INEEL's James Jones combats smugglers
Page 2

Research Highlights . . .

DOE Pulse
Science and Technology Highlights from the DOE National Laboratories
Number 97 January 7, 2002

Coal-munching microbes yield cleaner fuel

Pushing the concept of "survival of the fittest" to the extreme, scientists at DOE's Brookhaven National Laboratory have developed bacteria able to live in harsh environments while chowing down on carbon-rich coal. The scientists started with bacteria naturally adapted to extreme conditions, and gradually added oil and then coal to the culture medium while decreasing the amounts of other nutrients, pushing the strains to adapt to use coal as food. Through their digestive action, these bacteria remove harmful pollutants. The resulting cleaner coal can be burned or converted to liquid or gaseous fuel more efficiently and with fewer pollutant by-products than untreated coal.

[Karen McNulty Walsh, 631/344-8350, kmcnulty@bnl.gov]

Magnetic refrigerator successfully tested

Using materials developed at DOE's Ames Laboratory, researchers have successfully demonstrated the world's first room-temperature, permanent-magnet, magnetic refrigerator. The refrigerator was developed by Astronautics Corporation of America, Milwaukee, as part of an agreement with Ames Lab. Instead of using ozone-depleting refrigerants and energy-consuming compressors, the new refrigerator uses gadolinium metal that heats up when exposed to a magnetic field, then cools when the magnetic field is removed. Water is circulated over the cooling metal then pumped through the refrigerator's cooling coils. The permanent magnets and the gadolinium don't require energy inputs; the only energy it takes is the electricity for the motors to spin the wheel and drive the pumps.

[Kerry Gibson, 515/294-1405, kgibson@ameslab.gov]

Evaluation makes gas turbines reliable

Sophisticated technologies developed at DOE's Argonne National Laboratory are playing a critical role in assuring the reliable operation of the nation's fastest growing electric power supply producer—natural-gas-fired turbine generators, expected to provide more than 60 percent of U.S. electric power demands. Argonne researchers have developed an arsenal of nondestructive evaluation technologies to enable reliable operation of high-temperature ceramic materials. Argonne is working with such turbine engine manufacturers as Pratt & Whitney, Rolls Royce-Allison, Siemens-Westinghouse, Caterpillar and Honeywell to transfer the techniques for industrial use. Funding for this research is provided by DOE's Office of Fossil Energy and Office of Energy Efficiency and Renewable Energy.

[Catherine Foster, 630/252-5580, cfoster@anl.gov]

Live on the Web: Fermilab Collider Run II

What's new at the Tevatron? What do particle collisions look like at the CDF and DZero detectors? DOE's Fermilab is now posting regular updates on the progress of Collider Run II through its public Web site. Visitors to the "News at Fermilab" box on the Fermilab home page can learn the day-by-day activities throughout the accelerator complex of the world's highest-energy particle physics laboratory (www-bd.fnal.gov/servlets/d11?project=outside). And there are links to a glossary of particle physics terms. The two detector experiments also offer links to events (www.fnal.gov/pub/inquiring/live_events/index.html) or to their "Greatest Hits" if no collisions are taking place.

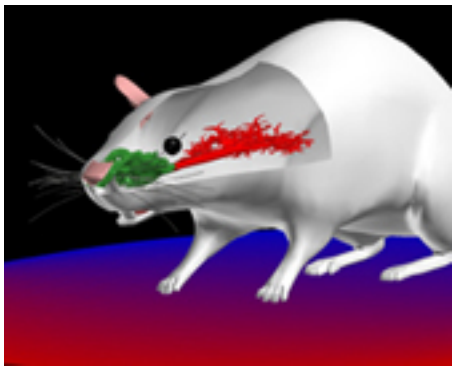
[Mike Perricone, 630/840-5678, mikep@fnal.gov]

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*** (www.ornl.gov/news/pulse/) is distributed every two weeks. For more information, please contact Jeff Sherwood (jeff.sherwood@hq.doe.gov, 202-586-5806).

Virtual lung models every breath you take

A virtual lung model developed at DOE's Pacific Northwest National Laboratory may help predict the impact of pollutants on respiratory systems and provide new insights into asthma, a condition afflicting 15 million American adults, as well as other pulmonary diseases.

The computer model, called the virtual respiratory tract, provides an unprecedented, three-dimensional view of how pollutants enter, travel through and collect in the entire respiratory system. PNNL scientists have developed a complete model of a rat's respiratory tract, which includes the nose, larynx and lungs, and have nearly completed a similar model of the human.



A mouse virtual-lung model

Collaborations will prove key to continuing the research. PNNL scientists anticipate continuing to work with researchers at the University of California, Davis, who have conducted extensive research into asthma using animal models, and the University of Washington's pulmonary biology and bioengineering programs. Understanding biological impacts from pollution has become more important as respiratory ailments have increased, as evidenced by the nearly doubling of asthma sufferers since 1980. By learning how particulates travel through the lungs, scientists can design treatments that more precisely target drug delivery for pulmonary diseases and understand how pollutants impact differently damaged and healthy lungs.

"We designed a tool that will open up new possibilities for understanding how our environment affects our bodies," said Rick Corley, PNNL environmental toxicologist.

Using the virtual respiratory tract, PNNL scientists can analyze the influence of various factors, such as the amount of pollutants or length of exposure, on healthy versus diseased lungs by manipulating the computer model. For example, they can begin to simulate how gases, vapors and particulates may act differently within lungs of people suffering from cystic fibrosis, emphysema and asthma.

PNNL scientists designed the highly detailed virtual respiratory tract by combining the powerful capabilities of supercomputers, rapid semi-automated computer modeling and nuclear magnetic resonance imaging systems.

Submitted by DOE's Pacific Northwest National Laboratory

INEEL's James Jones foils smugglers

It's a story that could have been taken from the pages of a Tom Clancy thriller, but this account comes directly from the news wires. A Frenchman and two cohorts were recently arrested in Paris trying to smuggle 80-percent-enriched uranium out of the country. They encased a glass vial of the material in a lead cylinder and transported the package in a mundane delivery van. Fortunately, they were caught.

James Jones

This tale of international intrigue adds credence to the ominous warnings of counterterrorism and other security professionals who say the danger of radioactive materials falling into the wrong hands is more of a threat today than ever. To make matters worse, these experts point out that 70 percent of manufactured goods are imported/exported in gigantic 40-foot cargo containers, an easy place to bury a wrapped and shielded package.

National Security physicist James Jones of DOE's Idaho National Engineering and Environmental Laboratory has proposed a solution. He uses a pulsing electron accelerator to produce high-energy photons, and then aims those photons at a target, such as a shipping container. The energetic photons penetrate the target and stimulate photonuclear processes within the inspected object. The neutrons that result from this process are detected between each accelerator pulse and are used to identify any nuclear materials inside—shielded or not.

To differentiate between legally shipped medical or commercial isotopes and uranium potentially targeted for terrorist purposes, Jones shoots two different beam energies (from the same accelerator) at the target and analyzes the ratio of neutron counts that results.

His next step is incorporating these active interrogation methods into existing inspection systems at a U.S. port-of-entry.

Submitted by DOE's Idaho National Engineering and Environmental Laboratory