Breakthroughs

Science. Technology. Innovation.

SPRING 2000

NORTHWEST SPECIAL EDITION

Lights on– lights off

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PACIFIC NORTHWEST NATIONAL LABORATORY

OPERATED BY BATTELLE FOR THE U.S. DEPARTMENT OF ENERGY

editor's screen

Computers and information technology have changed our world; there's no doubt about it. According to the experts, however, the effect of information technology on our daily lives has only just begun.

One of Pacific Northwest National Laboratory's most experienced staff members in information technology expresses his visions of the future in this issue's Special Report. We've also included stories about some of Pacific Northwest's new software tools for law enforcement, energy code compliance and distance learning, as well as how we're helping protect the nation's critical infrastructure.

Pacific Northwest's scientific discoveries and innovative technologies are addressing the challenges of today and the uncertainties of tomorrow. These pages highlight a few exciting examples—like a promising water treatment method, coatings to protect a new generation of flexible electronic displays and altered cotton bandages that could help wounds heal.

Please contact us if you'd like more information about Pacific Northwest or any of the stories in this magazine.

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- To find out more about Pacific Northwest National Laboratory's economic development programs, as described on page 14 in "Smoothing the road to success: Pacific Northwest assists start-up skin-care business," see **http://www.pnl.gov/edo/**
- For information about how Pachelbel was put to use as a rehabilitation tool for patients recovering from spinal cord injuries, as mentioned in "Pachelbel composing information online," page 10, visit **http://www.pnl.gov/news/1999/spinal.htm** or **http://www.neuro.wustl.edu/rlc/**
- Catch up on the details of CATCH, featured on page 9 in "Computer tools for CATCHing criminals," by taking a look at **http://www.emsl.pnl.gov:2080/proj/neuron/papers/kangas.spie99.html**
- Go to **http://www.pnl.gov/main/welcome/awards/flc/** if you'd like to read more about Pacific Northwest National Laboratory's most recent awards for excellence in technology transfer from the Federal Laboratory Consortium featured on page 12, or about winners in years past.

Guarding the nation's infrastructure

Fears of widespread power outages at the stroke of midnight on New Year's Eve were unrealized, but potential risks to the nation's energy system may extend beyond the Y2K bug.

With the dramatically changing role of information systems and e-commerce in business, there is a growing need to ensure competitors, hackers, terrorists and even disgruntled employees cannot access the information or physical systems that keep the lights on.

Pacific Northwest National Laboratory and other national laboratories are helping meet a 1998 Presidential Decision Directive to protect the United States' critical infrastructure through their involvement in the U.S. Department of Energy's Infrastructure Assurance Outreach Program.

"It may be necessary for an organization to have flexible and robust information systems to achieve its mission, but along with that there must be a level of discipline and structure," said Landis Kannberg of Pacific Northwest, who serves as the program's executive agent.

"After years of developing technology to protect national security and sensitive information for the government, the national laboratories have a wide breadth of expertise in this area," he said. Pacific Northwest often leads the program's assessments to raise an organization's awareness of potential vulnerabilities and provides insight into how it can enhance security.

Organizations in the electric utility industry request the voluntary assessments, which are subject to stringent nondisclosure agreements that allow no one but the client to receive the report. The assessments

may include reviews of computer network architecture, operational and physical security, administrative policies and procedures and configuration management. They also take a close look at interdependencies that result from sharing information within an organization and with contractors, suppliers and subsidiaries.

"While this interconnectedness is meant to streamline business, it could conceal a risk if it's not acknowledged and understood," Kannberg said.

Acc ›rding to Kannberg, even simple things to improve the discipline of operations can significantly reduce risks. Some examples come from reviewing how organizations control the dissemination of information, how and where information is accessed and backed up, what kind of information is posted on the Internet and whether sensitive documents are shredded before disposal.

While resources are limited, DOE has been funding a good portion of accepted assessment requests as part of its commitment to help ensure adequate protection of the nation's energy infrastructure.

Pacific Northwest has been involved in assessments for 10 organizations in the electric utility industry since the outreach program began in 1997. As soon as mid-2000, the program will likely expand into the gas and oil industries as well as add new activities such as pre-assessments to help utilities better identify what they have that needs to be protected.

In addition to the assessments, the program embodies more traditional outreach activities such as sponsoring conferences and forums that bring utilities and other agencies together to explore how they can collectively address the issue. The program also works with organizations such as the North American Electric Reliability Council and the National Infrastructure Protection Center, which is managed by the Federal Bureau of Investigation. ●

Builders checking out *tools* for *energy code* compliance

There has to be an easier way!

The frustrated pleas of builders and building inspectors ready to give up on page after page of complicated energy codes have been answered by Pacific Northwest National Laboratory. By designing two suites of tools—one for residential construction and one for commercial construction—Pacific Northwest is making complex building energy codes easy to follow.

Under the direction of the U.S. Department of Energy's Building Standards and Guidelines Program, Pacific Northwest set out to make the Model Energy Code, now known as the International Energy Conservation Code, more understandable to users. This building energy code has been adopted in its entirety or serves as the basis for state-specific residential codes in 21 states.

"We translated building codes into 'English,' creating tools that speak the language of builders and giving them materials they can use," said Craig Conner, in the Building Energy and Standards Program at Pacific Northwest. Because it was developed when the code was still called the Model Energy Code or MEC, this simple, comprehensive set of tools was named MEC*check*™.

MEC*check* is designed specifically for builders and building code officials. The workbook includes a plain explanation of the code, a list of pre-calculated combinations of materials that meet code and user-friendly forms to demonstrate compliance. The MEC*check* software gives homebuilders the flexibility to easily compute different combinations of windows and insulation, allowing them to choose less expensive or more advantageous materials while meeting code requirements for energy efficiency.

The suite of tools also contains user's guides, videos, training materials and a hotline for people requesting materials or asking questions about them.

MEC*check* has gained national acceptance by a wide variety of users including the U.S. Department of Housing and Urban Development, the National Home Builders' Association and all three of the national code organizations.

"It's popular with builders and code officials because it reduces their headaches and the time they spend dealing with these issues," said Linda Connell, who manages MEC*check* development.

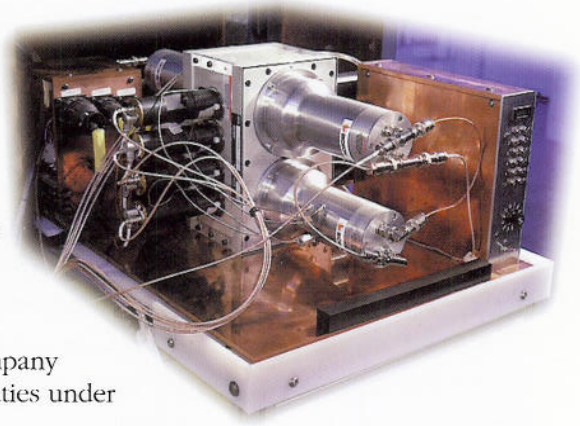
MEC*check*'s success led to the creation of COM*check-EZ*™, a similar set of tools to address energy codes for commercial buildings.

The software and user's guides for COM*check-EZ* and MEC*check* can be downloaded from the Internet at no cost from http://www.energycodes.org. It's also available from some states, code organizations and even some building materials manufacturers, such as insulation companies. Conner estimates that more than 20,000 copies of various versions of the tools are in circulation and new tools continue to be developed.

"We're connecting a paper-based process with information technology to bring the world of building codes into the modern age," explained Rob Briggs, who manages the development of COM*check* products. For example, Briggs is helping develop a prototype that links the COM*check-EZ* software directly to computer-aided design tools so compliance eventually can be checked in real-time as a building is designed. ●

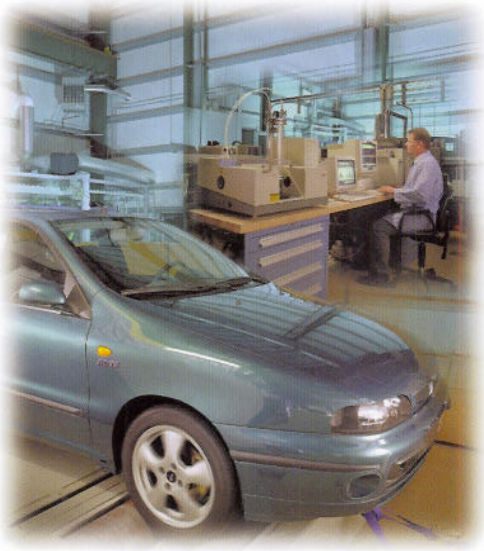
Dress rehearsal for nuclear weapons detection

Performing for an international audience may induce stage fright for some, but not for a nuclear detection device being tested in Freiburg, Germany. The device debuted in October for its first international demonstration and proved it could measure short-lived isotopes produced by underground nuclear testing.



ARSA, the Automated Radioxenon Sampler/Analyzer, was developed by Pacific Northwest National Laboratory scientists to collect, purify and measure the fission product xenon, a telltale sign of an underground nuclear detonation. In Freiburg, ARSA detected a short-lived radioactive isotope called xenon-135 that was produced by European nuclear power plants and also is emitted during underground nuclear tests.

Once completely developed, ARSA will be licensed to a commercial company that would sell it to countries attempting to fulfill radionuclide monitoring duties under the Comprehensive Nuclear-Test-Ban Treaty.



A lean, low-emission machine

Delphi Automotive of Troy, Mich., and Pacific Northwest National Laboratory have teamed to develop a new technology that greatly reduces emissions from lean-burn engines, such as diesels. Their durable, compact and energy-efficient technology can be incorporated into a vehicle's existing exhaust system to break apart and convert environmentally harmful oxides-of-nitrogen (NOx) and particulate matter in auto emissions, to nitrogen, water and carbon dioxide.

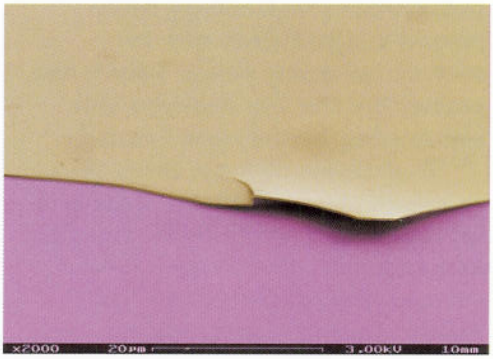
Initial tests of this nonthermal plasma and selective catalytic reduction technology on a diesel engine showed a reduction of NOx by 55 percent without the need to add hydrocarbons to the exhaust. This technology received the Financial Times Global Automotive Award in late 1999 as a "technical development with the greatest potential to improve efficiency, safety, comfort, environmental performance or cost structure of motor vehicles and their associated services." Delphi and Pacific Northwest continue research to optimize the performance of the nonthermal reactor and catalyst materials. ●

On the cutting *edge*

Pacific Northwest National Laboratory researchers have demonstrated that a new cutting technique previously used only for electronic materials can work with more complex oxides and ceramics to cleave single-crystal films of controlled thickness. The ion cutting process uses hydrogen or helium implantation and subsequent heating. It's an emerging technology for transferring thin films of crystalline semiconductor materials and devices from one substrate to another.

Ceramic materials are often used in hydrogen storage devices, fuel cells, batteries and ultra-capacitors, for example. In these and other applications, this technology could offer an attractive method for generating single-crystal thin ceramic films with precise thickness.

Pacific Northwest scientists at the William R. Wiley Environmental Molecular Sciences Laboratory continue exploring this new application of the cutting technology. ●



Films as thin as a few atomic layers to the size of a strand of human hair can be ion cut.

Imagining the Future

Today's adults can easily remember the days before there were computers on every desk, before e-mail was the quickest way to communicate with a colleague and before the Internet was the easiest way to find information. According to Jim Thomas, a senior chief scientist in Pacific Northwest National Laboratory's Information Science and Engineering organization, the dramatic changes that we've seen in information technology are just the beginning. He expects this area to accelerate more quickly and impact our daily lives even more significantly than it has already. We asked this visionary about the future of information technology and the changes we can look forward to in the years ahead.

How is information technology changing society?

I think we can safely say that there has been no change in society in the last 100 years that will equal what we're going to see in the next ten. This major transformation will affect all aspects of life—how we buy things, how we use them and how we maintain them. Your refrigerator will be connected to the net, and when it has a problem, it will automatically send a signal to the repair shop letting them know what needs to be fixed. Cars will become information and transportation appliances. You'll be able to drive and talk to people in comfort with built-in devices instead of having to use cell phones. Cell phones, by the way, will become videophones.

Information technology has played a significant role in society for many years, what's the reason for the big changes you see coming in the near future?

This transformation is taking place as a result of a combination of things—the availability of high-speed networks, the availability of information content, the ease of developing access tools and the developments in wireless technology and small information appliances. In the last 18 months, the cost to manufacture a video camera has dropped from $200 to $2. We'll be walking around with computers in our pockets and writing things in our information devices, even our clothing or our shoes will contain information devices.

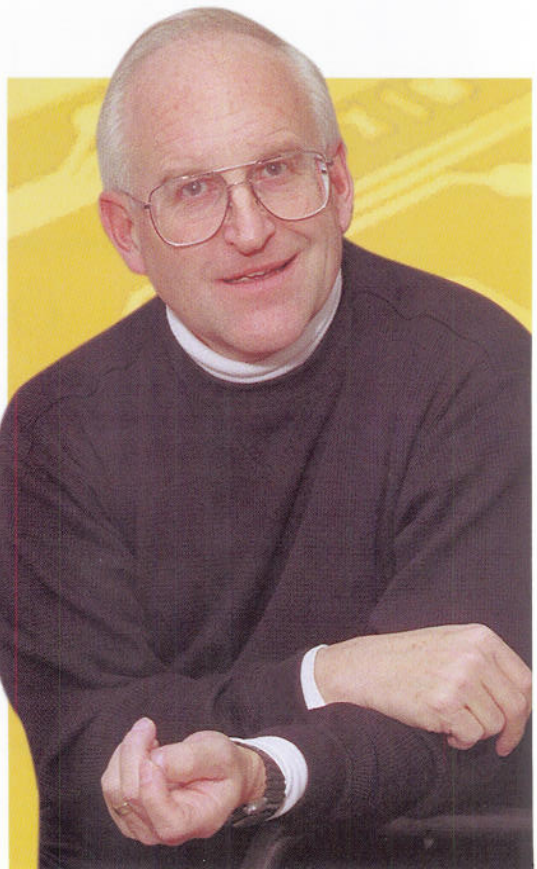
Where will we first see the biggest changes?

The first video devices and other dramatic advancements will be in games. That's where the money is. Entertainment will shift from presenting something to allowing people to experience it. You'll be able to take a trip to Egypt without actually going there. You might smell things. You'll be able to walk around, talk to people and go to the pyramids. You might even get to stand on top of them. You'll be able to do things that you can't do in real life. Rather than going somewhere to be entertained, you'll be able to experience things from home. Everything will be in 3-D surround-sound, but you'll probably only need two speakers. In fact, the technology needed to do that by bouncing the sound off each other is already available.

If the entertainment industry is driving changes, will these advancements help us work smarter or faster too?

The impact may not be on speed, but on the depth of understanding. With the advancements that allow you to "experience" things, you'll be able to engage yourself in what you're doing. You can be part of an experiment as you run it. You could be in the middle of a simulation with the information displayed all around you. You could see a molecular reaction and feel the forces around you. You might even "virtually" feel the surfaces remotely.

The way we learn is going to change. You can get down and see things from all angles. You can *experience* science. You can read a physics textbook that describes how a ball bounces, but if you see a ball bounce, that's different. If you can hold it while it bounces and feel it move,



that's different still. It's going to be so much more fun to learn in the next 10 years. I hope that students will be more excited to learn about science with these tools, especially underprivileged kids. When it comes to using information technology in education, there are enormous opportunities.

Tell me where Pacific Northwest's strengths fit into this fast-paced industry.

This lab has continually demonstrated the ability to pull together interdisciplinary teams of scientists—like nowhere I've seen. We fuse together chemistry, biology, advanced materials, information technology and physics here. Even our individual people are multidisciplinary. Nearly all of our computer scientists have dual degrees.

I also find our lab to be particularly successful at bringing together clients and science. I spend about one-third of my time with clients. When I find out what they're doing and the challenges that they face, it allows me to invent solutions and encourage others to invent. I think the excitement of the scientific opportunities and people's commitment to invent something useful are the reasons that we're able to attract and retain professionals in this field.

What areas of information technology will Pacific Northwest be pursuing?

There are many hot areas where we'll be involved. One is information visualization. These developments will help people sort through mounds of data—not just text, but video, audio and images—to find what they need, identify relationships within the data and explore trends. This is part of a broader vision called the new Human Information Discourse. Imagine having a two-way dialogue with your information resources, just like you would with another human.

We're working with agents, programs with "smarts" built into them so they can do things for you. You might carry around a personal device that gives you directions. Information agents can perform personalized information searches and package the results in a way that you find useful. You'll be able to tell these agents what you want and they'll go out and get it.

We're developing new ways for people to collaborate. The need to work with others, especially in this age of mega-mergers, requires new ways to communicate and interact. In the future both real people and "virtual" people will be working together with these tools.

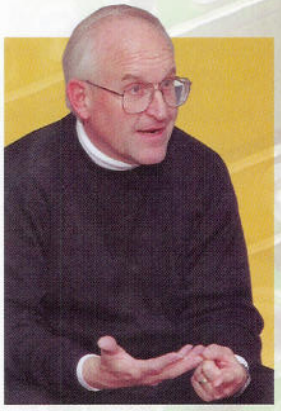
Another really important area is knowledge management. We'll have the world's library at our fingertips, but we need to be able to manage raw data, aggregate it, summarize it, merge it with other information and present it in a way that people can use it. This is the behind-the-scenes function. For example, SPIRE™ (Spatial Paradigm for Information Retrieval and Exploration) assigns a mathematical signature to text, without knowing the content of the text, and then organizes the information and presents it in a way that meets the needs of the user.

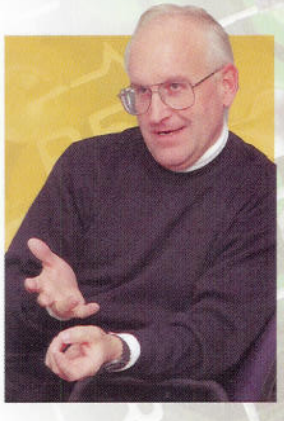
We also do a substantial amount of work to protect vital information, detect break-ins or attacks from hackers and monitor information flow.

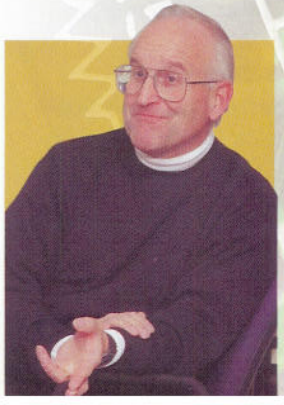
If we can take a "virtual" vacation, have devices in our homes to alert us when repairs are needed and ask an agent to go get information, will people still need to interact with each other?

The virtual experience will be fun, but it won't be real. People will still want to experience reality. Sure, with technology we'll be able to see each other and talk with each other anytime and anywhere, but nothing replaces the social experience of people talking with people face-to-face. When it comes to working with information, you can't take humans out of the loop. We know how to make sense of things. It will be a lot longer than 10 years before computers can do that for us on any broad scale. ●

Jim Thomas has more than 30 year's experience in information technology at Pacific Northwest National Laboratory. His responsibilities include establishing investment directions for information technology, leading major technology initiatives, representing information technology internally and externally and serving as the principal investigator on several major programs. He specializes in the research, design and implementation of innovative information visualization, multimedia and human computer interaction technology. In addition to his work at Pacific Northwest, Thomas serves as editor-in-chief for IEEE Computer Graphics and Applications, is a member of the Academy of Sciences Virtual Reality Panel, is a member of several advisory boards and has authored more than 100 publications.







Water treatment *technology* glows *bright* with promise

Water is one of nature's most recycled resources; however, today's water decontamination technologies cannot eliminate some of the hazardous chemicals and drugs polluting much of the world's water supply.

That's why researchers at Pacific Northwest National Laboratory developed Glow Discharge Plasma for the U.S. Department of Energy.

"Conventional treatment technologies such as biological treatment don't destroy some of the materials that show up in wastewater and groundwater," said Gary Josephson of Pacific Northwest's electrical and chemical processing group.

He gives examples such as a gasoline additive known as MTBE that can leak into the groundwater and is resistant to treatment with traditional municipal water treatment methods. Household chemicals and solvents kill the microbes used in certain treatment methods. Lastly, recent studies show that 50 to 90 percent of pharmaceutical drugs such as cholesterol inhibitors and estrogen pass through the body, into wastewater systems and right through treatment plants in their active forms.

Glow Discharge Plasma could help solve these problems. "In wastewater treatment, multiple technologies often are put to work. This could be part of a treatment chain," said Amit Sharma, who developed Glow Discharge Plasma with Josephson. "Its niche is to treat those things that other treatment technologies cannot."

Perhaps the greatest advantage of this technology is the extremely broad range of contaminants that it can treat. "Although our testing is certainly not comprehensive, we have yet to find an organic chemical that it doesn't destroy," Josephson said.

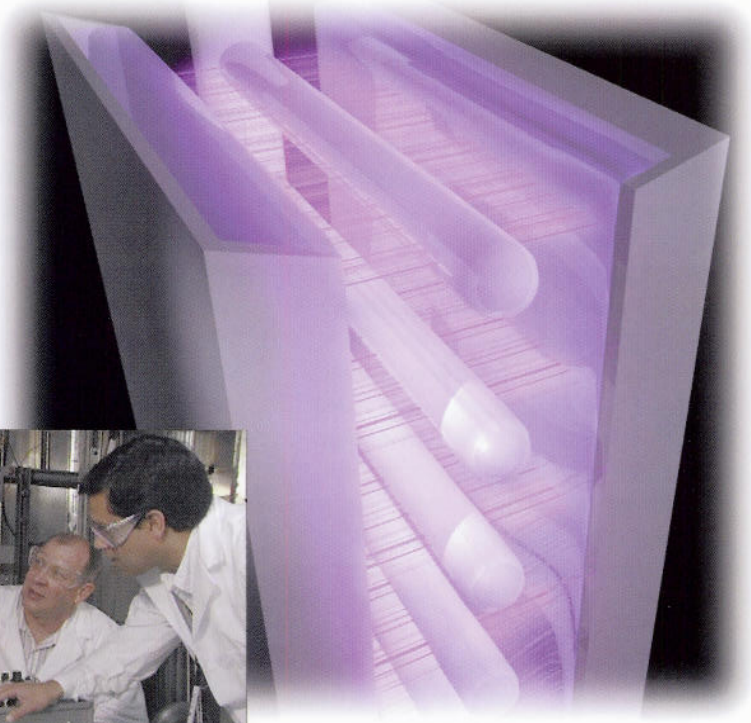
Glow Discharge Plasma was developed to address recalcitrant organic contaminants from processes at DOE sites. In its most likely application, it could serve as a wastewater pretreatment method. Used in conjunction with conventional systems, this method could remove the worst of the resistant contaminants such as trichloroethylene and chloroform from wastewater before it's released.

The same technology also could be used to treat groundwater contaminants including carbon tetrachloride and solvents at industrial and government sites. It even has potential applications in disinfecting drinking water by killing common intestinal parasites.

With Glow Discharge Plasma treatment, a strong electric field accelerates electrons in nonthermal plasma, which is an electrically neutral gas that has very energetic electrons. The contaminated water is continuously circulated in a falling film, maximizing the surface area where contaminants are destroyed. As the water circulates, the fast-moving electrons in the plasma collide with molecules in the gas above the water and on the water's surface. This activity causes the molecules to break apart, forming reactive radicals and ions that react with the surface of contaminated water and destroy the contamination.

"The key to Glow Discharge Plasma's versatility is that the nonthermal plasma creates both oxidizing and reducing active species and they can be controlled to address almost any contaminant," Josephson said. The glow, while interesting, is not responsible for wiping out the contaminants. It occurs because some electrons emit photons as they fall from higher energy levels to lower energy levels.

Pacific Northwest, which is operated by Battelle, is interested in working with commercial partners who would like to license and deploy this patented technology and support further improvements. ●



A view of the Northwest

The Northwest is a region known for its majestic mountains, flowing rivers, a picturesque coastline, wildlife and wide-open spaces. Of course, the landscape also includes growing economies and successful industries. In this special insert, we take a closer look at how Pacific Northwest National Laboratory is involved in the region for which it was named. While we have room for only a handful of examples, we hope that these snapshots demonstrate how our contributions of science and technology fit in the picture of innovative solutions for the region and the world.

A clear cleanup solution

Pacific Northwest National Laboratory is testing an innovative groundwater cleanup technology at the U.S. Department of Energy's Hanford Site and at the Army's Fort Lewis in Tacoma, Wash. In Situ Redox Manipulation allows contaminated groundwater to be treated in place, which may provide a safer, easier and more cost-effective alternative to conventional pump-and-treat cleanup methods.

At Hanford, this technology is being used to treat underground plumes of chromate, used as a corrosion inhibitor in nuclear reactors years ago. Demonstrations have shown a potential for this treatment to cost 60 percent less than previous treatment methods. The ongoing tests at Fort Lewis may determine if In Situ Redox Manipulation could treat groundwater contaminated with chlorinated hyrdocarbons from engine degreasers and chemicals used to maintain equipment.

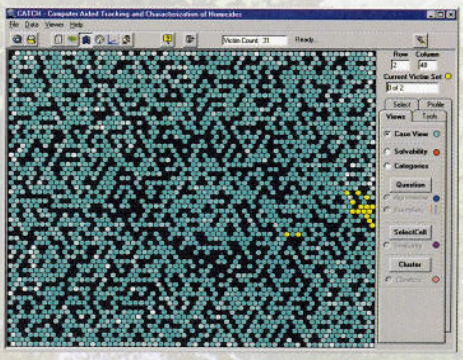
Minding mining impacts

Marine scientists at Pacific Northwest National Laboratory have been working with Kennecott Greens Creek Mining Company of Alaska over the past 12 years, conducting metals analysis in seawater and fresh water. The mining company is located on national forest lands within the Admiralty Island National Monument, which is administered by the U.S. Forest Service. Through the cooperative efforts of Kennecott and the Forest Service, a monitoring program was designed and implemented to ensure that mining activities are not adversely affecting the island's ecology.

Pacific Northwest scientists at the Marine Sciences Laboratory analyze seawater samples collected quarterly near the company's oceanside activities. As part of the freshwater program, they also analyze surface and groundwater samples taken monthly near the mine tailings and at sites along Greens Creek. Based on the analyses to date, scientists have not seen indications of negative environmental impact from mine activities.

Technology—the long arm of the law

Pacific Northwest National Laboratory helped crack a methamphetamine production case in Washington State, by assisting the Tri-City Metro Drug Task Force in demonstrating probable cause to search a suspected home. Pacific Northwest provided sample collection devices and a dehumidifier that converts the water vapor in air samples into water that can be collected in bottles. When scientists analyzed the water samples resulting from air samples taken near the home, they found high levels of a chemical byproduct that is a strong indication of methamphetamine production. Adding this information to their investigation, police obtained a warrant to search the home and found drug paraphernalia and methamphetamine inside.



Pacific Northwest has developed technologies especially for law enforcement, including software to identify patterns in crime investigation databases and a monitoring and tracking system for offenders under parole supervision. The Laboratory collaborated with the Washington State Attorney General's Office on both of these projects.

A flow of fish research

As the salmon debate in the Northwest continues to escalate, Pacific Northwest National Laboratory continues to increase the knowledge and understanding of how fish respond to environmental conditions and human activities. Providing this solid science to government agencies and decision makers can help them make informed choices for the region.

These projects are among the fish and fish habitat research that Pacific Northwest performs for government agencies including the U.S. Army Corps of Engineers, the Bonneville Power Administration and the U.S. Department of Energy as well as regional public utility districts.

Better than the real thing

Pacific Northwest scientists designed synthetic "sensor fish" to measure some of the conditions that fish experience as they pass through turbines at hydroelectric dams. These "fish" have been deployed at Bonneville Dam on the Columbia River between Washington and Oregon. Equipped with instruments that can record pressure and acceleration, the sensor fish may help pinpoint where real fish are affected the most. This scientific data may be useful to engineers designing fish-friendly turbines.

Fish psychology?

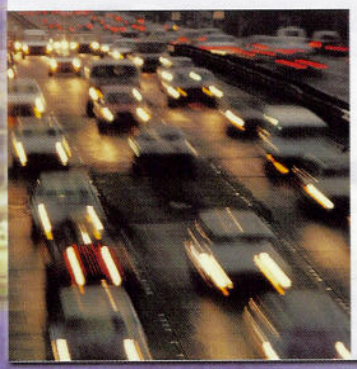
Scientists have developed monitoring tools to study how fish behave near bypass systems that route them over dams rather than allowing them to pass through turbines. Coupling a modification of a sonar device commonly used to map the bottom of oceans with interactive computer animation, researchers tracked about 15,000 juvenile fish as they approached a prototype bypass system being tested at Bonneville Dam. Results from these studies could help in future designs of surface flow bypasses for safer downstream passage.

Home improvement

Researchers at Pacific Northwest are studying fish habitat and ways to improve the places where fish live and spawn. At the Marine Sciences Laboratory in Sequim, Wash., marine scientists are using a seawater greenhouse to test growing eelgrass from seed. This vegetation, which provides habitat for sea life including juvenile salmon, could then be transplanted to supplement eelgrass populations in the Puget Sound near Seattle, Wash.

A driving partnership

The Northwest Alliance for Transportation Technologies provides a format for diverse public and private entities from the Northwest to collaborate and develop innovative solutions for the transportation industry. Led by Pacific Northwest National Laboratory, this alliance combines the strengths of national laboratories, the Big Three auto manufacturers; the Boeing Company; regional producers of aluminum, magnesium and titanium; regional power suppliers such as the Bonneville Power Administration; and other automotive and aerospace suppliers.



NATT's partners are designing new lightweight metal shaping and connecting techniques to help meet the objectives of the Partnership for a New Generation of Vehicles. This Presidential Initiative is aimed at reducing the weight of vehicles by 50 percent to increase energy efficiency and reduce emissions. NATT also is helping to improve fuel efficiency in heavy vehicles, such as pickups, sport utility vehicles and heavy-duty trucks through the use of lighter-weight materials.

A new partnership in global security

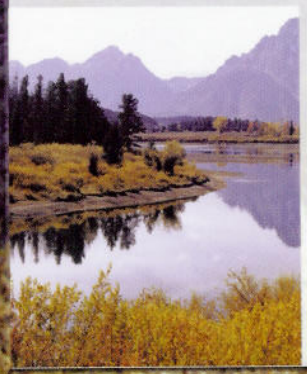
Pacific Northwest National Laboratory and the University of Washington established a Joint Institute for Nonproliferation and International Security Studies in March 2000. The new Joint Institute will support expanding the university's teaching, research and public outreach programs on the nonproliferation of weapons of mass destruction and related international security issues.

The Joint Institute is founded upon collaboration between Pacific Northwest and faculty in the University of Washington's Jackson School of International Studies and the Department of Political Science. It will enlist university faculty as well as scientists and policy experts from Pacific Northwest.

The Laboratory's involvement in the Joint Institute is aligned with the Pacific Northwest Center for Global Security, which was created in 1998. The Center promotes collaboration on nonproliferation activities among Northwest academic, private and nongovernmental stakeholders throughout the region. The Joint Institute will enhance the Laboratory's ability to respond to the U.S. Department of Energy's growing nonproliferation mission and provide leadership for a new generation in nonproliferation and national security programs.

Getting the drift

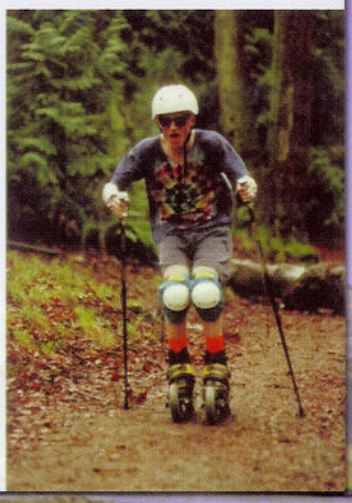
In one project for the U.S. Forest Service field office in Montana, research scientist Jerry Allwine led the development of a computer model to assess how pesticides spread or drift in mountain valleys. The model was tested, comparing results from the computer model with field data from actual aerial spraying.



Relying on the Pacific Northwest National Laboratory's expertise in meteorology in complex terrain, the model helps determine the affect of wind and other factors on how much and how fast pesticide may spread from the target areas. While the model was tested in Salt Lake City, Utah, it potentially could be used to determine the safest time and places to spray pesticides in mountain valleys throughout the Northwest.

Paving the way to business success

Pacific Northwest National Laboratory has shared its expertise with more than 270 firms in the Northwest through its Technical Assistance Program. This program, which is part of ongoing economic development activities, supplies small businesses with up to 40 hours of technical assistance annually at no cost. For example, the Laboratory helped GateSkate Inc., with materials selection, product design and component testing for its all-terrain roller skates. Pacific Northwest also funded two market studies for GateSkate that were performed by students in the Master's of Business Administration program at Washington State University Tri-Cities.



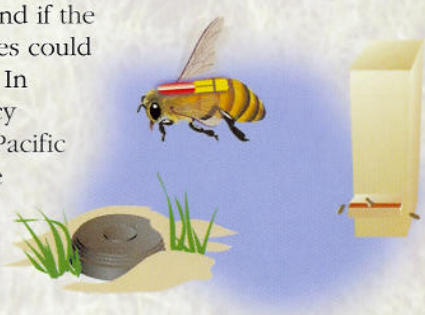
Sharing with the region

Pacific Northwest National Laboratory supports education, arts and community projects through Battelle's corporate contributions and its staff volunteer organization, Team Battelle. Battelle, which manages Pacific Northwest for the U.S. Department of Energy, contributed $714,000 to philanthropic and civic organizations in the region in 1999. Most of these funds support community activities in locations where Pacific Northwest has offices, however contributions also were made to schools in neighboring communities and to statewide organizations for science education. In 1999, Team Battelle's first year, 36 volunteer projects were launched in the community and staff members logged more than 4,100 hours in volunteer labor.

Bees on the lookout for landmines

Engineers at Pacific Northwest National Laboratory helped outfit honeybees with tiny radio frequency tags as part of a project to determine if bees could help pinpoint landmines or unexploded ammunition on firing ranges or past battlefields. An entomologist from the University of Montana coordinates this multi-agency, multi-laboratory project funded by the Defense Advanced Research Projects Agency, the central research and development organization for the Department of Defense.

Activities include investigating whether foraging bees could be trained to seek the chemical components of explosives, if bees could be identified and tracked with radio frequency tags and if the materials they brought back to their hives could be analyzed for chemicals such as TNT. In addition to working with radio frequency tags weighing less than a grain of rice, Pacific Northwest engineers also developed the electronics and software to "read" the tags as bees entered and departed from man-made hives.



Northwest makes good use of user facility

Of the 834 users who conducted research at the William R. Wiley Environmental Molecular Sciences Laboratory in the 1999 fiscal year, 609 of them were from the Northwest states of Alaska, Idaho, Montana, Oregon and Washington.

Pacific Northwest National Laboratory operates DOE's world-class scientific user facility in Richland, Wash. Scientists and engineers from throughout the country and around the world can gain access to its equipment, its computer resources and its research staff.

Many of the users and collaborators were from academia, representing more than 25 institutions, including major regional research universities—the University of Washington, Washington State University, the University of Oregon, Oregon State University, the University of Idaho, the University of Montana, Montana State University and the University of Alaska. Researchers from many smaller public and private academic institutions in the Northwest, for example, Boise State University, Eastern Oregon State College, Portland State University, Evergreen State College and Gonzaga University, also have benefited from using EMSL capabilities and the expertise of EMSL's resident scientific staff.

In addition to meeting the nation's need for basic research, EMSL's diverse capabilities also meet the needs of industry. For example, visiting scientists from the Northwest used EMSL and collaborated with Pacific Northwest staff on projects for the petroleum, steel, health and medicine, pulp and paper, electronics and agriculture industries.

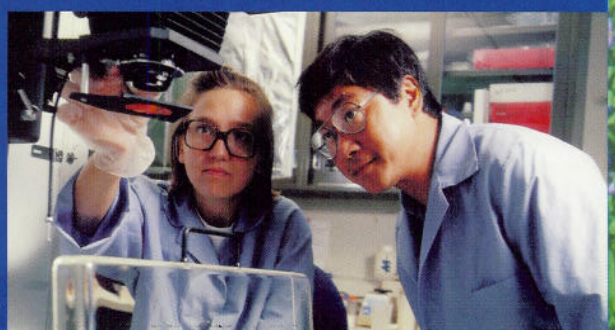
Collegiate collaborations abound

Each year nearly 800 students and educators spend several weeks at Pacific Northwest National Laboratory participating in research assignments where they can work alongside laboratory staff. The majority of these visitors are college students, but participants also include pre-college students, graduate students, faculty members and postdoctoral students. About 65 percent are from the five Northwest states of Washington, Oregon, Idaho, Montana and Alaska.

"Both the Laboratory and the universities benefit from this commitment because these connections don't stop with onsite appointments," said Eric Leber, Manager of Pacific Northwest's College and University Programs. "We often loan or give surplus equipment to schools. We continue to communicate with students and faculty after their assignments. We often collaborate with them on future projects. And in many cases, we hire students from these programs to fill entry-level technical positions."

There are numerous examples of ongoing education partnerships and joint research projects with colleges and universities in the region. Some of the unique examples include:

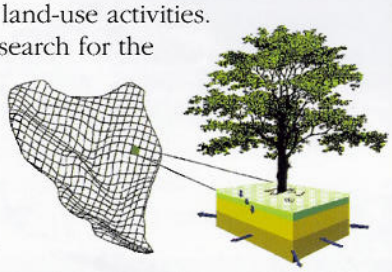
- Students at Eastern Oregon University are accessing the nuclear magnetic resonance equipment in the William R. Wiley Environmental Molecular Sciences Laboratory from their classroom in La Grande, Ore., and conducting experiments remotely.
- Interactions over the last decade have helped bring environmental science and technology curriculum to Western Washington University, Evergreen State College and Peninsula College, a community college in Port Angeles, Wash., providing opportunities for area minority students and displaced loggers.
- A researcher from Pacific Northwest's radiological and chemical sciences group is working together with a faculty member at Washington State University to develop improved radiation detectors.
- Pacific Northwest researchers collaborate with students and faculty at the University of Idaho in materials science and chemistry projects and are beginning to pursue partnerships in the growing area of cyber security.
- The latest accomplishment in a 30-year history of joint projects between Pacific Northwest and Dr. Paul Boynton, a University of Washington physics and astronomy professor—the establishment of an underground gravity laboratory in a former military command bunker on the U.S. Department of Energy's Hanford Site.



GISWA lessens land-use guesswork

Decision makers could consider how a new forest road may affect a watershed and its wildlife habitat with a computer model that Pacific Northwest National Laboratory expanded and enhanced in 1999. The Geographic Information System-based Modeling System for Watershed Analysis or GISWA simulates hydrologic conditions at thousands of locations within a single watershed, providing a detailed representation of water movement.

Using the model, it's possible to explore the economic and environmental trade-offs of various land-use activities. Pacific Northwest conducted this research for the U.S. Forest Service and the paper industry's National Council for Air and Stream Improvement, which will test the latest version of the model this year and evaluate it for potential use by the forest industry.



One bad sensor spoils the bunch

Apple growers risk losing a room full of apples worth $500,000 if ammonia leaks from cooling systems into a cold storage facility. Ammonia detectors often fail or don't detect leaks soon enough. With the mounting cost of growers' claims leading insurance companies to consider no longer covering controlled atmosphere facilities, the Washington Tree Fruit Research Commission asked Pacific Northwest National Laboratory to evaluate the reliability and sensitivity of ammonia detectors on the market.

Pacific Northwest researchers determined that several detection systems they were testing at a facility in Wenatchee, Wash., no longer performed adequately after a matter of months. Researchers are evaluating those that remain as the project moves into its second year. In a newer project for the Commission, researchers are measuring other important gases in controlled-atmosphere rooms such as ethylene, which controls fruit ripening.

Who needs a decoder ring?

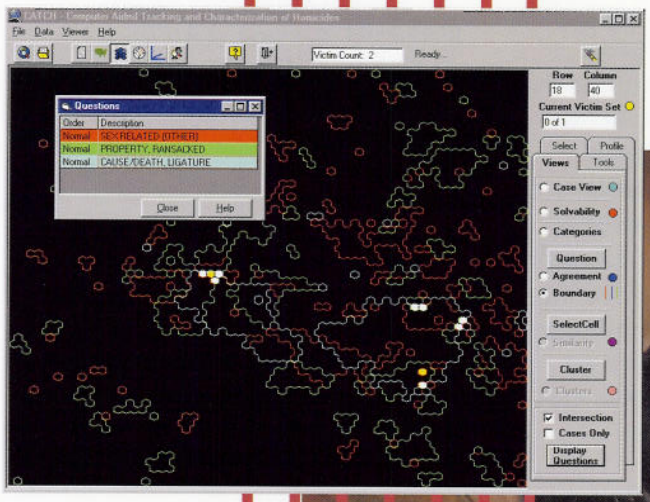
Rather than depend on page after page of confusing text, builders and inspectors in Idaho use tools developed at Pacific Northwest National Laboratory to translate complicated building energy codes and take the headaches out of code compliance. Under the direction of the U.S. Department of Energy's Building Standards and Guidelines Program, Pacific Northwest created two sets of compliance tools, one for residential construction and one for commercial buildings.

In addition to making codes much easier to understand, MEC*check*™ and COM*check-EZ*™ include simple calculations to determine combinations of building materials that will meet code requirements and tools to demonstrate compliance. State energy officials in Idaho have adopted MEC*check* and COM*check-EZ* and provide the tools along with other state-specific information on a CD to builders and code officials throughout the state.

Computer tools for *CATCHing* criminals

In murder mysteries there often is one big clue—a connection—that finally allows investigators to see the answer in the information and evidence swimming before them. Unfortunately, real-life crime investigations aren't always blessed with the same serendipitous discoveries.

For that reason, Pacific Northwest National Laboratory is developing a software tool to help find connections and relationships in data from ongoing investigations and solved cases. Computer Aided Tracking and Characterization of Homicides, or CATCH, could be especially valuable in solving serial crimes that include thousands of leads and long-term investigations.

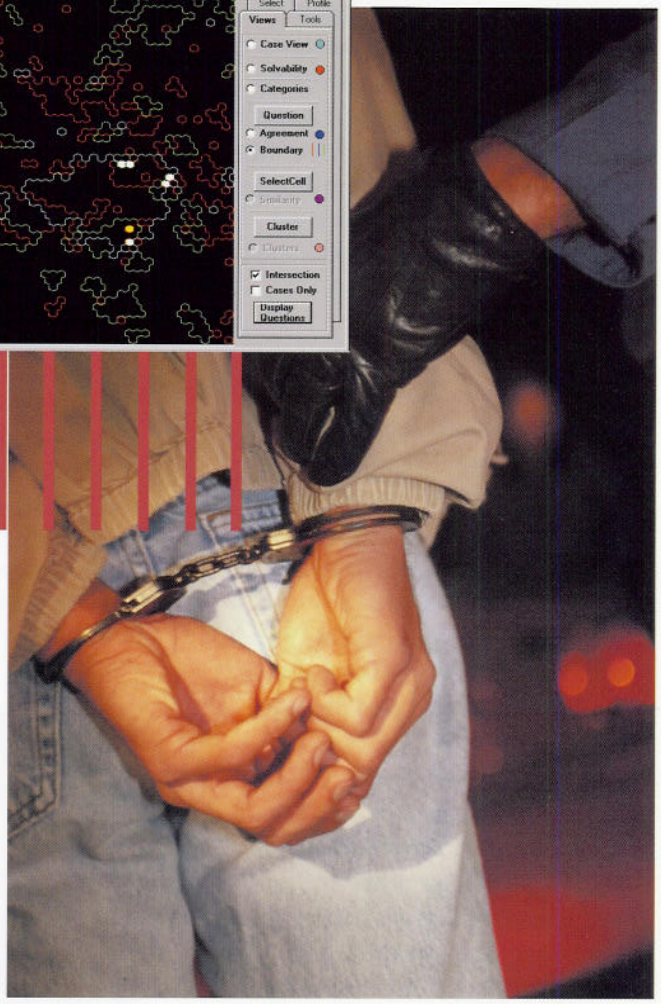


With tools for both database mining and in-depth exploration of data, crime analysts can use CATCH to better understand the contents of a large database as well as to retrieve and compare specific crimes. The software is based on artificial neural networks, which mimic the human brain's ability to find hidden patterns in complex information.

CATCH was built around Washington state's Homicide Investigation Tracking System, a 10-year-old database that contains the details of about 7,000 murders and 6,000 sexual assault cases in the Northwest. The software "learns" to relate specific cases from the state's homicide database to each other. Then, it can be used to cluster together similar cases based on more than 200 parameters including the weapon used, time and place of the crime and details about the victim and offenders.

"With minor modification, CATCH could be used to manage information from other investigative systems and crime databases," said Lars Kangas in Pacific Northwest's Information Sciences and Engineering organization. "We've already developed a promising second version of CATCH called CATCH RAPE specifically for sexual assault investigations."

Analysts using CATCH can select a combination of crime details and see where they fit on a grid display. Crimes fitting into cells located near each other on the grid have similar details. Finding these relationships could help investigators realize connections between unsolved crimes. It also could help build a profile of likely suspects based on similar cases that already have been solved.



CATCH was developed with support from the National Institute of Justice and in collaboration with the Washington State Attorney General's Criminal Division, which is now evaluating the first prototype.

It was based on groundbreaking work in information visualization conducted at Pacific Northwest in the 1980s. ●

Online learning goes the distance

In education, a one-size-fits-all approach, and even a one-place-fits-all approach, often does not work. With this in mind, researchers at Pacific Northwest National Laboratory have developed powerful web-based tools to create customized online lessons.

Pacific Northwest's Pachelbel™ serves as the foundation for flexible online courses. This information management and delivery software allows instructors to change course content and specially tailor information to meet students' needs and learning styles. Valuable resources that support the lessons can be provided in the context of the learning material and contribute to the goals of the learning experience.

"These learning environments can be used to supplement traditional classroom learning, for distance learning or for business training for people in several locations," said Doug Rice, project manager.

The software tracks students' progress so they—and their instructors—can see what they have covered, where they left off and what lies ahead. Students can flag pages, add personal notes directly to the lesson screen and use quiz tools to review what they've learned. Students can also communicate and collaborate with peers and instructors without leaving the lesson.

In addition to being used for Pacific Northwest's own corporate training and at some regional universities, Pachelbel was used to create educationLink, an online course designed for about 1,000 students who will be participating in three internship programs sponsored by the U.S. Department of Energy's Office of Science this summer. This course will give students information about DOE and their upcoming assignments at national laboratories throughout the country as well as help them communicate with each other during their internships. ●

Pachelbel composing *information* online

In the 17th century, Johann Pachelbel arranged melodies and harmonies, creating beautiful music. Today, Pachelbel™ software arranges information, creating web sites that are flexible, easy to update and extremely accessible to a wide range of users at local and remote locations.

Pacific Northwest National Laboratory developed Pachelbel as an information management and delivery tool for the U.S. Department of Energy and is now licensing it to commercial users. In addition to simplifying web page development and maintenance, Pachelbel can track users and vary the content they see based on their preferences and their history within the site.

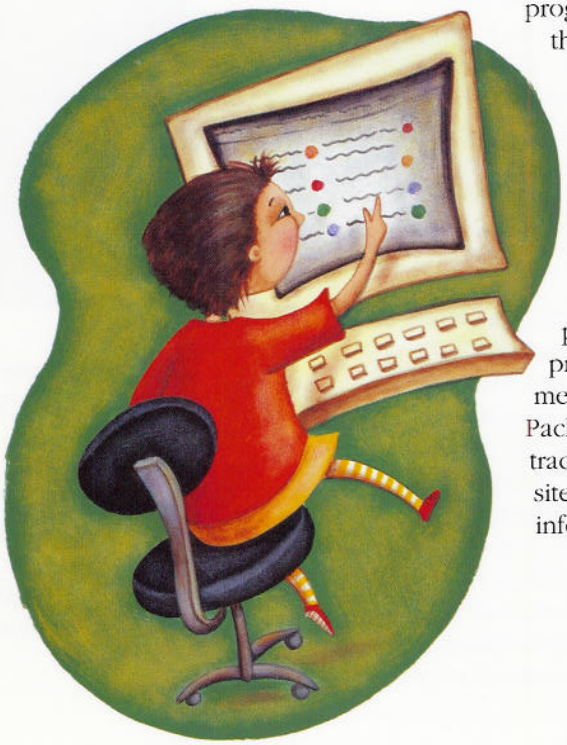
"Pachelbel uses templates to build web pages on the fly as users go through a site," said Doug Rice, who manages the project at Pacific Northwest. "It automatically generates customized pages from one large set of information while maintaining a consistent look and feel for easy navigation."

With its simplicity and modularity, Pachelbel is ideal for applications such as project management and communication, distance learning, marketing and e-commerce.

For example, Pachelbel drives the International Nuclear Safety Program web site. This program involves 65 nuclear reactors at 29 sites in the former Soviet Union. With Pachelbel's flexibility, a single web site serves as a public education tool, a media resource and a publication site for the program's technical reports. The site contains both public and sensitive documents. Pachelbel specifically regulates which pieces of information are displayed depending on a person's user profiles.

The Washington University School of Medicine in St. Louis, Mo., used Pachelbel to create the Rehabilitation Learning Center for patients recovering from spinal cord injuries. This online program allows patients to learn about their injuries and access personal assistance and counseling information after leaving the hospital.

In the growing world of e-commerce, Pachelbel could be used to lead potential customers through custom shopping experiences. As users travel through the online store and provide feedback, Pachelbel would present the items most likely to meet the customers' personal needs. Pachelbel also could automatically track customers' progress through the site, collecting valuable marketing information as they go along. ●



A flexible technology for *flat panel* displays

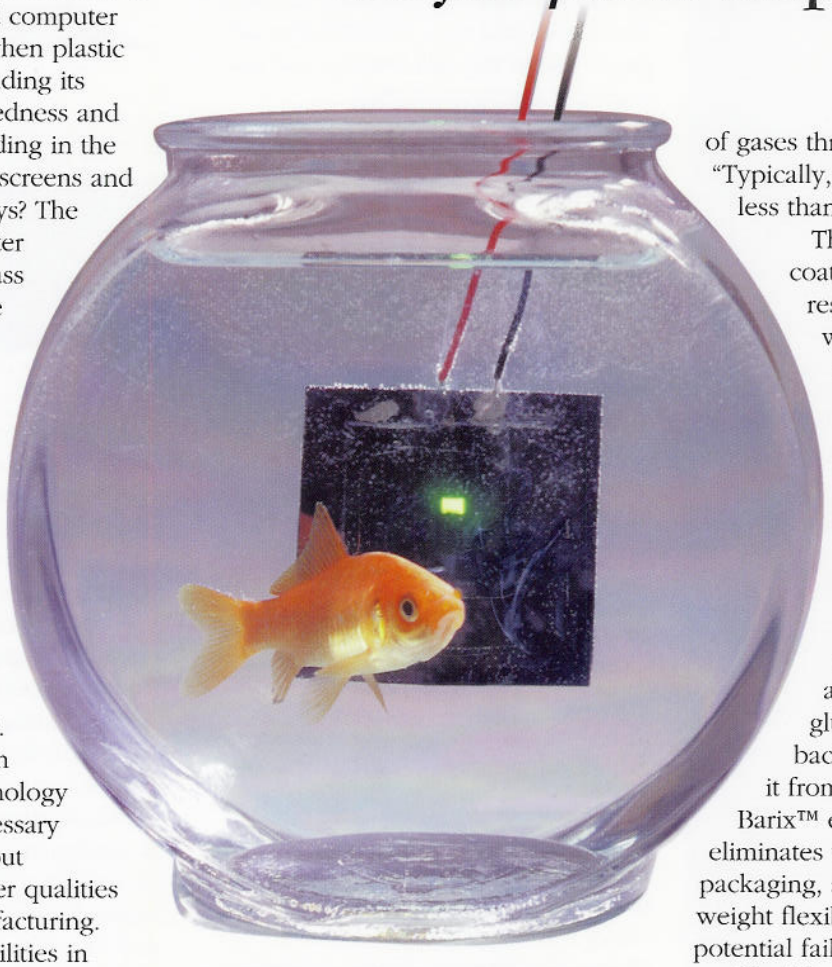
Why are the electronic displays in cell phones, watches and computer monitors built on glass when plastic is ripe with benefits including its thinness, flexibility, ruggedness and light weight? What's standing in the way of roll-up computer screens and other new flexible displays? The major obstacle is that water vapor and oxygen can pass through plastic and cause harm to sensitive display devices—until now.

Researchers at Pacific Northwest National Laboratory have found a way to make plastic virtually impermeable, which may allow plastics to replace glass in electronic displays and meet the demanding needs of new display technologies.

They've developed an ultra barrier coating technology that gives plastic the necessary levels of protection without affecting its clarity or other qualities needed for display manufacturing. Pacific Northwest's capabilities in advanced materials development and film coating technologies, as well as its vapor deposition expertise, underpin these new ultra barrier coating technologies.

"We've created engineered substrates that we call Flexible Glass™ because they offer the display industry the best of both worlds—the flexibility of plastic and barrier protection approaching that of glass," said Gordon Graff, who works in Pacific Northwest's materials resources group.

The superior barrier qualities of the coating technology are achieved by depositing multiple layers of organic and inorganic materials in stacks during a single vacuum process. The stacks include a unique smoothing layer that helps cover surface flaws and prevent defects in the extremely thin coating layers.



Pacific Northwest National Laboratory's Ultra Barrier Coatings for Flat Panel Displays protect this Organic Light Emitting Device (OLED) test unit from moisture. Without the coating, just the moisture in the air would cause this extremely sensitive device to fail in a matter of days. This coated test unit has survived eight months of exposure to air and continues to function while being completely submerged in water.

"The stacking architecture allows each layer to help protect against defects in the adjacent layers, which significantly lowers the permeation rate of gases through the film," Graff said. "Typically, the total barrier stack is less than 10 microns thick."

The same ultra barrier coating technology has resulted in a second product, which involves depositing the thin protective coating directly on next-generation emissive displays such as Organic Light Emitting Diodes. In conventional OLED display manufacturing, the display is built on a rigid substrate such as glass and then a metal "lid" is glued or soldered on the back of the display to seal it from the atmosphere. The Barix™ encapsulation coating eliminates the need for this bulky packaging, allowing for thin, lightweight flexible displays and stopping potential failures at seams and joints.

Flexible Glass substrates and Barix encapsulation can be used separately or together. Their levels of protection and flexibility could prove valuable in any application needing lightweight, conformal or unbreakable displays.

Battelle, which operates Pacific Northwest for the U.S. Department of Energy, created a subsidiary to commercialize these products. Vitex Systems, Inc. was established in November 1999 and is already working with more than 45 companies to develop display products and devices. ●

NOTABLE Achievements

Madia named *Director of the Year* for technology transfer efforts

The Federal Laboratory Consortium named Bill Madia, former director of Pacific Northwest National Laboratory, as a Laboratory Director of the Year.

Each year, the FLC's National Advisory Council honors one or more laboratory directors who have promoted the transfer of technology from the federal laboratory system to industry. Madia shares the honor this year with three colleagues who represent Department of Energy, National Aeronautics and Space Administration and Department of Agriculture facilities.

Madia served as Pacific Northwest director from August 1994 until November 1999. On April 1, he began serving as director of DOE's Oak Ridge National Laboratory, which will be managed by Battelle and the University of Tennessee.

While at Pacific Northwest, Madia established valuable ties with industry and launched the Laboratory's Economic Development Office, a central resource for technology transfer programs. These economic development efforts resulted in the creation of 42 local businesses in 40 months, including a spin-off company that has commercialized a conversion technology for treating solid wastes.

Programs initiated under Madia's tenure also allow staff members to pursue entrepreneurial interests while maintaining employee benefits, such as insurance coverage; provide technical assistance to companies relocating to the area; and offer new businesses access to facilities with state-of-the-art laboratories and equipment.

Technology on the move

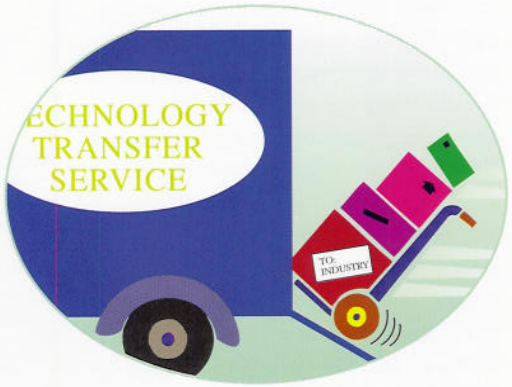
Society can benefit when scientific discoveries and new technologies are put to use in the real world—and not stuck on a laboratory shelf.

The Federal Laboratory Consortium honored Pacific Northwest National Laboratory this year with three awards for moving technology out of the laboratory and into the marketplace. Each year the FLC, a nationwide network with more than 600 laboratories and 16 federal agencies, presents up to 30 awards for excellence in technology transfer from federal laboratories to the public and private sectors.

Pacific Northwest continues to lead the other national laboratories with a total of 44 awards earned since the FLC established the program in 1984.

The three newest awards recognize efforts to move superplastic forming, molecular science software and plasma enhanced melter technology into the hands of industry.

- New understanding and optimization of the **superplastic forming process** for aluminum alloys was transferred to General Motors Corporation, MARC Analysis and Kaiser Aluminum. The integrated approach yields accurate models that have dramatically reduced the forming time of complex parts, making the traditionally slow process attractive and practical for higher volume manufacturing.
- **Molecular Science Software Suite (MS^3)** is the first general-purpose software that provides access to high-performance, massively parallel computers for a broad range of chemists on a broad range of applications. Already in use by more than 37 universities and supercomputing centers, 14 national laboratories and federal agencies and 15 industries, this suite of tools can enable quick and cost-effective solutions to complex chemical problems encountered in the environment and in the chemical processing and pharmaceutical industries.



- The commercialization of the **plasma enhanced melter** represents the integration of two waste conversion technologies that were developed separately with funding from the U.S. Department of Energy. Researchers at Pacific Northwest teamed up with Massachusetts Institute of Technology to develop a direct current arc plasma melter for treating DOE's radioactive and mixed hazardous wastes.

A novel concept for merging the best features of MIT's direct current arc plasma furnace and the alternating current heated waste melter technologies developed at Pacific Northwest evolved from this successful partnership. The result is a plasma enhanced melter that efficiently treats a much wider range of waste materials than conventional options. It produces a highly inert waste form and many useful byproducts while avoiding the environmental problems that have plagued incineration facilities.

Pacific Northwest scientist *named* *Battelle* Inventor of the Year

Richard D. Smith, an analytical biochemist at Pacific Northwest National Laboratory, was named Battelle Inventor of the Year in March. Battelle, which operates Pacific Northwest for the U.S. Department of Energy, established this award to honor employees nationwide whose outstanding career achievements and creativity have contributed to the company's success.

Smith is recognized as an international expert in mass spectrometry and separation techniques. During his career he has been issued 14 patents, received six R&D 100 awards for significant technology advancements and one Federal Laboratory Consortium Award for technology transfer.

One of Smith's most recent accomplishments is the development of the electrodynamic ion funnel. This device prevents ions in a sample from becoming lost as they're transferred into mass spectrometers, making these instruments that weigh atoms and molecules 10 to 80 times more sensitive.

In September 1999, *R&D Magazine* recognized a technology that Smith and colleague Harold Udseth invented in the late 1980s as one of the top 40 technologies of all time. Capillary electrophoresis mass spectrometry greatly advanced mass spectral analysis techniques. It allowed chemicals and biological samples to be analyzed at levels that were previously not measurable and is now being used in a range of clinical, health and environmental monitoring areas. ●

Scientist goes for the *gold*

Pacific Northwest National Laboratory scientist Jean Futrell learned that athletes aren't the only people who win gold medals for performances of a lifetime. In February, he received the prestigious Erwin Schrödinger Gold Medal for his achievements in the field of mass spectrometry.

Futrell, director of the William R. Wiley Environmental Molecular Sciences Laboratory, was presented with the international award at the Symposium on Atomic and Surface Physics in Folgaria, Italy. The International Scientific Committee selected Futrell in recognition of his contributions to the field of mass spectrometry and its applications to ion-molecule reactions.

The gold medal award for outstanding scientific achievement was established in 1992. It was named for Erwin Schrödinger, an Austrian physicist who developed some of the most important principles of quantum mechanics. ●

Science of doing business

Smoothing the *road* to success

Pacific Northwest assists start-up skin-care business

When Dr. Robert Hopp started thinking about launching his own line of skin-care products, he recognized that there were some areas where he might need some help.

Pacific Northwest National Laboratory is in the same Southeastern Washington community he calls home for both his family and his dermatology practice, so he found technical and marketing resources right in his own backyard.

For starters, Hopp's company, Virion, is occupying about 1,400 square feet in the Applied Process Engineering Laboratory. Pacific Northwest is one of several local partners in this permitted, state-of-the-art center for start-up technology businesses. With engineering and manufacturing-scale space and wet labs, the facility also has the necessary clean room where Virion's products are manufactured and packaged.

Hopp understood the need for products that don't contain ingredients such as fragrances and preservatives that irritate sensitive skin. He's quick to cite that 14 percent of the population is allergic to fragrances and that contact dermatitis, or skin allergies, is the second highest cause of employee disability in the United States.

In pursuing his ideas for new products, Hopp asked Pacific Northwest for help setting up a microbiology laboratory to test products for quality control. A scientist calibrated a specialized piece of equipment that does high-performance liquid chromatography for chemistry testing and ensured that it was working properly. A researcher from the Polymer Chemistry Department also investigated the use of a Kynar coating on the mixing blade used to blend ingredients.

"This is an example of the transfer of federal technology and technical expertise to the private sector," said Gary Spanner, who leads Pacific Northwest's economic development activities. "Pacific Northwest is a useful place to get help in technology commercialization, even if it's not our invention."

Hopp's business even received investment financing as a result of Pacific Northwest's economic development efforts. Virion was among start-up businesses featured at an investor forum that Pacific Northwest hosted for private investors.

After only four months on the market, Virion's first three specialized products—Skin Quencher™, Baby's Bottom™ and LipDoc™—were already available in more than 15 retail stores in Washington and Oregon. They contain no fragrances, no preservatives and no chemical additives to react with skin.

The products embrace the benefits of Plastibase®, a product prescribed by dermatologists to treat sensitive skin that also serves as the base for pharmacists to mix with other medicinal ingredients. While Plastibase requires a prescription and is only distributed to pharmacists in bulk, Virion's products are available in consumer-sized packages and without a prescription.

Four more related products will be available before the end of 2000 and another exciting development may lie ahead. Over the last five years Hopp has received and continues to receive a wide range of support from Pacific Northwest on a promising new treatment for warts. This longer-term project will require clinical trials and FDA approval before hitting the marketplace. ●

Researchers "doctoring up" *cotton* bandages

A Band-Aid might be enough to make tears disappear when a young child skins his knee, but a better solution may lie ahead for two million Americans who suffer from chronic wounds.

Researchers at Pacific Northwest National Laboratory are working with the U.S. Department of Agriculture and Virginia Commonwealth University's Medical College of Virginia Hospitals to alter cotton gauze to enhance healing.

Instead of focusing directly on mending wounds, this research centers on eliminating what may be preventing wounds from healing.

Studies show a link between non-healing wounds and elevated levels of elastase, an enzyme that degrades proteins needed for tissue repair. This association prompted researchers to investigate modifying cotton so that it would remove the enzyme while retaining qualities such as absorbency and air permeability that are needed for bandages.

In one approach researchers bound a particular peptide to the surface of the cotton. The peptide serves as a "recognition site" for elastase, absorbing the enzyme away from the wound. According to Steve Goheen in Pacific Northwest's analytical chemistry group, the challenge is to determine how to remove the enzymes that cause harm while leaving others that are needed for healing.

Goheen studied how proteins adhered to different samples of modified cotton gauze during this project. Previously, he was researching how the three proteins in blood plasma bind to solid materials. Building this knowledge about blood clotting could eventually lead to compatible biomaterials that could be used to repair heart valves and arteries, for example.

"The altered cotton bandages may be a more immediate application of our techniques," Goheen said. "Biomaterials and biocompatibility are further down the road."

Initial lab tests of the modified bandages were successful. They will enter clinical trials on patients at Medical College of Virginia Hospitals this year. The USDA has funded the bandage research to date.

Pacific Northwest is seeking funding from other organizations to learn more about protein binding. In addition to significant advances in the field of medicine, Goheen gave two examples of seemingly unrelated applications for this basic research—environmental cleanup and ship maintenance.

In the area of environmental cleanup, finding more about how bacteria adhere to soils could further the use of soil components to help convert organic materials during bioremediation. More information about the process of protein adhesion and recognition also could reveal how immature barnacles attach to ship hulls. By studying this process, it may be possible to develop ways to minimize the interaction and address a concern for the shipping industry. ●

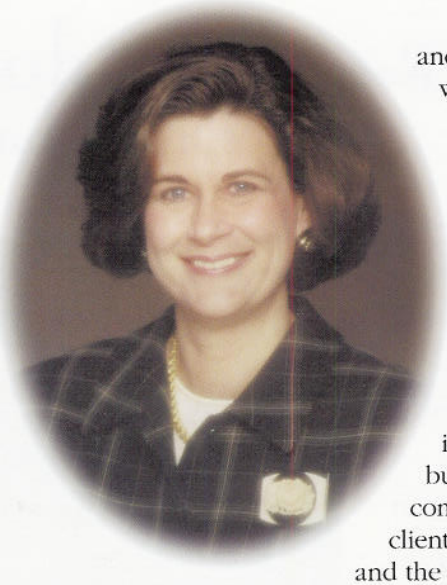
Chronic wounds often affect diabetics and those confined to beds or wheelchairs. Related complications lead to more than 60,000 amputations in diabetics each year.

New lab director *takes* the helm

Lura J. Powell became the Director of Pacific Northwest National Laboratory on April 1. Before joining the laboratory, Powell served as Director of the Advanced Technology Program for the National Institute of Standards and Technology.

In that role, she was responsible for the selection and management of a technology investment portfolio exceeding $2 billion across the full range of technology sectors, including biotechnology, information technology, electronics, manufacturing materials and chemicals.

"Lura Powell is an excellent choice to lead this great national laboratory," said Douglas E. Olesen, president and CEO of Battelle, which manages Pacific Northwest for the U.S. Department of Energy. "She has a national reputation in the management of large research and development organizations and a strong track record in advanced technology, investment, strategic business planning and communications with staff, clients, Congressional leaders and the general public."



"Science and technology is the foundation of the Energy Department's work, and Dr. Powell's selection to head the Pacific Northwest National Laboratory underscores a commitment to keep our national labs at the cutting edge. This is a forward-looking choice—one that is right in sync with the Department's efforts to provide innovative solutions to the national security, energy, and environmental challenges facing our nation."

—Energy Secretary Bill Richardson

In addition to serving 28 years at NIST, Powell has operated her own technology consulting business. She is active in numerous science, professional and community organizations and has served on the boards of the American Chemical Society and on the National Institutes of Health's Women's Health Initiative Advisory Committee.

Powell replaces Bill Madia who is now Corporate Executive Vice President at Battelle and began his new role as director of Oak Ridge National Laboratory on April 1. ●

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