• NEWSLINE SPECIAL INSERT •

Up Close on Homeland Security

A monthly insert on special topics at Lawrence Livermore National Laboratory. This month: Homeland Security. • • • Fall 2004

Spotlight on

Homeland Security

—Wayne Shotts

Homeland security is a collaborative effort

Having passed the first anniversary of the formation of the Department of Homeland Security (DHS) earlier this year, it's a good time to take a look at what the new department and this Laboratory have been able to accomplish to make America better prepared to deal with the threat of terrorism.

One of the unique features of DHS is its Science and Technology Directorate. When Congress formed the new department, it recognized that the scientific expertise of the nation could be brought to bear to protect the country with new as well as existing technologies. In 2004 alone, DHS will invest more than $1 billion dollars in science and technology, much of it through the Science and Technology Directorate, to help the nation anticipate, detect respond to, and recover from terrorist threats.

Lawrence Livermore has been a key participant in this national endeavor. In December 2002, we formed the Homeland Security Organization (HSO) to provide comprehensive solutions integrating threat, vulnerability and tradeoff analyses, advanced technologies, field-demonstrated prototypes and operational capabilities to assist federal, state, local and private entities in defending against terrorism. Our homeland security work has grown significantly since then. To date in 2004, funding for homeland-security-related activities is supporting more than 200 full-time employees.

We have assisted DHS and its Science and Technology Directorate in many efforts over the past year. For example, we played a key role in the initial rapid standup of the BioWatch system in numerous cities across the country. Many of the DNA signatures used by BioWatch to detect pathogens were developed at Livermore, with the resulting assays validated by the Centers for Disease Control and Prevention (CDC). We continue to provide scientific and technical support to the core BioWatch team at DHS, the CDC, the Environmental Protec-

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Getting "Up Close" with science

Editor's note: This month's Up Close focuses on homeland security and how it has contributed to Lab missions. Groundbreaking projects are described to show the important role it plays in the innovative science that is the hallmark of this Laboratory.

Homeland Security takes shape

Homeland Security Secretary Tom Ridge, left, made his first visit to the Laboratory in July 2003, where he received briefings on Lab technologies to assist in the war on terrorism. Ridge also met with the media.

The Laboratory's Homeland Security Organization (HSO) was established in December 2002 to provide technical assistance to the newly formed Department of Homeland Security (DHS) and complement the nation's homeland security efforts.

"Many dedicated people put in extraordinarily long hours, often away from home for weeks or months on end, ably and very successfully supporting the DHS mission," noted Wayne Shotts, associate director for Nonproliferation, Arms Control, and International Security (NAI) and acting director of HSO.

In the year and a half since then, Lawrence Livermore has worked closely with the new department, particularly its Science and Technology Directorate, and has secured leading roles in numerous DHS programs.

"DHS has made it clear that it will call upon a wide variety of Laboratory capabilities in the coming years," Shotts said.

In May 2004, Shotts announced a realignment of HSO to focus on the execution of homeland security programs and maximize synergisms with other ongoing Laboratory activities.

"Delivery on all of our commitment to DHS is critical to our success, to S&T's ability to support the DHS mission, and securing the homeland," Shotts said.

"HSO will continue to be responsible for the success of DHS activities at LLNL and for managing our interactions with DHS and its components as well as with other federal, state and local organizations, universities, laboratories and private entities on topics related to homeland security."

With the realignment, Don Prosnitz is deputy director for HSO, which will function as a pro-

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Working together to reduce terrorist threat

Northern California leaders know they need to work together in efforts to prevent terrorist attacks in the Bay Area and to minimize the effects of any that do occur.

Emergency responders and security leaders from around the Bay Area gathered in early 2003 to discuss ways to improve regional cooperation against terrorism.

The importance of regional cooperation is stressed by Department of Homeland Security representatives, emergency professionals, critical infrastructure managers, national lab researchers and others.

"The boundaries between agencies need to drop in an emergency," said Pat Martel, executive director of the San Francisco Public Utilities Commission, which supplies water to 2.4 million people and is the largest water supplier in northern California.

In facing the threat of bioterrorism, she said, the San Francisco Public Utilities Commission is attempting to work with other water districts for mutual assistance. "No individual district can act alone in an emergency."

Ed Gabriel, deputy commissioner for Preparedness in New York City's Office of Emergency Management, is one of the emergency managers and personnel who responded to the September 11, 2001 attacks.

"When the big one hits, you need to think big and the turf barriers need to come down," Gabriel said.

Gabriel also emphasized the importance of having biodetection equipment that is accurate and functions without false positives.

The New York City subway can't be closed down because of false readings on detectors, he said, adding "Political and public information

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New Laboratory center for radiation detection

Rep. Ellen Tauscher looks on while Simon Labov speaks during ceremonies marking the opening of the Radiation Detection Center.

When the Laboratory's Radiation Detection Center, or RDC, officially opened in April 2003, Rep. Ellen Tauscher said it was a fine example of how "the leading-edge, out-of-the-box thinking of Livermore researchers has been important in countering the increasing threats to our nation."

The usage of radiation detection range from detecting nuclear materials in the fight against terrorism, to medical technology, to assisting in the fundamental understanding of the universe.

For years, much of the Laboratory's expertise in radiation detection resided within the Nuclear Test Program. When nuclear testing was halted, the Laboratory restructured and many of Livermore's radiation detection experts applied their skills in other parts of the Laboratory, including Chemistry and Materials Science, Physics and Advanced Technologies, Defense and Nuclear Technologies and the Nonproliferation, Arms Control and International Security (NAI) directorates.

Now, the RDC is the Laboratory's new home for coordinating radiation detection research. The primary technical focus of the RDC is the detection, identification and analysis of nuclear materials and nuclear devices as part of the nation's fight against terrorism.

Simon Labov, who joined the Laboratory in 1987 as a postdoctoral researcher developing X-ray detectors for astronomy, has been appointed as the RDC's director. Christine Shannon is the center's administrator.

Established under a memorandum of understanding, the RDC boasts participation of eight Lab directorates and the Homeland Security Organization.

"Historically, Lawrence Livermore has had a great deal of expertise in radiation detection," Labov said. "What the center does is leverage our past work to help meet today's security needs."

More than a dozen advanced R&D projects for detecting clandestine nuclear materials or devices are now under way and coordinated by the center.

Technologies under development range from a cell phone that doubles as a radiation sensor, to gamma- ray imagers and gamma-ray spectrometers that provide increased detection capabilities for nuclear materials.

"In the wake of the September 11, 2001 attacks, we were able to help various federal agencies because we offered a coordinated and easy way to access the Laboratory's radiation detection capabilities," Labov said.

Jeff Richardson, of NAI, noted, "Even though the RDC's efforts started prior to September 11, this center is exactly what the Laboratory and the nation need as part of their response to the threat posed by terrorism."

More than 200 Laboratory employees are involved in radiation detection research, with everything from growing crystals and developing detectors to serving on the Nuclear Emergency Search Team.

Labov and Richardson view the RDC as an umbrella organization to provide cohesion for Lab radiation detection efforts, and as something of an "information exchange."

Some of the activities the RDC uses to enhance the Lab's radiation detection capabilities include sponsoring seminars and classes, hiring students and postdocs, and staging workshops. The center has sponsored seminars on topics

Radiation detection, See page 7

RadScout, ever prepared in nation's fight against terrorism

Reporter Rich Ibarra of KCRA-Channel 3 of Sacramento interviews physicist Mike Dunning of the Defense and Nuclear Technologies Directorate during a press briefing about RadScout, a portable radiation detection and identification tool.

As a premier example of homeland security technology moving to the marketplace, the Laboratory signed a licensing agreement in June 2003 with ORTEC Products, a business unit of AMETEK Inc., to commercialize the Lab's RadScout radiation detector and analyzer.

ORTEC, based in Oak Ridge, Tenn., has incorporated the RadScout technology in its next generation of advanced portable nuclear detection systems. The company released the detector as the ORTEC Detective in March 2004.

"RadScout is an excellent example of NNSA laboratories providing solutions to help our nation improve homeland security and assist in the war on terrorism," said Linton Brooks, NNSA administrator.

"This is a good example of working with partners to make homeland security stronger," said Lab Director Michael Anastasio at the time the agreement was signed. "RadScout represents a breakthrough in radiation detection and identification technology. RadScout reduces existing bulky equipment to a compact, lightweight, battery-powered device that can be permanently mounted or fully portable. It is easy to use by nonscientists with minimal additional training."

RadScout was developed within the Lab's B Division of the Defense and Nuclear Technologies Directorate. The technology was developed for emergency first responders and inspection personnel who need rapid detection and identification of material to determine the nature and scope of a threat.

Weighing about 20 pounds, RadScout features a miniaturized refrigeration system that eliminates the need for liquid nitrogen to cool the device's germanium crystal to cryogenic temperatures. RadScout measures neutrons and gamma rays emitted by radioactive materials and then analyzes them to identify the sources.

These high-performance, high-resolution portable systems can be used at border crossings, cargo ship docks and transportation terminals to differentiate between potentially dangerous radioactive materials and otherwise harmless radiation sources.

"RadScout puts the ability to detect radiation into the hands of the people who need it most, our emergency responders," said Bruce Goodwin, associate director of DNT.

Emergency responders invited to the Laboratory have been able to see RadScout in action and determine whether the technology would be useful in

RadScout, See page 8

Lab's multiple efforts to counter bioterrorism

In the world of homeland security, the Laboratory is well known for its work in biodefense. Because it began a focused program in biological counterterrorism in 1995, it was ready to help respond to the events of fall 2001.

The BioWatch system that was deployed in early 2003 by the Department of Homeland Security is adapted from the Biological Aerosol Sentry and Information System (BASIS), which was developed by Livermore and Los Alamos, and deployed at the 2002 Winter Olympic Games in Salt Lake City.

BioWatch is a national system with the capability to detect airborne pathogens. The Centers for Disease Control and Prevention and the Environmental Protection Agency are responsible for BioWatch operations.

Lawrence Livermore provided significant assistance to the initial standup of BioWatch by performing sample analysis until local laboratories came on line. Since October 2001, the Laboratory has processed more than 500,000 environmental samples for pathogen detection.

"We continue to have a pivotal role in BioWatch," notes Pat Fitch, leader of Livermore's Chemical and Biological National Security Program. "We provide supplementary detection and analysis capabilities as well as on-call subject matter experts in the event of a positive or anomalous detection."

As successful as BASIS and BioWatch have been, they are very labor-intensive, and Livermore researchers are exploring various approaches to greater efficiency.

The Autonomous Pathogen Detection System (APDS) has been in development for five years. Unlike BASIS and BioWatch, which use filters that must be collected from sampling stations and brought to a lab for analysis, APDS operate on its own for more than a week. It autonomously collects samples, performs up to 100 antibody assays simultaneously (and confirmatory PCR on any samples that test positive), and electronically reports out results every hour to a "base station."

APDS has been successfully demonstrated in such high-traffic venues as subway stations and airport terminals. It has also been tested at the U.S. Army Dugway Proving Ground against two live bioagents — *Bacillus anthrasis*, which causes anthrax, and *Yersinia pestis*, which causes plague.

APDS has garnered a lot of attention lately. It won a 2003 R&D 100 Award from the trade journal *R&D Magazine* for being among the year's top 100 industrial innovations worldwide.

APDS was also featured as the cover article of the October 15, 2003, issue of *Analytical Chemistry*. Shortly thereafter, Chemical Abstracts Service (CAS), a division of the American Chemical Society, selected that article as the "most intriguing" paper published during the fourth quarter of 2003.

Chemical Abstracts Service named a journal article about the Lab's APDS, above, as the "most intriguing" paper out of about 200,000 documents reviewed.

"There are several facets that caused the Livermore paper to be selected as 'most intriguing,'" said Dr. Matthew Toussant, vice-president of editorial operations for CAS. "In many papers, the testing isn't realistic, but in this case they were using live agents and the detection threshold was realistic and sensitive."

"To have this paper recognized by CAS is a huge honor," said Mary McBride, the paper's lead author and an analytical chemist in the Physics and Advanced Technologies (PAT) directorate. "The recognition we've received, by almost immediate acceptance, the positive feedback from our peers outside the Lab and then this selection, are very gratifying."

To address the "front end" of the bioterrorism problem, the Biodefense Knowledge Center (BKC) has been established. This new center will provide a 24 hour, seven day a week capability for threat assessment and other assistance related to bioterrorism.

This national DHS center draws upon researchers and subject matter experts at the Oak Ridge, Pacific Northwest, Sandia, and Lawrence Livermore national laboratories, Science Applications International Corp., and the Department of Homeland Security centers of excellence located at the University of Southern California, University of Minnesota, and Texas A&M.

The BKC was formally dedicated on Sept. 10, 2004. In attendance for the unveiling were Charles McQueary, under secretary for DHS's Science and Technology Directorate; Maureen McCarthy, director of the DHS Office of Research and Development; Mim John, Sandia vice president; Lab Director Michael Anastasio; Wayne Shotts, director of LLNL's Homeland Security Organization; and Bill Colston, BKC director.

"The BKC is a milestone for our national laboratories, DHS, and the biodefense program," McQueary said during the dedication. "The BKC serves as a hub of biodefense expertise. It can protect us against and help us recover from a biological attack."

The BKC has already been called upon by DHS to assess several reported disease outbreaks and other biodefense-related events. Initially, the center will provide assessments and respond to information requests from the DHS Operations Center, although other federal agencies may be able to use the center as a resource in the future.

"Our mission is not just to respond to terrorist attacks but to anticipate, understand and prevent them," Colston said.

"The nation is far better prepared to respond to an act of terrorism than three years ago," said McQueary, although "there's still a lot to be done….The world has changed irreversibly, and the national labs are critical to protecting the nation."

Leading-edge nanoscience tapped for portable biodetection devices

Imagine a place where a scientist uses the light emitted from a single molecule to understand how proteins repair damaged DNA, while another scientist uses tiny nuclear magnetic resonance coils to make a rapid handheld detector for biological and chemical agents.

The BioSecurity and Nanosciences Laboratory (BSNL) is that place. Scientists working in the BSNL explore the microscopic world of living organisms, many of which are harmful biological pathogens such as viruses, spores and bacteria, as well as biological toxins and protein machines.

Working with a plethora of new technologies, the scientists support internal program areas aligned with the Laboratory's national security mission and work to improve human health with fundamental and applied research.

Through investments in new infrastructure and bright young talent, the BSNL has established a dynamic environment for pursuing leading-edge research.

"Now we want to do a better job of letting people know about what we do," said Andrew Quong, BSNL deputy director.

Andrew Quong, deputy director of the BSNL, explains how the BioAerosal Mass Spectrometer (BAMS) identifies airborne particles.

Computer modeling within the BSNL provides the framework to help develop and design experiments as well as develop sound hypotheses and make accurate predictions.

One of the technologies developed at BSNL is the BioAerosol Mass Spectrometer (BAMS) that was deployed in November 2001 to the postal sorting facility in Florida to scan the billions of pieces of mail for harmful biological or chemical aerosol particles.

Created with help from UC Davis researchers, BAMS can be used to address biodefense and public health issues. Individual airborne particles can be identified at the single-cell level in about 100 milliseconds. BAMS identifies signatures for different spores and the differences between harmful and benign spores. The ultimate goal is near-instantaneous characterization of deadly airborne cells intentionally released during a biological weapons attack.

Mass spectrometry is also being used by BSNL scientists to understand the chemical response of cells following exposure to pathogens, with an eye on creating a nationwide monitoring system for disease outbreak.

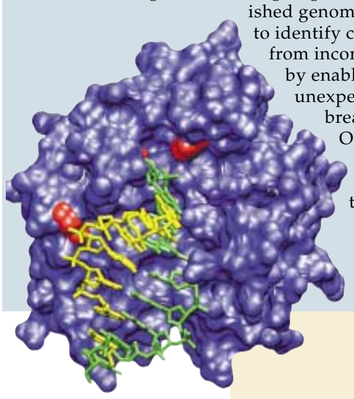
Nanoscience, See page 7

Computing capabilities diversified

The power of LLNL's diverse computing capabilities is crucial to the homeland security effort. For example, the Lab's computer programmers have designed detailed simulations and scenarios to improve emergency response planning and crisis management operations. The National Atmospheric Release Advisory Center (NARAC) is an example of this with its ability to model the fate and transport of chemical and biological agents in the atmosphere.

Advanced computing is also required for comprehensive assessments and analyses to protect critical U.S. infrastructures. For instance, by combining the Lab's simulation strengths in shock physics and structural mechanics, authorities can understand the impact of explosions on buildings, dams, or other structures and then design appropriate countermeasures.

Advanced computing techniques are also being used to speed the development of the DNA and protein signatures that lie at the heart of biodefense. For example, Lab biologists, computing scientists, and mathematicians have collaborated to invent the first-ever algorithm for aligning draft genomes with finished genomes, making it possible to identify candidate signatures from incomplete data and thereby enabling rapid responses to unexpected disease outbreaks.



Other computer science advances have significantly reduced the time of a key step in the signature development process, and the algorithms involved are being scaled to permit work on organisms with larger genomes (e.g., fungi). Taken together, these computing advances will result in faster, less expensive, and more reliable biodetection capabilities for homeland security.

The development of better radiation detectors and biosensors is enhanced by advanced computing capabilities. Advanced computations also guide the micro- and nanoscale engineering required to miniaturize the devices.

A major challenge is the difficulty for security and intelligence agencies to find and connect the critical pieces of information amidst mountains of data. Advanced scientific computing is key to developing the scalable information analysis and large-scale data integration tools that are needed to solve this problem. In addition to developing new algorithms, the Lab is also exploring novel computing architectures that could dramatically speed the discovery of relationships in large datasets.

Even though many of these new algorithms are developed on LLNL's massive supercomputers, the end results often can be implemented by first responders in the field on ordinary desktop computers, laptops or even handheld devices.

In these and many other instances, advanced scientific computing is one of the keys to "being smart" about how the Lab tackles homeland defense, enabling it to provide technologies and capabilities that significantly improve security.

Advanced scientific computing capabilities, such as adaptive mesh refinement and complex geometry modeling, underlie NARAC's ability to model the dispersion of chemical and biological agents in urban settings.

NARAC tapped for homeland security

Photo and NARAC plot of the plume from the Staten Island fuel barge fire (February 21, 2003).

It started with a phone call a few minutes after high noon on a Monday in May 2003. There was a massive explosion in Seattle, and HAZMAT analysis would reveal it was a radioactive dispersal device (RDD).

Playing a part in the national terrorist exercise TOPOFF 2, the Lab's National Atmospheric Release Advisory Center (NARAC) went to work analyzing the plume and figuring out where the release was headed so that first responders could determine which areas needed to be evacuated.

The drill was one of many that NARAC has participated in over the years to test the ability of federal, state, and local authorities to handle emergencies involving the atmospheric release, accidental or otherwise, of hazardous materials. TOPOFF 2 was the first exercise in which the Department of Homeland Security played a major role.

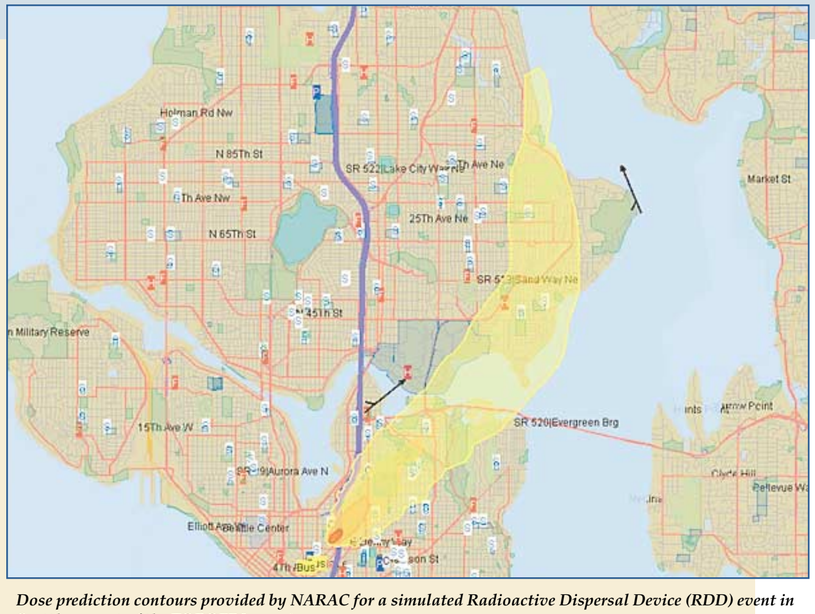
Emergency response personnel from the state of Washington, King County, the city of Seattle, the state of Illinois, Cook, Lake, Kane, and DuPage counties, the city of Chicago, 19 federal agencies, the American Red Cross, the National Capitol Region, the District of Columbia, the state of Maryland, and the commonwealth of Virginia all participated in the event.

Laboratory staff played actively in the 36-hour exercise through the NARAC operations center, specifically in support of the RDD scenario in Seattle.

"NARAC had an unprecedented role in this exercise because we support first responders and the city of Seattle under a DHS program called LINC — Local Integration of NARAC with Cities—as well as supporting NNSA's regional and national nuclear incident response teams," said John Nasstrom, deputy NARAC program leader.

LINC provides a unified tool for city, county, state and federal agencies to use in emergency planning and response. Through its Web- and Internet-based tools, first responders can access and distribute NARAC plume predictions. At present, five cities are participating in LINC — Seattle, New York City, Cincinnati, Albuquerque and Fort Worth.

In April 2004, the Department of Homeland Security established the Interagency Modeling and Atmospheric Assessment Center (IMAAC) to consolidate and integrate the various federal efforts to model the behavior of airborne releases into a single emergency response entity for homeland security. NARAC has been designated as the primary interim provider of IMAAC capabilities and is currently supporting some 200 new DHS stakeholders in addition to its traditional suite of customers and users.



Dose prediction contours provided by NARAC for a simulated Radioactive Dispersal Device (RDD) event in Seattle as part of the TOPOFF 2 exercise.

Forensic Science Center maximizes the tiniest clues

Livermore's Forensic Science Center (FSC) offers a comprehensive range of analytical expertise to counter terrorism, aid law enforcement, and verify compliance with international treaties.

The center's combination of human and technological resources has made it among the best of its kind for collecting and analyzing virtually any type of evidence.

Founded in 1991, the center is a multidisciplinary effort of chemists, materials scientists, microtechnologists, instrument designers, and others.

The center's approach to forensic analysis maximizes the information that can be obtained from extremely small, often unique samples — of explosives residues, dust particles, hair strands, fibers, bloodstains, radioactive materials, drugs, and unidentified chemicals.

As a result of its unique combination of sampling handling and analytical capabilities, the center is one of only a few facilities in the country that can accept, analyze, and attribute all threat - unknown samples.

For these reasons, the Forensic Science Center was recently designated by the Organization for the Prohibition of Chemical Weapons (OPCW) as a chemical weapons challenge inspection analytical laboratory — one of only a dozen or so such laboratories in the world.

Accreditation was earned over a two-year period through rigorous testing in international round-robin mock inspection exercises.

Rich Whipple displays the elements of the Lab-developed chemical diagnostic kit now being produced in Hawaii.

"OPCW designation validates our expertise in chemical analysis and detection," said Armando Alcaraz, chemist and FSC researcher in charge of OPCW work. "It puts the Lab at the forefront of standup capabilities in the event of a chemical threat, terrorist or otherwise."

Many of the center's projects have required its personnel to devise new analytical tools, forensic techniques for analyzing trace amounts of evidence, unique sampling procedures, and a range of new portable instruments that bring laboratory analytical capabilities into the field.

One such technology is a chemical diagnostic kit that can be used to analyze for the presence and amount of stabilizers in propellant mixtures found in munitions.

The technology, known as field-portable thin-layer chromatography (TLC), has been licensed to Alu Like Enterprises LLC and is being manufactured by its subsidiary, is Ho'olana Technologies of Hilo, Hawaii.

Stabilizers, which normally comprise two to five percent of propellant mixtures, are slowly consumed as the propellant ages. Lacking sufficient stabilizers, the propellant is susceptible to accidental decomposition or burning, and is unsafe for handling or storage and must be destroyed.

Unlike traditional laboratory TLC processes, the new kits can be used in the field, require much smaller samples, and yield results in only a few minutes.

"This is but one example of the many ways in which the FSC is delivering premier scientific insight and technical solutions to meet real-world, often-urgent problems in national security, counterterrorism, and law enforcement," said center director Glenn Fox.

Diagnosing disease before symptoms arise

Doctors may someday be able to tell whether individuals have been exposed to a disease-causing pathogen well before they know they are sick.

Rapid diagnosis of infection within a day or two of exposure, rather than waiting days to weeks for symptoms to appear, is the aim of a new research initiative at the Laboratory.

Now more than a year old, the Livermore "pathomics" project is a multi-million-dollar strategic initiative funded by the Laboratory Directed Research and Development Program and supported by seven directorates.

Ken Turteltaub, head of Biology's Biodefense Division, is one of the co-leaders of the pathomics project.

Lab scientists have joined forces in this effort with researchers from two southwestern universities. The collaboration, called the Biosignatures Consortium, partners Lawrence Livermore with the University of New Mexico Health Sciences Center and with the Center for Biomedical Inventions at the University of Texas Southwestern Medical School.

Pathomics is, in effect, the study of the molecular basis of infectious disease. It focuses on changes in protein levels and other molecules in the blood that occur when a body has been exposed to a pathogen.

"We don't have any technology right now to detect the presence of anthrax, for example, before you're essentially too sick to help," said project co-leader Fred Milanovich, who also founded Livermore's Chemical and Biological National Security Program (CBNP) in 1996.

Pathomics was conceived in late 2001 as a strategic vision for the CBNP by Milanovich, current CBNP leader Pat Fitch, and Ken Turteltaub, head of the Biodefense Division in the Biology and Biotechnology Research Programs directorate.

"The premise of pathomics is that before the onset of illness, there is a molecular indication of disease in human blood," Milanovich explained. Faster disease detection, followed by more rapid treatment, could help save the lives of people exposed to biothreat agents such as those that cause plague or anthrax.

The pathomics research team began by checking the blood of humans and animals to identify the thousands of components, such as nucleic acids and proteins, that constitute normal blood.

"We then examined the changes in these

Pathomics, See page 7

Lab's researchers receive a few helping hands

Lab homeland security researchers received a helping hand this summer from some of the nation's best and brightest university science students.

The students worked at the Laboratory for eight -to 10-week internships under the Department of Homeland Security (DHS) Scholars and Fellows Program.

One of the most important aspects of this year's scholars and fellows program was that many of the students made real contributions to homeland security projects.

That's the view of Igrid Gregory, who oversees the program for DHS through the Oak Ridge Institute for Science and Education.

"I think the program worked extremely well," Gregory said. "So far, we've gotten excellent reviews from both the students and the mentors. Some students have already been offered jobs; others are planning continued collaborations and some researchers are serving as school advisers."

Terry Brugger, a Livermore computer scientist in the Lab's Information Operations and Assurance Center, supervised the work of two students, one a graduate student and the other an undergraduate student.

"The DHS internship program, both scholars and fellows, succeeded in picking the cream of the crop," Brugger said. "I think both of our students worked out very well. I've been impressed with the caliber of their work."

The goal of the internship program is to involve the students in research projects relevant to DHS missions and to foster a desire to contribute to homeland and national security. There were 50 scholars (undergraduate students) and 50 fellows (graduate students) in the program nationwide.

Brugger's two students, who both study computer science, were Rachel Greenstadt, a third-year graduate student at Harvard University, and Dan Wendlandt, a senior this fall at Stanford University.

Greenstadt conducted survey work and researched technologies that people who live in authoritarian nations can use to circumvent Internet censorship controls.

Wendlandt's project focused on analyzing how the paths followed by Internet traffic such as e-mail or Web downloads map onto geopolitical boundaries.

"I think my internship was great," he said. "Often undergrad students don't get to come up with research projects, but I've been able to do that here."

Nanoscience

Continued from page 3

Other BSNL scientists are developing synthetic membranes and nanofibers to fight biological threats and ensure water safety. Pore diameter ranges from 50 nanometers to 2.5 micrometers. They collaborate with chemists, biologists, physicists and engineers to build durable membranes that can be used in the field.

Using atomic force microscopy, still other BSNL scientists can make these observations at the molecular level. They are measuring the forces that bind antibodies to proteins, mapping the architecture of viruses and spores, and learning how biological molecules can inhibit kidney stone growth.

Underlying many of these technologies is the synthesis of chemicals with special structures that allow them to bind to specific targets including toxins or pathogens as well as silicon surfaces.

With more than 60 multidisciplinary scientists, more than half of whom are less than 35 years old, working at BSNL, the long-term goal is to help the programs get real devices into the field, Quong said.

"It's a very vibrant place to work," he said. "Scientifically, it's exciting and there is a growing need in these fields for the safety of the country."

Radiation detection

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such as high-energy neutron imaging, gamma-ray detection, Department of Energy (DOE) radiation detection needs, work with the International Atomic Energy Agency and structural features of semiconductors for nuclear spectroscopy.

The RDC also serves to train college students in what has been a declining field. "Because of the decline in nuclear power and nuclear engineering departments on university campuses, there has been a shortage of young scientists trained in radiation detection," Labov notes. "We are working to attract and help train students and postdocs to assist in solving important national security problems."

In addition to working with students in nuclear science, the center is providing training in radiation detection to postdocs coming from related fields such as high-energy physics and astrophysics.

RDC staff have won plaudits for organizing a number of workshops on topics important in the field of radiation detection. In 2002, the center assisted in organizing a joint DOE/Department of Transportation workshop that focused on cargo container shipping security. In March 2000, the RDC set up a DOE/Defense Threat Reduction Agency conference on "out-of-the-box" concepts for detecting shielded nuclear materials from 1,000 feet away.

As the center develops, it will provide special facilities for radiation detection instrument development, demonstrations and joint experiments.

Although the primary use of new radiation detection technologies will be locating nuclear materials for the fight against terrorism, the advances will also find use in other scientific fields.

Other applications, Labov said, include arms control verification, use in diagnostics for the National Ignition Facility, environmental monitoring, astrophysics and the search for dark matter.

Pathomics

Continued from page 6

components, from increased or reduced concentrations to the appearance of new constituents," said Turteltaub, who is also a pathomics project co-leader. "It's in these changes, brought on by the presence of the pathogen, that we believe we can find an early diagnostic tool to detect the presence of disease before you have symptoms."

As part of this three-year strategic initiative, researchers hope to validate their approach by addressing three main questions:

- Can molecular signatures be used to differentiate a sick person from a healthy person before they develop disease symptoms?
- Is it possible to distinguish a bacterial infection from a viral infection?
- Can differences be identified between bioterrorist pathogens and naturally occurring diseases such as influenza?

In the past year, the project team has conducted a first clinical study and an animal experiment and obtained extremely promising results.

The preliminary clinical study, in July 2003, exploited a major target of opportunity — namely smallpox vaccinations. Researchers collected blood samples over five to seven time points before and after vaccination. "Analysis of more than 100 samples from 15 volunteers successfully demonstrated provided promising data on the feasibility of presyndromic detection of smallpox vaccination (and presumably infection) in humans," said Turteltaub.

More recently, the pathomics team conducted an experiment in which mice exposed to cowpox were monitored at selected time points to determine how early a developing infection could be detected using selected molecular markers.

"In this experiment," noted Turteltaub, "our initial analyses indicate that infection can be clearly distinguished at day 8 and possibly as early as day 1 following exposure to the cowpox virus."

Another of the project's challenges, according to Milanovich, is bioinformatics — the acquisition and analysis of large amounts of biological data from diverse sources.

"We anticipate making measurements or gathering biological statistics that will generate more than 80 million different pieces of data," Milanovich noted.

Fortunately, the Laboratory has a strong competency in bioinformatics as a result of Livermore's participation in the Human Genome Project.

Another Lab capability is being created for the pathomics project — the development of high-throughput mass spectrometry to identify protein components of blood.

"We are focusing on developing the national security aspects of this technology with an end-to-end vision," Turteltaub said. "We want to be able to move from the discovery of a disease signature to its use in the country's national biodefense architecture."

The Lab's pathomics research could provide a major breakthrough for the national security challenge of biodefense in Milanovich's view.

"Currently, we are only prepared for what we know, which leaves us in a vulnerable position, since there is a lot out there we do not know about. We need to be ready for the unknown.

"The holy grail, and greatest hope, of this project is that we would gain enough knowledge of disease and its molecular response in the human body that we would be able to identify the presence of a disease we've never seen and even recommend a treatment for it," said Milanovich.

Spotlight

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tion Agency and at the local level. In a related biodefense effort, we helped the U.S. Department of Agriculture, the California State Veterinarian and the California State Diagnostics Laboratory at UC Davis deal with three animal disease outbreaks, developing assays for rapid identification and providing operational assistance.

By partnering with industry and first responders, we are fast-tracking the demonstration and deployment of new technologies and systems to counter nuclear, biological and chemical threats. One such technology is RadScout, which was shown to DHS Secretary Tom Ridge when he visited the Laboratory in July 2003. This portable nuclear detection and identification system developed for first responders and inspection personnel was licensed this year to ORTEC Products (Oak Ridge, Tenn.) for commercialization.

We are contributing to DHS efforts to improve the security of our nation's borders, ports and transportation systems. Laboratory researchers are using conflict simulation models in their work with the U.S. Border Patrol to identify opportunities to use technology to improve agent effectiveness and border security. We are also assisting on the US-VISIT program, providing expertise in systems analysis. Laboratory scientists are working with the Port of Oakland and other major ports to develop radiation detection systems for screening cargo containers. Livermore researchers are also providing Customs, Coast Guard and other first responders with expert advice to resolve radiation detector alarms.

We are making important contributions to emergency planning and response as well, notably through the National Atmospheric Release Advisory Center (NARAC) and the Local Integration of NARAC with Cities (LINC) program. To date, LINC has been set up in five cities (see article on page 4) to provide local emergency response personnel with direct access to NARAC plume models and hazard predictions. NARAC was called into action for a number of incidents and exercises this past year, including the Staten Island fuel barge fire, and a chemical fire in Conyers, Ga.

The San Francisco Bay Area, with its numerous universities, high-tech industries, R&D institutions, transportation systems and national icons, is well positioned to be a focal point for homeland security efforts and a leader in homeland security R&D for the entire country. To this end, Lawrence Livermore and Sandia-California are working with the Bay Area Science and Innovation Consortium (BASIC) to ensure that the benefits of our laboratories' investment enhance the economic vitality of the region.

DHS and its Science and Technology Directorate are working to utilize the full strength of the nation's "scientific brain trust" to protect America and its citizens. As an open society, America cannot expect a future free from the threat of terrorism. But at Lawrence Livermore, with the help of the National Nuclear Security Administration (NNSA), DHS and our other partners, we're working to ensure that homeland security professionals have the technologies, tools, training and information they need to do their jobs and do them well.

Wayne J. Shotts is the associated director for Nonproliferation, Arms Control, and International Security and director (acting) of the Homeland Security Organization.

Wayne Shotts, acting director of the Homeland Security Organization (center) and Bill Colston (right), Biodefense Knowledge Center director, presented Charles McQueary, undersecretary for the Department of Homeland Security's Science and Technology Directorate, with a special calling card at the center's dedication on Sept. 10, 2004.

Overview

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gram office to oversee the Laboratory's homeland security programs and projects. He will oversee the execution and integration of DHS projects delegated to the divisions both within NAI and across the Laboratory.

The emphasis of the realignment is to place project execution in the divisions. HSO's programs map directly onto the DHS mission areas:

• Nuclear and Radiological Countermeasures, led by Page Stoutland. Stoutland is dual-hatted as a deputy in the Proliferation and Terrorism Prevention Program (P Division).

• Chemical and Biological Countermeasures, led by Pat Fitch. Fitch heads Livermore's Chemical and Biological National Security Program, which is in the Counterterrorism and Incident Response Program (R Division).

• Information Analysis and Infrastructure Protection, led by Wes Spain. Spain is also principle deputy division leader for the International Assessments Program (Z Division).

• Border and Transportation Security, led on an acting basis by Rob Hills. Hills is also the section leader for Tactical Systems in the Proliferation Detection and Defense Systems Program (Q Division).

• Emergency Preparedness and Response, the leadership of which is currently open. This effort was previously led by Harry Vantine, leader of the Counterterrorism and Incident Response Program (R Division).

A deliberate result of the reorganization is the consolidation of "centers of gravity" for homeland-security-related work. Each of the HSO program leaders also serves as a liaison between their respective DHS activities and their "home" division and the centers that already reside in those divisions. These include the Forensic Science Center in R Division, the Radiation Detection Center associated with P Division, the Information Operations and Assurance Center in Z Division, the new Biodefense Knowledge Center that draws upon both R and Z Division and the systems analysis capability embedded in Q Division.

"Our success is based on our ability to develop a strategic approach to our missions and to integrate multidisciplinary capabilities and multiple projects into effective products and comprehensive solutions to important national and homeland security problems," Shotts said. "I have every confidence that HSO and the Laboratory will continue to make essential contributions to the fight against terrorism for years to come."

Working together

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problems result when devices don't work."

Don Prosnitz, deputy director in the Laboratory's Homeland Security Organization, discussed how Bay Area communities and jurisdictions would deal with a terrorist attack, particularly compared with an earthquake.

"We need to strike a careful balance between panic and complacency, and look at the threats realistically," Prosnitz said. "Good management and good planning can limit the consequences of these events."

Although a biological terrorist release is a very real threat, Prosnitz stated that the consequences are "highly uncertain."

Comparing a bioterrorist release with an earthquake, for which extensive planning and training have already been done and for which Bay Area officials are well trained to handle, Prosnitz noted that quake damage is observable whereas the effects of a biological release would be difficult to immediately discern.

If a major earthquake strikes along the north Hayward fault, it is projected that up to 65,000 homes could be uninhabitable, he said, next asking: "How many homes would be uninhabitable for a bioaerosol release?"

In the wake of a bioterrorist attack, housing may need to be provided, and evacuation and rehabitation policies may well need to be standardized across jurisdictions, he said.

"The Bay Area has a lot to share (its earthquake expertise) with the country and we should take that on as an obligation."

Discussions about regional cooperation have been sponsored by the Bay Area Council, the Association of Bay Area Governments, the Bay Area Science and Innovation Consortium (BASIC) and the Bay Area Economic Forum.

RadScout

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their own inspection and security efforts. Agencies attending have included the Federal Aviation Administration, Transportation Security Agency, the U.S . Postal Inspector's Office and California Highway Patrol (CHP).

"This is exactly in line with what we are doing to keep our highways and California safe," said Chief Stan Perez, who heads up CHP's Enforcement Services Division, which oversees cargo inspection, commercial enforcement and border security. Although the CHP already has equipment for detection of radioactive material, Perez said "it is nothing to the extent and capabilities" of RadScout.

The CHP has been working with the Lab over the past two years in the development of truck stopping technology and other security concerns. "We get approached by hundreds of vendors each year. But we come to this Lab and the people here always sort things for us and help us with our needs."