Sandia experimental package of piezoelectric films to be part of NASA space station experiment

Team led by Mat Celina spent the past three years researching the films

MAT CELINA displays the piezoelectric polymer films that will be tested on an upcoming Materials International Space Station Experiment. (Photo by Randy Montoya)

By Chris Burroughs

For the past three years a Sandia research team headed by Mat Celina (1821) has been investigating the performance of various piezoelectric polymer films that might one day serve as ultra-light mirrors in space telescopes.

In 2007 the research will go one step further when a Labs' experimental package of promising polymers will be part of a NASA experiment on the upcoming Materials International Space Station Experiment (MISSE-6) to be launched into low Earth orbit (LEO).

"This will be the first time these polymers will be remotely operated in an actual space environment," Mat says. "We hope to learn which polymer materials will work best in space. The materials will boldly go where they have not been before."

Sandia delivered the package to NASA in May, and it will become one of many polymer performance experiments conducted on MISSE-6.

Lightweight piezoelectric polymers based on polyvinylidene fluoride (PVDF) and its copolymers expand and change shape when an electric field is applied. They have not been used much in space because they degrade when exposed to the conditions of LEO, such as atomic oxygen, solar UV (ultraviolet), and temperature variations.

To be successful as space mirrors, the polymer films, which would be covered with a metallic coating, will have to be able to survive the rigors of space.

Space telescopes equipped with piezoelectric polymer films will be quite different from the Hubble, which was deployed into orbit in 1990 and uses the traditional polished glass mirror approach, and the James Webb Space Telescope scheduled for launch in 2013, which will be made of 18 beryllium mirror segments. Instead, the new polymer film mirrors would be

(Continued on page 4)

Sandia LabNews

Vol. 58, No. 16 August 4, 2006

Managed by Lockheed Martin for the National Nuclear Security Administration

Sandia National Laboratories

Michael Dell visits Sandia, signs plaque with Labs President Tom Hunter

Agreement details cooperation between Labs, computer company

By Neal Singer

Michael Dell, chairman of Dell Corporation who in 1992 became the youngest CEO of any company listed on the Fortune 500, visited Sandia last Friday to tour Sandia's Dell Thunderbird supercomputer and sign a commemorative plaque with Laboratories Director and President Tom Hunter.

Crowning the success of Dell's entry with Sandia into the supercomputer market, the Sandia Dell Thunderbird is currently the sixth fastest supercomputer in the world on the widely accepted Linpac test. At its $15.2 million price tag, it is the cheapest per flop of any general-purpose supercomputer of its scale anywhere.

The signing took place in the Visualization facility at JCEL (the Joint Computational Engineering Lab). Tom and Dell spoke briefly on what supercomputing will mean to US industrial competitiveness and national security in terms of transforming engineering and science.

SANDIA PRESIDENT TOM HUNTER and Dell CEO Michael Dell tour the 8,960-processor Thunderbird cluster during Dell's visit last week. (Photo by Bill Doty)

"This has been a truly remarkable partnership. I look at success in many ways, but this one has been outstanding. Leaders look at today's norms and say, 'tomorrow must be different.' This project shows that we are doing that with Michael Dell, who has helped shape the way the world is thinking about information technology," Tom said.

Sometimes referred to as the "Henry Ford of computers" for his success in bringing a technological product to market, Dell said, "All the great problems in physics, chemistry, and biology are really computational problems. We now have a great amount of computational

(Continued on page 5)

Mim John reflects on her time as Division 8000 vice president

MIM JOHN

After 28 years at Sandia, 8000 Division Vice President Mim John has announced she will retire and leave her office Aug. 31. Read about her career at the California site — which she has headed for the past seven years — and her view of the future in *Lab News* reporter Nancy Garcia's interview with Mim on **pages 6 and 7**.

The elite cyber defenders of Sandia

Making cyberspace safer

By Darrick Hurst

When you first enter Sandia's nationally recognized Center for Cyber Defenders — known as the CCD — you may find yourself wondering if you've inadvertently stepped into a university's computer science lab.

As it turns out, the collaborative peer-learning environment of college is exactly the concept behind the Cyber Defenders program.

The large room, buzzing with the activity of students and the hum of computer workstations, is the place students of the Cyber Defenders program call home.

Ryan Custer (5616), now a full-time Sandia employee, was one of the nearly 90 students who have participated in the CCD to date. The teams of students have developed a reputation for their remarkable speed and effectiveness in completing projects — a direct result of their ability to

(Continued on page 4)

What's what

Dealing with — even peripherally — the weapons that are Sandia's *raison d'être* and living in a 24-hours-a-day news cycle filled with reports of earthquakes, tsunamis, hurricanes, volcanoes, tornadoes, wildfires, and other cataclysmic natural phenomena, we are at once awed and jaded about the forces of nature.

Lightning certainly falls into that category. And at the height of the summer season, New Mexico has been treated to an ongoing lightning show over the past few weeks. (Our California colleagues are just withering in higher-than-usual heat — no lightning or thunderstorms.) While we're grateful for the summer rains and fascinated by the flashing and crackling displays — particularly at night — most of us also feel a little edgy while it's going on.

According to figures compiled for a story about lightning in the June 30 issue of *OCALA Magazine*, on average, lightning strikes somewhere in the world about 100 times each second, and about 20 million times a year in the US alone. And in reporting about the deaths of two New Jersey teens struck by lightning in July, CBS News cited National Weather Service statistics in reporting that, "Over the past 30 years, lightning killed an average of 67 people annually in the US, based on documented cases. That's more than the average of 65 deaths per year caused by tornadoes and 16 from hurricanes."

Lightning is truly awesome, as were its namesake fighter aircraft the twin-engine, twin-boom Lockheed P-38 of World War II and the swept-wing British jet of the Cold War era. And obviously evoking the famed performance of those warplanes from the past, the Air Force announced July 7 that the Lockheed Martin F-35 Joint Strike Fighter will be called the *Lightning II*.

Awesome as it is, and certainly not to be trifled with, lightning also gets light treatment now and then. U2 lead singer Bono was once seated on a plane next to legendary beauty Sophia Loren, who became visibly shaken when the plane was hit by lightning and lost its lights and radar. Bono reportedly leaned over and said soothingly, "God must have been taking a picture of you!"

In October 2003 while Mel Gibson's *The Passion of the Christ* was being filmed, there was a strike close to James Caviezel, the actor portraying Jesus. Producer Steve McEveety said later, "I'm about a hundred feet away from them when I glance over and see lightning coming out of Caviezel's ears!" And Caviezel recalled, "On film, you see this flash; then the camera pans, and there I am with my (shoulder-length) hair sticking straight up!"

On a lighter note, in "Why Can't the English?" from the musical *My Fair Lady*, Professor Henry Higgins laments the failure of the English to learn their own language, singing,

Arabians learn Arabian with the speed of summer lightning.
And Hebrews learn it backwards, which is absolutely frightening.

And in a couple of well-known treatments, Mark Twain noted:

— "The difference between the right word and the almost right word is the difference between lightning and a lightning bug," and

— "Thunder is good, thunder is impressive, but it is lightning that does the work."

For more on lightning and staying safe around it, be sure to catch Iris Aboytes' story on page 12.

— Howard Kercheval (844-7842, MS 0165, hckerch@sandia.gov)

EMCORE, Sandia sign agreement for the development of PV power systems

EMCORE Corporation and Sandia have signed a contract authorizing the Labs to provide technical support for EMCORE's terrestrial solar systems products.

Sandia has worked for more than 25 years in the development of photovoltaics for grid-tied, utility-scale power generation.

About the arrangement, Jeff Nelson, manager of Sandia's Solar Technologies Dept. 6218, says, "We are happy to work with EMCORE on these programs. Sandia has worked for many years on the development of solar power. EMCORE, with its advanced solar cell technology, provides an excellent path for the commercialization of this technology."

EMCORE CEO Reuben Richards concurred.

"EMCORE is the leading supplier of GaAs, multi-junction solar cell technology for application in satellite systems," he says. "Our company is using this state-of-the-art solar cell technology as a base for the development of large-scale, terrestrial photovoltaic power systems."

He adds that "Sandia has long been a valuable partner in technology development for EMCORE. We look forward to their contributions to our program in the terrestrial power systems over several phases."

In the first phase, Sandia will contribute to the design of the mechanical structure, solar tracking system, and DC-to-AC voltage inverters for EMCORE's first-generation systems that will be ideal for systems up to 10 megawatts of power.

In subsequent phases, Sandia will team with EMCORE to develop larger-scale systems targeted for up to 100 megawatt power stations at less than a $2-per-watt cost."

EMCORE is a leading provider of compound semiconductor-based components and subsystems for the broadband, fiber optic, satellite, and wireless communications markets.

Sandia staff members working on the project include: Sigifredo Gonzalez (6216), Greg Kolb (6216), David King (6216), Jay Kratochvil (6216), Chuck Andraka (6218), Rich Diver (6218), Cheryl Ghanbari (6218), Jimmy Lloyd (6218), Tom Mancini (6218), Doug Ruby (6218), Michael Quintana (6218), Subhash Shinde (17152), and Dahwey Chu (1715-1).

Sandia LabNews

Sandia National Laboratories

http://www.sandia.gov/LabNews

Albuquerque, New Mexico 87185-0165
Livermore, California 94550-0969
Tonopah, Nevada • Nevada Test Site • Amarillo, Texas •
Carlsbad, New Mexico • Washington, D.C.

Sandia National Laboratories is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin company, for the US Department of Energy's National Nuclear Security Administration.

Bill Murphy, Editor 505/845-0845
Chris Burroughs, Writer 505/844-0948
Randy Montoya, Photographer 505/844-5605
Nancy Garcia, California site contact 925/294-2932

Contributors: Janet Carpenter (844-7841), John German (844-5199), Neal Singer (845-7078), Stephanie Holinka (284-9227), Howard Kercheval (columnist, 844-7842), Will Keener (844-1690), Iris Aboytes (844-2282), Michael Padilla (284-5325), Julie Hall (284-7761), Rod Geer (844-6601), Michael Lanigan (844-2297), and Michelle Fleming (Ads, Milepost photos, 844-4902), Darrick Hurst (intern, 844-8009). Dept. 3651 Manager: Chris Miller (844-0587).

Lab News fax 505/844-0645
Classified ads 505/844-4902

Published on alternate Fridays by Media Relations and Employee Communications Dept. 3651, MS 0165

LOCKHEED MARTIN

Lab News Reader Service

The *Sandia Lab News* is distributed in-house to all Sandia employees and on-site contractors and mailed to all Sandia retirees. It is also mailed to individuals in industry, government, academia, nonprofit organizations, media, and private life who request it.

Retirees (only):

To notify of changes in address, contact Benefits Dept. 3332, Customer Service, at 505-844-4237, or Mail Stop 1021, Sandia National Laboratories, Albuquerque, NM 87185-1021.

Others:

To receive the *Lab News* or to change the address (except retirees), contact Michelle Fleming, Media Relations and Communications Dept. 3651, 505-844-4902, e-mail meflemi@sandia.gov, or Mail Stop 0165, Sandia National Laboratories, Albuquerque, NM 87185-0165.

Employees:

To change the number of copies of the *Lab News* your mail stop is receiving please call Honario Anaya, Mail Services Team 10268-4, at 844-3796. At Sandia/California contact the Mail Room at 294-2427.

Web users:

The *Lab News* is on the Web at www.sandia.gov/LabNews.

Retiree deaths

Robert P. Gall (age 85) . . . . . May 31
Jack W. Labrier (77) . . . . . June 2
Otis L. Wright (93) . . . . . June 4
Curtis H. Cofield (61) . . . . . June 8
Hugh L. O'Dell (90) . . . . . June 8
H. Ray Sheppard (80) . . . . . June 12
William E. Stockum (71) . . . . . June 14
Stephen A. Winters (65) . . . . . June 14
James H. Lindell (81) . . . . . June 15
Bobbye J. Goodman (78) . . . . . June 15
Frederick D. Brown (84) . . . . . June 17
Ira D. Hamilton (67) . . . . . June 19
John H. Gieske (67) . . . . . June 19
Herschel W. Rogers (79) . . . . . June 19
Florence E. Wicke (86) . . . . . June 20
Hyder B. Burress (94) . . . . . June 29
Edward J. Peterson (82) . . . . . June 29

Sandia News Brief

New free version of Sandia DAKOTA software available

A software toolkit created at Sandia to help designers answer design questions and assist engineers in designing anything from components to sophisticated systems, DAKOTA version 4.0, can be downloaded for free. More information: http://endo.sandia.gov/DAKOTA/

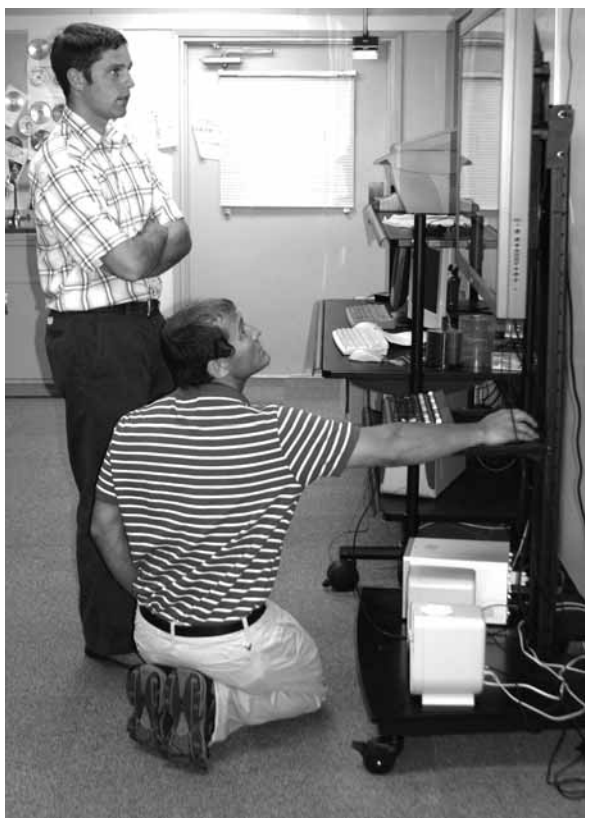
DHS official visits cyber security scholars and fellows interning in Livermore

By Nancy Garcia

Laura Petonito, manager of the Department of Homeland Security Scholars and Fellows program, is already a true believer in Sandia's Center for Cyber Defenders program, having hired one of its former interns — who now has a master's in technology policy from MIT — to study the impact and outcome of technology transition from the DHS Centers of Excellence.

At the end of a day-long visit to both national laboratories in Livermore on July 26, she spent nearly an hour being briefed by several cyber security interns. (She had to miss a second stop involving bioscience to catch a flight out that evening.)

The DHS scholarship began in 2003 and now supports about 250 undergraduate and graduate students annually. Ten of those students have interned in the Cyber Defenders program, including two this year at the California site, according to their head mentor Steve Hurd (8941).



OVERVIEW – Levi Lloyd (8941), left, and Josh Governale, prepare a presentation for the visit by Department of Homeland Security scholars and fellows.

In the briefing, Kevin Fairbanks, a DHS fellow and PhD student at the Georgia Institute of Technology, presented a couple of research projects, along with interns Danny Lungstrom and Scott Coull, that offer unique ways to spot otherwise cryptic potential cyber attacks — so that Steve characterized the work as being able to "spot the stilettos in the haystack."

Josh Governale, a DHS scholar entering his senior year at the University of Alaska in Fairbanks, presented work on an experimental test bed and testing of collaborative systems for vulnerabilities, with interns Ian Oberst and Nick Kosmas.

SECURITY-MINDED – Kevin Fairbanks presents an information-security research topic to, from left to right, Patty Hsieh of DHS, Steve Hurd, and Laura Petonito. Between Steve Hurd and Laura Petonito is Jill Hruby. (Photos by Bud Pelletier)

"There are a lot of interesting challenges," Petonito said, asking if they liked working in a national laboratory environment. Josh responded that the emphasis on security issues has been a good learning experience for applying his classroom education.

"These stellar scholars and fellows are noteworthy for their academic and professional potential that is being honed through training with the national laboratories that will prepare them to address pressing homeland defense needs in their future careers," said Kelly Nykodym, team lead, student programs, Recruiting, Staffing, and University Partnerships Dept. 8524.

The interns' work has already made an impact, stimulating new thinking through presentations at research conferences and drawing attention of other visitors over the summer, Steve added. The 15 California-based Cyber Defender interns have been visited in recent weeks by representatives of the computer-security solutions provider Symantec, Sandia Chief Information Officer Ken Washington, and Mim John, vice president of Division 8000.

Overall, Sandia has 14 DHS scholars and fellows this year. For more information about the program, see: http://www.orau.gov/dhsed/.

Sandia CaliforniaNews

Feedback

Q: *Why is CNN the only source of news for the various TV monitors placed throughout the corporation? For the sake of equal time, why not Fox News?*

A: We have an agreement with CNN to broadcast its signal to the video monitors for no fee. We are fortunate to have such an arrangement, as it is standard practice to charge a fee based upon the number of monitors that carry the signal. We recognize that there is no single news network that will please everyone, so we have made our choice based upon the desire to be fiscally responsible. *— Judy Hubbard (3653)*

* * *

Q: *I work in a Property Protection Area, and until recently, we have been allowed to bring personal cell phones in our building. This is permitted under Sandia's current policy.*

However, recently our director has imposed a more stringent policy and now prohibits them. There is a sign posted near the entrance to the building that states, "Employees and customers — no cell phones allowed in the building."

However, all day long Sandia suppliers are making deliveries to the building, and I would guess that almost all of them are carrying a cell phone. Some of them may also be making deliveries to other buildings at Sandia. Shouldn't we have the rules uniformly enforced for all people in our Property Protection Area? Also, if I observe someone in violation of this policy should I report it? And if so, to whom? I wouldn't feel comfortable approaching the individual.

A: Due to the fact that most cellular phones on the commercial market now have cameras built in, and with OPSEC concerns rising, many departments and divisions are taking precautionary steps to protect assets by banning cellular phones from their areas. This is becoming more prevalent throughout Sandia. You are quite right to raise a security question about visitors and vendors who may not be familiar with Sandia policies and who may not have observed the new signs or be aware of the restrictions.

The vendors who have permission to bring a company vehicle into the limited areas should have been briefed by their Sandia host (whether by Purchasing or a department manager) regarding their security responsibilities. If they have a company cellular phone, it should be registered with Technical Surveillance Countermeasures Org. 301-1 and they will receive a card to carry with the phone while they are in the limited areas. These phones will have the same feature restrictions Sandia phones have; i.e., no cameras and no PDA combinations. These phones are not authorized to leave the company vehicles, however, and should remain turned off while in the limited areas.

Those vendors who do not enter the limited areas may not receive a Sandia-specific security briefing, other than a general overview of security on Kirtland Air Force Base. They may be unaware that your area has a concern with electronic devices such as camera cell phones. The vendors may in fact welcome a friendly reminder, or a simple heads-up message regarding the change in security status of your area. If you are uncomfortable approaching the individuals but you still would like to raise the issue with the vendors' companies, there are several avenues open. One is to contact the buyer who works with the vendor company and ask the buyer to speak with the person who is in charge of the folks who come to Sandia and remind them to be aware of rules and restrictions regarding your areas. Another is to ask your manager to speak with the individuals who are causing you concern. Another option is to report the observation to the Security Incident Management Program (540-2382), who may be able to assist you with an immediate concern even in the Property Protection Areas. Finally, the Security Education and Awareness Lessons Learned (SEALL, Charles Montoya, 4232) team gives security briefings to contracting vendors in an annual forum. We are sure they would be willing to include this concern as part of their annual forum.

Again, thank you for your question and your concern that everyone at Sandia, not just employees, should be informed of the information security policies that are always evolving.

— Paul Linke (301-1)

Cyber

(Continued from page 1)

instantly consult with their peers, says Ryan.

"If there's something you don't know the answer to, if there's some code you're unfamiliar with," says Ryan, "all you have to do is shout out, 'Hey, what do you know about this?' and you're guaranteed to get at least a few knowledgeable people right there helping you."

While a student with the CCD, Ryan collaborated with fellow student Erik Lee (5616, now also a Sandian) to design a suite of tools that presents a human with a way to visualize events as they occur on a network. Together, Ryan and Erik developed a variety of ways to visually interpret the huge amounts of information flying across a network. By using these visualization tools, an operator can watch a detailed, real-time representation of a network, and thereby gain insights into the behaviors of that network.

This is a valuable tool because the human brain cannot quickly or easily interpret the massive amounts of data created by a network. As a result, nearly all network analysis, particularly intrusion detection, had to be done "post-mortem" and was time-consuming. Now, with these tools, a grouping of spheres and lines traveling across different planes of view represent ports and connections — views that make use of the rapid visual processing capabilities of the human brain — and can give instant feedback about a malicious distributed denial-of-service attack on a network, or a scan of network ports.

A STUDENT at the CCD Cyber Security Bootcamp concentrates on the delicate task of building her own network cable.

Through projects like this, the CCD is making significant advances in network security.

"Our goal is to address homeland and national security needs while providing a way for students who are interested in information assurance to be exposed to the challenges of those needs while in a research environment," says program manager Bob Hutchinson (5616). "We looked at the caliber of students coming out of colleges, and how well-versed they were in today's computer sciences, and thought to ourselves, 'There really isn't anyone more qualified than these people to take on the emerging challenges facing our technology.'"

SANDIAN AND FORMER CCD STUDENT Ryan Custer demonstrates a visualization of a network port scan generated by a suite of tools he designed in collaboration with Erik Lee. (CCD photos by Karen Shanklin)

As a result, the CCD currently employs nearly 20 students who represent the most knowledgeable and passionate students of those in their field. The mentors and staff of the Cyber Defender program have developed a unique environment that provides students from varied computer backgrounds with cutting-edge research projects while instilling them with new skills.

"By providing a collaborative pool for these students, they are able to solve the challenges presented to them incredibly efficiently and effectively," says Bob.

The CCD has actually provided such a strong talent pool to Sandia that nearly a quarter of the students who participate in an internship with the program go on to be hired as employees by the Labs. Additionally, the work performed by CCD students has gone on to reshape the computer science curriculum at several universities across the nation.

"People may not realize how much we learn from these students, as well," says Bob. "We're here mentoring them, but so many times we hear back from people who have worked with our students as mentors on projects and have come away having learned more from the student than they had ever expected."

Cyber Defenders roots

The Cyber Defenders program began in 1998 at Sandia/California as a collaboration between the DOE Defense Program's Education Department, faculty members at Las Positas and Chabot Colleges, and Sandia information security experts.

Today, the program spans both Sandia sites and employs between 20 and 30 students each year in a wide variety of information technology, information protection, and distributed computing projects.

Since the program's creation, participants have racked up an impressive record of accomplishments that includes creating a database of known attack techniques and defense methods, analyzing hundreds of published attack techniques gleaned from Internet sites, and building prototype networks that demonstrate concepts now being used in cyber-infrastructure protection at Sandia.

The projects that the students take on come from a variety of places within Sandia. Through collaborative projects in digital forensics, supercomputers, and safeguards and security, the CCD has contributed to a broad range of work at the Labs.

"It has been rewarding to watch the CCD grow and evolve," says Bob. "It's really become an asset to the entire laboratory."

Boot camp beginning

This year also marked the first pilot run of the CCD Cyber Security Boot Camp. The boot camp is a three-day, hands-on program designed to cultivate interest in computer science at the high school level.

In the inaugural run of the boot camp, six high school freshmen participated in a series of skill-building computer projects. The events began with an overview of how computers work, leading to a course during which students built their own computer from the ground up and then loaded an operating system onto their freshly built machines.

Over the remaining days of the boot camp, the students learned how to choose secure passwords, create their own network cables, and "ping" a computer to determine whether a specific Internet protocol (IP) address is accessible. Before wrapping up, the CCD gave the students a thorough explanation about how viruses, worms, trojans, and spyware take advantage of vulnerabilities to exploit, and even destroy, information on computers and the role that antivirus software and firewalls play in securing computers against such attacks.

"The kids were really amazed to see not only how capable they were of building something as complex as a computer, but also how easy it was to protect that computer against attacks through things like carefully designed passwords and antivirus programs," says program coordinator Karen Shanklin (5616). "The boot camp has proven to be a very valuable resource."

The CCD plans to offer the boot camp annually, and semiannually if demand for the program continues to grow.

Space mirrors

(Continued from page 1)

lightweight, and — because of their piezoelectric qualities — could adjust focal lengths when electrical fields are remotely applied.

"NASA and Boeing have been running experiments with polymers in space for some time," Mat says. "The space materials community first looked extensively at polymers in space in the late 1980s. They launched a large satellite, the LDEF (Long Duration Exposure Facility), and found significant polymer degradation issues. The Hubble had polymer degradation problems as well, with its thermal control blankets."

The research team spent the past three years developing and testing polymers in an effort to identify the ones that just might work best.

"We did many experiments on the ground both at Sandia and with the support of NASA-Glenn," Mat says. "We managed to do as complete a testing as possible before we put the polymer films in space. Our [former] postdoc Tim Dargaville was instrumental in conducting a comprehensive evaluation program. Many other Sandia staff with specialized equipment also assisted."

As part of the experiments the research team measured how the piezoelectric material would change in different circumstances and identified a range of materials.

The team experimented with a variety of polymers, including some that were off the shelf and others that were specially created.

After coming up with the most promising polymers, the materials were placed in a 6-inch by 6-inch sample holder designed by Gary Jones that is part of the MISSE-6 experimental package. This experimental unit will be launched as part of a larger suitcase-type container where experiments from a range of universities and other agencies will be assembled as well. Astronauts will attach the container to the International Space Station during a spacewalk and will open it inside out to expose the samples.

Depending on which side of the container the samples are located, they will either receive primarily vacuum UV (VUV) radiation or both VUV and atomic oxygen exposure. Both passive experiments, which are not hooked up to electric excitation, and active experiments, which will be connected to high voltage, will be flown, allowing for a range of experiments and materials to be tested over the course of the exposure — estimated to be six to eight months.

The degradation trends and loss in perfor-

(Continued on next page)

Sandia researchers solve mystery of attractive surfaces, work featured in *Nature*

Large issue in why some small things snap together

By Neal Singer

Researchers have been interested for at least 25 years in understanding interactions taking place underwater between materials, but stymied in their ability to observe, quantify, and explain them.

When flat water-hating surfaces approach each other underwater, scientists have observed that they snap into contact. This is due to attractive forces that extend for tens to hundreds of nanometers.

These distances are unexplainable by conventional theories, which find no naturally occurring local force strong enough to accomplish this task.

In a paper published Aug. 3 in the journal *Nature*, Sandia researchers were able to increase the distance from nanometers to microns of what may be the same interaction. The new conditions may help explain the unexpectedly long-range attractions of hydrophobic surfaces under water.

SANDIA FELLOW JEFF BRINKER sometimes enjoys bouncing water off superhydrophobic surfaces.

(Photo by Bill Doty)

One change was this: Rather than using merely smooth hydrophobic surfaces, the materials were rough superhydrophobic surfaces on which water droplets roll like marbles.

Superhydrophobic surfaces can be formed simply from a silica solution by an evaporation-driven assembly process developed by Sandia Fellow Jeff Brinker (1002).

"Previous experimentalists had always used smooth materials — but most common materials are rough, and roughness greatly influences the interaction with water," says Jeff.

The group's observations indicated that two superhydrophobic surfaces approaching each other force the water between them to change state to a vapor, creating a cavity. This cavitation event is characterized by less internal pressure that may be the cause of a very long range attractive interaction and possibly of longer-scale version of the unexplained interactions seen to date for smooth surfaces.

In addition, a microscope that resists the "snap-together" effect enabled the Brinker group to measure the forces involved as the surfaces closed upon each other.

The microscope, called an Interfacial Force Microscope, was developed at Sandia under the direction of Jack Houston (1114).

Unlike the Atomic Force Microscope, the IFM actively resists "snapping" because of a kind of teeter-totter built into its observational tip. Through this resistance, the group slowed the "snap" into a longer time frame that allowed step-by-step observation of what exactly was happening in the formerly indecipherable moment.

"When force becomes overwhelming for an AFM, surfaces snap together uncontrollably," says Jack. "The IFM just measures the force without caving in to it. We can move in as slowly as we want until we reach the point of contact."

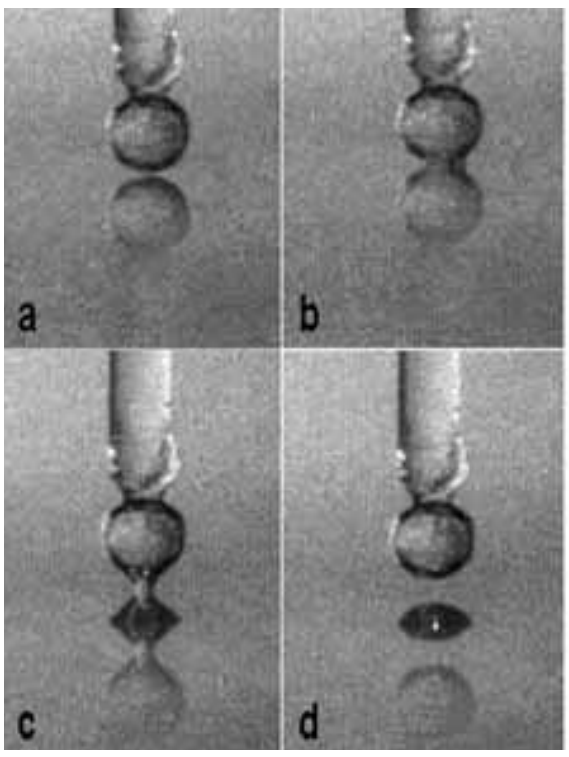
"There's no other instrument that can do that," says first author Seema Singh (1815), who did the experimental work under direction of Jack and Jeff.

"Seema Singh is a phenomenal experimentalist who really enabled all this stuff to happen," says Jeff.

Although rough superhydrophobic surfaces have been of much recent interest for their self-cleaning properties (the so-called Lotus effect, where rolling drops of water cleanse such surfaces of particles and parasites), their interactions underwater have not been studied.

The superhydrophobic material was self-assembled by simply drying a slurry of hydrophobically modified silica in a technique originally developed to create super-low-density silica aerogels. During drying, the silica gel shrinks and re-expands to create a rough rather than smooth surface. The roughness creates a spike-like effect causing a water drop to adopt an almost spherical shape. (See photo to right.)

"This greater hydrophobicity apparently increased the distance over which cavitation could occur, allowing it to be visually imaged for the first time," says Sandia researcher Frank van Swol, who calculated the theoretical cavitation distance and the energy and forces associated with cavitation. The improved observation led the group to conclude that cavitation may be responsible in general for the hydrophobic interactions that exceed the known range of van der Waals forces.



OPTICAL IMAGES OF CAVITATION — Panel A shows the tip/substrate position just prior to cavitation, which is shown ~33 msec later in Panel B. Panel C shows the cavity meniscus during tip retraction, one frame prior to its unstable collapse leaving a cavity "bubble" behind on both the tip and substrate. These bubbles, attributed to air supplied from water and the porous superhydrophobic (SH) surface, are unstable and readsorbed in approximately six seconds. In all frames the circular image at the bottom is the reflection of the spherical 150-µm diameter SH tip from the flat SH surface.

The work was funded by Sandia's Laboratory Directed Research Development (LDRD) office and then by DOE's Office of Science, and the Air Force. The paper was authored by Seema, Jack, Frank, and Jeff.

Space mirrors

(Continued from preceding page)

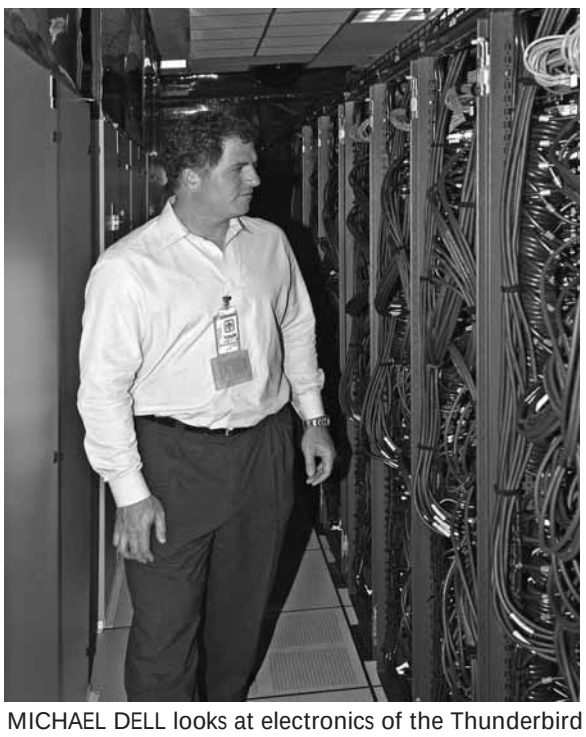
mance caused by exposure to the space elements will be monitored in real-time and logged into NASA-qualified data-loggers. When the loggers are returned to Earth, Sandia researchers will analyze the data to determine which materials were able to best survive the harsh space environment. Mat anticipates it will take at least one year to evaluate the materials and data to decide which polymers might be best suited for space mirrors.

"This work has been really interesting and a personally rewarding and challenging project," Mat says. "We've done fundamental science on the piezoelectric polymers and, once the experiment in space is completed, we'll be able to provide real scientific feedback to engineers intending to use such polymer films in space."

Michael Dell

(Continued from page 1)

power deployed at lessening institutional cost. We've done this in partnership with Sandia, using industry-standard technology. It's fascinating to me to see our product used at Sandia in the great work you're doing."



MICHAEL DELL looks at electronics of the Thunderbird cluster — designed jointly by Sandia and Dell — during his visit to Sandia last week.

(Photo by Bill Doty)

A video produced by Sandia's Regina Valenzuela (6039-1) showed the Thunderbird cluster in action. The highly original piece opened by showing a caterpillar turn into a butterfly, and then switched images to say that "the transformation from slide rule to supercomputer is as mysterious as any transformation in nature."

Preceding the pageantry of the signing, which took place late in the day, was an early morning signing of an agreement that detailed future cooperation between the Labs and the computer company.

The agreement was signed by Sandia Div. 1000 VP Rick Stulen and Dell VP Jennifer Smith.

"The extraordinary results we have obtained to date on the Dell Thunderbird cluster are representative of the future of simulation-enabled engineering. Our agreement with Dell will enable our partnership to continue to focus on the future of high-performance computing," Rick said.

One reason for the success of the 8,960-processor Thunderbird cluster — designed jointly by Sandia and Dell — is that Sandia and Dell were willing to gamble on a new "interconnect" technology that communicates between computer nodes. The interconnect, called Infiniband, had never before been deployed in a computing system of this scale or complexity. The ready availability of this now-proven component as an "off-the-shelf" commercial product may lead to an increase in the number of supercomputers worldwide by improving speed while lowering prices.

Goodbye and good luck to Mim John

Mim John looks back and forward upon her retirement as Division 8000 VP

Editor's note: After 28 years at Sandia, Division 8000 VP Mim John announced she will retire and leave her office Aug. 31. Lab News *reporter Nancy Garcia interviewed her in June about her career at the California site — which she has headed for the past seven years — and her view of the future, regarding both her prospective plans and expectations for national defense policy and the nuclear weapons complex. Photos by Ken Ball.*

***LN:** Have you been thinking at all about what you see as your legacy, or proudest accomplishments?*

MJ: I think my legacy is for other people to decide. At each step along the way, there was something that I was really pleased about. Early on it was the solar energy business. We were able to provide guidance to DOE about how to get a new technology off the ground. It was fun — real learning. It was followed by some work on weapon components. In the end, the decisions were made by the program leadership to scrap the project. It was a good example of leadership, saying that this is just not going to work, so let's stop pushing on it, and that's a hard decision for technical folks to make. You keep saying to yourself, "If we only did this, if we only did that."

MIM JOHN retires from Sandia Aug. 31 after 28 years at Sandia.

***LN:** And other things you are proud of?*

MJ: The next steps were when we were working on the Strategic Defense Initiative and the X-ray laser program. I got an opportunity to work very closely with all the weapons labs. I saw how we could build teams that were seamless, where we put the good of the program ahead of institutional concerns. That was good practice for the next job, when I got asked by [former Executive VP] John Crawford to work with Jim Wright [8200] on the W89. I'd never been in a weapons program before at that level. Jim was the most wonderful mentor. The partnership with Lawrence Livermore National Laboratory was, for many of us, absolutely one of the strongest that ever happened in the history of the valley. And the partnership with the Air Force was fantastic. It was a great teaming experience, and a great lesson in how to realize big dreams through efforts where everybody's pulling together.

In 1992 we restructured and created Center 8100 to go after new programs. Through John Vitko's [8001] leadership, we developed our work in the Atmospheric Radiation Measurement program at the DOE with our Unmanned Aerial Vehicle program, and established our presence in the chemical demilitarization program through Jack Swearengen's [ret.] single-minded efforts. We got into the chem/bio defense business, which has become the biggest part of the Labs' business with the Department of Homeland Security (DHS). We were able to convince the VPs that we needed to have grand challenges as part of the Laboratory Directed Research and Development process — the first was MicroChemLab. We were about to destroy the Tritium Research Laboratory the day that [researchers] Joe Schoeniger [8321] and Dave Rakestraw [5923] came to me and said, "We're about to get rid of a first-class chemical laboratory; why would we do that?" We renovated it and got an award of excellence from DOE.

Certainly there have been a lot of challenges in the more recent era when the operational problems of Los Alamos were starting to appear, just about the time I became VP. It started to bring into question the operational credibility of the laboratories. Part of the challenge was to realize our vision of exemplary operations. That's one thing I'm very proud of. The site has a very, very special character that is unique among the laboratories. Certainly the very existence of the site has been called into question in the last couple of years, as the DOE has looked for opportunities to consolidate. The various people who come to us with that question walked away with the impression that this is a pretty special place with unique capabilities for both DOE and the nation.

***LN:** Why do you think the site is so special?*

MJ: Just the very nature of the site, being small enough so that we're able to integrate talents and skills across organizations much more readily, and to include the folks responsible for our operations, so that we're able to reassign people and turn space around in ways to support programs quickly. We all understand that the history of the site is such that we came along second. We reminded ourselves of that at the 50th anniversary, that our existence has always been called into question. So what we've been dealing with the last couple of years is something that has happened throughout our history. Jack Howard was the first director at the site, and he said, "Oh yeah, we knew we were going out of business from the start." So we just have to try harder, and it's still a really, really strong characteristic of the site. The power of our ideas is what has made, and will continue to make, us special.

Having said all that, I also became the "proud mamma" as VP of a number of things that were working extremely well, like combustion research, materials sciences, engineering sciences, and the weapons program. However, since the national security environment has gotten to be so complicated, the environment in which the labs can have an impact has followed suit. We are going to have to understand much more intimately the policy context along with the technical work. It's put different requirements on leadership. I'm really proud of how this director team in particular has pulled together over my tenure.

A couple of examples: As pressures on the weapons program have grown with respect to budgets and the future of nuclear weapons and national security posture, we came to realize that we couldn't just let it keep running under its skilled local leadership, that we had to start taking on higher-level issues. It got several of us heavily involved in work with the Department of Defense, to grapple with some of these big issues, because if the country can't decide where nuclear weapons fit, then they'll start to question the need for the laboratories. Part of the strategy is to articulate clearly what we firmly believe is a vital role for nuclear weapons in our national security posture, to provide any number of creative ideas around how to think about nuclear weapons in the current and future context that moves beyond Cold War thinking — along with understanding that other national security challenges have also gotten much more complex. Certainly 9/11 drove that home with respect to homeland security, but we also were thinking and worrying about energy problems before gas prices started climbing. We were prepared to assume leadership, for example, for the Labs' transportation fuels initiative due to anticipatory thinking and planning by folks in [Center] 8300 under [Director] Terry Michalske's leadership. We have also pushed our combustion research into balancing efficiency with environmental issues.

***LN:** Any more accomplishments?*

MJ: Any leader who takes direct credit is fooling themselves, because the job of good lab leadership is to recognize good ideas when you see them and provide support, resources, and championing so that those ideas can turn into something real. We've created countless ideas like that in my 28 years. With everything we did, there is a person or a group of people who just pops into mind.

***LN:** After retirement, will you be spending more time in Washington?*

MJ: I don't think I can spend more time in Washington unless I move there! One of the things I did as soon as I announced my retirement was to offer to step off of the many boards I'm on: Defense Science Board, Naval Studies Board, Threat Reduction Advisory Committee, the California Council on Science and Technology, and some university boards, because a lot of those invitations came originally because of the affiliation with Sandia. Every one of them said, "Absolutely not, if anything it will be great because you'll have more time to spend helping us." Now, keeping in mind all this comes free to them, of course they love the notion they'll have more of my "free" time. So, yes, I will be still a part of all those things I've been doing. I suspect I will take another position. As [husband] Bill and I were talking, he looked at me as we were talking about my retirement and said, "You know, I'm not sure if I want you at home all the time." He said, "You've still got too much in you and too much energy. Let's figure out just what's going to make you have a lot of fun over the next several years."

Thinking about retirement

***LN:** So it wasn't another opportunity that led you to retirement?*

MJ: I've been in the job a little over seven years now, and by the time I leave it will be closer to seven and a half. A number of people know how strongly I was influenced by the Defense Science Board (DSB) study that I recently ran. We were looking at a pretty egregious case of abuse of authority. One contributing factor was simply being in place too long. The common practice in the private sector is that the top executive stays in place for typically no more than five years — maximum six to seven — because at that point people can become complacent about their leadership and thinking about the future. I remember the day that the DSB group turned to me and said, "Well Mim, how long have you been in your position?" It was coming on six years at that point. I said, "Oh, I guess I better start thinking about this." It looks like things are pretty stable here for a while with the directors — and not just stable, but in my estimation, full of hope since we've got a top director team, so it seemed like the right time to hand things over to my successor.

***LN:** It sounds like the decision was about looking at what you wanted, but also what the organization needed. If you look back, is there something you might have done differently?*

MJ: Well, a large part of my philosophy is the old Satchel Paige saying — he was maybe the best pitcher in baseball ever, but also an African American in a time when he wasn't allowed to play in the major leagues — "Don't look back; they might be gaining on you." I didn't fully appreciate that this level made a real difference in the way people started to interact with me. I hope people see I'm a little more patient now and willing to listen and not jump to conclusions.

***LN:** So you've grown.*

MJ: I think anybody that's not growing in their job needs to find a new job — there's too much of your life spent at work not to feel constantly challenged.

***LN:** Speaking of changing, it's been an interesting time with our new customer the Department of Homeland Security, and looking at how to handle that. What are your observations about your experiences with that new agency?*

MJ: We oscillate between real highs and lows. Any new organization such as DHS needs some time to mature, but we never anticipated how much turmoil we would face. We've realized Science and Technology is not a mainstream mission for the department and it's got to earn its stripes. There are certainly some enlightened people there. After Secretary [Michael] Chertoff visited the labs last year he said, "I have a totally different perspective on what you are all about and I really, really need you as part of my team." But then Hurricane Katrina and Hurricane Rita hit and he's been scrambling ever since. Hurricane season has started again, and Asian bird flu has created all kinds of concerns, and so he's gotten occupied with the here and now. It's taken us longer than we would have liked to get traction around creating an enduring relationship between DHS and DOE. By that I mean moving beyond the current arrangement where we are in the typical work-product mode, project by project, task by task, to something that is more stable, where DHS is committed to a level of mission and core competency support for facilities or capital equipment. To do that requires some change in agreement between DOE and DHS. [8100 Director] Jill [Hruby] and I have been spending a lot of time in the last few months supporting the two departments to effect that change and it seems to have some positive momentum now.

Staying the course

***LN:** It would be nice if the agencies could all leverage those potential contributions.*

MJ: In this case [DHS and DOE] you've got some of the principals who are more than willing to try to make that work. We've got to get it beyond just people of goodwill, because people of goodwill move on and they need to have institutional agreements in place. Having said that, it is just far too important a mission for us to not be in the running. So as hard as it is, as difficult as it is, we've just got to stay the course; we've just got to do it.

***LN:** Is it premature to talk about what will happen with the Homeland Security and Defense Strategic Management Unit (HSD SMU)?*

MJ: That will be Tom's decision [Sandia President Tom Hunter]. I think it makes a lot of sense to keep it here due to the strong presence Lawrence Livermore has with DHS. Without us they would often go off without considering the advantages of partnership with Sandia. We've also worked hard with program leads in New Mexico to make it a true lab-wide SMU, and I've been blessed

"The power of our ideas is what has made, and will continue to make, us special."

with two great deputies resident there, T.J. [Allard, 4210] and Billy [Marshall, 8000].

***LN:** One change we've experienced here is going from a geographically discrete site to a division with a presence in New Mexico, too.*

MJ: We needed to create critical mass and leadership that would make bioscience efforts much more coherent, because as a laboratory we had too many different things going on, each of which was sub-optimal. I get pretty good feedback from the folks in New Mexico that at this point, the arrangement seems to be working.

***LN:** This leads to a larger question: Where do you see the site going?*

MJ: At the spring managers' leadership conference we laid out where we needed to push program development activities. Part of it focuses on DHS, but another element is working with Albuquerque, where the facilities protection and physical security business with DoD is growing and they can't provide all the staffing. That's one thing that led to reorganizing 8200 to free up [Dept. 8229 Manager] Curt Nilsen. He's done a great job to build trust with Center 6400 and train our folks so the program leads in New Mexico are comfortable in moving work out here. Terry [Michalske] and [8360 senior manager] Don Hardesty and [Center 8700 senior scientist] Stewart Griffiths have been instrumental in defining a new thrust in energy programs and transportation fuels. That intersects very nicely with new DOE initiatives to explore advances in bioenergy. I'd like to imagine we were clairvoyant when we put combustion and bio folks together, but the honest answer is that we were just plain lucky! . . . And as long as Livermore is in the weapons business, this site is going to have a strong weapons program. I've said it, and more importantly, [Deputy for Nuclear Weapons] Joan [Woodard] has said it, and we're absolutely committed.

***LN:** What is your view of how the DoD considers nuclear weapons?*

MJ: We've got to get DoD engaged again, in the Office of the Secretary of Defense, with awareness that many levels of leadership need to pay attention to the nuclear weapons enterprise at both DOE and DoD. The Defense Science Board helped raise that awareness to Secretary Rumsfeld, but it's still not "infected" much of a wider audience at DoD. There are a few lonely voices in the Air Force and the Navy who continue to carry the nuclear banner, but it's off the radar screen for most of the leadership. They're fighting a war and they are stressed for resources. We do need to work through mechanisms with the Secretary's office and STRATCOM, to make sure nuclear weapons are getting the right attention. That's what I spend a lot of time doing. It's not real visible, or things you can report a lot of progress on. Only when you step back and look at where things were two, three, four years ago, and where are they now, they're better now than they were then, but they're far from where they need to be.

***LN:** Do any pieces of that concern Congress?*

MJ: Congress will continue to keep the pressure on both DoD and NNSA until there's a good story they can both tell, consistently and well. Better that DoD tell it first, with NNSA backing it up. Not the middle managers, but the leadership. There are a number of things that we're doing, like I say, behind the scenes, to help through the advisory functions I'm able to provide.

Meeting the security challenges

***LN:** Our weapons are aging so there's some imperative.*

MJ: Yes, not only should we be concerned about aging, but we are the only country left that's a declared nuclear power that's not modernizing and transforming its arsenal to meet the security challenges of the 21st century. I don't mean just the Russians and the Chinese, but the French and the Brits are doing it too. RRW is the step in that direction, but it's a new program and still fragile politically, so it's going to be a rocky road for that one, too, unless DoD and DOE can tell a story together that's convincing. It doesn't have to be complicated. But the story also has to be honest that we're going to take a few risks along the way. We may stop [stockpile] Life Extension Programs, we may change the way we do operations, so that we can free up time and dollars to build new capabilities.

***LN:** Along these lines, how do you see the relationship with Lawrence Livermore changing, if at all, because of their new contract?*

MJ: If we're going to get down to a couple thousand weapons in the active stockpile, one or more congressmen will question the right size of the complex. Most decision makers still believe the nation needs the laboratories as they're currently configured because we will be changing out the stockpile without the benefit of underground testing. However, the overall budget will decline, and [NNSA Administrator Linton] Brooks expects all three of his laboratories to have less than 50 percent nuclear weapons work within the decade. Sandia will be there first. By the way, that will not be new for us, we've been there before — we were there in the 1990s.

I think you'll see the labs transform from a perception of nuclear weapons laboratories to national security laboratories. For us here in the valley, where our core rationale for a Sandia presence has been the nuclear weapons partnership with LLNL, we can either try to go it alone, but we're pretty small to do that, or we can seek partnerships, some of which will be with Livermore, some with other laboratories, and of course a lot with Albuquerque.

***LN:** Do you have impressions of the view the community has of Sandia/California?*

MJ: Tom worked hard to get us a presence in the local community. We have expanded that since he was here, and we are now much more widely recognized in the Bay Area and in the state. We're highly valued participants in the California Council on Science and Technology. We've been participating in a number of regional forums. When it came time to seek support for our joint proposal with Lawrence Berkeley National Laboratory and Livermore on a new bioenergy facility, people from both the Bay Area and Sacramento rallied around. It surprised us with offers, not just letters of support, but offers of space, partnerships —— and the opportunity to do R&D side-by-side with existing institutions. Terry and his counterpart from Lawrence Berkeley were in Sacramento recently testifying to seek a resolution of support for the facility. They got that and more from the committee. It's really been terrific to see a level of name brand recognition in the California state equation now, where I don't believe we had much of a presence six, seven years ago.

***LN:** Does the bioenergy initiative pick up where the previous request for proposals led us to seek the protein facility?*

MJ: It's morphing into the bioenergy institutes; we're not sure what DOE is going to call for in the reissue of the RFP. The chief criticism of the original plan and call — from a study the National Academies did — was the large facility, sequential approach DOE was taking was going to be too little, too late because biotechnology was moving so fast they needed more agile structures. I think we're going to see some investment in facilities, but also more support for consortia and partnerships dedicated to certain tasks, than some sort of specialized large facility focus for the program.

***LN:** Do you have advice for your successor?*

MJ: It's going to be hard on the next person. It will be a tough time for everybody because of pressures on our core nuclear weapons mission, and because we need to evolve our multiprogram status faster than normal program development typically supports, and still maintain the essence of a national laboratory. We've done it before, we'll do it again, and it will come out great because people recognize the value, once they look into it, of what's here.

***LN:** You mean we need to be doing national lab-type things, but change quickly?*

MJ: We need to be much more open to the fact that stability, which we've known and loved for decades, is just not the name of the game anymore. Constant change is — so let's get started with a new leader who can bring new energy and ideas. (See "Paul Hommert to become 8000 VP" above.)

Paul Hommert to become 8000 VP

Paul Hommert

Labs President Tom Hunter announced Monday that Paul Hommert will rejoin the Labs Aug. 25 as vice president for Sandia/California and leader of the Homeland Security and Defense SMU. He follows VP Mim John, who is retiring.

"Paul brings to us a broad and deep experience base," Tom says. "As a Sandia director, he led our Engineering Sciences organization before moving to the United Kingdom as part of the Lockheed Martin team operating the Atomic Weapons Establishment."

Paul then returned to Sandia for a brief period, and currently serves as leader of X Division at Los Alamos National Laboratory.

An advocate for natural systems, Sandra Postel calls for a new perspective on global water issues

By Will Keener

In Bangladesh, 1.2 million poor farmers have purchased treadle pumps — a $35 piece of hardware — to irrigate their lands with shallow groundwater, turning poverty and starvation into a healthier existence and extra food crops to take to market.

In Boston, water consumers have stuck with a massive conservation program that brought water consumption to a 50-year low and has helped avoid building a new dam on the Connecticut River.

In South Africa and in the US, scientists and economists are at work answering the thorny question "How much water does a river need to maintain its health?"

The common thread in these examples is a vein of what Sandra Postel calls "realistic optimism." It's a feeling that — despite the specter of doom that a global view of water problems appears to offer — humans can use creativity, technology, and a shift in their point of view to solve these problems.

Postel spoke last week at the Steve Schiff Auditorium in Sandia's Technology Transfer Center before a crowd of about 200. Another 100 or so watched the talk by videolink in California and on streaming video at their desks around the labs.

Director of the Global Water Policy Project, Amherst, Mass., and a Senior Fellow at the Worldwatch Institute, a nonprofit research organization,

SANDRA POSTEL told a group of Sandians last week in a forum that humans can use creativity, technology, and a shift in their point of view to solve global water problems.

Postel is a prolific speaker and author, with several books on international water topics and numerous scientific and popular articles to her credit. She spoke at Sandia's Environmental Management System Excellence Awards and Lecture Series ceremony. (See "Three teams" below.)

Through a water lens

Looking through a "water lens" at some current global trends, Postel told her audience, "One of our biggest challenges as a global community is how are we going to meet the water demands of our population and maintain the health of the aquatic environment at the same time?"

"There is no substitute for fresh water, unlike other problems, such as our use of petroleum," Postel reminded. While water is part of a renewable hydrological cycle, the part that humans manage — the surface and groundwater "runoff" back to the sea — is finite and dwindling on a per capita basis as our population grows.

Further, the 40,000 cubic kilometers of water that we manage annually isn't equitably distributed. This creates water stress among populations in places like the northern China plains, the Indus River Basin of India and Pakistan, and the Yellow, Nile, Colorado, and Rio Grande river basins.

Water stress

Showing a map that outlined areas of water stress, Postel said, "This is uncharted territory for us. We haven't dealt with this globally before. How the world responds will have significant future implications."

Postel identified three areas of concern:

• Food security;

• The health of the world's aquatic environments; and

• The social and political instabilities that result from water problems.

Water tables in many agricultural areas are falling rapidly as food is produced in nonsustainable ways. In India, for example, 25 percent of food production depends on over-pumping of groundwater. And Indians are looking to buy food on the international market, forgoing a 50-year history of self-sufficiency.

Population and economic growth since the 1950s have resulted in a nine-fold increase in the number of large dams (some 45,000 today) in the US, impacting natural stream flow and hydrologic environments.

"Economically dams are very valuable to us, but we came late to the understanding of the environmental impacts dams have. They are severing connections…between the channel and the flood plains, the deltas, and the sea."

The health connection

Postel compared the environmental damage at the Aral Sea, in central Asia, with that of the Colorado River outlet into the Sea of Cortez. In the case of the Aral Sea, a Soviet decision to divert water from two rivers to agriculture in the 1960s has led to a dry sea bed, dust storms laden with salt and agricultural chemicals, and high rates of respiratory ailments and cancer in the area.

"These areas have resilience," Postel said, discussing a so-far unsuccessful effort to divert one percent of Colorado River water back to the delta area in Mexico. Similar experiments have worked, she said, "if you can find a way to provide the water."

While the US National Intelligence Council has identified water as a driver for political conflict, Postel is not worried about water wars directly. Instead, she sees civil unrest within countries and long-lasting tensions related to unfair distribution of water that will contribute to future wars. "Even if we could resolve the conflicts like those in Israel and Iraq right now, we will still have to deal with the water issues to have a lasting peace," she said.

Shift in viewpoint

"We need a fundamental change to meet the water demands of eight billion people in the world," Postel said. "We need changes in the way we use water, the way we value water, and the way we think about water." A mindset shift is needed that will allow us to keep water in streams and value it for the work it does in preserving biodiversity, food control, purification, and providing other natural services, she said.

These kinds of "natural service" values must be carefully defined and bounded so that they can be protected, she said.

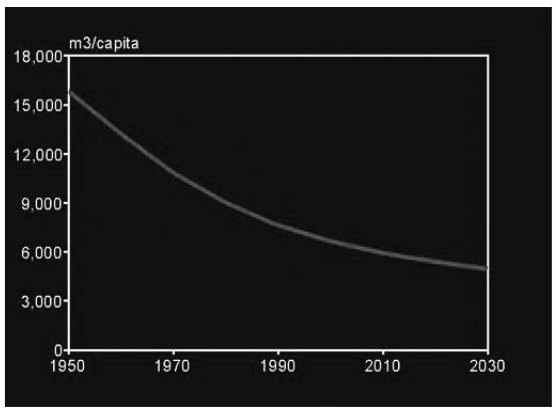
Finally, Postel called on Sandians to look for ways to increase water productivity in terms of agriculture, industry, and in cities. "We need to double productivity. The technology is there. It is doable," she said.

One example is answering the question "Are we growing the right crops in the right places?" Shifting in some areas to crops requiring less water use can make a significant impact in water savings, she said.

Underpinning all of this is the need to guide our efforts with a "water ethic," Postel said. "Because water is the basis of life, it clearly has an ethical dimension we can use to underpin the framework of our efforts."

Global Renewable Freshwater Supplies Per Capita, 1950-2030

Source: Global Water Policy Project



Three teams, two individuals receive awards for efforts in improving the environment

Sandia's Environmental Management System Excellence Awards for the second quarter of 2006 went to two teams and one individual, cited for their efforts in the category of improved environmental policies and procedures. One team and one individual earned awards in the environmental awareness category.

The Roofing Program team improved roof assessments preventative maintenance, and building sustainability, lengthening the life cycle of roofs and reducing maintenance tickets. Members include Matthew Brito (10863), Danny Baca (10864-1), and Alex Clark, Ajamu Clayton, William Derosia, and Dean Lopez (all contractors in 10825-1).

The Focused Waste Management team for Centers 2400 and 2700 was able to increase efficiency and reduce costs to the tune of $2 million. These two centers are the largest users of hazardous materials at Sandia. Team members include Max Saad (2700), Gary Campbell and John Zich (both 2400), Sherron Mirdman (2700), and Sylvia Saltztein (2733).

Ron Thomas (2736) proposed a policy change that eventually eliminated the need to build 150 neutron generator tubes planned for testing purposes — a $3 million lifetime savings. The reduction also supports Sandia's environmental stewardship goals.

In the awareness category, the Sustainable Design Integrated Education Series team offered workshops for professionals in the building trades and others interested in including sustainable design principles in new construction projects. Members included Israel Martinez and Isabel Martinez (both 10863), Lucille Roybal (10861), Anthony M. Baca (10826), Roy Hertweck (10853), and Morgan Gerard (10331).

Tim Sage (8224), the first California site employee to receive an EMS Excellence Award, was cited for "countless hours" of work in fostering environmental awareness. He has helped develop innovative waste minimization and environmental practices and encouraged others through his mentoring efforts and example.

In addition to the awards and a keynote address on water conservation, water-conservation projects from the New Mexico State Engineer's office, Sandia research efforts, and the private sector were featured in displays in the Technology Transfer Center lobby.

George Bachand to participate in NAE symposium

George Bachand (8331) is among 81 US engineers selected to participate in the National Academy of Engineering's (NAE) 12th annual Frontiers of Engineering symposium Sept. 21–23 at the Ford Research and Innovation Center in Dearborn, Mich.

The goal of the symposium is to examine the nanotechnology-biology interface, intelligent software systems and machines, supply chain management, and personal mobility.

"This symposium brings together engineers with a variety of backgrounds to discuss cutting-edge developments in engineering, many of which may have a tremendous impact to the US," George says. "One of this year's topics is the nanotechnology-biology interface, which is an area of engineering that I have been working for almost 10 years."

He is a member of the Biomolecular Interfaces and Systems Department, a scientist in the Center for Integrated Nanotechnologies (CINT), and an adjunct professor of cell biology and physiology at the University of New Mexico.

His primary duties at Sandia involve conducting research at the nano-bio interface. His research includes understanding and exploiting motor proteins (nanoscale, biological motors) to engineering integrated materials, devices, and systems.

George serves as a principal investigator of a project funded by the Defense Advanced Research Projects Agency (DARPA) to develop "smart dust" sensors that are powered by motor proteins and capable of remotely detecting a wide range of biological agents. The project involves the Naval Research Laboratory, University of Florida, Swiss Federal Institute of Technology, and Albert Einstein College of Medicine.

He is leading an LDRD-funded project focused on capture of rare intracellular analytes using motor protein-based nanotechnology. As a CINT scientist, he is involved with a variety of users in understanding how motor protein-based transport can be used in nanotechnology.

George received a PhD from State University of New York in 1997 and spent three years at Cornell University as a research associate in the Department of Biological and Environmental Engineering. George recently chaired symposia focused on the interface between biology and nanotechnology at meetings of the Materials Research Society and the American Association for the Advancement of Science.

GEORGE BACHAND will be participating in the National Academy of Engineering's 12th annual Frontiers of Engineering symposium this fall.

Julia Phillips (1100), chair of the 2006 NAE symposium, says the participants, ages 30 to 45, from industry, academia, and government were nominated by fellow engineers or organizations and chosen from nearly 200 applicants.

"The symposium is an opportunity for these engineers, who will be the engineering leaders of the future, to become familiar with new areas of engineering, to exchange ideas, and to form a network with others at a similar career stage," says Julia.

— Michael Padilla

Center 2700 celebrates 2006 Shingo Public Sector bronze award

With senior management passing out barbeque and desserts, Center 2700 enjoyed a barbeque in celebration of their announced Shingo Public Sector Prize. The award places the Neutron Generator group among an elite few manufacturing enterprises recognized for their excellence in production and process.

Utah State University's Shingo Prize, described in a 2000 *Business Week* article as the "Nobel Prize of manufacturing," is awarded yearly to organizations for excellence in manufacturing. The prize, established in 1988, honors organizations in three distinct areas: business, research, and four levels of public sector awards. Utah State University will present 2700 with its award on Sept. 7 in a ceremony at a public sector conference at the Tropicana Hotel in Las Vegas, Nev.

The public sector prizes are given at bronze, silver, gold, and platinum levels. Public sector facilities apply for consideration in one of those award levels.

The Neutron Generator group won a bronze-level award in the Public Sector area. This is the first time the group has applied for the award. Steve Rottler, VP of Weapons Engineering and Product Realization Div. 2000, credited the group's receiving the award on its first try to a "culture of ownership of the work by everyone," and an "ownership of continuous improvement."

Representatives from the Shingo organization visited the facilities on May 30-31. They toured production facilities, spoke with line employees and senior management, and gauged the facility's production metrics. The group was notified in late July that it had won the bronze-level prize.

VP 2000 STEVE ROTTLER, right, serves up potato salad at the Shingo Public Sector Prize celebratory picnic. (Photos by Bill Doty)

At the conference, Shingo winners such as Kathleen McCaughey, director of Center 2700, will serve as "team coaches" for other organizations, passing on their best practices and sharing their learning processes with future prize-winner hopefuls.

Steve explains that, originally, critics of the lean business practice program were skeptical. "Five years later," he says, "we are being honored at an international event, and the life-cycle metrics we've put in place have resulted in a 20 percent reduction in costs of production."

The Shingo Prize for Excellence in Manufacturing is named for Japanese industrial engineer Shigeo Shingo. Shingo distinguished himself as one of the world's leading experts in improving manufacturing processes. He helped create and popularize the revolutionary manufacturing practices of the Toyota Production System.

A few years ago, the US Department of Defense requested the expansion of the Shingo Prize to include "public sector entities." The Board of Governors authorized an expansion of the Shingo Prize in 2005, adding a public sector category for manufacturing, industrial, or "maintenance, repair and overhaul" activities.

— Stephanie Holinka

HOSTESSES at the Shingo Public Sector prize celebratory picnic relax and taste some of the food they served up.

National Atomic Museum gets a new location to go with its planned new name

The National Atomic Museum Foundation announced Monday that DOE has made available 12 acres of land near Kirtland Air Force Base on which to relocate the museum. The land is the southwest corner of Eubank and Southern at the north end of the Sandia Science and Technology Park.

The museum is now located in a rented building near Old Town Albuquerque.

The Foundation is planning a groundbreaking event for November, with construction beginning in early 2007. It expects to occupy the new museum, under the new name The National Museum of Nuclear Science and History, in fall 2008.

The museum will be located in a 30,000-square-foot building, along with an outdoor park for aircraft and other large artifacts that are currently housed at the museum's previous location on base. Studio Southwest Architects have been selected for the project design.

"The new museum exhibit floor will present dynamic nuclear science fields such as nuclear medicine, space exploration, and international issues facing our world today, along with the historical development of nuclear weapons," says Jim Walther (3656), museum director.

The National Atomic Museum was opened in 1969 on Kirtland and was chartered by Congress in 1991 as the official atomic museum of the United States. The museum is managed by Sandia and operated by its own foundation board. The Museum Foundation employs 15 full-time staff members along with several additional part-time employees.

Mileposts

New Mexico photos by Michelle Fleming
California photos by Bud Pelletier

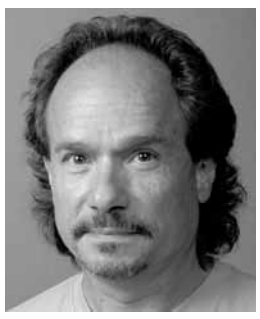
Dahwey Chu
30 1715

Thomas Hinkebein
30 6118

Thomas Ashwill
25 6214

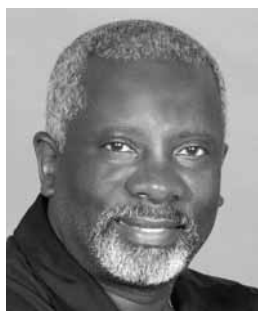
Lucille Forster
25 10761

Michael Johnson
25 5625



Duane Schneider
25 2453

Steven Yearout
25 5733



Marvin Kelley
20 8524

Recent Retirees

Charles Borgman
40 5416

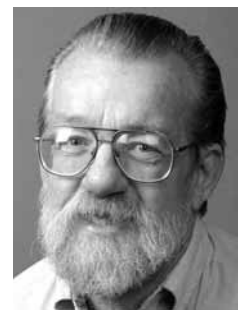
Julie Bouchard
15 6225

Laurel Moore
15 3652

Patti Sanchez
15 2998

Daniel Schell
15 3523

Patricia Tode
15 6141



Randy Cole
38 6862

Rod Geer, others receive New Mexico PRSA awards

Rod Geer (3600), who recently celebrated his 30th anniversary at Sandia, has been awarded the prestigious New Mexico Public Relations Society of America's (NMPRSA) Lee and Marie Hirst Vista Award.

The award is the top honor given annually to a NMPRSA member who has contributed significantly to the public relations field and to the organization.

Rod is currently a senior administrator for Sandia's Public Relations and Communications Center. For all but about two years of his Labs career, Rod has been in Sandias' public relations organization — first as a staff member and then as a manager and at various times doing media relations, employee communications, and community relations. During his two-year hiatus from public relations, Rod was the assistant to the director of the Solid State Sciences Center.

Among Rod's various assignments at Sandia: director of the Labs' 40th anniversary celebration and events in 1989, membership on the Labs' Disciplinary Review Committee, spokesperson trainer, and primary spokesperson.

Rod's PRSA activities have included various board memberships, speaker at various functions, and other duties. He has been a periodic contributor to Ragan Communications publications and a presenter at a Ragan national Corporate Communicators Conference.

Prior to joining Sandia in 1976, Rod worked at the University of New Mexico, serving first as radio-TV manager and then as manager of its news bureau.

The Lee and Marie Hirst Vista Award was named in honor of Lee and Marie Hirst, who operated a public relations company in Albuquerque and New York for many years. They recently passed away.

At the annual NMPRSA awards event, held at the Albuquerque Marriott Pyramid, Sandia received several other NMPRSA Cumbre Awards, which honor New Mexico public relations professionals for their dedication to providing the highest quality work.

Sandia recipients include:

• Gold Award, Safety Awareness Posters, Alice Baltz, Michael Vittitow, Gail Lemen, Michial McDuffie, Sherri Mostaghni (all 3654), Noel Fletcher (10330)

• Gold Award, *Sandia Technology* issue "Our Global Water Future," Will Keener, Chris Burroughs (both 3651), Doug Prout (1010)

• Gold Award, "Time Traveling at Nevada Test Site," Bill Murphy, Randy Montoya (both 3651)

• Gold Award, for *Sandia Technology*, Will Keener (3651), Doug Prout (1010), Michael Vittitow (3654), Randy Montoya (3651), Sherry Mostaghni (3654)

• Silver Award, Sandia Annual Report 2006, Will Keener (3651), Michael Vittitow, Sherri Mostaghni (both 3654), Nigel Hey (retired)

• Silver Award, *Sandia Lab News*, *Sandia Lab News* team

• Silver Award, Shoes for Kids campaign, Patty Zamora (3652)

• Bronze Award, School to World program, Pam Catanach, Cheryl Garcia, Amy Tapia (all 3652)

Sandia recruits employees for Yucca Mountain

KEN HOLLEY (3555) talks with a potential candidate at the Sandia booth during a July 21-22 job fair in Las Vegas, Nev. Since being designated lead lab at the Yucca Mountain repository in January, Sandia has begun the process of establishing workforce agreements with contract employers to fill a variety of openings in science, engineering, and business areas. The job fair featured 14 additional exhibitors who represent many of the potential workforce providers for the lead lab effort. For additional information about the workforce transition and links to the many employment opportunities available with Sandia activities at Yucca Mountain, visit http://ymp-workforce.sandia.gov/employment.htm.

(Photo by Lisa Polito)

Nature's fireworks

Lightning is an awesome sight, but its effects can be deadly

By Iris Aboytes

It is a typical summer day in New Mexico. Cooling showers arrive in the late afternoon easing the sting of the sun's rays. But they do not arrive unannounced. Thunder booms and nature's fireworks illuminate the darkened sky, bringing danger to those in its path.

According to a Sandia report, "Lightning Safety: The Whole Shocking Truth," lightning is the most dangerous and frequently encountered weather hazard in the US. New Mexico ranks sixth in the nation in lightning fatalities per capita. There are more than 20 million lightning strikes every year in the US.

The frequency of thunderstorms from June through early September peaks at the same time many people are working outdoors.

A few years ago a Sandia contractor was working at a remote job site as a road grader operator. He waited out a rainstorm in a pickup truck. When he got down from the truck he was in the proximity of the road grader when lightning struck. This resulted in an electrical shock to the employee.

If you can see lightning or hear thunder, you are already at risk. Louder or more frequent thunder indicates that lightning activity is approaching. If the time delay between seeing the flash of lightning and hearing the thunder is less than 30 seconds, you should be inside, or seek a safer location.

Recently a Sandia employee had left her car windows down. She was told by her coworkers it was starting to rain so she went outside to close the windows. On her way back, it started to rain a little harder but instead of running she decided to walk because the pavement was wet and she was afraid of falling.

She says she heard a buzzing sound. Her hair seemed to be standing up, and in an instant she felt a burning pain on the back of her neck going down her back and coming out though her chest. She saw a trace of light but heard no thunder and saw no lightning.

Cold and clammy, she was taken into the building and 911 was called. Her heart was racing and she was sick to her stomach. She says she felt a little surreal.

"I love the outdoors," she said. "I go camping and fishing. I know about this stuff." More than a week later she still has terrible headaches and all her muscles hurt.

According to the Sandia report, the best safety practice during a lightning storm is to seek shelter and go inside. If you are in a car, keep the windows rolled up. Before dashing inside, follow the 30/30 rule – stay there until more than 30 seconds pass from the time you see lightning to the time you hear thunder. (This usually means the storm is about six miles away and could still be dangerous.)

Wait 30 minutes after you last heard thunder before resuming outdoor activities.

If no shelter is available, find a low-lying, open area as far as possible from trees, poles, or metal objects. Assume a tucked position, squat low to the ground, and place your hands and head on your knees. Try to touch as little of your body to the ground as possible. Stay that way until well after the storm passes. If you feel your hair stand on end during a storm, drop into the tucked position immediately.

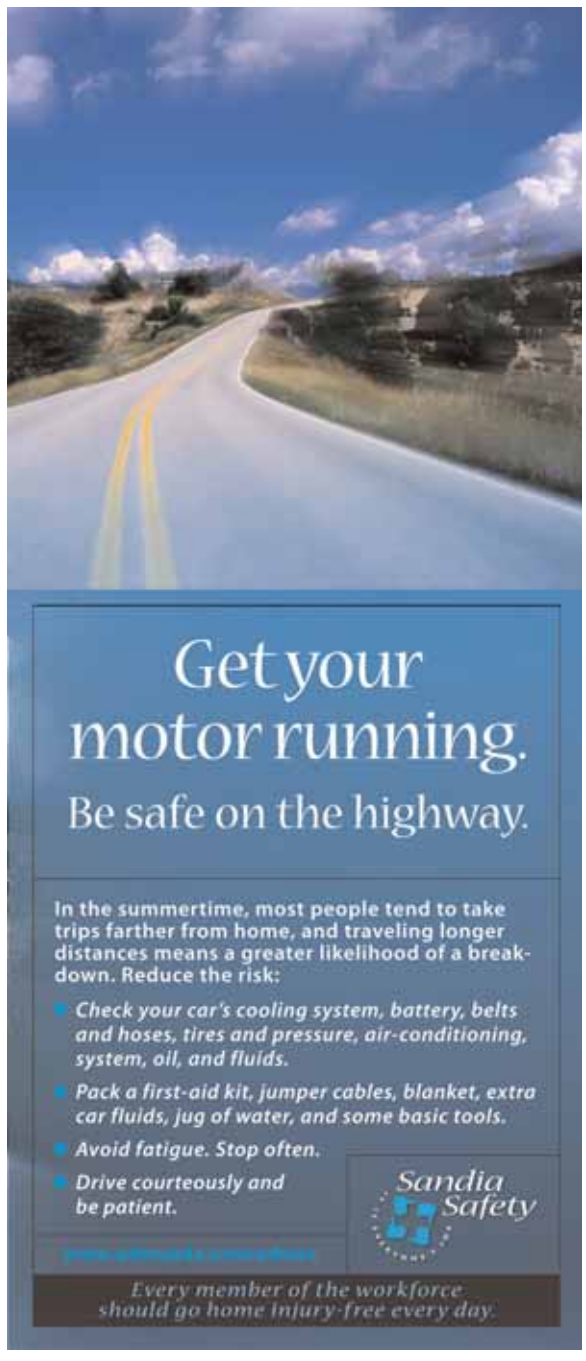
"Safety goes well beyond work inside our buildings," says 10000 VP Frank Figueroa. "Let's be vigilant wherever we are and make watching out for each other our way of life."

For the Sandia report, go to http://cfo.sandia.gov/esh/lightning.doc

Lightning guidelines

Outdoors — When possible find shelter, go inside. Avoid water, high ground, and open spaces. Avoid all metal objects.

Indoors — Stay away from doors and windows. Avoid water. Do not use the telephone. Remove headsets. Lightning may strike exterior electric and phone lines, causing surges to inside equipment.



Linton Brooks holds all-hands Q&A meeting

NNSA Administrator Linton Brooks

Ambassador Linton Brooks, the top administrator for the National Nuclear Security Administration, held an all-hands question-and-answer forum with Sandians Monday at the Steve Schiff Auditorium. The meeting followed a tour of the Sandia/NM site by Brooks and members and staff of the House Armed Services Committee's Subcommittee on Strategic Forces, including subcommittee chairman Terry Everett. Brooks spoke highly of the tour. Employees asked Brooks questions ranging from the role of nuclear security in the current events in Iran to the future of employee benefits at the national labs. The presentation was joined via video-link by employees in California and Carlsbad, N.M.

(Photo by Bill Doty)