

## Enhancing the Security of Nuclear Materials

By Todd Peterson



To date the RMTC has trained 3,800 staff and inspectors from more than 30 nuclear facilities throughout Russia, Lithuania, Kazakhstan and Ukraine

The Russian Methodological and Training Center (RMTC) on Nuclear Materials Control and Accounting (NMC&A) plays a prominent role in improving the security of weapons-usable nuclear materials of the former Soviet Union. Created in November 1996 by special Russian Ministry of Atomic Energy (MINATOM) decree, the Center is a collaboration between MINATOM, the European Commission and the National Nuclear Security Administration's (NNSA) Material Protection, Control and Accounting Program (MPC&A). The RMTC's purpose is to provide advanced technologies for nuclear materials accounting and control, and to conduct theoretical and practical training for the staff, government officials and inspectors of nuclear facilities. Pacific Northwest National Laboratory was given lead responsibility for the development of the training Center from its beginning, and continued with a single project manager until April of 2002.

The dissolution of the Soviet Union left the former nation's nuclear materials inventory and advanced weapons technology in the hands of new states with limited resources to maintain and safeguard these materials and technology properly. This made them more vulnerable to theft and diversion to rogue states or terrorists. Of urgent concern was the diminished security of large quantities of plutonium and highly enriched uranium, the essential components of nuclear weapons.

In response to this threat, DOE created the Russia-Newly Independent States Nuclear Materials Security Task Force. The Task Force assisted nations of the former

Soviet Union (FSU) to improve their nuclear weapons material security, inventory control and accounting. The "task force" has evolved into a more expansive organization of multiple MPC&A programs, that continues to make much impact on the large task of securing tens of tons of weapons-usable nuclear material throughout the FSU and installing physical detection devices such as motion detectors, surveillance cameras and vibration sensors at multiple nuclear sites targeted for security upgrades.

The RMTC, established at the Institute for Physics and Power Engineering (IPPE) in Obninsk, 100 miles southwest of Moscow, conducts material control and accounting education and training. The RMTC collaborates with the Interdepartmental Special Training Center (ISTC), which offers instruction on physical protection of nuclear facilities; and the State Central Institute for Continuing Education (SCI), which hosts RMTC-related conferences and symposia, and gives professional development and refreshment training to nuclear scientists and technicians. The ISTC and SCI are both located in Obninsk, and instructors commonly do "guest lectures" at each other's facilities.

The RMTC also develops guidance for implementing new federal and MINATOM regulations on nuclear materials control and accounting. For example, the RMTC assisted in development of new Russian Federal NMC&A Rules and the manual for applying these rules. The RMTC also developed techniques for monitoring the Uranium 235 content in the filter systems and equipment of nuclear facilities and for measuring the mass of plutonium in waste. The Center is now developing a

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## New PNWCGS Director

This month, Founding Director of PNWCGS, Jim Fuller, is succeeded by Carol Kessler, former Senior Coordinator for Nuclear Safety at the Department of State. Kessler, who has an extensive background in nuclear energy and nonproliferation, will be the new director of the Center as it reorganizes itself to expand its policy research and international role.



Carol Kessler, new PNWCGS director

"It may be," Carol Kessler, new director of the Pacific Northwest Center for Global Security said, "that to deal more effectively with nuclear proliferation, one needs to look more holistically at the range of problems facing a country. You may need to address economic and environmental conditions, even political structures, as well as the technical/nuclear ones. These others may actually be root causes behind a country's desire to obtain or sell nuclear weapons."

Citing her work with the G-7 to help Ukraine close the Chernobyl plant, Kessler noted that until the G-7 took into account some of Ukraine's broader economic and non-nuclear energy problems, a successful route to closing Chernobyl was not possible. "So there can be important tradeoffs," she said, "and we need to discover them."

Kessler, who served as Deputy Director General for the Nuclear Energy Agency at the Organization for Economic Cooperation and Development from August 2001 until joining PNWCGS, envisions the Center delving into this "broader examination" of nuclear nonproliferation and international security problems, including investigating possible political, social, economic, energy, and environmental issues where PNNL expertise can be brought to bear. Harking back to the G-7 initiative, Kessler noted that nuclear safety work did not stop, nor political pressure for closure cease, but those efforts were integrated with economic, non-nuclear energy and social technical assistance to ensure a more effective solution to the Chernobyl closure problem.

PNNL offers a unique setting for the Center as a Department of Energy Office of Science Laboratory with a National Security Directorate. PNNL is divided into four Directorates: Fundamental Science, Environmental Technology, Energy Science and Technology and National Security. These provide avenues for the Center to harness new and different resources for DOE on national security issues. Also with this broad array of capabilities, PNNL can work with a broad base of U.S. government and private organizations entities in the Pacific Northwest, bringing these resources to bear on international security problems as well. This capability at PNNL provides an important chance for PNNL to team with DOE defense program laboratories on national security issues. "My hope," she said, "is that the Center will become a broader resource for the Department of Energy through Center activities with other

governmental and nongovernmental entities. And I'm especially excited about working with private companies and the academic community in the Pacific Northwest."

Coordinating among disciplines characterizes Kessler's career. It began with her bachelor's degree which she cobbled together out of the biology, chemistry and geology departments at Brown University to create an AB in Bio-Geology. Her master's work continued the trend with her attendance at the MIT's Technology and Policy program where students from a variety of scientific and engineering disciplines were asked to apply their skills jointly to solving specific science policy problems. But it was her work in the State Department as the Senior Coordinator for Nuclear Safety that crystallized her vision that successful resolution of complex security issues such as nuclear safety requires discovering ways to address simultaneously some of the interlocking problems that countries face in their pursuit of political and social stability and economical security.

Kessler's interest in non-proliferation was born in her graduate work. Her bio-geology career was transformed by Professor Marvin Miller, whose course at MIT, *Energy in the 21<sup>st</sup> Century*, introduced her to the concerns about nuclear weapons proliferation. She looks forward to working with students affiliated with the University of Washington's Institute for Global and Regional Security Studies to encourage their interest in careers in nonproliferation and arms control. There are few formal training programs in this discipline—an urgent need as the non-proliferation community ages. She hopes to help address as Director of the Pacific Northwest Center for Global Security.

Kessler's last two years at the Nuclear Energy Agency in Paris added another dimension to her experience and vision - the importance of America's international relationships. She believes that effective international relations are essential to addressing nonproliferation. She hopes that the Center can foster further collaboration between PNNL and the European Bank for Reconstruction and Development, the International Atomic Energy Agency, the Organization for Economic Cooperation and Development, and other organizations working in this area.

Asked why she decided to accept the Center's directorship, she said without hesitation, "The people. Absolutely. I came into the interviews with little understanding of the dynamic group that exists here at PNNL. Paris was my dream city. There was no way I was going to leave. But I was overwhelmed by the warmth and intellectual interest of the people I met in Richland and Seattle. I have moved constantly throughout my life and seen many different places. When I came to Seattle I realized, "This is a place I could be happy. This is a place I eventually can call home."

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### Pacific Northwest Center for Global Security

4500 Sandpoint Way NE, Suite #101

Seattle, WA 98105

<http://pnwccgs.pnl.gov>

Phone: (206) 525-3130/ Fax: (206) 528-3552

For information on this publication, contact:

Jana Fankhauser

Phone: (206) 528-3264

[fankhauserj@battelle.org](mailto:fankhauserj@battelle.org)

## Featured Projects

### Enhancing the Security of Nuclear Materials

(Continued from cover)



*The Institute of Nuclear Materials Management acknowledged the contributions of the RMTC with the Institute's 2003 Special Service Award*

cross-calibration technique for active neutron coincidence counters.

To date the RMTC has trained 3,800 staff and inspectors from more than 40 nuclear facilities throughout Russia, Lithuania, Kazakhstan and Ukraine. The RMTC operates seven training laboratories, and offers more than 40 courses covering beginning to advanced nuclear materials control and accounting topics. The curriculum consists of 27 courses divided into six series. Subjects range from computerized nuclear materials accounting, product sample analysis and mass and volume measurement technologies, to assessment of system effectiveness, and the uses of statistical methods for verification of inventories. On-site courses offered by the RMTC include bar-code technology, tamper-indicating device technologies, physical inventory taking, and basic material control and accounting techniques. In addition, the RMTC has begun supporting International Atomic Energy Agency (IAEA) Inspector training, and has provided real-life inspection training for several groups of new IAEA MC&A inspectors.

Perhaps just as important as technical education are the communications and shared purpose the RMTC provides to nuclear scientists and technicians throughout Russia. The RMTC has given them a vehicle through which to communicate, a physical venue to meet, to share lessons-learned and work together to solve common problems. At the RMTC people get to know their counterparts from other institutions and facilities to create a network with which to work in addressing the challenges of managing nuclear materials from "cradle to grave."

At the beginning of the RMTC's operation, Russian partners primarily used the American curriculum. Today, curriculum development and instruction is 100 percent Russian, with staff comprised of experts from IPPE, MINATOM, Gosatomnadzor and major Russian enterprises. RMTC future plans include expansion of its course selection, construction of a larger computer center, and provision of CD-ROM courses and three-dimensional video imagery technology to facilitate training in nuclear material safeguards and accounting. A principal challenge for the Center is how to make its training more widely available in a country as vast as Russia.

Debbie Dickman, PNNL Manager for Nonproliferation and Arms Control Programs, says that the RMTC, now well into its 8th year of operation, has strongly expanded the breadth and depth of training and education capabilities. There is a strong mutual Russian-American interest in engagement and education concerning methods and technologies supporting nonproliferation and materials control and counting, as well as technical content of the training and education itself.

"Is the RMTC living up to initial expectations for it? The answer can be found in the opinions of the many of the Russians who participate in the training. In some cases these individuals travel for days to get to the RMTC for a course. They look to the RMTC and its staff as expert resources for technical problem solving and formation of methodological enhancements. They speak about the training as providing them with life-changing events. They believe the Center is important to Russia's future. Having been part of its growth and development from the beginning, I share that feeling and believe that the RMTC can play a central role in the modernizing of Russia's nonproliferation and materials control and accounting systems."

The international Institute of Nuclear Materials Management (INMM) acknowledged the contributions of the RMTC with the Institute's 2003 Special Industry Service Award. This special award is given very infrequently to an organization or entity that provides special and unique service to the nonproliferation and nuclear materials management world community. This award was prepared and sponsored by the US, the European Commission and numerous members of the international community. It reads, in part:

*With strong policy support from officials in the Russian Ministry of Atomic Energy, the Commission of the European Community, and the United States Department of Energy/Nuclear Security Administration, our recipient has developed an MC&A (materials control and accounting) curriculum of over 30 courses in*

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## Featured Projects

# Reducing the Threat of Chemical and Biological Weapons

By Todd Peterson



Michael L. Charters <http://www.calflora.net/>

*Ricin, derived from castor beans, is one of the deadliest natural poisons—an estimated 6,000 times more potent than cyanide*

Following the catastrophe of September 11, 2001 but before the anthrax mailings to the Senate office building, Dr. Barbara Seiders, Director of Chemical and Biological Defense Research at the Pacific Northwest National Laboratory (PNNL), gave a talk on the threat of an attack with biological agents. Speaking about the security of the

Hanford Site and the Laboratory, she said prevailing sunny, dry and windy conditions argued against a successful attack with biological weapons, specifically via an aerosol released from an airplane, the most likely scenario. Then, a terrorist delivered anthrax spores through the mail, and everyone's preconceptions had to be reassessed.

"The fundamental problem," Seiders noted recently, "is that the threat of biological and chemical agents is limited only by a terrorist's imagination and skills. It's a wide-open threat. In one sense protecting against a chemical or biological attack is like protecting against crime in general."

In the Fall 2000 edition of PNNL's *Breakthroughs* magazine, Seiders described the threat from chemical and biological weapons as "far from new."

"Dangerous chemicals and disease-causing biological organisms have been used in conflict for centuries. But these weapons didn't get a lot of attention during the Cold War because they were far less devastating than nuclear weapons. With the progress of nuclear disarmament in recent years, the international community could focus on the next most serious threats—including chemical and biological weapons. Only a small number of countries have nuclear weapons, and we keep an eye on those who have the means to acquire them. Chemical and biological weapons are more accessible—you don't need

complex facilities or large teams of highly technical scientists and engineers. They're easy to manufacture and easy to hide, so it's a broader risk, but the threat has always been serious," she said.

But since the anthrax attack important changes have occurred in our ability to respond.

"The most powerful change," she points out, "is the increased awareness and sensitivity of the public. Education and general awareness are extremely important." Medical clinicians have received specialized training. She identifies clinicians as our "first line of defense in the event of an attack with biological agents." And heightened awareness has certain other benefits. "Smart clinicians" she said, "spotted SARS (Severe Acute Respiratory Syndrome)."

PNNL scientists, Seiders emphasizes, continue to respond with intense research in chemical and biological sensors and monitors, including projects involving detection, personnel protection and decontamination. For example, PNNL's Bob Wright, whom Seiders calls "an unsung hero," has worked for years to improve detection of traces of chemical agents and the sensitivities of detection methods. Don Hadley in the Lab's building sciences program is working to answer the question, "What do you do if your building comes under a biological or chemical attack?" Chris Aardahl, a member of the Advanced Processing and Applications group, is evaluating the use of a hybrid plasma reactor filter system installed in-line with ventilation to purify air contaminated by chemical or biological agents. And, PNNL scientist Genia Rainina, Jim Wild at Texas A&M and Bill Rigby of Encapsulation Technologies, are developing enzymatic and other decontamination solutions for use in an aerosol fog to degrade chemical and biological agents.

Seiders comes to this work directing chemical and biological defense research from at the Army Chemical Research Development and Engineering Center and as Chief of Research at the Arms Control and Disarmament Agency (ACDA). When at ACDA she was particularly concerned about Soviet non-compliance with chemical and biological arms control treaties. She served as science advisor to Ambassador Jim Goodby, who negotiated the framework for the Cooperative Threat Reduction Program aimed at safe, secure dismantlement of nuclear weapons. Since joining PNNL, she has led the Detection and Characterization of Biological Pathogens initiative.

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## Featured Projects

### Study Explores Threat to Puget Sound/Georgia Basin Environmental Security

By Kirea Jebali

This spring researchers at PNNL studied environmental security in the Puget Sound/Georgia Basin. The purpose of this analysis, conducted by research scientists Ann Lesperance, Kathleen Judd and Nancy Peterson of PNNL's National Security Division, was to determine whether the environmental challenges of the Puget Sound/Georgia Basin region and increasing demands upon the ecosystem may create a threat to U.S.-Canada relations and, thus, a threat to regional stability.

The concept of environmental security has been gaining momentum over the past decade as attention is paid to the connection between environmental issues and security by policy makers, military leaders, and academics. The study of environmental security in this region stemmed partly from a course on ecosystem management- *Puget Sound /Georgia Basin: Managing an International Ecosystem*- taught by Lesperance and colleagues from the University of British Columbia and Western Washington University.

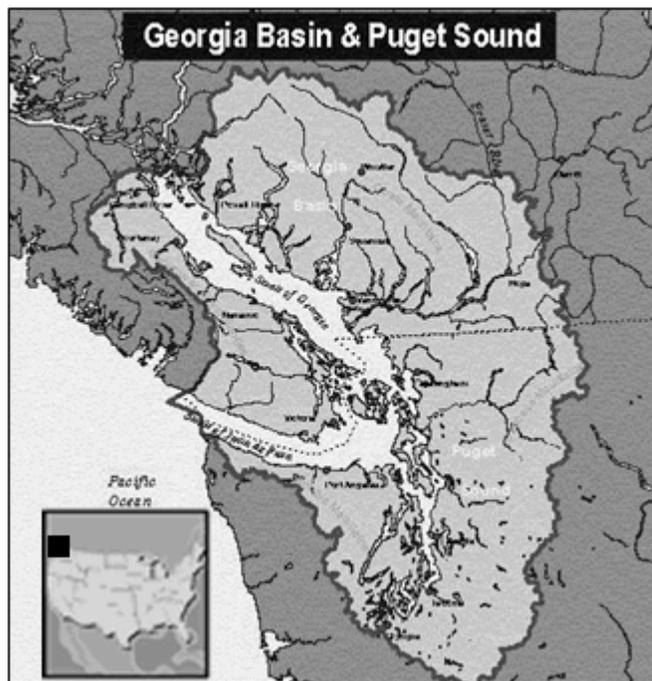
For the purpose of the study, environmental security was defined as "relative safety from political, economic and societal upheaval as a result of environmental change, be it slow or rapid, both within national and across national borders."

The primary questions of the study were whether environmental issues could impact regional cooperation or stability, and if there were mechanisms in place for transboundary dispute resolution or cooperation.

Researchers employed a "scale of conflict," developed by E.E. Azar and adapted by S.B. Yoffee and K.L. Larson for conflict analysis in international water basins, to aid in characterizing past and present U.S.-Canada diplomatic interactions over the environment. Issues ranging from the 1964 Columbia River Treaty and 1995 Marine Spill Prevention Cooperative Agreement, to the 1997 Salmon Wars and current controversy over the status of Lake Roosevelt as a Superfund cleanup site were rated on a numerical scale (-7 to 7) with -7 being a formal declaration of war and +7 being a voluntary national unification.

"We plotted several transboundary regional events using the scale and found that a relatively balanced situation with events clustered toward the middle of the conflict scale," explained Lesperance.

As largely expected, the analysis confirmed that the threat to Northwest stability over environmental issues is relatively low. U.S.-Canada relations are predominantly



*The Puget Sound/Georgia Basin region is experiencing a high level of population growth that is anticipated to continue increasing pressure on the ecosystem.*

cooperative in the area of environmental management. But, the research yielded some potentially useful results for Canadian and U.S. policy makers.

For example, while current mechanisms for cooperation seem to be effective at addressing many environmental issues, there is a need to develop a common vision for addressing long-term issues such as global warming.

"Climate change is gaining increased attention, yet dialogue on the topic is in its infancy in this region and no long-term planning between the U.S. and Canada is occurring," said Lesperance. In addition, those interviewed in the U.S. and Canada for the study cited air quality, water quantity and species at risk as the most likely sources of future tensions.

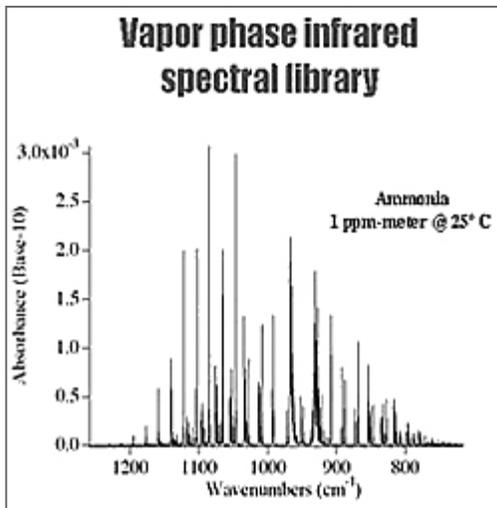
Water scarcity is anticipated to be one of the greatest challenges of the 21st century, and is expected to be a major problem for western North America. Canada has over 300 boundary water basins that cross or form the U.S.-Canada border, suggesting that the two countries will have to arrive at some sort of long-term comprehensive vision for water management.

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## Featured Projects

# IR Spectral Database: A Library of Chemical Signatures

By Marina Skumanich



The IR Spectral Database provides spectral data for a wide range of IR wavelengths

The international/national systems for nuclear nonproliferation regime depends upon national systems for controlling and accounting for nuclear materials that are verified by the IAEA. While historically both political and technical attention has been paid primarily to nuclear materials control and accountability, increasing attention is now being given to accounting for non-nuclear materials such as toxic or other chemical agents as well as biological materials that might also be used in weapons of mass destruction. One priority in this area is the development of more accurate and portable chemical detection systems.

Researchers at the Pacific Northwest National Laboratory (PNNL) are conducting a series of projects for the U.S. Department of Energy in the area of chemical detection that include research and development (R&D) on both detection hardware tools and systems to support detection analysis. A key example of this research is the Infrared (IR) Spectral Database Project, managed by Steve Sharpe of PNNL's Environmental Molecular Sciences Laboratory.

The IR Spectral Database includes quantitative, high-resolution IR (infrared) data on a wide range of vapor phase compounds, i.e., a reference library of "signatures" that can uniquely identify chemical compounds when they are airborne. The data are based on IR spectral analysis, which measures the amount of infrared energy absorbed by the compound.

IR spectral analysis—called IR spectroscopy—is a common way to identify chemicals. It relies on the fact that when low-energy (infrared) light shines on chemical compounds, the compounds begin to vibrate as the light is absorbed. However, just as a musical string only vibrates at certain frequencies, so different chemical compounds will only vibrate at certain characteristic frequencies. An IR spectrum (plural "spectra") is therefore a chart of the amount of energy absorbed by the compound as different wavelengths of infrared light are shined on it.

A library of IR spectra is critical to IR-based chemical detection. That's because having an excellent chemical detection device makes no difference if you are not able to identify the specific chemical being detected by comparing it to reference set. A good analogy is a fingerprint library. If a fingerprint is taken at a crime scene, it doesn't really help to identify a suspect unless the print can be compared with a reference set. The IR Spectral Database fills that need for suspect chemicals.

The IR Spectral Database provides spectral data for a wide range of IR wavelengths. This is particularly important in the case of mixed or

contaminated samples since it increases the likelihood the analyst will find a region of the spectra where a given chemical's signature is clear from confounding signatures by other chemicals. Creating the Spectral Library is a true "labor of love," said Steve Sharpe. "It requires attention to detail at every stage of development. For instance, acquiring the thousands of sets of "low level" laboratory data is essential yet time-consuming, boring, and sometimes frustrating. In order to keep the project on schedule and still maintain the sanity of those involved requires that we take turns working in the laboratory. The tedium and frustration is quickly offset by each new chemical we add to the library and watch the library grow into a truly unique national resource."

The IR Spectral Database is also useful in the development of detection hardware. Knowing the signatures of certain important or critical chemical compounds, one can design technologies that are optimized to measure them in the field.

IR chemical detection and the IR Spectral Database provide support not only for nonproliferation and security, but also for a wide range of chemical assessments, including ambient air quality assessment, greenhouse gas or pollution management, industrial process management, and occupational health assessments.

The Ultra-Selective Chemical "Sniffer"—a portable device being developed at PNNL that will use the IR Spectral Database to do in-field detection and identification—is intended for use with the IR Spectral Database. Together, these products should represent a real boon to efforts to identify chemical materials and to their control, when needed.

## Featured Projects

### Reducing the Threat of Chemical and Biological Weapons

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In her interview with *Breakthroughs*, Seiders said, "I started government service as a Diplomacy Fellow from the American Association for the Advancement of Science in the State Department. Although I was assigned to work issues of nuclear nonproliferation, my colleagues knew that I was a chemist, so they routed all the chemical and biological cables to me to read. In the early 1980s, we were trying to find out what agents were being used to kill people in Southeast Asia and Afghanistan. I read countless reports of refugees from Laos and Cambodia describing loved ones dying of terrible hemorrhagic diseases after being exposed to clouds and mists sprayed over their villages. I found out some years later that many of these refugees were mothers describing how their young children had died in their arms. Those children are why I have stayed in this field."

Today, Seiders and her PNNL colleagues remain deeply involved in researching, developing, and testing

sensors and monitors for defending the U.S. from chemical and biological weapons. An important challenge is aligning requirements for detection with technology development and deployment. Biodetection tools now include nucleic acid amplification, immunoassay, mass spectrometry, gene chip arrays, and cultures. Seiders says it is possible to match particular detection technologies with specific potential threats to reduce exposure. She says the development of new biodetectors should be guided by the needs of the military, first responders, those responsible for the security of government facilities and others. However, technology users, "want 24/7/365 monitoring against all possible threats, but monitoring to that extent with existing technologies is enormously expensive. We have to get smarter about how we're spending our money. We have a moral obligation to make sure detectors do what they should."

### Study Explores Threat to Puget Sound/Georgia Basin Environmental Security

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"The water issue was surprising in its intensity. Water to Canadians is like oil to Texans—it's part of the fabric of who they are," said Lesperance. Canada and the U.S. have experienced points of contention concerning water resources in recent years.

Judd also expressed surprise at the extent of conflict already existing over water issues, adding, "The fact is that there is not really an ongoing dialogue between the U.S. and Canada on the issue in this region—I think the time is ripe."

According to Judd, looking at the region from a perspective of environmental security provided useful insight.

"We don't always see the border in this region," she commented. "We tend to see one (country) as an extension of the other. However, when we look at the events of the past we see that we are both very nationalistic and that points of conflict and expressions of tension arise as a result of trans border issues."

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the short time it has been operating. Our recipient, as part of the Institute of Physics and Power Engineering, is not limited to a teaching curriculum. Its hard-working staff regularly presents papers at the INMM and ESARDA annual meetings; hosts and organizes the Tripartite Seminar series; provides consulting; leads in the development of several critical regulatory documents, standards and norms pertaining to improved safeguards practices; develops nuclear reference materials; and translates training material into Russian. In its spare time this same staff also supports the Russian nuclear complex by way of a mobile training team.

For outstanding contributions to the domestic and international nuclear industry, for its ability to reach solutions to complex, difficult MC&A challenges please join me in recognizing the recipient of the INMM 2003 Special Service Award, the Russian Methodological and Training Center. To accept the award is the Director, and really the father of the RMTC, Dr. Boris Ryazanov.

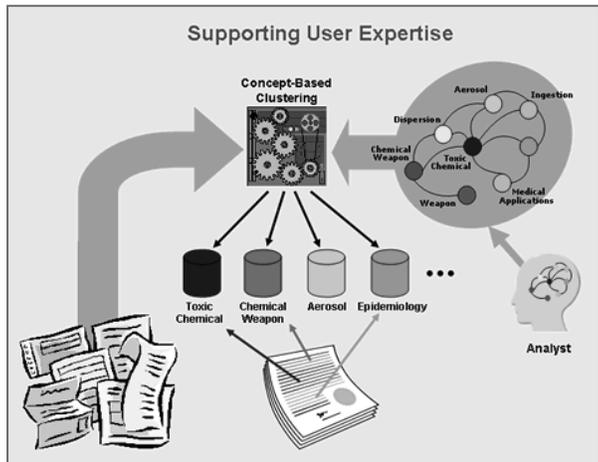
In his presentation to the Institute's 2003 meeting, Dr. Ryazanov said, "The RMTC is playing a significant part in the reforming of the Russian national NMC&A system, and in the foreseeable future, thanks to the fruitful collaboration with the US national labs and EC JRC (European Community Joint Research Center), it will have a profound impact on this system by continuing to train experts and by providing technical and scientific assistance to agencies and facilities."

Dr. Ryazanov goes on to say, "It is important to mention that the RMTC is going to become one of the most important structures in the world of NMAC, capable of providing training and methodological approaches. As such the RMTC is able to provide support to international safeguards and non-proliferation in both the training and methodological areas. Therefore the RMTC has a future role as international training and reference center, besides its important national role."

# Applied Technology

## Concept-Based Document Analysis: A Human-Centered Approach to Information Discovery

By Marina Skumanich



*Concept-Based Document Analysis brings the knowledge of the analyst back into the process*

We live in a time of information-overload, where the amount of information on any given subject seems almost limitless, and is often beyond easy assimilation. Intelligence and security professionals are keenly aware of this situation, since information analysis—the analysis of published materials, written reports, and even open source news stories—plays such a central role in their work on proliferation and other security concerns. Fortunately, for those struggling to manage this information, more help is on the way. Researchers Alan Chappell, Judi Thomson, and Alan Willse of the Pacific Northwest National Laboratory (PNNL) are working on a lab-funded research and development project to develop a “Concept-Based Document Analysis Program.”

One of the biggest issues for analysts seeking to identify trends and events of relevance in a set of documents is how to sort and group the documents by appropriate topics. The most straightforward, but tedious, approach is to have the documents sorted “by hand” —that is, by using

the analyst’s own knowledge to determine appropriate groupings or clusters of documents. While this approach has the advantage of drawing on the analyst’s internal “expert system,” it clearly becomes harder and harder to accomplish with increasing quantities of data.

The obvious limitations to the manual approach have led to the development of a series of computer-based systems such as PNNL’s SPIRE

and Starlight systems. These commercialized systems use automated rule-based document association, with visual outputs. In this approach, certain rules of association (e.g., similarities of words, etc.) are applied to a set of documents. As documents show greater or lesser association, they are automatically “clustered” together and displayed on a visual graph, so that the user can see various themes “emerge” from the documents. In the case of SPIRE, document themes appear as mountains, with greater concentrations of documents in a theme leading to higher peaks. In the case of Starlight, document themes appear as clusters of stars in a constellation. Both of these programs have proven to be very helpful in the effort to analyze large numbers of documents.

The innovation of the Concept-Based Document Analysis approach is to bring the analyst’s knowledge back into the process. In particular, Chappell explained, “Concept-Based Document Analysis seeks to create more of a partnership between the automated processing in which computers excel and the expert judgment of analysts

regarding what is important and what particular topics are of interest.”

Concept-Based Document Analysis starts by asking the analyst: What are the topics or subjects you are concerned about? What are representative documents—or sections of a document—that would reflect these topics? Then once the analyst has identified “cluster themes” and the representative, the Concept-Based Document Analysis Program can cluster the rest of the set of documents based on these themes. It also allows a given document to fall into multiple clusters, if more than one theme is identified in it. Finally, documents that don’t fit into any defined cluster can be re-analyzed to determine what novel concepts they might represent. This latter feature means that the analyst has some assistance in identifying knowledge or issues that don’t fit current concepts, as a way to keep his or her thinking fresh.

“One of the biggest advantages of Concept-Based Document Analysis,” Chappell pointed out, “is that it uses themes or cluster topics that are meaningful to the analyst and that reflect the way humans think about issues. In addition, it helps make the clustering process more transparent and explainable to others. While it may not serve all the needs of a security analyst, it will provide a real addition to the toolbox of document analysis.”

This past year, Chappell and his colleagues have developed an initial proof-of-concept for the Concept-Based Document Analysis program, using funding provided by PNNL for lab-directed R&D exploratory efforts. This next year they will be seeking to test their prototype with actual analysts and their document sets.

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## Applied Technology

# Rapid Detection of Strategic and Dual-Use Materials

By Lesley Snowden-Swan

Several countries worldwide are now employing the Material Identification System (Material ID) for inspection of metals and other conductive materials of concern at international borders. The Material ID system, developed by scientists at the Pacific Northwest National Laboratory (PNNL), is a portable instrument that enables a border inspector or other field agent to rapidly and non-intrusively identify dual-use, strategic and other controlled and high-value materials.

Dual-use materials are materials that are commonly found in industry but which can also be associated with the production of weapons of mass destruction. They are subject to international control regimes associated with nuclear, chemical and biological weapons and missile delivery systems (e.g. Nuclear Suppliers Group, Australia Group, and Missile Technology Control Regime). Recent events such as those of September 11 and the Iraq war, have intensified concerns over the possible transport of weapons-related materials worldwide and heightened the need for on-the-spot inspections to detect strategic and dual-use materials.

For on-the-spot inspections, an accurate and timely method of determining the presence of controlled materials is essential. Many of the metals contained on the dual-use lists and the nuclear trigger list are indiscernible in appearance from common materials, making visual detection of controlled commodities difficult or impossible. Alternatively, the time and cost necessary for sample collection and off-site analysis can be impractical. The Material ID provides a rapid, highly accurate and inexpensive alternative to both visual inspection and direct sample collection and analysis.

The Material ID system consists of a small sensor probe and a personal digital assistant-based device with custom acquisition and analysis technology, developed by scientists at PNNL. Employing eddy current technology, the system detects the presence of materials based on their electrical conductivity. Metals and other materials (such as graphite) conduct electricity in varying degrees, providing an electrical conductivity "fingerprint."

"When the system probe is held in ambient air, it responds with specific electrical impedance. When the user moves the probe close to or touches an object that conducts electricity, the electrical impedance of the probe changes," explained Kurt Silvers, Material ID project manager at PNNL.



*Employing eddy current technology, the Material ID system detects the presence of materials based on their electrical conductivity*

Since the electrical conductivity of a material is temperature dependent, the probe simultaneously provides a temperature reading for the material. These two pieces of information—the change in electrical impedance and the temperature—are converted to an electrical conductivity value and this value is compared to a library of "fingerprint" values in the system's database to identify the materials present, the results of which are immediately displayed on the lap-top screen.

The system's user interface allows an inspector to rapidly sort a large number of items into groups of "like" and "unlike" (comparison mode); verify that a material has been properly declared (verification mode); and identify an undeclared or unknown material (identification mode). Approximately 50 materials are currently contained in the Material ID library of signature values; however, the system is designed to connect remotely online and download material signatures.

According to Bill Cliff, manager of PNNL's International Border Security Training, research for the original Material ID system began after the U.S. Customs service expressed interest in the ability of eddy current technology to sort metals. A prototype was first built and tested domestically for tariff and duty control. Later, the Departments of Defense and State funded projects for applications to national security, specifically aimed at preventing dissemination of materials related to weapons of mass destruction from countries of the former Soviet Union. Subsequent generations have been fielded in 12-15

*(Continued on page 15)*

# Forging Alliances

## An Agenda for A Safer World

*FRAEC Event Highlights WMD Challenge*

By Kirea Jebali

On May 1<sup>st</sup> 2003, the Foundation for Russian American Economic Cooperation (FRAEC), a strategic partner of the Pacific Northwest Center for Global Security (PNWCGS), sponsored a dinner in Seattle with keynote speaker, Laura Holgate, to discuss collaboration between the Russian Federation and the United States to reduce the threat of nuclear, biological and chemical weapons. The event was attended by FRAEC members and supporters interested in issues of global security.

The Foundation for Russian American Economic Cooperation is a nonprofit organization founded in 1989 to foster expanded economic ties between Russia and the United States. FRAEC's efforts also include cooperation with Russia in the areas of economic development, civil society and social services.

Holgate's speech, "An Agenda for A Safer World," addressed the challenges posed by the threat of weapons of mass destruction (WMD), offering insight and recommendations. Holgate has been with the Nuclear Threat Initiative (NTI) since 2001 and is vice president of the Newly Independent States/Russia programs.

Holgate explained that NTI was founded on the idea that WMDs pose the greatest danger to the world today, terrorists are the most likely to use WMDs, and preventing the proliferation and use of nuclear, chemical and biological weapons should be the primary security focus of the 21<sup>st</sup> Century.

The fall of the Soviet Union, which created a vulnerable supply of WMDs and WMD-knowledge; the rise in demand for

WMDs on the part of terrorist organizations; and the acceleration of science and technology, have all combined to create a new and accelerated arms race in which "terrorists are racing to acquire nuclear, biological and chemical weapons" necessitating a counter response.

As recounted by Holgate, the most stunning aspect of an October 2001 security alert that terrorists were attempting to smuggle a 10-kiloton nuclear bomb into New York was not the fact that the alert was cancelled on the grounds of flawed intelligence, but that nobody ever considered the report to be implausible.

Holgate said that while countering the innumerable scenarios in which groups might acquire WMDs is difficult, it is not impossible.

"How difficult is it for terrorists to attack us with a nuclear weapon?" she asked the audience. "That depends on how difficult we make it."

Holgate explained that the least expensive and most effective method of promoting nonproliferation was to secure WMDs themselves, as well as the materials necessary to construct them, especially fissile materials.

Scientists at PNNL are working to do just that through a range of activities such as the Materials Protection, Control, and Accounting program.

"Even small improvements in security can make a big difference in our future," she said, sharing statistics from Warren Buffet, an American investor who funds NTI's work.

According to Buffet a ten percent chance of a WMD attack per year over ten years makes the likelihood of such an attack—95.5 percent—a near certainty. Reducing the likelihood to a one percent chance per year over

the same period would decrease the likelihood to 39.5 percent.

To date, there have been several accomplishments in reducing the proliferation

of WMDs, particularly through cooperation between the United States, Russia and other Newly Independent States: half of the former Soviet Union's strategic nuclear arsenal has been destroyed; Ukraine, Kazakhstan and Belarus have foregone their nuclear forces; and more than 100 tons of nuclear weapons material have been secured. Yet, there is much still to be done. For instance, there are approximately 100 research reactors and facilities in 40 countries throughout the world that produce highly enriched uranium; there are hundreds of tons of unsecured weapons-grade fissile material in Russia's network of nuclear facilities; and there are over 20,000 nuclear warheads in Russian weapons storage sites.

"Today's reality is that we cannot reduce risks with only a series of national plans—though these are essential. We must develop a truly global approach in which any nation with weapons or materials must secure them, or ask for help if they need it, and offer help to those in need," Holgate stated, expressing her belief in the global responsibility to participate in the nonproliferation struggle.



*Keynote Speaker, Laura Holgate, Vice President of NTI's NIS/Russia programs*

# Forging Alliances

## AIDS and SARS

*The Impact of Public Health on Stability*

By Kirea Jebali

Since the 1970s, the mood of the global health community has changed from confidence to concern as governments have steadily reduced public health funding and those in the medical field have witnessed a resurgence in old and the emergence of new infectious diseases. High among the causes for concern are the increasing microbial resistance to antibiotics; the re-emergence of diseases once believed to be relics of the past such as tuberculosis, malaria and cholera; the global spread of HIV, the AIDS virus; and the emergence of over 30 previously unknown diseases for which there are currently no cures such as Ebola and Hepatitis C.

Researchers at The National Bureau of Asian Research (NBR), a strategic partner of the Pacific Northwest Center for Global Security (PNWCGS), that conducts advanced research on issues relevant to policy in Asia, recently published articles examining the political, economic, social and military implications of AIDS and SARS, two of today's greatest infectious disease threats.

### AIDS

In his November/December 2002 article in *Foreign Affairs*, "The Future of AIDS," Nicolas Eberstadt, Senior Advisor at NBR, warns that the toll of the AIDS epidemic will be more keenly felt by the global community in the near future as the center of the epidemic shifts from sub-Saharan Africa, where over 28 million of the world's present 40 million victims live, to Eurasia. This increase in the global impact of the disease will be due to regional power discrepancies. While sub-Saharan Africa has limited economic and military power—aggregate economic output of sub-Saharan Africa is equivalent to that of Switzerland—Eurasia had a combined GNP of \$15 trillion in 2000, substantially greater than that of the U.S. In addition, five out of every eight people and four out of five of the world's armies of over one million are from Eurasia. Eurasia is home to four out of seven of the present declared nuclear states.

The question is not whether Eurasia, and particularly, China, Russia and India, will be victims of the crisis, but rather, how hard they will be hit. Eurasia has experienced a steady growth in infection rates. China, Russia and India all have in

excess of one million cases. In 2000-2001, U.S. intelligence sources estimated the number of people infected with the virus in China and Russia was between one and two million. In India, the estimate was between five and eight million infected people. According to official estimates, in less than a decade AIDS cases in sub-Saharan Africa rose from seven million to 25 million. Furthermore, the responses of the Chinese, Russian and Indian governments have been insufficient to significantly reduce the spread of the disease. In China, open discussion of the epidemic is not officially permitted, and the government has denied that the disease poses a danger to the country. Russia has few resources to dedicate to the crisis and has been resistant to foreign involvement in managing the disease. And, while the Indian government is in the second phase of a ten-year program to combat AIDS, the federal system allows individual states considerable leeway in applying the program

Eberstadt warns that Eurasian nations face major military, societal and economic losses if the epidemic is not contained. Using figures from the growth and spread of the AIDS epidemic in sub-Saharan Africa and demographic and epidemiological modeling techniques, Eberstadt examined potential scenarios in Eurasia as a result of AIDS. Employing a baseline from current demographic trends in China, Russia and India, and basic assumptions about the epidemics in each country (including three estimates of disease severity—mild, intermediate, severe), he concludes that life expectancy may be considerably reduced as a result of AIDS, particularly in Russia, where the expected lifespan could decrease by as much as a decade; GDP and per capita productivity will likely decline, again, particularly in Russia, with ramifications for Eurasian economies and militaries; and the collective death toll from AIDS could be anywhere from 43 million to 155 million between 2000 and 2025 depending on the severity of the epidemic.

In the region's favor, Eurasia has a higher level of nutrition and lower rate of endemic disease than sub-Saharan Africa, and the success of the Thailand's anti-AIDS campaign has demonstrated that competent government

*(Continued on page 13)*

## Forging Alliances

### Uzbek Scholar Visits Pacific Northwest Center for Global Security

By Ghuzal Badamshina

In May 2003, sponsored by the Pacific Northwest Center for Global Security, Dr. Mirzokhid Rakhimov visited the Pacific Northwest National Laboratory's Seattle office. Dr. Rakhimov is an historian and Senior Researcher at the History Institute of the Uzbekistan Academy of Sciences. At the Academy he leads a research team studying Uzbekistan's relationships with international organizations over the last 12 years. The research team functions under the Uzbekistan State Committee for Science and Technology, a government body in charge of making the country's science policy and of distributing funds among the republic's research organizations.

Dr. Rakhimov and his colleagues focus on the challenges of preventing and resolving conflict in modern Central Asian societies.

As the international community's concern about stability and security in the Central Asian region becomes more pronounced, a variety of exchange grants are being offered to scholars and scientists in the region. These grants aim to expand Uzbek and other Central Asian scientists and academic's understanding of Western models for the management of scientific organizations and to support public outreach and engagement with decision-makers. The

Regional Scholar Exchange Program of the U.S. Department of State, now in its tenth year, fosters Community Connections in Armenia and Azerbaijan, as well as in Kyrgyzstan and Uzbekistan, and also encourages joint work in projects through the Collaborative Research Grant program aimed at the academic communities in Georgia, Mongolia and Tajikistan.

Dr. Rakhimov was awarded an International Research & Exchanges Board (IREX) scholarship to conduct research at the University of Washington's (UW) Henry M. Jackson School of International Studies. He was hosted by the Russian, Eastern Europe, and Central Asian Studies Center (REECAS). During his stay in Seattle, Rakhimov took advantage of numerous opportunities to discuss regional issues with the professors at the UW's REECAS Center, History Department, Department for Near-Eastern Languages and Civilizations, and the Institute for Global and Regional Security Studies (IGRSS), the joint UW/PNNL program. He attended the April 2003 Caspian Sea Basin Security Conference, organized by the National Bureau of Asian Research (NBR), co-sponsored by the U.S. Army War College's Strategic Studies Institute, Pacific Northwest Center for Global Security and UW's REECAS. At



*Dr. Mirzokhid Rakhimov, Senior Researcher at the History Institute of the Uzbekistan Academy of Sciences*

the conference Dr. Rakhimov met U.S. experts on the large post-Soviet territories of the Caspian and Central Asian regions and had an opportunity to participate in informal discussions with them.

Dr. Rakhimov returned to Uzbekistan in June. He is now seeking avenues to further scholarly work with Seattle colleagues on Uzbekistan's relationships with international organizations during the post-Soviet era.

"I am excited," Dr. Rakhimov wrote in a recent correspondence, "about the possibility of joint research with Dr. Badamshina and her colleagues. Collaborations bring about new inquiries, new ideas, and this is what scholars on both sides can gain from."

# Forging Alliances

## AIDS & SARS: The Impact of Public Health on Stability

*(Continued from page 11)*

monitoring, frank public education and management of curable sexually transmitted diseases—a proven indicator for HIV transmission—are all effective methods of reducing the spread of AIDS. However, the indications at this point and time, in view of the current government responses, are that AIDS may very well change the course of Eurasia's—and the world's—future.

“To the extent that prosperity and health conduce stability and a more desirable world, health is a (security) factor,” Eberstadt said. “We can probably say that a broad environment in which health challenges and expectations of well-being are on the decline is not consistent with the concept of a free society that open and liberal societies share,” he added.

### SARS

In his essay “What Does SARS Means for China?,” Neil Beck of NBR's Strategic Asia Project assesses the economic and political impact of Severe Acute Respiratory Syndrome (SARS) on China. Between November 2002 and early May 2003, the disease spread to 30 countries and infected 7,300 persons, killing 514. Its greatest impact was on mainland China, particularly Beijing, the medical and political epicenter of the outbreak. In China, as the government struggled to manage the economic and social effects of SARS, experts predicted that China's economic growth for 2003 might be its lowest since 1990.

Beck argues that China's economy did suffer as a result of the outbreak, but the effects appear to be short-term. Investors have, for the most part, retained their interest in China, and industries damaged by SARS were given a needed lift by an emergency tax break package approved on May 8, 2003. Still, certain sectors experienced sharp downturns during the second quarter. China's service industry, which accounts for 33 percent of the country's economy, was hardest hit. The manufacturing sector, responsible for half of all economic output in China, was less successful. Some factories did report significant drops in sales, as buyers from the United States, Australia, and Hong Kong reportedly shied away from some Chinese goods. Still, the fundamentals driving China's manufacturing power did not change because of SARS, and Beijing's successful efforts

at containment appear to have mitigated long-term economic damage.

He also describes the political and social ramifications of SARS on China and argues that the outbreak was more politically potent than past crises because it endangered the foundation of the Communist Party's legitimacy—meeting the public's expectations of safety and rising living standards. He cites evidence that disappointment in the government's handling of the outbreak cut across social strata and threatened the central government's credibility as a caretaker of public needs. Even traditional supporters of the Party felt betrayed by government attempts to hide the extent of the SARS crisis. University students were assertive in criticizing Party leaders, and there were public protests—both in urban and rural areas—against government plans to use local facilities to treat and quarantine SARS patients. However, after disclosing the full extent of the crisis on April 20, the Communist Party moved quickly to counteract the loss in public confidence.

Beck reports that both President Hu Jintao, who has portrayed himself as a populist leader, and the party had to address several democratic principles: political accountability, transparency, and the government's responsibility for social infrastructure. However, he points out that several important forces in Chinese politics that aggravated the crisis—the resistance of local governments and turf-conscious bureaucracies, central government control of media and online content, and factional political divisions— and that these were left unchanged.

“The political impact will continue to evolve... In the end, SARS may be an important—but not decisive—contributor to growing popular support for political reform in China,” commented Beck in the conclusion of his article.

According to Beck, the crisis also demonstrates the immediate impact that some public health issues can have on social and political stability.

“While some economic and political developments build slowly toward a crisis point, new, fast-moving public health issues can quickly spawn fear and uncertainty in an age of instant communications. Governments lacking transparency and efficient information channels are at risk of instability, partly stemming from partially-informed populations that feel compelled to take matters into their own hands,” he said.

## Featured Seminar

### Micro and Macro Analysis of International Conflicts

*Case Studies of Afghanistan, Iraq and Cyprus*

By Kirea Jebali

On July 8, 2003, Professor Birol Yesilada, Executive Director of Portland State University's Northwest American Turkish Research Institute, conducted a seminar for the benefit of Pacific Northwest National Laboratory (PNNL) staff on the subject of conflict analysis. During the seminar, Yesilada, who has served as a policy consultant to the Central Intelligence Agency, Department of State, RAND Corporation and World Bank, shared new theories and methods of decision-modeling developed over the last few decades. He discussed the application of these approaches to case studies of Afghanistan, Iraq and Cyprus.

During the seminar, Dr. Yesilada discussed power transition theory, power being defined as the ability to influence others to act in accordance with one's will and being able to project this influence. The macro theory, used both regionally and internationally, takes the following into consideration: international hierarchies; relative power; the degree of satisfaction with international regimes; the dynamics of economic growth; and a nation's political capacity (the ability to extract resources and mobilize citizens). These factors are relative, non-static and must be evaluated in relation to one another as well as other related issues. For example, India's per capita productivity will likely continue to rise steadily; China's economy will probably surpass that of the United States by 2050. As economic dynamics are an important factor of relative power in power transition theory, both developments have implications for the balance of global power.

The degree of satisfaction with the status quo of countries lower

in a hierarchy also help determine whether a peaceful shifts in power will occur.

"China is constantly showing dissatisfaction with the 'rules of the game,'" said Yesilada, explaining that the reigning trade, monetary, developmental and security regimes were created without China's inclusion. "Whoever dominates the Chinese market is most likely to re-write these rules," he added.

The relationship between economic growth—which is affected by population growth—and national capacity is also an important factor. For instance, the oil wealthy countries of the Middle East, long reliant on single commodity export markets, will face great challenges in the years ahead as their populations increase relative to national capacity, and oil from the Caspian Sea region hits the global market.

The seminar also included discussion of regional integration theory, which looks at how regional integration and shifts in relations are likely to take place. Discussion highlighted the number of non-cooperative players currently in the Middle East, Caspian Region, and South and Central Asia, and the consequent threat to peace. For instance, Iran, which recently tested a new missile, is a discontented player hemmed in by Israel on the regional level and by the U.S. on the international level.

"When (military) parity is reached (in such a scenario) the potential for war increases," Yesilada said, explaining that a discontented nation with equal power to inflict damage has a greater incentive to push for change.

The use of decision-modeling software that combines bounded

rationality, game theory and expectations utility provided a method to apply these theories on a micro level. This approach uses data that is very time sensitive and poses the challenge of assigning quantitative value to factors such as power. The computer modeling technique, also used by the CIA, Defense Intelligence Agency and Department of Defense, has been tested on approximately 2,000 historical and contemporary cases for the purpose of military, economic and political analyses, and has a success rate of 90 percent in predicting actual bargaining scenarios.

The process takes six steps: frame the problem at hand; the main issues of concern of all participants; gather and measure data; analyze the interests, positions and potential bargaining trade-offs of the participants; interpret the findings; and identify potential bargaining scenarios. A limitation of the model is that it assumes the availability of full information.

Power transition theory combines macro theory and peer analysis to identify areas of conflict, power parities, economic dynamics and levels of satisfaction of participants. The microanalysis is then conducted to identify issues and interests of participants, as well as bargaining opportunities.

The Afghan case study concluded that U.S. efforts in maintaining stability in Afghanistan are crucial, and that without the U.S. it is possible that the Taliban will resurface. Some other findings of the full microanalyses concluded that Iraq was never a danger to the United States because to take action against the U.S. would have been "suicidal." However, if Iraq were to have acquired nuclear weapons it would have posed a serious threat to Israel. The model also found

## Featured Seminar

### Recent PNWCGS Seminars

*PNWCGS sponsors seminars, conferences and workshops to benefit the global security community and its leaders. These events promote interaction between policymakers, laboratory science and technology staff, and government officials, offering an opportunity for them to discuss and share ideas about the security issues of today.*

#### July 31

##### **International Security and Nonproliferation**

*Ambassador Thomas Graham, Jr.*

Graham, former general counsel of the Arms Control and Disarmament Agency and author of "Disarmament Sketches: Three Decades of Arms Control and International Law," discussed current issues in global security and the challenge of reducing the threat of weapons of mass destruction.

#### July 8

##### **Application of Power Transition Model to Studies of Afghanistan, Cyprus, and Iraq**

*Dr. Birol A. Yesilada*

Yesilada, Professor of Political Science and International Studies at Portland State University (PSU), foreign policy consultant, author, and Executive Director of PSU's Northwest American Turkish Research Institute, shared new theories and methods of decision-modeling developed over the last few decades, applying the approaches to case studies of Afghanistan, Iraq and Cyprus.

#### June 4

##### **Human Security in a Time of Terrorism and War: The Canadian View**

*The Honourable Lloyd Axworthy*

Axworthy, former Canadian Foreign Minister and Nobel Peace Prize Nominee for his role in the Ottawa Convention to ban anti-personnel landmines, provided his views on the U.S. war in Iraq and on terrorism. The University of Washington's Jackson School of International Studies, among others, co-sponsored this event.

that the potential for political stability in post-Sadaam Iraq is extremely low. It indicated there is an increased threat to the United States in the future if trans-Atlantic alliances are not mended because rivalry between the United States and European Union would only make it easier for a third power, such as China, to challenge the international power regime. Lastly, the results indicated that UN Secretary General Kofi Anan's plan for peace is the best solution for Cyprus. While the present Turkish president, his party and the military in Ankara do not like the plan, it is supported by other Turks and could well be the last opportunity to resolve the 40-year old conflict.

"This is not a substitute for policy analysis, but an additional tool," Yesilada said of the combined approach, adding that while most analysts like the combined model, traditionalists "hate it" and that one half of the current U.S. administration likes it and the other half does not.

"Some of the results are just not what people want to hear," he said. ■

## Material ID

*(Continued from page 9)*

Eastern and Central European nations as well as Asia and Cyprus and Malta according to Dr. Richard Pappas, lead developer for the system. The project was most recently funded by the Department of Energy (DOE) for national security purposes and has been used to help control surplus materials at DOE sites.

The technology is also a primary advanced detection technology used in the PNNL Interdict/RADACAD International Border Security Training conducted at DOE's Hazardous Materials Management and Emergency Response (HAMMER) Training Center.

Funded by NNSA (Second Line of Defense), State, Customs and DoD, this program trains U.S. Customs and Border Protection Officers as well as Central and Eastern European and former Soviet Union border-enforcement officials to deal with all aspects of smuggling related to weapons of mass destruction.

More information concerning the Material ID system can be found at the Interdict/RADACAD training site at: <http://www.pnl.gov/interdict/training/curriculum.html>. ■

# Upcoming Events

October 22, 2003

**Linking Random Graph and Loglinear Models of Networks**

Steve Goodreau and Marina Morris

12:30-2:00 p.m./209 Savery Hall, University of Washington

Many of the recent statistical models for the analysis of dependence in social networks build on the general class of exponential random graphs, including Mockov, random graphs, "p-star" models, and actor-oriented models. This talk examines how this class of models is related to the log-linear modeling framework used in earlier work to analyze mixing patterns in local network data.

Sponsored by the Center for Statistics and the Social Sciences.

October 23, 2003

**Finding Common Ground: The Missing Pieces of Middle East Peace**

October 27, 2003

**Security and Our Ports: Global Business Series Breakfast**

Patty Murray; Mic Densmore; Charles Mandigo

7:30-9:00 a.m./The Rainier Club, 820 Fourth Ave.

Seattle, WA

Discussion of port security and how it impacts business and the region. Sponsored by the World Affairs Council.

Information: 206.441.5910

November 10, 2003

**Security and Economic Growth: Global Business Series Breakfast**

Clyde Prestowitz

7:30-9:00 a.m./The Rainier Club, 820 Fourth Ave, Seattle, WA

Founder and President of the Economic Strategy Institute, Clyde Prestowitz is a leading thinker on international trade policy. He served as a vice chairman of the President's Committee on Trade and Investment. Sponsored by the World Affairs Council.

information: 206.441.5910

December 2, 2003

**Security and Business with Canada: Global Business Series Breakfast**

James Blanchard

7:30-9:00 a.m./ The Rainier Club, 820 Fourth Ave, Seattle, WA

Sponsored by the World Affairs Council

December 3, 2003

**Exploring Spatial Heterogeneity in Regional Tax Effort in Russia**

Judy Thornton and Avery Ke

12:30-2:00 p.m./209 Savery Hall, University of Washington

*For updated and additional information on PNWCGS events and seminars, see: <http://pnwccgs.pnl.gov>*

## Pacific Northwest National Laboratory

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P.O. Box 999, K8-02

Richland, WA 99352

