PNNL's peerless pair Smith (left) and Dixon
Page 2.

DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Research Highlights . . .

Field kit helps police solve real crimes

A chemical detection technique developed at DOE's Sandia National Laboratories and licensed to Law Enforcement Technologies (LET), Inc., of Colorado Springs has helped police departments solve at least five real crimes, including four murders, in recent months. The technique is useful for identifying minute traces of gunpowder residue left at a crime scene—and on the shooter's hands, arms, and clothing—whenever someone fires a gun. Each kit costs $16.95 and is about the size and shape of a VHS cassette. The technology has been used successfully in homicide investigations in New York, Arizona, Texas, and Virginia.

[Howard Kercheval, 505/844-7842, hckerch@sandia.gov]

Follow that chemical trail

What do you get when you pair a global positioning system with an ion mobility spectrometer? Chemical mapping made easy. A system developed by scientists at DOE's Idaho National Engineering and Environmental Laboratory integrates the two types of information, keeping tabs on the exact location of air-borne pollutants in the environment. By keying in on a particular chemical signature, their method can map out a trail leading right to its source. What's more, the program saves the information for future reference. The team initially developed the technology to ferret out abandoned gas wells, but its potential is vast. For example, the system could give law enforcement a nose for chemical mischief such as improper waste dumping, chemist David Atkinson says.

[Kendall Morgan, 208/526-3176, morgkk@inel.gov]

Looking 'in' with Linac Coherent Light Source

Just as the Hubble telescope vastly increased our ability to see "out", the Linac Coherent Light Source project at DOE's Stanford Linear Accelerator Laboratory will increase our ability to see "in" with x-rays 10 billion times brighter than ever before. The LCLS project recently passed the DOE Critical Decision 1 (CD-1) process. LCLS is now authorized to start Project Engineering Design activities. The LCLS project is a multi-institutional proposal for a single-pass, x-ray Free Electron Laser (X-FEL) using electron beams from the SLAC linac and operating in the wavelength region of 1 to 15 ten-billionths of a meter. The institutions with major LCLS responsibilities include SLAC, Argonne, Lawrence Livermore, and UCLA. Los Alamos and Brookhaven are also collaborators on the project.

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Conductors aim to lift sagging lines

DOE's Oak Ridge National Laboratory and 3M Company are hoping for powerful results from a project aimed at making transmitting electricity more efficient and reliable. Researchers from 3M, working with ORNL, are developing a promising replacement conductor for conventional power lines that addresses the problem of power outages caused by sagging lines. Lines sag under the heat of high current loads. The replacement conductor also avoids the high cost and environmentally harmful effects of building new towers. ORNL researchers will test 3M's small, medium and large diameter conductor cables successively in a field experiment at ORNL.

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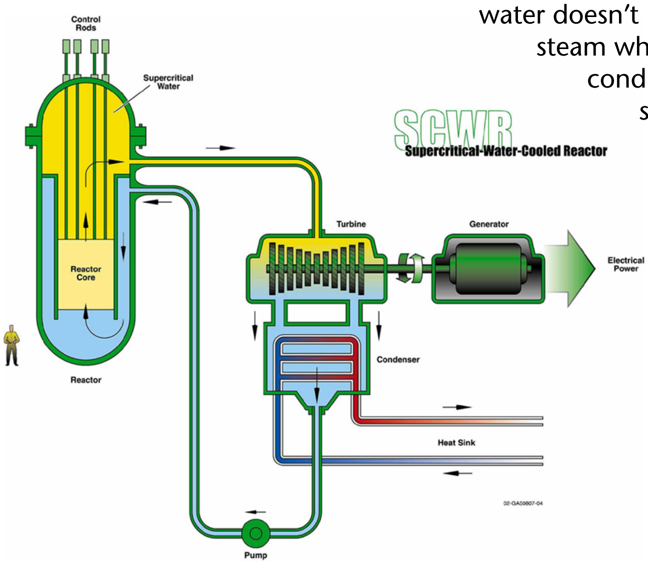
DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions. ***DOE Pulse*** is distributed every two weeks. For more information, please contact Jeff Sherwood (jeff.sherwood@hq.doe.gov, 202-586-5806)

INEEL revamps reactor design for 'super'efficiency

Scientists at DOE's Idaho National Engineering and Environmental Laboratory are turning up the heat and pressure of today's light water nuclear reactors—the source for 20 percent of all electricity in the U.S. The next generation reactors—called supercritical water reactors—promise to increase reactor's energy efficiency by as much as thirteen percent while simplifying plant design, INEEL nuclear engineer Jacopo Buongiorno says.



The Supercritical Water Reactor

When under extreme pressure, water doesn't boil and turn to steam when heated—a condition known as supercritical. That means more of the heat produced via fission can be converted into electricity in reactors cooled with supercritical water, Buongiorno says. In addition, the elements that handle water's phase change from liquid to gas in conventional light water reactors can be cut from the design, reducing construction costs.

Yet building supercritical reactors "won't be easy," Buongiorno says. Researchers can take hints for part of the design from conventional coal-burning power plants that operate under supercritical conditions, Buongiorno notes. However, they'll need materials that can withstand not only the extreme temperature and pressure—but also the radiation field in the reactor core.

To address the technical issues, Buongiorno and his INEEL team have joined forces with researchers at the University of Michigan, the Massachusetts Institute of Technology and Westinghouse, to analyze design safety and begin testing materials under conditions that mimic those of a supercritical reactor. The team plans to conduct more realistic materials testing that incorporates supercritical water in INEEL's Advanced Test Reactor—tests that will be "unique worldwide," Buongiorno says.

The supercritical water reactor design concept is one of six chosen for further development based on the criteria of economics, safety and sustainability by the Generation-IV International Forum and is one of two selected for primary research focus in the United States.

Submitted by DOE's Idaho National Engineering and Environmental Laboratory

PNNL PAIR IMPROVE KNOWLEDGE OF BIOLOGY, ATMOSPHERE

DOE's Pacific Northwest National Laboratory is seeing double—both in scientific advancements and in recent recognitions that highlight the work of two scientists: Richard D. Smith and David A. Dixon.

Smith's work in analytical chemistry involves the advancement and integration of two analytical disciplines: separation science and mass spectrometry with an emphasis on their use for study of biological systems. Smith's current research focuses on the development and application of new methods for quantitatively probing the entire array of proteins expressed by a cell, tissue or organism, otherwise known as its "proteome." This has particular significance in the area of systems biology, in which scientists are seeking to understand at the molecular level how biological organisms operate and function. This information has applications in several areas, including the development of new medications.

Dixon is a world leader in computational fluorine chemistry. He played an important role in enabling the use of alternatives to chlorofluorocarbons. These alternative compounds are key to minimizing the destruction of the stratospheric ozone layer. Dixon uses numerical simulation methods to obtain quantitative results on molecular systems and is applying computational methods to solve environmental problems. Dixon's current emphasis in computational chemistry focuses on predicting the thermochemistry and rates of chemical reactions and the design of new molecules.

Both scientists are Battelle Fellows at PNNL and were recently recognized for their respective work by the American Chemical Society. Dixon will receive the 2003 Award for Creative Work in Fluorine Chemistry, and Smith will be honored with the 2003 Award in Analytical Chemistry.

Submitted by DOE's Pacific Northwest National Laboratory