Polymeric Medium

A patent was issued to Alan Wertsching, Christopher Orme, Eric Peterson, John Klaehn, Michael Jones, Tammy Trowbridge, and Thomas Luther for Polymeric Medium. This invention is an improvement on polybenzimidazole (PBI) compounds, a well known class of heterocyclic polymers, but also improves methods for making substituted PBI compounds.

Patent Number: 8,129,498

Issued: March 6, 2012

Centrifugal Separators and Related Devices, Systems and Methods

Two related patents were issued to David Meikrantz, Jack Law, Troy Garn, Terry Todd, and Lawrence Macaluso for centrifugal separator devices. These inventions are designs for fluid transfer fittings and connections for a centrifugal separator system. The first is for support assemblies with a movable coupling to connection tubes such that the movable member is constrained along a fixed path. The second is for fluid transfer fittings to deliver fluid into a longitudinal fluid passage of a rotor shaft and attending couplings.

Patent Number: 8,128,548

Issued: March 6, 2012

Patent Number: 8,137,255

Issued: March 20, 2012

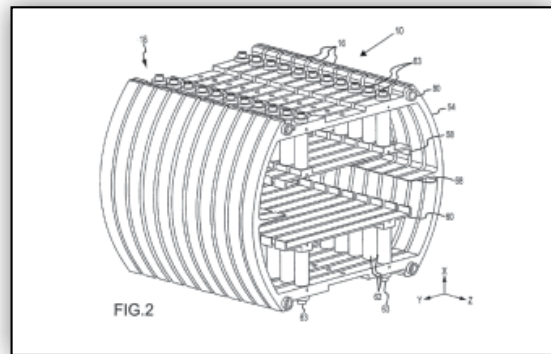


Method and Apparatus for Ion Cyclotron Spectrometry

A patent was issued to David Dahl, Jill Scott, and Timothy McJunkin titled Method and Apparatus for Ion Cyclotron Spectrometry. Fourier transform ion cyclotron resonance mass spectrometry differs from other mass spectrometry techniques because ions are not detected by hitting a detector, but only by passing detection plates. This invention describes a novel design for trapping electronic field and the effects on ions traversing the field. Ions experience a net magnetron effect on a cyclotron frequency of the ions that is substantially equal to zero.

Patent Number: 8,129,678

Issued: March 6, 2012

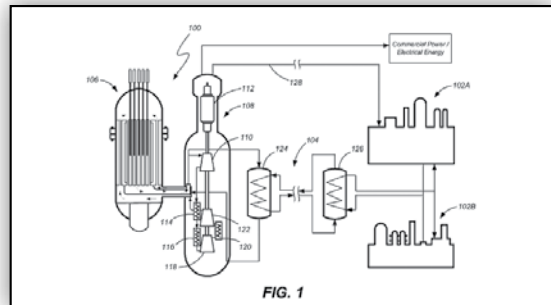


Methods and Systems for the Production of Hydrogen

A patent was issued to Chang Oh, Eung Soo Kim, and Steven Sherman. This invention describes how to operate a Very High Temperature Reactor at lower temperatures, alleviate material challenges, and produce hydrogen in an efficient way.

Patent Number: 8,132,410

Issued: March 13, 2012

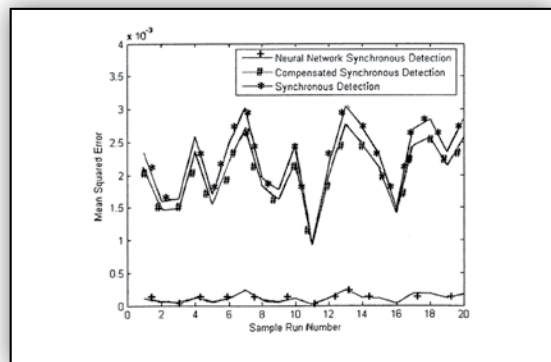


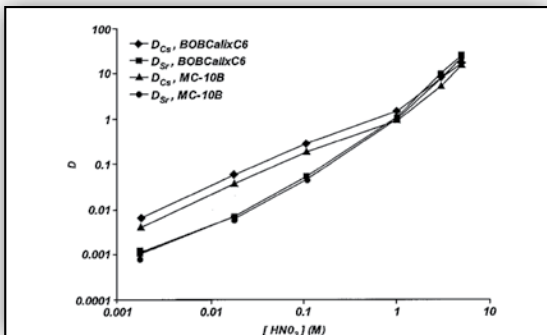
Method Of Detecting System Function By Measuring Frequency Response

A patent was issued to John Morrison, Jon Christophersen, and William Morrison. This invention enables improved onboard sensor technology for advanced diagnostics and prognostics of energy storage devices such as vehicle batteries. The Fast Summation Transformation (FST) is a new measurement technique and data processing algorithm that eliminates crosstalk interference and improves the speed of both measurement and data processing for online applications. It is part of INL's 2010 R&D 100 Award-winning technology.

Patent Number: 8,150,643

Issued: April 3, 2012

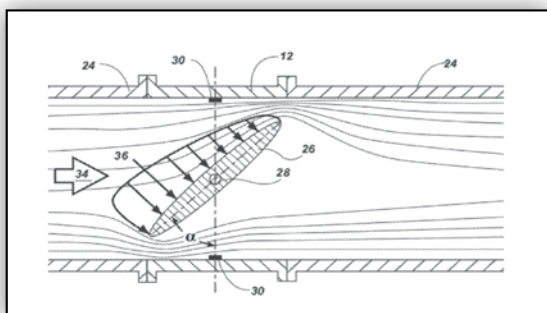




Extractant Compositions for Co-Extracting Cesium and Strontium, a Method of Separating Cesium and Strontium from an Aqueous Feed, and Calixarene Compounds

A patent for this invention was issued to Bruce Moyer, Catherine Riddle, David Meikrantz, Dean Peterman, Jack Law, Laetitia Delmau, Mitchell Greenhalgh, Peter Bonnesen, Richard Bartsch, Richard Tillotson, and Terry Todd. This patent addresses the simultaneous co-extraction of Cesium and Strontium from used nuclear fuel, which makes storage of these materials safer by lowering the short term heat load. Isotope recovery processes for medical or industrial applications also are possible.

Patent Number: 8,158,088 Issued: April 17, 2012



Force Measuring Valve Assemblies, Systems Including Such Valve Assemblies and Related Methods

A patent was issued to Humberto Garcia, Kevin DeWall, and Michael McKellar for this invention. Called the Intelligent Power-Operated Valve Assembly (Intelligent POV), this invention is a valve assembly that uses its actuator to sense and assess system conditions, such as fluid flow, differential pressure, and upstream or downstream fluid disturbances. It can detect and diagnose anomalous system or valve assembly performance, then react to that performance assessment based on predetermined system logic.

The Intelligent POV is both an actuator and a health assessment device that can conduct on-line condition monitoring and control functions without the need for instrumentation penetrations throughout the connected piping system.

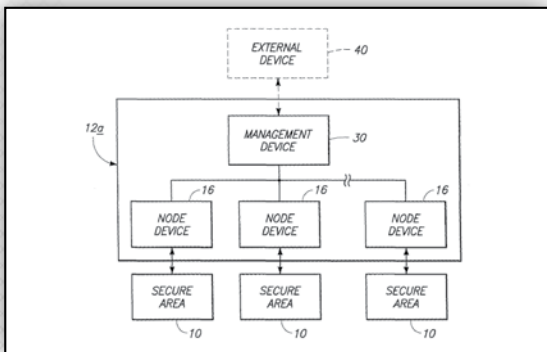
Patent Number: 8,156,822 Issued: April 17, 2012



Electronic Firing Systems and Methods for Firing a Device

This patent was issued to John Svoboda and Steve Frickey for an electronic firing system that includes a first firing circuit and a second firing circuit. A detection system that operates in association with the first and second firing circuits detects whether a device to be fired is connected, before actuating either of said first and second firing circuits to which is connected the device to be fired.

Patent Number: 8,161,877 Issued: April 24, 2012



Wireless Device Monitoring Methods, Wireless Device Monitoring Systems, and Articles of Manufacture

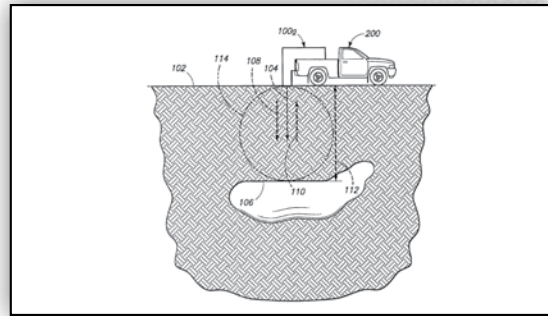
A patent was issued to Kenneth Rohde, Kurt Derr and Steven McCown for this invention. Sensitive facilities and controlled areas typically ban all Personal Electronic Devices (PEDs). This invention enrolls an organization's PEDs into an access control system. By authenticating PEDs approved for entry into controlled areas and ensuring that device configuration information on authorized devices has not been compromised, an organization can allow PED use in sensitive facilities while simultaneously discovering and disallowing non-approved devices.

Patent Number: 8,175,578 Issued: May 8, 2012

Earth Analysis Methods, Subsurface Feature Detection Methods, Earth Analysis Devices, and Articles of Manufacture

A patent was issued to Jerry Wright, Phillip West and Stephen Novascone for this invention. Similar to an orbital vibrator physical properties logging tool, which has been previously demonstrated, this invention innovatively uses lineal vibration and synthetic comparative algorithms to achieve mono-directional interrogation.

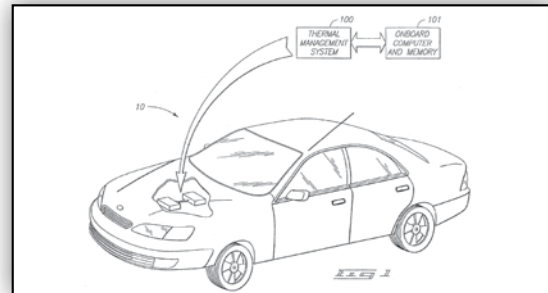
Patent Number: 8,189,426 Issued: May 29, 2012



Methods of Forming Thermal Management Systems and Thermal Management Methods

A patent was issued to Daryl Haefner and Kevin Gering for Thermal Management Methods. Varied climatic conditions can impact the performance of hybrid car batteries. For example, colder latitudes see reduced lithium ion battery performance, and higher temperatures prematurely age batteries. This invention is a thermal management system that minimizes such impacts to enhance battery performance and extend battery life.

Patent Number: 8,191,618 Issued: June 5, 2012



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

A patent was issued to David Thompson, David Reed, Emily Henriksen, Jeffrey Lacey, Vicki Thompson and William Apel for this invention, which teaches the efficient degradation of cellulose by using enzymes isolated from thermophilic bacteria. This discovery adds another step toward cost-effective biofuel production.

Patent Number: 8,202,716 Issued: June 19, 2012

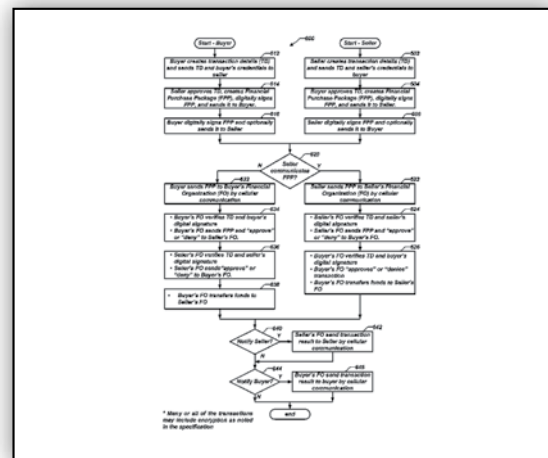
FIG 3A

RAAC00568	1	MGMHIEQTDFTTSEAIRPDTLISPPDDWAFLGRPSRFVDV
6686567		
4586418	1	MLEDTSFAIQPE.QDDKTQETHRIDIGNMHTFS
89098051	1	MNDTSFAIHFG.KSRKIENSVDYQAGDVLAIIE
114844717	1	MYQ
<hr/>		
RAAC00568	41	HDBGWATVQYDAGVWVWVALEDTVLVRVAYCRSPGEMPTST
6686567	1	MVGVVALEDTVLVRVAYCRSPGEMPTST
4586418	33	HTEHVFSFHCOTGIKIRFYREDIVRIAFM.PFGETSLSST
89098051	32	ECRNGLKARTETGELRIVFYANEIVRIWM.FGQADAGT
114844717	4	KTSEGIIVRVNREGKLELRVLGDKIINUVFVS.DXEBKRKDT

Systems Methods for Performing Wireless Financial Transactions

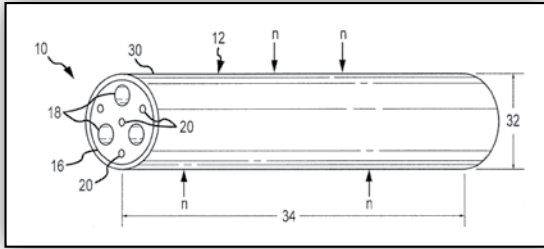
A patent was issued to Steven McCown for this technology, which resulted in a spin-out company, RFinity, that uses cell phones to conduct everyday purchases in a secure fashion.

Patent Number: 8,214,298 Issued: July 3, 2012



"The business of transferring technology is complicated, especially for the extremely technical research conducted here at INL."

Jason Stolworthy
Deputy Director, Technology Deployment

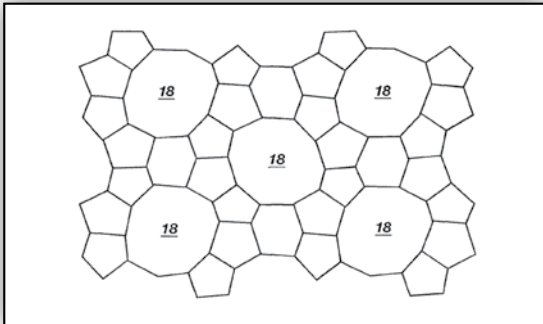


Methods for Absorbing Neutrons

A patent was issued to Donna Guillen, Glen Longhurst, Douglas Porter, and James Parry for this invention. Fast reactor materials are difficult to study in the nation’s existing test reactors. Such materials require a fast neutron with minimal neutron moderation. This invention enables the creation of a fast reactor environment in the middle of a water-cooled test reactor by dispersing high thermal neutron-absorbing material within aluminum and running small water-carrying pipes through it. This allows the material to be cooled in a gas environment with minimal neutron moderation.

Patent Number: 8,229,054

Issued: July 24, 2012

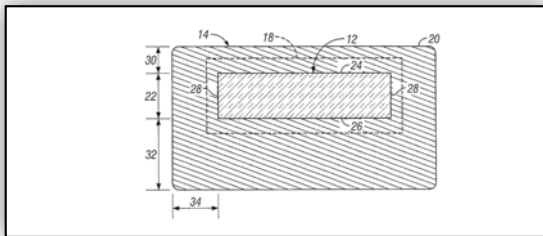


Systems Including Catalysts in Porous Zeolite Materials within a Reactor for use in Synthesizing Hydrocarbons

A patent was issued to Daniel Ginosar, Harry Rollins and Lucia Petkovic. Directly converting carbon-dioxide-rich feedstocks into liquid hydrocarbons such as methanol can be done more efficiently with this invention. It teaches the use of hybrid zeolite matrix catalysts, which boosts conversion rates, uses less energy and lowers costs for capital.

Patent Number: 8,226,909

Issued: July 24, 2012



Armor Systems Including Coated Core Materials

A patent was issued to Henry Chu, Kevin McHugh and Thomas Lillo for a spray forming process that creates three-dimensional metallic encapsulation to cover ceramic armor tile. This light weight armor provides high-performance protection to vehicles and is licensed to Premier Technology, Inc. of Blackfoot, ID.

Patent Number: 8,231,963 Issued: July 31, 2012

“Our researchers generated 88 Invention Disclosure Records and were issued 38 patents during the year, which helped our eight year total reach nearly 330 issued patents. Since 2005, INL has filed nearly 375 patent applications.”

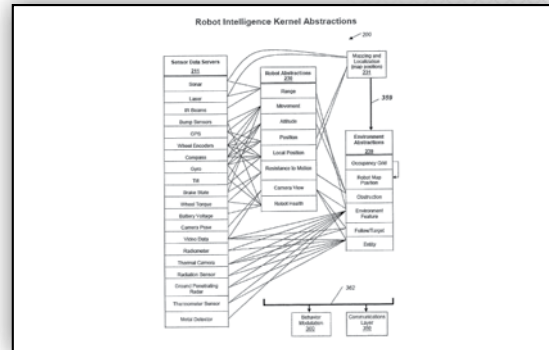
John J. Grossenbacher
 Director, Idaho National Laboratory

System and Method for Seamless Task-Directed Autonomy for Robots

A patent was issued to Curtis Nielsen, Miles Walton, David Bruemmer and Douglas Few for this invention, which provides a highly intuitive approach for directing a robot's activities without having to understand available robot behaviors or autonomy levels. This approach provides a bridge between a user's intentions and a robot's behavior by creating a new user interface that does not have to be directly controlled by the operator.

Patent Number: 8,271,132

Issued: Sep. 18, 2012

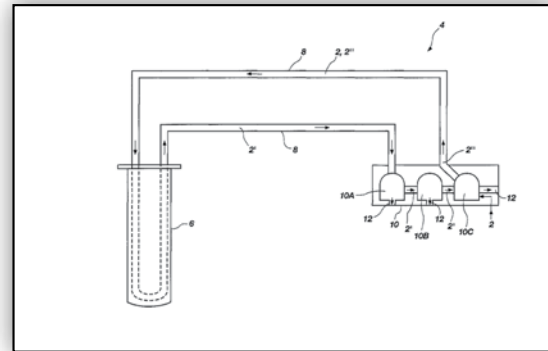


Methods of Producing Cesium-131

A patent was issued for "Methods of Producing Cesium 131" to David Meikrantz and John Snyder. This invention produces Cesium 131 from barium in a much shorter time than conventional processes and prevents loss of product for its very short half life of 9.7 days. Cesium 131 is used for both cancer research and therapy.

Patent Number: 8,270,554

Issued: Sep. 18, 2012

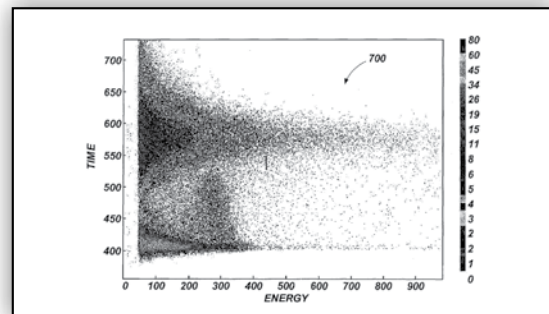


Method, Apparatus and System for Low-Energy Beta Particle Detection

This patent was issued to Doug Akers and Mark Drigert. Facilities that treat and process radioactive waste need to be able to detect minute levels of suspect radioactivity in soils and elsewhere. Typically, many alpha- and beta-only emitting radionuclides are not detectable without sampling and chemical processing. This invention provides a direct detection technology using a specialized annular beta detector that can rapidly measure beta- and alpha-emitting radionuclides such as Technetium-99 and Strontium-90 at extremely low levels in air, water or soils. This technology was originally developed for measuring subsurface concentrations of Tc-99 in soils under the Hanford waste site.

Patent Number: 8,274,056

Issued: Sep. 25, 2012



Apparatus and Method for Radioactive Waste Screening

A patent was issued for "Apparatus and Method for Radioactive Waste Screening" to Doug Akers and Lyle Roybal. Facilities processing radioactive waste material must be able to accurately estimate radionuclide content to ensure shipments don't exceed criticality and other control limits. Such assessments can be time consuming and require trained specialists. The Fissile Material Monitor Waste Screener (FMM-WS) is a rapid radioactive waste assay system that rapidly measures a range of material types, volumes and densities. It is sufficiently automated such that all assay operations can be performed by facility operators with little expert data review.

Patent Number: 8,260,566

Issued: Sep. 4, 2012

"INL's commitment to deploying technology has been significant. The past several years have been filled with leadership accomplishments, recognition for our team, and strong performances in process improvement."

Steven McMaster
Director, Technology Deployment.

The Impact of Technology Deployment

“INL’s commitment to deploying technology has been significant. The past several years have been filled with leadership accomplishments, recognition for our team, and strong performances in process improvement,” said Steven McMaster, director of Technology Deployment.

INL’s Technology Deployment (TD) group diligently worked to finalize its 2009-2012 transformation roadmap, which included more than 80 strategic initiatives and areas of improvement.

“This was a very significant accomplishment, which required TD to accept greater responsibilities and exceed normal work expectations,” McMaster emphasized.

During the transformation, TD seized a series of opportunities to contribute and lead major technology transfer efforts within the DOE national laboratory system, Battelle-managed organizations and in support of INL research missions and directorates.

Dedicated to Continual Improvement. “During the past three years, TD aggressively pursued transformation, reviewing and improving processes in seeking greater efficiencies for INL researchers. The process began with candid self-assessments and external peer reviews of our program,” McMaster noted.

Using this feedback, TD earnestly began making changes. These included establishing management systems for its processes that monitor performance, negotiating goals with research directorates, retooling failing processes and hiring new talent.

“The business of transferring technology is complicated, especially for the extremely technical research conducted here at INL,” said Jason Stolworthy, deputy director of Technology Deployment.

“Our Agreements Administrators, who include Kathy Bohachek, Sue Forman and Beth Jaggard, have leveraged new technology, proactively managed processes and responded to feedback from our customers,” TD Business Manager Wendy Skinner added. “During the past three years, we have significantly reduced the time required to execute a variety of agreements.”

“Innovation and flexibility are key to improving technology transfer,” noted Stolworthy. TD has implemented several pilot programs that are dramatically decreasing workloads while increasing flexibility. “In 2012, TD carried out a Fast Track CRADA program that eliminated redundant reviews and implemented Agreements to Commercialize Technology (ACT) that provides industry friendly terms and conditions,” Stolworthy added.

Commitment to Technology Transfer. INL has demonstrated a strong commitment to the DOE technology transfer community, securing

Technology Deployment Integration				
<i>The Energy of Innovation</i>				
INL Idaho National Laboratory				
	FY-09	FY-10	FY-11	FY-12
Increase Value to INL Mission	<ul style="list-style-type: none"> ✓ Redefine mission & vision of TD ✓ Establish transformation map ✓ Require ALD approval of all transactions or delegate ✓ Define organization, financial & staffing needs to best meet mission of TD ✓ Post greatly needed positions (GM) ✓ Define and outline process for royalty utilization/require stakeholder input 	<ul style="list-style-type: none"> ✓ Set TD strategic FY-10 goals with each Directorate ✓ Establish INL’s intellectual property strategy and rollout to patent committees (Completed in FY-12 Strategic Plan) ✓ Establish IP strategy aligned with INL’s mission/support Objective 10 ✓ Establish communication and awards plan ✓ Initiate Human Capital Management Plan for TD ✓ Create TD start/rollout approach & technology deployment teams ✓ Increase INL value by improving regional entrepreneurial climate, reevaluate technology-based economic development (TBED) staffing to identify needs 	<ul style="list-style-type: none"> ✓ Set TD strategic FY-11 goals with each Directorate ✓ Achieve strategic goal for each Directorate ✓ Assess TD teams and restructure as necessary ✓ Restore deal building capability ✓ Develop INL TBED as a key economic driver for region ✓ Develop CM brand as licensing professional-identify/acquire skills, develop and execute plan 	<ul style="list-style-type: none"> ✓ Set strategic FY-12 goals with each Directorate ✓ Achieve strategic goal for each Directorate ✓ Establish 2020 Vision ✓ Establish nuclear patent pool tied to mission ✓ Achieve integration of CMs with organizations ✓ Create self-service approach for simple transactions ✓ Establish nuclear patent repository/portal
Improve Operations	<ul style="list-style-type: none"> ✓ Align employee PDs with R2A2s ✓ Off-site WFO process improvement session ✓ TD conflict of interest policy revision & training ✓ Begin spin-out process assessment 	<ul style="list-style-type: none"> ✓ Improve spin-out process (80%) ✓ Escrow assurance portfolio ✓ Improve copyright process operations ✓ Establish governance models for TD decisions ✓ Dedicate resources to RELAP licensing ✓ WFO process improvements implemented ✓ Perform external peer review of TD operations ✓ Establish protocol for interacting with industry 	<ul style="list-style-type: none"> ✓ Define & discontinue non-value adding processes & work ✓ Develop & execute TBED strategic plan to support INL’s mission in energy research, leveraging regional ED synergies ✓ Institute strategic partnership culture with SEA Legal ✓ Institutionalize royalty utilization/require stakeholder input ✓ Perform compliance review and develop compliance strategy ✓ Identify partnering challenges 	<ul style="list-style-type: none"> ✓ Cross training and labor communication between Business Operations & Support staff ✓ Upgrade IP Manager to be faster and more stable ✓ Improve compliance with prime contract ✓ Update external webpage ✓ Establish work process suite of tools ✓ Set and achieve operational goals ✓ Implement improvements based on FY-10 peer review ✓ Define a sustainable training program for technology deployment at INL ✓ Achieve strategic partnership culture with SEA Legal
Implement Performance-Based Culture	<ul style="list-style-type: none"> ✓ Establish quality level metrics ✓ Establish quarterly TD risk assessment reporting 	<ul style="list-style-type: none"> ✓ Institutionalize deployment as a cross-function of the Lab (RD&Q) ✓ Institute annual INL TD goal setting process, incorporate ALD input on employee goals ✓ Establish quarterly metrics for assessment with ALDs ✓ Institute annual TD goals for ALDs ✓ Evaluate skills deficiencies of TD employees & training plans to acquire skills ✓ Analyze and measure INL TBED efforts to decide on future programs, integrate TBED efforts with INL, education, communications & small business programs ✓ Establish FY-10 deployment goals for ALDs ✓ Establish FY-10 goals for employees (tie to strategic plan to goals) ✓ Define and execute on strategy to improve G-12 scores ✓ Organizational conflicts of interest for TD integrated with INL OCI policy 	<ul style="list-style-type: none"> ✓ Establish deployment metrics in S&T manager’s performance reviews ✓ Measure CMs by quality of deals with a focus on contribution to INL’s mission ✓ Set ED metrics aligned with strategy ✓ Continue to improve TD engagement and work environment ✓ Ensure transfer of know-how and content from Senior ED employees ✓ Establish working relationship with key TD representatives at DOE-ID and DOE-HQ ✓ Evaluate TEST/BEST effectiveness and improve as necessary ✓ Evaluate on “Eliciting Strategic Partnering” plan 	<ul style="list-style-type: none"> ✓ Perform Peer Review of TD ✓ Reevaluate TD metrics – driving appropriate activities ✓ Develop new roadmap for FY 13, 14, and 15 focused on innovation for next generation technology deployment
Budget Commitments:				
Unallowable	\$ 4,350	\$ 4,250	\$ 4,460 (est.)	\$ 4,655 (est.)
Royalty	\$ 861,254	\$ 900,000	\$ 700,000 (est.)	\$ 900,000 (est.)
G&A	\$ 3,844,038	\$ 4,956,900	\$ 5,207,895 (est.)	\$ 5,468,250 (est.)
Purpose: Technology Deployment promotes public access to INL facilities, capabilities, and intellectual property in a manner that benefits the American economy and competitiveness.	Success: Characterized by deployment results as measured by metrics and effectiveness of ALD relationships, efficient management of DOE-ID/INE/Battelle and Executive Council expectations and the deployment of technology in INL mission areas.			Metrics: Quarterly Progress Assessments with ALDs and DOE metrics (qualitative/quantitative).

leadership roles in think-tanks and communities of practice to advance effectiveness. Currently, Steve McMaster serves as co-chair of the Battelle Commercialization Council (BCC), an influential group making positive changes in technology transfer policies and regulations. Jason Stolworthy serves as the Technology Transfer Working Group vice chair, a group commissioned by Congress in the Energy Policy Act of 2005.

TD leaders also have served on Governor Otter's Idaho Innovation Council, Rexburg's Entrepreneurial Center Board, Utah's Energy Commercialization Center, Idaho Technology Council and Idaho TechConnect's Board.

"These leadership positions expand INL's influence and allow INL to achieve greater impact in deploying technology," McMaster noted. Working in these groups, INL has helped organize social media forums for exchanging information, aligning leadership efforts through strategic meetings and webinars, organizing efforts to develop improvements and innovating new practices.



Left Side - Back Row - Bill Farris, John Freisinger, Antonio Sandaval, Mark Reeves, Front Row - Drew Bond, Rui Resendes, Right Side - Back Row - Derek Maughan, Steve McMaster, Steve Krak, Front Row - Cheryl Cejka, Jason Stolworthy, Shawn Perkins

Recognition for Excellence. TD staff have received important recognition for their impact during FY2012. INL received three Federal Laboratory Consortium – Far West awards for developing partnerships, leadership and advancing a patent-pending technology. These awards were presented at a ceremony during a joint Far West/Mid-Continent Regional meeting Sep. 6, 2012 in San Antonio, Texas.

Commercialization Manager Lisa Nate was recognized with the Outstanding Partnership Award for managing INL's successful partnership with Lindsey Manufacturing Company to protect high-voltage transmission lines from sabotage. Lindsey has licensed and uses INL's Transmission Line Security Monitor technology.

Stolworthy received the Far West Technology Transfer Professional of the Year award for his exceptional contributions, performance excellence and leadership in technology transfer.

Senior Commercialization Manager Mark Kaczor and INL researcher Hussein Moradi were recognized for advancing the Wireless Spectrum Communications technology, which will aid in making more of the radio frequency spectrum available for use.

In fact, during the past three years, TD staff have been recognized with a total of six FLC Far West awards, including the three above and three more for advancing new technologies in electric battery management, biofuel production from waste products, and environmental cleanup of the BP oil spill in the Gulf of Mexico.

Within INL, TD staff members were recognized with the Most Valuable Intern Experience Award at INL's mentor and education recognition event. The award was presented for providing the most rewarding intern mentoring experience during the year. Ben Goodrich, Gary Smith, Kathy Bohachek, Keith Arterburn, Jason Stolworthy, and Steve Paschke received the award.

At their 10th Anniversary Celebration, the Southern Idaho Economic Development Organization (SIEDO) honored INL's Nancy Bergmann, who retired from TD in Jan. 2012. Citing a decade of support, SIEDO dedicated the Nancy Bergmann/INL Math & Science Scholarship, which will be managed by the College of Southern Idaho Foundation. TD's Steven McMaster was the keynote speaker for the event, along with Jeff Sayer from Idaho's Department of Commerce.

TD annual reports during the past several years have detailed contributions in support of all of the research missions with a special focus on nuclear energy research. These include support for the formation of the Consortium for Advanced Simulation of Light Water Reactors (CASL) and the exponential expanse in licensing the nuclear safety code called RELAP. Last year, INL began licensing the Multiphysics Object Oriented Simulation Environment (MOOSE) software to help in modeling nuclear fuel experimentation.

To generate and sustain the entrepreneurial and research culture, TD has sponsored a six-month, on-site seminar series beginning each Jan. and July to increase researcher knowledge of how discovery and business combine in entrepreneurial enterprises. INL researchers have the opportunity to understand commercialization and its many facets from this graduate-level seminar series.



Technology Deployment agreements administrators, Beth Jaggar, Kathy Bohachek, and Sue Forman have refined processes with feedback from customers. TD Business Manager Wendy Skinner added. "We have significantly reduced the time required to execute a variety of agreements."

The Future. TD staff members are appreciative of the recognition for recent achievements in improving the transfer of technologies, business practices, and INL's commercialization culture.



Technology Deployment Deputy Director Jason Stolworthy received the Far West Technology Transfer Professional of the Year award for his exceptional contributions, performance excellence and leadership in technology transfer.

“Now we are focused on the future with a strategic plan for 2013 and beyond that clearly articulates how TD can make contributions to INL’s 2020 strategy,” McMaster emphasized.

A key element cited in this strategy is building “substantive collaborations with industry and international entities.” Four focus areas outline the framework for efforts in FY2013 and beyond. They include:

- Achieving fast, flexible and efficient mechanisms,
- Bridging the gap with industry,
- Advancing the deployment ecosystem, and
- Achieving a deployment culture at INL.

“Successfully converting new technology and laboratory capabilities into tangible benefits substantiates the public’s investment in federal research and leads to long term viability of the laboratory,” McMaster explained. “Ensuring the nation’s energy security cannot be achieved without the deployment of INL’s work products,” he added.

Technology Deployment’s support and contributions to INL’s vision continue to grow by maintaining a vigorous technology transfer effort. These efforts are primarily focused on the core functions of licensing, commercialization, and publication of INL technology; collaborating with industry for joint mission accomplishment; and encouraging utilization of INL capabilities by the federal and private sector.

Granted Copyrights

INL received permission to assert copyright for seven newly developed software codes – four for Nuclear Science and Technology, two for National and Homeland Security and one for Energy and Environment.

Copyrighted Software	Authors
RELAP5-3D Version 4.x	Arthur Shieh, Bob Martin, Cliff Davis, George Mesina, Glenn Roth, Han-Hsuing Kuo, James Fisher, Jennifer Forsmann, Jerry Judd, John Tolli, Joshua Hykes, Kenneth Carlson, Larry Siefkin, Nolan Anderson, Paul Bayless, Paul Murray, Peter Cebull, Rex Shumway, Richard Riemke, Richard Moore, Richard Wagner, Riley Cumberland, Seungho Paik, Walter Weaver
Wide Area Detection Grid On Cell Phone Software	Jonathan Chugg, Joshua Cogliati, Kurt Derr,
Wide Area Detection Grid Software - Image Processing	Joshua Cogliati
Parallel and Highly Innovative System for INL Code System (PHISICS)	Aaron Epiney, Andrea Alfonsi, Cristian Rabiti , Giuseppe Palmiotti, Hikaru Hiruta, Joshua Cogliati, Sameul Bays, Sonat Sen, Yaqi Wang
Global Access-Controlled Transfer e-Frame (GATE)	Hope Forsmann, Lynn Rockhold, Tyson Hansen
Dynamic Attack Tree Tool for Risk Assessments	Karl Black
Fracturing And Liquid CONvection (FALCON)	Chuan Lu, Cody Permann, Derek Gaston, Hai Huang, Robert Podgorney

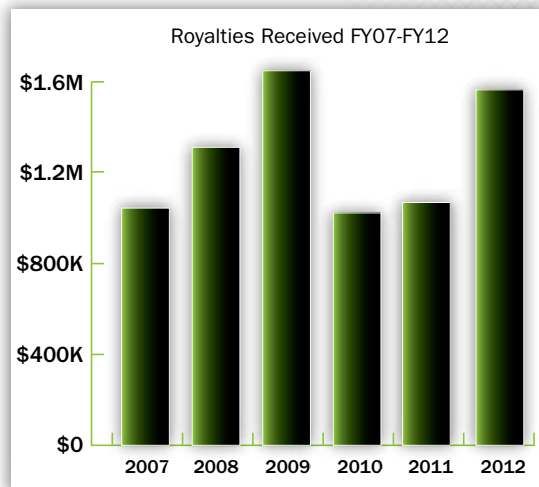
Royalties

Royalties have reached more than \$9 million during the past eight years at INL, varying each year from about \$800,000 in fiscal year 2005 to more than \$1.6 million in fiscal year 2009. Earning more than \$1.58 million in royalties this past year, FY2012 ranked among the highest royalty producing years for INL. This reflects an expanding portfolio of intellectual property and increased attention to commercialization of these discoveries and inventions.

During FY2012, U.S. businesses sold more than \$46.7 million in innovative products and processes based on INL patented technologies. As a result, utilization of INL technology in the market place has resulted in job creation and increased U.S. global competitiveness.

Commercial markets have been very accepting of INL-developed technologies. From FY2005 to FY2012, INL has signed more than 720 licenses and modifications for commercialization of technologies developed within the laboratory with 132 licenses being negotiated in FY2012.

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 the income from licensing activities 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. Some 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.



License Highlights

License agreements between BEA and a business or other organizations allow the business to reproduce, manufacture, sell, or use INL developed or owned intellectual property. INL contractor-managed inventions are available for license by U.S. and foreign companies, as well as other organizations, for commercialization. INL licenses its intellectual property on much the same terms as universities, and other research organizations and industrials firms.

During the past eight years, INL has signed nearly 720 licenses that have earned more than \$9 million in royalty fees. For FY2012, INL signed a total of 132 agreements. These include 16 patent licenses (2 new patent licenses, 2 modifications and 11 new license options, 1 modified license option).

In addition, INL executed 116 copyright licenses (27 fee licenses, 89 no-fee licenses), including 61 licenses for RELAP5-3D and 10 for other copyrights.

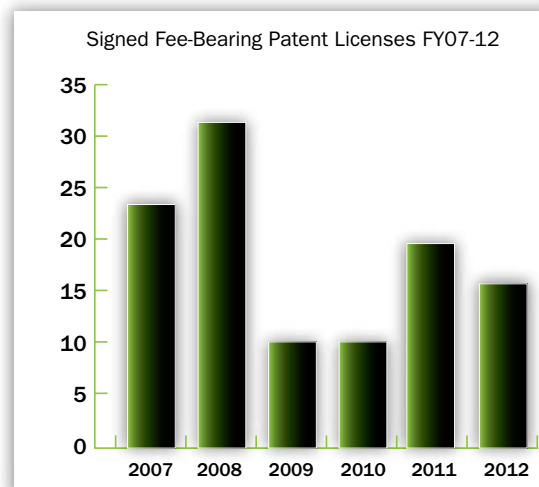
Below is a summary of patent licenses, license options and copyright licenses.

The Innovation Development Fund

INL's Innovation Development Fund is one mechanism that is used for reinvestment strategies and has advanced the transfer of laboratory-developed technologies to nonfederal parties as required by technology transfer legislation. IDF projects have permitted development of stronger relationships to 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.

The following projects and researchers are some of the activities funded in FY2012:

- Continuous Fiber Reinforced Material Kevin McHugh**
- Manufacture of Silicon Carbide Materials .. Kevin McHugh**
- Plasma Afterburner..... Peter Kong**
- Nanomaterials..... Robert Fox**
- Switchable Hydrophilic Solvent Aaron Wilson**
- Collection of Chemical Compounds..... Gary Groenewold, Jill Scott**
- Isosynthesis to Liquid Fuel Dan Ginosar**



Summary of INL patent licenses: 2 licenses, 2 modifications, and 12 options.

Licensee	Technology
SmartPlane, Inc.	Robotics Intelligent Kernel Suite of Intellectual Property
Torion Technologies, Inc.	INL's Field Vacuum Extractor
Environmental Alternatives, Inc.	Decontamination Foam (1 modification, 1 option)
Infinne Energy, LLC	INL's Compact Natural Gas Liquefaction (option)
Princess Energy	Batteries
RedWave Energy, Inc.	Nanoantennae Energy Technology (option)
Cogent Analysis Group, LLC	INL Plasma Technology (option)
Trace Detection Technology Corp.	Detection of Counterfeit Products, Labels and Documents (option)
Premier Technology, Inc.	Pressurized Feed-Injection Spray Forming; An Additive Resin Treatment of Wood Products; and Blue Mussel Adhesive (3 license options)
SigNa Chemistry, Inc.	In situ Generation of Steam and Alkaline Surfactant (option)
Superior Graphite Co.	INL's Composite Armor Technology (option)
Forsche Innovations Ltd.	Thermal Plasma Process for Proppants and Solar Silicon (option)
Hydration Technology Innovations	INL's Forward Osmosis Technology (option)

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

Premier Technology Inc.: **Signs 3 license options**



Premier Technology Inc. of Blackfoot, Idaho, has taken advantage of the DOE's Startup America Partnership Initiative by signing license option agreements for three INL-developed technologies. They include Pressurized Feed-Injection Spray Forming Apparatus and Process; An Additive Resin Reaction Product and

Treatment of a Wood Product; and Cloning and Expression of Recombinant Adhesive Protein MEFP-2 of the Blue Mussel, *Mytilus Edulis*. DOE's Startup America Initiative promotes entrepreneurship through lab-created technologies and offers opportunities to investigate technologies without the associated risk of high upfront fees and performance obligations for technologies that may not be ready for deployment. INL was an early participant in getting companies to participate in this new partnership.

Hydration Technologies Innovations (HTI): **Signs License Option to Deploy Forward Osmosis Technology**



HTI, a U.S. based company, has executed a license option agreement for rights to a unique forward water osmosis draw solution. Leveraging DOE's Startup America Program, HTI will explore opportunities for using the technology in several fields including sea water desalination, treatment of water used in oil and gas extraction operations, and treatment of landfill leachate.

Tracer Detection Technology, Corp.:
Executes License Option to Identify Counterfeit
Products, Labels, and Documents



Tracer Detection Technology, Corp. of San Antonio, TX is intending to commercialize INL patented technology that addresses the problem of identifying counterfeit products, labels, and documents. The technology exploits randomly occurring patterns of materials with unique optical characteristics matched to a machine-readable code. The license option agreement allows Tracer to negotiate license rights to two INL patents directly

related to Tracer's core business of perfluorocarbon-based taggants used for tagging, tracking, and locating targets of interest for positive identification and/or authentication in applications for law enforcement, intelligence, and national and homeland security.

Superior Graphite:
Executes option for INL's Composite Armor Technology



Leveraging DOE's Startup America Initiative, Superior Graphite licensed INL's composite armor technology to advance their specialty work in thermal purification, advanced sizing, blending and coating technologies. This technology advances manufacturing of a light weight turret system to provide greater protection to our soldiers.

SmartPlane, Inc.:
Executes Evaluation License for the Robotics
Intelligent Kernel (RIK) Suite



SmartPlane, Inc. of Los Angeles, CA signed an evaluation license for the RIK suite of intellectual property to determine its suitability for use in robotically controlled airplanes.

LATA Environmental Services of Kentucky, LLC.:
Licenses INL's Integrated Waste Tracking System
(IWTS) Software



LATA Environmental Services of Kentucky, LLC., who is the remediation contractor of Paducah Gaseous Diffusion Plant

for DOE, signed a Government Use Agreement to use IWTS in their remediation project contract. LATA provides support for nuclear materials management and nuclear safety programs, as well as facility transition and material disposition. IWTS will assist LATA in properly tracking nuclear waste.

Torion Technologies Inc.:
Licenses INL's Field Vacuum Extractor (FVE)



Torion Technologies of American Fork, Utah, licensed INL's FVE technology to increase its portable chemical analysis capabilities. Torion develops and sells portable chemical analysis systems and FVE offers a unique solution to collecting chemical samples from fixed surfaces in a sensitive and non-destructive fashion. INL's technology may offer Torion the ability to use their product for advanced forensics and attribution tools by investigators tasked with responding to a chemical warfare agent release.

RedWave Energy, Inc.:
Licenses INL's Nanoantenna Technology to
Commercialize Energy Harvesting Devices and
Executes a CRADA for More Development



RedWave Energy, Inc., a new company, signed a license option agreement to design, engineer, fabricate, manufacture, and commercialize INL's Nanoantenna energy harvesting technology. INL developed a novel method for designing and manufacturing nano-scale antenna arrays that are imprinted on flexible materials for harvesting energy from electromagnetic fields. The new approach garnered a Nano50 award in 2007.

The CRADA forms a joint collaboration to research, design engineer, fabricate and validate prototype energy-harvesting devices from electromagnetic fields.

Cogent Analysis Group:
Licenses INL's Plasma Technology to Enhance Waste
to Energy Conversion Process



Cogent Analysis Group executed an option to license INL's thermal plasma process for incorporation into Cogent's proprietary gasification process. Cogent intends to combine technologies and develop the capability to cleanly generate electricity from pre-sorted municipal waste and renewable biomass feedstock.

Sophia SCADA Network Fingerprinting Tool: Beta Test License Agreements

INL signed 30 beta licenses during FY2012 that helped perfect this cyber security software tool. Developed with funding from the DOE's Office of Electricity Delivery and Energy Reliability, Sophia is a passive, real time tool for inter-device communication discovery and monitoring of the active elements in a Supervisory Control and Data Acquisition (SCADA) system. Beta test licensing has been brisk with many utilities, universities, and cyber security researchers using a new on-line process to accept the license agreement and obtain an executable version of Sophia for their internal use.

SiGNa Chemistry: Executes license option to Maximize Oil Recovery



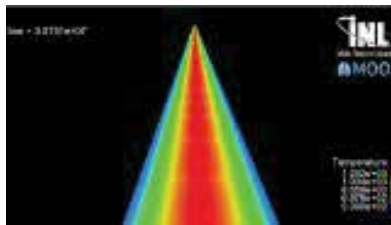
SiGNa Chemistry, a U.S.-based company, signed a license option agreement for INL's innovative in situ generation of steam and alkaline surfactant for use in enhanced oil recovery to improve the overall efficiency of oil extraction.

Electric Power Research Institute (EPRI): Licenses BOA and FALCON Software Codes



EPRI licenses codes installed on INL computers to support the Consortium for Advanced Simulation of Light Water Reactors (CASL) program. The "BOA" software code is titled, "Boron-Induced Offset Anomaly Risk Assessment Tool" and the "FALCON" software code consists of four components entitled, "Falcon Fuel Performance Code", "Verification and Validation Case for FALCON Fuel Performance Code", "Pre-SW Falcon Version 31," and "Fuel Analysis and Licensing Code: FALCON MOD01 Documentation CD-ROM".

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



INL signed 18 multi-year, non-exclusive licenses for INL's MOOSE software during FY2012. 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 has been licensed to:

- Argonne National Laboratory
- University of Wisconsin
- Massachusetts Institute of Technology
- Sandia Corp.
- Mississippi State University
- UT Battelle, Oak Ridge National Laboratory
- Pennsylvania State University
- Colorado State University
- University of Tennessee
- General Atomics
- Atomic Energy Canada Ltd.
- Colorado School of Mines
- University of Michigan
- Brigham Young University
- New Zealand's Institute of Earth Science and Engineering
- State of Oregon Board of Higher Education
- National Nuclear Laboratory, Ltd.
- University of Utah

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

For decades, RELAP has been widely used by the international nuclear community to support research and nuclear studies, including safety analysis and evaluating innovative ideas. INL, in cooperation with the International RELAP Users Group (IRUG), has developed the latest in the RELAP5-3D code series to analyze transients and accidents in water-cooled nuclear power plants and related systems. Known for its fully integrated, multi-dimensional thermal-hydraulic and kinetic modeling capability, RELAP5-3D now is being used by utilities and other companies for additional systems analyses.



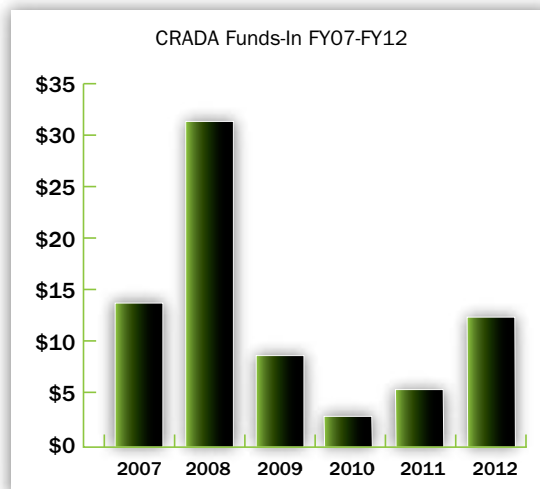
During FY2012, INL signed 61 licenses including:

- Engineering Planning and Management, Inc., Risk Solutions Division
- Studiecentrum Voor Kernenergie Centre D' Etude De L' Energie N, Belgium
- Oceanit Laboratories, Inc.
- Texas A&M
- Bel V, the Belgium Federal Agency for Nuclear Control
- Ansaldo Nucleare SpA, Genova, Italy
- Japan Nuclear Energy Safety Organization
- Babcock & Wilcox, 2 licenses
- NIKIET, N.A Dollezhal Research and Development Institute of Power Engineering, Russia
- University of Palermo, Italy
- University of L'Aquila, Italy
- Institute for Advanced Studies - IEAv , Brazil
- Ansaldo Nucleare SpA, Italy
- Nebraska Public Power District
- Industrial Leak Detection, Inc.
- Oregon State University
- University of Michigan
- Mitsubishi Heavy Industries, LTD., Japan
- Western Services Corporation
- University of California, Berkeley
- Daewoo Shipbuilding & Marine Engineering Co., Ltd., Korea
- Karlsruhe Institute of Technology (KIT), Germany
- University of Pisa RELAP5-3D Version 2.4.x for Attucha Power Plant Analysis. Italy, 2 licenses
- Nuclear Research Institute – Rez plc, Czech Republic
- University of Illinois
- University of Milan, Politecnico di Milano Department of Engineering, CeSNEF Nuclear Engineering Division, Italy
- Universidade Federal de Minas Gerais, Brazil
- Rolls Royce Power Engineering
- University of Akron
- Ansaldo Nucleare SpA, Italy
- Massachusetts Institute of Technology
- Tractebel Engineering S.A.
- Imperial College London
- University of California
- Institute of Nuclear Safety Systems, Inc., Japan
- Los Alamos National Security, LLC.
- Savannah River Nuclear Solutions Inc.
- Western Services Corp.
- CD-Adapco
- Georgia Tech
- Babcock and Wilcox Nuclear Energy, Inc.
- University of Bologna, DIENCA Department, Montecuccolino Laboratory, Italy
- ENEA Italian National Agency for New Technologies Energy
- University of Fukui, Japan
- National Technical University of Athens, Greece
- Virginia Commonwealth University

Cooperative Research and Development Agreement Highlights

During the past eight years, INL's successful Cooperative Research and Development Agreement (CRADA) program has signed 108 CRADAs representing nearly \$253 million of research work. Eighteen new CRADAs were signed during FY2012 and 12 modifications to existing CRADAs were negotiated. The total CRADA value during the year was more than \$45.27 million, including about \$12.8 million of funds-in, \$9 million of in-kind contributions from participants, and about \$23.4 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.



CRADAs for FY2012 are listed below, followed by a summary of selected agreements.

CRADA Participants	Technology
Electric Power Research Institute, Inc.	Evaluate biomass in co-firing trials
TerraPower	2 CRADAs: Vulnerability assessment of industrial controls, Traveling Wave Reactor concept and fuel element
Invensys	Assess vulnerability of control systems
OriginOil	Test and report on algal production technology
Broadway Holding	Evaluate Microwave torrefaction of biomass feedstock
Virent, Inc.	Assess methods for ash reduction in biomass feedstock
Westinghouse Electric Co., LLC.	Demonstrate higher density nuclear fuel fabrication
Hart Communications Foundation	Assess vulnerability of industry control systems
Curtiss Wright Corp.	Develop and test tailored nuclear materials for coolant pumps
Southern California Edison	Evaluate control room concepts for San Ofre nuclear plant
Environmental Defense Fund	Research degradation of graphite reactors
Zilkha Biomass Energy	Research densified biomass feedstock
Forsche Innovations, Ltd.	Develop new plasma process for converting oil
Progress Energy	Human Factors Engineering for Plant Process Computer Upgrades
Idaho State University	Investigation of Fission Signatures and Interferences Induced by High-Energy Bremsstrahlung
RedWave Energy	Nano-Antenna Electromagnetic Energy Gathering Film

Summaries of selected CRADA activity in FY2012 are provided below:

**The Electric Power Research Institute, Inc. (EPRI):
Evaluates the use of Renewable Biomass in
Co-Firing Trials**



EPRI and INL will collaborate in a joint research project to evaluate the advantages, disadvantages, and technical barriers of substituting biomass feedstock for coal to produce cleaner electrical power using domestically secure renewable biomass. The project will generate data for DOE-EERE and private stakeholders to address the feasibility and sustainability of biopower in the U.S.

**TerraPower LLC:
Signs two CRADAs for Nuclear Fuel and
Materials Research**



TerraPower and INL will conduct experiments to support development of TerraPower's traveling wave reactor (TWR) concept. The CRADA covers fabrication and testing of seven experiment capsules containing various fuel 'slugs', which will be irradiated in the Advanced Test Reactor (ATR) along with other DOE Advanced Fuel Cycle (AFC) experiment capsules. Research will include post irradiation examination, which will contribute to TerraPower's understanding of metallic fuel behavior to advance toward a goal of developing and constructing a TWR.

They also will review and research nuclear metallic fuel and materials, including characterization of unirradiated fresh fuel with possible post irradiation examination of DOE's archived Experimental Breeder Reactor II (EBR-II) and Fast Flux Test Facility (FFTF) irradiated fuel. The work also will include evaluations of fuel and component fabrications and development of scientific models of irradiation behavior.

**Invensys Industrial Control System Assessment:
Signs CRADA to Evaluate Control
System Robustness**



Invensys Foxboro Control Software system has contracted with the National SCADA Test Bed Program (NSTB) to have its industrial control system evaluated for cyber security vulnerabilities and receive recommended mitigation strategies. A primary purpose of this project is to enhance industry control system robustness, further protecting critical national infrastructure.

**OriginOil, Inc.:
Developing Algal Production Technologies**



OriginOil and INL are collaborating in a joint research project to advance OriginOil's novel algal production technology by researching and developing approaches to overcome barriers to converting algal biomass feedstock to biofuels. Dewatering approaches compatible with OriginOil's electro-flocculated algae will be investigated, along with a variety of cross-flow filtration membranes, available commercially or fabricated in-house. In addition, integrated harvest and pretreatment systems based on hydro-cyclone technology and a Fundabac filtration device designed to produce filter cakes will be investigated and adapted for use with the electro-flocculated algae.

**Virent, Inc.:
Research Ash Reduction in Biomass Feedstock**



Virent, Inc. will collaborate with INL in a joint research project to reduce ash components in corn stover based biomass feedstock. The ash component in biomass includes "physiological ash," which is derived from the plant tissue itself, and non-physiological ash called "introduced ash," which often comes from environmental contaminants (e.g. soil contamination during harvest). Physiological ash is divided into two categories: "nonstructural physiological ash," comprised primarily of salts and other minerals present in the vascular system, and "structural physiological ash," derived from silica, proteins and DNA within plant cells.

**Ford Motor Company:
Modifies CRADA on Plug-in Electric Vehicles**



Ford Motor Company and INL have been collaborating in testing and validating Ford plug-in electric vehicles since 2010 and this agreement continues that collaboration. INL serves as the lead laboratory for testing and validating advance batteries and/or battery packs, some of which are used in next generation of electric vehicles. INL will use its unique testing capabilities to assist in the advancement of this technology.

Westinghouse Electric Company, LLC.: Research on Higher Density Nuclear Fuels



Westinghouse signed a CRADA for research to demonstrate the ability to fabricate uranium silicide (U₃Si₂) fuel pellets for use in light water reactors, which will enable increased power rates, longer fuel cycle and burnups, and improved economics for nuclear power plants. The U₃Si₂ fabrication demonstration effort (pellet fabrication, testing, and final report writing) is anticipated to take approximately 12 months to complete.

HART Communication Foundation (HCF): Assess Protocol of Industry Control Systems



HCF has contracted for a NISTB vulnerability assessment of its new Protocol Specification, Revision 7.3, the Wireless Highway Addressable Remote Transducer (HART) Protocol. The agreement calls for INL to evaluate the industry control system's robustness to ensure added protection of the critical national infrastructure. Established in 1993, HCF provides worldwide support for application of HART technology and ensures that the technology is openly available for the benefit of the industry, including the WirelessHART Protocol, a wireless mesh network communications protocol for process automation applications.

Curtis-Wright Corporation: Collaborating on Strengthening Nuclear Manufacturing



Curtis-Wright Corporation and INL negotiated a joint development CRADA project to develop and test a tailored material system suitable for specific components in nuclear reactor coolant pumps produced by Curtis-Wright. The joint research project will focus on development of an improved internal pump housing material through the combined effort of Curtis-Wright and INL.

Southern California Edison, San Onofre (SONGS): Developing Digital-Based Control Room Systems



SONGS signed an agreement for research in support of the Light Water Reactor Sustainability Program and a comprehensive plan to address control room system characteristics. The focus of the research is to help SONGS: (1) develop the end-state vision for incorporating digital controls and operator interface design into a traditional analog control room, (2) implement this vision through meeting intermediate goals, and (3) develop first principles of control room design management that will help establish the technical basis for the design of new control room systems at SONGS and other power plants.

Energy Nuclear Generation Limited (EDF), Gloucester, UK:

Signs CRADA to Research Degradation Issues Related to Graphite Reactors



EDF has contracted for a viability assessment of a comprehensive approach to substantiating the control rod insertion safety case during Advanced Gas Cooled Reactor (AGR) operation, including a table-top assessment of graphite degradation issues. A risk-based review also will be conducted to ensure the acceleration of risk reduction and vulnerability mitigation.

Zilkha Biomass Energy: Researching Densified Biomass Feedstock



Zilkha signed a CRADA to collaborate with INL in characterizing the conversion properties of densified biomass feedstock for use in Zilkha's proprietary process to produce advanced fuels and chemicals. At pilot scale, prepared biomass materials may be further characterized for conversion performance by secondary organizations.

"In 2012, TD carried out a Fast Track CRADA program that eliminated redundant reviews and implemented Agreements to Commercialize Technology (ACT) that provides industry friendly terms and conditions."

Jason Stolworthy
Deputy Director, Technology Deployment

Work For Others

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, WFO has negotiated 384 projects that represent nearly \$1.246 billion of work. In FY2012, ten new federal WFO projects were added and 249 projects were modified worth about \$126 million. The private sector WFO agreements totaled 28 new projects (17 for EEST, 8 for NST, 3 for NHS) with another 35 modified, representing more than \$4.1 million for a total of \$130 million during FY2012. Continual process improvements were emphasized and completed during the year to accelerate response time and reduce processing.

Some of INL's significant WFO projects include:

TerraPower, LLC:

Review Design of a Traveling Wave Reactor, Advancing New Commercial Reactor Concepts



INL's Reactor Physics Analysis and Design organization will review and offer recommendations on TerraPower's design of a traveling wave reactor (TWR) concept and the concept's safety system

design, and approach. This research aligns with the objectives outlined in the DOE, Office of Nuclear Energy 2010 R&D Roadmap.

Physical Optics Corporation:

Evaluate High Temperature Material Microstructure Compton Imaging Tomography



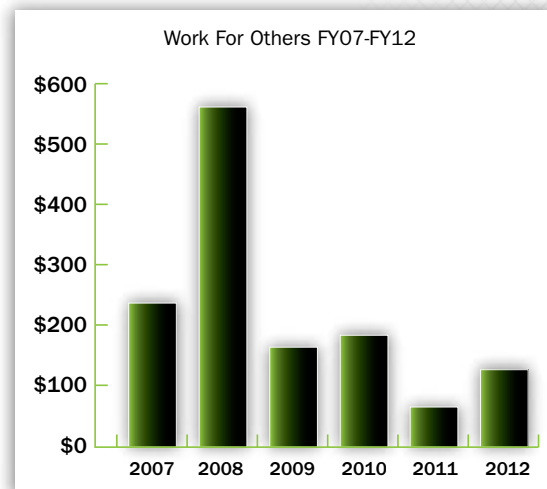
Physical Optics Corporation requested to have their Microstructure Non-destructive Evaluation Compton Imaging Tomography (MicroCITO) evaluated. It is capable of imaging structures in situ,

in one pass, providing accurate identification of internal microstructure features, micro-flaws and micro-defects using precise 3D high-resolution X-ray images. This technology may address material issues in advanced nuclear reactors that are beyond current evaluation techniques.

Central Arizona Project:

Study Replacing Coal Fired Navajo Generating Station with a Small Modular Reactor

INL is assisting the Central Arizona Project in evaluating investment trade-offs in replacing the coal fired Navajo Generating Station with a small modular reactor (SMR). This research advances the commercialization of SMRs, providing critical information to make further investment decisions.



Electric Power Research Institute (EPRI):

Executes WFO on National Electric Sector Security



EPRI signed a WFO to leverage INL's cybersecurity expertise to assess architectures and applications for vulnerabilities in new cyber technologies developed for the National Electric Sector, including

analysis and dissemination of infrastructure weaknesses and threats. The results will further advance the commercial sector's ability to reduce cyber threats to U.S. power plants.

CH2M Hill Constructors, Inc.:

Executes WFO on Enzyme Activity Probe Analyses



CH2M Hill contracted for evaluation of microbial presence and activity at contaminated sites, including investigation

and development of a suite of aerobic oxygenize enzymes and indigenous microbial populations. Several molecular methods will be used, including quantitative polymerase chain reaction, deoxyribonucleic acid and ribonucleic acid extractions, and other community assessments (terminal restriction fragment length polymorphism and cell staining).

Mississippi State University: Executes WFO to Displace Gasoline with Biofuels



INL will assist Mississippi State in assessing the benefits of reformatting lignocellulosic biomass resources into a “uniform-format” product that can

be stored and handled in an expanded grain commodity infrastructure. This research is part of DOE’s goal to displace 30% of gasoline used with biofuels with as much as 60 billion gallons per year by 2030, which will require annual deliveries of 700 million tons of biomass to biorefineries.

Aramco Services Company: Developing Polymeric Membranes for CO2 Separations



For Aramco, INL will evaluate the feasibility of INL-developed membranes meeting post-combustion carbon dioxide capture standards at high tempera-

tures. Aramco seeks a high performance polymeric membrane that can give a desired CO₂/N₂ separation at high temperatures, while maintaining stability in an oxidative environment.

U.S. Army Engineering R&D Center: Enters WFO with INL titled “Watchman 2”



The U.S. Army Engineering Research and Development Center signed a WFO for INL to use its wireless test bed to evaluate the chemical/biological hazard sensor system, called Watchman Communications System, and recommend improvements.

Giner, LLC.: Evaluate Syngas Process for Aviation Fuels



Giner, LLC, a research and development firm specializing in the development of proton exchange membrane based electrochemical technologies, has contracted with INL to assist in designing a carbon dioxide reduction system. The goal is to

develop a system to provide the U.S. Air Force with an electrochemical system to generate synthesis gas for downstream conversion to aviation fuel.

Central Research Institute of Electric Power Industry: Contracts to Collect Core Debris Stability Data



Leveraging INL’s expertise in analyzing Three Mile Island core debris, CRIEPI has contracted with INL to conduct research on core fuels and structural materials related to the Fukushima #1 power station, Units 1, 2, and 3.

United States Nuclear Regulatory Commission: Executes WFO to use of Nuclear Materials



USNRC has signed a blanket WFO agreement that contracts INL support for a wide variety of services, including systems engineering and research; structural and seismic engineering and research; operational data collection and analysis; probabilistic risk assessment; software development; human factors and human reliability analysis; environmental engineering and research; training; and distribution of the SAPHIRE probabilistic risk assessment software package.

University of Idaho: Assess Products from Anaerobic Digester Systems



The University of Idaho contracted for an estimate of the revenue potential of energy production for a variety of products and by-products, (e.g. methane, etc.) that could be produced from anaerobic digestion of dairy manure. The evaluation also will consider commingling organic materials (substrates). This activity encourages regional dairy farmers to produce energy from waste.

ExxonMobil: Study Fractured Permeability Oil Shale



ExxonMobil has contracted with INL to evaluate the permeability of oil shale core that has existing fractures as a

function of temperature while obtaining X-ray computer tomographic (CT) images of the fracture aperture. The work also will evaluate INL’s x-ray CT compatible oil shale permeameter for its ability to measure oil shale fracture permeability as function of temperature under pre-retort temperatures and to obtain images of the fracture aperture. The goal is to determine if fracture aperture as measured by the X-ray CT scan can be related to the permeability measurements.

Ceramic Cement Corporation (C3): Executes WFO to Analyze Ceramic Concrete



C3 has contracted with INL to perform an assessment and characterization of C3’s novel ceramic concrete for potential use as shielding for waste containment. The work includes a series of neutron and gamma radiation transport calculations for ceramic cements with varying compositions and some variation in the compositions to show the effect of the

composition on the shielding capabilities of the materials.

AECOM Technology Corporation: Signs WFO to Design a Deployable X-ray System



AECOM Technology Corporation has contracted for INL to design a field-deployable x-ray inspection system based on existing field-deployable digital radiography and computed tomography x-ray. The deployable X-ray system will be used by AECOM to inspect stored chemical munitions.

Department of Transportation with DOE and NFPA: Evaluates Emergency Response to e-Vehicle Battery Hazards



The Department of Transportation, DOE, and the National Fire Protection Associations (NFPA) Research Foundation signed a WFO for INL to evaluate and validate best practices for emergency response to electric vehicle battery incidents. INL will review the technical basis for NFPA's proposed emergency responder training guidance for first responder emergency response procedures,

an urgent requirement as more electric vehicles are sold.

Idaho State University (ISU): Signs WFO for Developing MOV Instruction



ISU performs regular training on nuclear power plant motor-operated valves (MOV's) for USNRC staff and are expanding this training to support needs within the nuclear utility operators.

ISU has contracted with INL for course development and providing experienced instructors to deliver a detailed understanding of MOV's operation and function in nuclear service; a comprehensive awareness of the design basis for performance and test criteria for MOV's; regulatory aspects of MOV maintenance and testing; and, hands-on work with MOV actuators.

U.S. Drug Enforcement Agency (US DEA): Executes WFO for Wireless Spectrum Communications (WSComm)



U.S. DEA has signed a contract with INL to develop a secure wireless communication scheme for its video and audio surveillance and other information gathering. INL will use its award-winning WSComm technology to develop an undetectable, wireless communication system based on a spectrum agile Radio Frequency (RF) cognitive radio platform that uses Filter Bank Multi-Carrier Spread Spectrum (FB-MC-SS) technology.

Carrier Spread Spectrum (FB-MC-SS) technology.

Oklahoma State University (OSU): Signs Contract for Feedstock Study



OSU has contracted for a study on pre-processing of sponsor-selected biomass feedstock, which includes torrefaction and densification processes. This study will examine torrefaction and pelletization process quality and optimize the process variables including temperature, residence time, particle size and moisture content.

University of Utah: Signs WFO Contract to study Geomechanic Properties of Oil Shale



The University of Utah has contracted for a study in characterizing fluid flow and transport across various media types with differing mechanical properties of oil shale formations. INL will use hydraulic fracture modeling to process parametric data from the University during multiple fracture propagation simulations under various conditions.

OSIsoft: Signs WFO to Develop a Cyber Security Training Plan



OSIsoft contracted with INL for assistance in developing a new computer security training course specific to their Performance-Driven Intelligence (PI System) suite of products. Plans are for

OSIsoft to offer this new training course at the vCampus12511Live event in November 2012.

Progress Energy: Contracts for Human Factors Engineering for Plant Process Computer Upgrades



Progress Energy has signed a WFO for Human Factors Engineering (HFE) services and deliverables in anticipated replacement of Plant Process Computers (PPC) at the Harris Plant and Brunswick Plant. The PPC replacement project is being conducted as part of an ongoing Turbine Control System (TCS) replacement project and will incorporate the TCS into the Honeywell Distributed Control System.

"During the past three years, we have significantly reduced the time required to execute a variety of agreements."

Wendy Skinner
Business Manager, Technology Deployment

Technology-Based Economic Development Highlights

Nurturing Economic Development

INL's Technology-Based Economic Development (TBED) program seeks to assist in the creation of a regional, high-technology entrepreneurial climate. During the past decade, TBED has launched, developed and sponsored a wide variety of activities to promote technology business development growth. Those include:

- Continuing the development of key partnerships in the business sector, academia and various industries,
- Supporting entrepreneurial networks with active, high quality professional forums,
- Sponsoring special events and training on technology and business skills,
- Coordinating federal assistance to companies, and
- Accessing INL expertise and equipment through the Technical Assistance Program (TAP).

These efforts connected entrepreneurs, private industry, state government, technology researchers and investors who are interested in growing existing and new 'start up' businesses. A summary of selected efforts follows:

INL joined many regional organizations in supporting the Governor's Idaho Rural Partnership (IRP) in their Idaho Community Review Program. INL was very active in supporting IRP in this program with financial support, in-kind services and speakers. This program has had excellent success in evaluating Idaho communities with populations less than 10,000 and recommending proven techniques to better approach their individual economic development challenges. INL supported the Region IV, a registered non-profit group, with \$25,000 for regional development in coordination with IRP efforts.

During FY2012, the City of Lapwai and the Nez Perce Tribe were evaluated and provided several recommendations for improvements. IRP also conducted a review for American Falls in 2008, which produced a \$2.3 million revitalization grant from the U.S. Department of Transportation in Dec. 2011.



The Trading Post in Lapwai, Idaho is a high quality small business that may benefit from exposure to technologies and marketing techniques to advance their enterprise and the Nez Perce Tribe brand in this small community.

University Engagement. INL supported several successful efforts during FY2012, including:

- A workshop, "Turning Your Ideas into Businesses," was presented in northern Idaho at the University of Idaho Research Park in partnership with University of Idaho and Idaho TechConnect.
- Idaho State University, Idaho TechConnect and INL partnered in providing entrepreneurial skills training to staff, research assistants and students with the "So What, Who Cares, Why You" training course on campus.
- INL's Idaho Ideas to Market (I2M) Program provides college and university students with a hands-on approach in researching and determining market feasibility of ideas developed at INL. Students at Boise State University, University of Idaho and Washington State University were mentored and coached by INL researchers and commercialization managers for a competition.
- INL's TBED provided three college scholarship opportunities totaling \$10,000 to university students in STEM and business related areas of study.



Operation Facelift team members pose for a picture in Glens Ferry, Idaho. Included are, left to right, Glens Ferry business owner David Payne, Randy Shroll of Idaho's Department of Commerce, Larry Hall of Southern Idaho Rural Development, Stephanie Cook from INL, and Glens Ferry business owner Jill Laib.

INL Contributes to Community Improvement Project

INL continued its funding and participation in the Southern Idaho Economic Development Organization's "Operation Facelift," a project created in 2011 to clean up and paint renovated spaces in downtown areas to attract new businesses. This year, 19 cities and more than 1,000 volunteers in Southern and Eastern Idaho participated in two weeks of work to improve great places to live, raise families and infrastructure to attract good paying jobs to communities.



Formed in 2000 to unify regional efforts at sustaining economic development, Idaho's Economic Development Association (IEDA) convened for its 2012 spring conference in Boise. INL joined in IEDA's sharing of ideas and best practices from across the state by 62 economic development regional leaders.

The conference recognized performance excellence in the region with the inaugural Entrepreneurship Program of the Year Award. Rick Ritter of TechConnect received the award for his focus on

successfully building programs in the community that serve and support entrepreneurs with demonstrated results and metrics.

Key speakers at the conference included Jeff Sayer from the Idaho Department of Commerce, Mike Field from LinkIDAHO Broadband Project, and Ken Pedersen, who spoke on the patent process and current laws.



Dr. Yaqiao Wu, research associate professor from Boise State University, demonstrates a 3-D model to representatives of the INL spin-out business, NanoSteel. Dr. Wu generated the model by using the local electrode atom probe in the Center for Advanced Energy Studies on the INL research campus. CAES facilities and equipment are used to mobilize resources and to advance innovation with university, industry and INL partners.

Industry. INL regularly sponsors industry forums at the Center for Advanced Energy Studies (CAES) with its other members – Boise State University, Idaho State University, and University of Idaho.

One forum during FY2012 highlighted for industry participants a microscopy and characterization suite used in the CAES Microscopy and Characterization labs and received a demonstration by Dr. Yaqiao Wu. Among those attending was NanoSteel, a successful INL spin-out business who is a leader in proprietary nano-structured steel materials. NanoSteel, a multiple winner of the R&D 100 Award, recently received another of these awards for their NPM 3100 technology. These forums often lead to the identification of additional collaboration opportunities with industry.



FY2012 marks nearly a decade of partnership between INL and Idaho TechConnect, which has enabled regional entrepreneurs to move ideas from thought to reality. Idaho TechConnect is Idaho's first and only private non-profit organization focused on development, transfer and commercialization of technology. This partnership provides access to resources and makes connections for entrepreneurs and new business ventures.

Coordinating Federal Assistance for Companies

During FY2012, 142 companies and individuals received assistance in seeking federal funding. This assistance includes information on SBIR/STTR, Broad Agency Announcements (BAA), federal and large company procurement, requests for information from agencies, notices on Funding Opportunity Availability (FOA) and federal appropriations process and contacts.

Federal Funding Asst. (from TechConnect since its inception)							
FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	Total
49	109	71	134	141	76	142	722

Programs and Activities



Kickstand of Idaho added a Pocatello, Idaho chapter during FY2012, to create a network spanning three regions in Idaho.

The other chapters are in Moscow and Idaho Falls.

INL co-sponsored the establishment of this growing network in 2009 to increase awareness in a series of Idaho technology and innovation initiatives. It also aimed to provide entrepreneurs and service providers with a monthly opportunity to “network, learn and connect” within technology business sectors.

More than 3,940 individuals have participated since Kickstand began. Speakers from local businesses, state agencies, INL, successful spin-out companies, and regional entrepreneurs are featured at each monthly meeting. INL provided financial support, coordinated sponsors and speakers for the Kickstand events. The total attendance for the three chapters was 642 with average monthly attendance of about 18 for Moscow, 30 for Idaho Falls and 30 for Pocatello.



TechLaunch 2012. In its ninth year, TechLaunch 9.0 had twenty teams of university students and innovators participating on May 15-16. More than 150 people attended the event held in Boise, Idaho. INL Technology Deployment staff served as judges for the I2M and Next Gen divisions. The winners included:

- The top award - Entrepreneurial Idol went to Kyle Kinghorn of Citius Composites of Rexburg, Idaho.
- Syphon LLC won the Perkins Coie People's Choice Award.
- UltraFast Fermentation from the University of Idaho won the Next Gen division.
- I2M Competition: Four student teams from University of Idaho, Washington State University and Boise State University participated with the top award going to the Boise State University ASSET team. The ASSET team presented a comprehensive market assessment of INL's patented auto-steering software and equipment technology (ASSET).
- Brian Starnes from TazerTag won the Crowd Pitch Competition.

In a State of Idaho proclamation, Governor C.L. "Butch" Otter designated May 14-18 to be Idaho TechLaunch 9.0 week in order to "encourage educators and leaders in the government, business, technology and science communities to celebrate innovation and entrepreneurs in Idaho and commend the TechLaunch organizers for helping student and aspiring entrepreneurs learn the complexities of product commercialization, start-up financing and networking with industry leaders."

Since 2004, 45 of the 63 companies that have participated in TechLaunch are still in business and have attracted more than \$37 million in R&D and investment capital.



Melanie Rubocki congratulates Tushar Jain and Josh Riley from the University of Idaho for winning the TechLaunch 9.0 Next Gen Competition in 2012. The university team won for their Ultra-Fast Fermentation project, which speeds up the fermentation process that converts sugars to alcohol by a factor of 3 to 7.

Science on Tap and Science Caf 



INL and TechConnect continue their participation and support of specialized regional science and technology forums in North-Central Idaho and Eastern Washington. These regular exchanges provide speakers on technology development and commercialization in energy research, electric vehicle technology development, intellectual property management, available technical assistance, and other subject areas. During FY2012, eight meetings were held with a total attendance of nearly 300.

This year the Science on Tap meeting in Coeur d'Alene featured Dr. David Gertman, principal research scientist for human factors and human reliability at the Idaho National Laboratory. Dr. Gertman's session - "Get Your Foot Off the Pedal: Engineering Driver Efficiency." He discussed how the habits and behaviors of drivers and new technologies in cars can increase fuel efficiency.

Harvesting Clean Energy

INL Lab Director John Grossenbacher served as the platinum sponsor and provided a keynote address on "Optimizing the Region's Energy Resources" for the 11th annual Harvesting Clean Energy Conference in Oct. 23-25 in Boise. More than 350 attendees gathered for keynote presentations, plenary sessions, and breakout panel discussions on topics, including USDA energy programs; smart grid and manufacturing jobs; the Northwest power grid; and state level best practices in rural energy development. INL provided speakers, planning and logistics support, and arranged the four clean energy tours for conference participants.

Community Outreach Event: INL Shares Contribution to Mars Project

INL's Dr. Stephen Johnson spoke to the East Idaho Rotary and shared technology innovations and personal experiences in working with NASA, the Mars Science Laboratory and Curiosity Project. Rotary members were impressed with his detailed outline of safety and project planning that bonded the team together for a successful Mars entry on Aug. 5, 2012. INL's Multi-Mission Radioisotope Thermoelectric Generator powered Curiosity and nuclear power played a key role in the mission.



TD Collaborates with Idaho on New Business Seminar

Potential new business owners from Rexburg, Rigby, Blackfoot, Aberdeen, American Falls, Idaho Falls, Pocatello and Chubbuck participated in a New Business Seminar, sponsored by INL and the Idaho Department of Labor (DOL). Goals of the seminar included sharing important resources that can be used to grow a new business and educate those interested in forming start-up businesses. DOL Regional Economist Dan Cravens spoke about interest in forming new businesses related to advanced



manufacturing, computer technology, engineering and education. An Aberdeen inventor described a new sensor technology which he believes could keep potatoes from rotting.

INL's TD Director Steve McMaster spoke about transferring technology from the research setting into commercially viable products and services. Stephanie Cook, INL's TBED manager, participated in a panel discussion that included representatives from the Department of Commerce, Small Business Administration, and USDA Rural Development.

Technical Assistance Program

INL's Technical Assistance Program (TAP) was developed to help small innovation based companies overcome technical challenges by providing 40 hours of free assistance not readily available in the private sector.

During the past eight years, INL researchers have provided support for more than 200 TAP projects, dedicating more than 7,900 hours of technical expertise. This year INL delivered 25 technical projects and more than 1,000 hours of assistance. TAP activities offer INL's researchers access to the commercial marketplace to help solve real-world problems and provides a forum for researchers and small commercial businesses to interact.



Chris Orme from INL performs feasibility testing on the use of a membrane based gas dehydration process in Marsing, Idaho.

Marsing, Idaho received technical assistance in order to understand the feasibility of producing usable methane that was trapped in local water wells. Chris Orme with INL Interfacial Chemistry Department assisted with field level knowledge and aided John Larsen, Marsing city superintendent, in the effort. The project

yielded a very clean natural gas with approximately 90 percent methane saturated with water. By using selected membranes, water vapor can be extracted from the natural gas stream and prepare the methane for use.

In another TAP project, the City of Stanley Geothermal Team requested assistance from INL researchers to develop a technical assessment of the geothermal energy potential in the Stanley Basin. The project also evaluated the feasibility of developing a resource for the city for ag-science or tourism.



As part of the Stanley Geothermal Team, John Welhan from the Idaho Geologic Survey, left, and Michael Ginsbach, a graduate student at ISU, survey the area using an electromagnetic induction tool to detect geothermal activity.

New Faces in Technology Deployment

Two Commercialization Managers join TD

During FY2012, two commercialization managers (CMs) joined Technology Deployment's staff to fill vacant positions. Ryan Bills and Aaron Sauers are contributing energetic approaches to TD's efforts at bringing new work into the lab under WFOs, CRADAs, and the new ACT contract mechanism. These new CMs also will be responsible for reviewing new invention disclosures, assessing the market potential of new technologies, and negotiating license agreements to transfer rights to commercialize INL technologies that may be protected by patents and/or copyrights.

Ryan Bills, Commercialization Manager for Energy and Environment

Ryan Bills supports Senior Commercialization Manager David Anderson in working the portfolio of technologies in Energy and Environment.

A Pocatello, Idaho native, Ryan has a professional background in supply chain management, research-based consulting, and process engineering. He has a bachelor's degree in chemical engineering from the University of Idaho and a master's degree in business administration from Idaho State University.

Ryan was previously employed by Hoku Materials in Pocatello as a supply chain specialist, where his responsibilities included cost of ownership analysis and negotiation of supply agreements for capital equipment and raw materials. Prior to his time at Hoku, Ryan worked for eleven years in various process engineering and supply chain management roles for ON Semiconductor (formerly AMI Semiconductor).



Ryan Bills

Aaron Sauers, Commercialization Manager for Nuclear Science and Technology

Aaron Sauers works with Senior Commercialization Manager Gary Smith to support Nuclear Science and Technology.

Originally from Knoxville, TN, Aaron has a professional background in supply chain management and technology transfer. Aaron moved to INL from Los Alamos, New Mexico, where he served as a business development associate in the Technology Transfer Division Office of the Los Alamos National Laboratory (LANL). Aaron worked to commercialize numerous technologies with an emphasis on multi-physics codes. Prior to working at LANL, Aaron served as a graduate assistant in the Partnerships Directorate at Oak Ridge National Laboratory (ORNL), while obtaining his master's degree in business administration at the University of Tennessee.



Aaron Sauers

INL's WSCComm wins 2012 R&D 100 Award, more recognition

Since 1986, INL researchers have won 47 international R&D 100 Awards, including one during the 2012 competition.

INL's winning technology this year offers potential short-term and long-term solutions to expanding the use and availability of the radio frequency spectrum that delivers mobile phone and other services for six billion devices. The patent-pending Wireless Spectrum Communications (WSCComm) technology fills an existing technology void and offers secure, nearly undetectable control communication channels for use in public safety and national defense.

Key researchers involved in this technology are INL's Dr. Hussein Moradi, principle investigator and wireless expert; Dr. Behrouz Farhang, University of Utah electrical and computer engineering professor and INL subcontractor; and Dr. Carl Kutsche, INL National & Homeland Security director of Strategic Integration. They were assisted by Daryl Wasden, University of Utah doctoral student and INL intern, and INL engineers Jose Loera and David Couch.

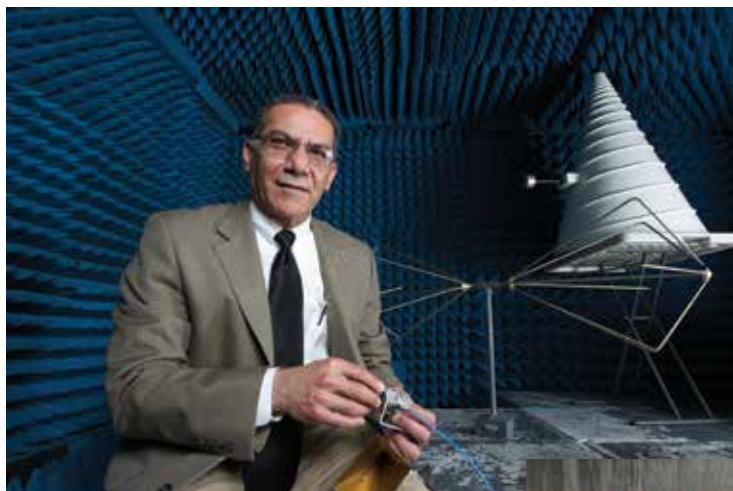
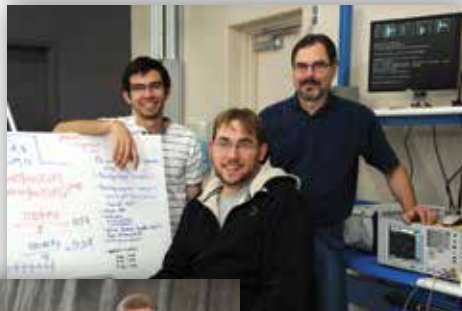
The international R&D 100 competition is hosted annually by R&D Magazine to honor the top 100 technologies in the world as chosen by the magazine's editors.

WSCComm also won a Federal Laboratory Consortium – Far West award for early stage technology and received recognition in Albuquerque, NM at their annual awards banquet. The Idaho Innovation Award competition also selected WSCComm as a finalist, recognizing a major contribution to managing the radio frequency spectrum in the future.



Senior Commercialization Manager Mark Kaczor speaks to local Idaho media during INL's R&D 100 news conference concerning the Wireless Spectrum Communications technology.

Electronic equipment successfully tests WSCComm algorithms with the transmitter (right) sending multi-carrier spread spectrum signals to receiver (left).



Above, Dr. Hussein Moradi tests the sensitivity of the receiver algorithm by artificially attenuating the radio frequency link. Right, WSCComm's engineering support team included Jose Loera, INL engineer; Daryl Wasden, INL intern and doctoral student at University of Utah; and David Couch, INL engineer. Bottom, WSCComm's Daryl Wasden, University of Utah; Dr. Behrouz Farhang, Professor, University of Utah; Dr. Hussein Moradi, INL; and Dr. Carl Kutsche, INL, received the R&D100 award during ceremonies in Orlando.





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