Rapid-fire pulse brings Sandia's Z method closer to goal of developing high-yield fusion reactor

AREA 51? NO, AREA 4 — Bill Fowler checks out a linear transformer driver device from Siberia that could replace the arcs-and-sparks generation of the current Z machine. The row of switches (circular devices) are connected to capacitors (rectangular objects). The tubes contain liquid resistors. (Photo by Randy Montoya)

Revolutionary circuit from Siberia fires thousands of times without flaw

By Neal Singer

An automobile engine that fired one cylinder and then waited hours before firing again wouldn't take a car very far.

Similarly, a machine to provide humanity unlimited electrical energy from cheap, abundant seawater can't fire once and quit for the day. It must deliver energy to fuse pellets of hydrogen every 10 seconds and keep up that pace for millions of shots between maintenance — a kind of an internal combustion engine for nuclear fusion. That's so, at least, for the fusion method at Sandia's Z machine and elsewhere known as inertial confinement.

But, unable to produce fusion except episodically, the method has been overshadowed by the technique called magnetic confinement — a method that uses a magnetic field to confine a continuous fusion reaction from which to draw power.

Now an electrical circuit emerging from the technological hills may change the balance between these systems. Tagged as "revolutionary" by ordinarily conservative researchers, it may close the gap between the two methods.

The circuit is easily able to fire every 10.2 seconds in brief, powerful bursts.

Arranged modularly, a collection of these circuits could

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Sandia LabNews

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Sandia National Laboratories

Many Sandians share Virginia Tech memories; nearly 50 have degrees from university

Several studied with Liviu Librescu, the hero who gave his life to save his students

By Michael Padilla

The news of last week's horrific events at Virginia Tech hit close to home for many Sandians who have connections to the campus.

Nearly 50 Sandians have degrees from the research university and several Virginia Tech alumni have created close friendships among themselves at the Labs.

Last week a lone gunman opened fire on the Virginia Tech campus, killing 32 and then killing himself.

Dan Hammerand (1524) spent almost a full decade at Virginia Tech where he received his bachelor's degree, master's degree, and PhD in aerospace engineering.

"I was there from 1989 to 1999 with the exception of '93 when I took a year off," he says. "I started out as a bright-faced 18-year-old and ended as an old married guy for the last year I was there."

(Continued on page 9)

Inside . . .

- Aviation legend Paul MacCready urges small solutions to big challenges . . . . . **Page 3**
- Modeling and simulation capabilities boost nano/micro research . . . . . **Pages 6-7**
- Sandia-mentored African American students headed for international science fair . . . . . **Page 8**
- High School Homeland Security Conference draws students from three states . . . . . **Page 9**
- Sudoku champ calls Sandia home. . . . . **Page 12**

Decon formulation, best known as an anthrax killer, takes on household mold

Bright green box makes its way to hardware stores nationwide

By John German

SCOTT'S LIQUID GOLD Mold Control, based on Sandia's decon formulation, is now on store shelves around the country. Here, a box of the product sits on the shelf at the Home Depot store on Eubank Boulevard in Albuquerque. (Photo by Randy Montoya)

There's a new product on the shelves of local hardware stores. Among the household cleaners is a bright green box emblazoned with a catchy promise: "Stops Mold Cold!"

On the back of the box, in tiny black letters, appears this: "New technology originally developed and patented by Sandia National Laboratories."

The product is Mold Control 500, distributed by Scott's Liquid Gold of Denver, Colo., and now available in Home Depot, Wal-Mart, True Value, Ace Hardware, and other home improvement stores across the country.

For around $30, a box of MC 500, dispensed as a foam, treats 500 square feet of mildew- and mold-contaminated surface area indoors or outdoors, according to the information on the box.

Mold and anthrax

The product is based on Sandia's decontamination formulation (a.k.a. decon foam), which has become a widely stockpiled first responder tool for cleanup following a terrorist attack involving either chemical or biological warfare agents. It is best known for its role in helping remediate anthrax-contaminated buildings in Washington, D.C., and New York in 2001 (see "Sandia's decon formulation: You've come a long way, baby" on page 5).

The formulation — which employs the active chemical ingredients of toothpastes and hair conditioners — kills fungi such as molds in much the same way it kills anthrax, says Mark Tucker (6327), who leads the Sandia team that has developed, improved, and tested the formulation during the last 10 years.

Mold growths form films over their surfaces that, like the shells of anthrax spores, are difficult to penetrate. Mold spores also are able to survive extreme temperatures and low humidity and can remain dormant indefinitely.

When used as a foam, the decon formulation expands to fill space and thus gets into corners and other hard-to-reach places, and it sticks to walls and ceilings and remains there, giving the chemistry time to do its work.

The decon formulation's surfactants poke holes in the mold's film, and its mild oxidizing components kill the fungal organisms beneath, its developers believe.

"This is pretty exciting," says Mark. "Mold

(Continued on page 5)

What's what

Well, I was "busted" last week for a grammatical breach. The upside, though, was that my error was pointed out by someone eminently qualified to parse the language. The transgression was in a sentence about people throwing chewed-up chewing gum on the ground and noted "the gooey gobs of it laying around all over the parking lots and sidewalks."

Retiree Patricia Newman emailed, "Lay is a transitive verb and therefore requires a direct object. So why did you write 'the gooey gobs of [chewing gum] laying around all over the parking lots and sidewalks.' Somebody may have been laying chewing gum around, but the gum itself was lying around. For shame!" I could imagine the pixie-ish twinkle in her eye as she sat in front of her monitor and typed.

PATRICIA NEWMAN accompanies a Soviet visitor on a flight during the 1990 Balloon Fiesta.

If you've been at Sandia a while, you may remember Patricia as the translator during visits by Russian delegations at the end of the Cold War era. (She's also skilled in German, Spanish, and French: *Lab News*, Aug. 27, 1999, page 8.) If you haven't been here that long, you missed knowing a delightful person.

And one thing farther, I hope we've looked this over enough to fully catch any breaches, because another egregious error is something Patricia wouldn't put up with.

* * *

There are a couple of research-based stories in this edition of *Lab News* that you won't want to miss.

A formulation created at Sandia to neutralize chemical and biological warfare agents is now on store shelves as Mold Control 500. First used in volume to clean anthrax-contaminated buildings in Washington and New York in 2001, it's now available commercially to treat mildew- and mold-contaminated household areas. Read about it in John German's story on page 1.

Meanwhile, it's been said for far more than 20 years that practical application of nuclear fusion to generate electricity is about 20 years away. If the work described in Neal Singer's story about the fusion method at Sandia's Z machine pans out, that 20-year prediction may finally be true. It also begins on page 1.

* * *

Finally, after the initial shock of last week's tragedy at Virginia Tech, Michael Padilla tracked down some of the nearly 50 alums now on the staff at Sandia. They talked about their time on the Blacksburg campus, friends, professors, and their sadness at hearing about the shootings. You'll find Michael's story beginning on the front page.

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

Sandia recognized for commitment to Guard, Reserve

Sandia has earned the Pro Patria Award and the Above and Beyond Award from the New Mexico Committee for Employer Support of the Guard and Reserve (ESGR), an agency of the Department of Defense.

The awards recognize the Labs' extraordinary support of its employees who serve in the New Mexico National Guard and Reserve.

In ceremonies last month, Sandian Mark Ackerman accepted the awards on behalf of the Labs. Also attending for Sandia was retired VP Heinz Schmitt, a longtime champion of the ESGR program.

According ESGR New Mexico State Chairman Steve Stevens, "The Pro Patria Award was created by ESGR to publicly recognize American employers who provide outstanding patriotic support and cooperation to their employees, who like the Minute Men before them, have answered their nation's call to serve. Supportive employers are critical to maintaining the strength and readiness of the nation's National Guard and Reserve units."

REPRESENTING SANDIA, Mark Ackerman (5928), right, accepts the Pro Patria award from Brig. Gen. Kenny Montoya, adjutant general of the New Mexico National Guard (left), and Steve Stevens, state chairman of the New Mexico Committee for Employer Support of the Guard and Reserve (ESGR).

Stevens also noted during the presentation ceremony that Sandia earned the "Above and Beyond" recognition for providing more support and services for Guard and Reserve employees than is required by law. Explained Stevens, "Many employers provide 'above and beyond' support with pay differential to offset the loss of wages, and extension of health care benefits which complement coverage provided by the military when their employees are mobilized."

During the awards ceremony, it was announced that Sandia has been nominated for the Secretary of Defense Employer Freedom Award, the highest DoD award aimed strictly at employers. Sandia was nominated for the Freedom Award by several employees (as required under the award guidelines).

Sandia Senior VP and Deputy Labs Director Al Romig says, "No one better embodies our core purpose — to provide exceptional service in the national interest — than our colleagues who serve in various capacities in the National Guard and Reserve. Those Sandians, drawn from across the Labs, represent the very best that we have to offer the nation.

"As a national laboratory, we consider it part of our mission to make sure that our Guard and Reserve members and their families have our support as they carry out their dual responsibilities," he says. "We're gratified that the New Mexico chapter of the Employer Support for the Guard and Reserve program has recognized our commitment, and even more gratified that our own Sandia Guard and Reserve members have nominated us for the prestigious Employer Freedom award."

Retiree deaths

John D. Patrick (age 78) .....March 2
Betty L. Straba (71) .....March 5
Charles J. Ray (59) .....March 5
Ted Varoz (84) .....March 5
John B. Hiller (89) .....March 8
Richard L. Crabb (68) .....March 12
Thomas D. Gardner (76) .....March 13
James A. Jordan (69) .....March 13
Eufemiano Garza (69) .....March 14
Peter C. Kaestner (75) .....March 14
Robert B. Yoder (92) .....March 14
C. Isabelle Fuller (91) .....March 15
Bill D. Yoder (81) .....March 15
William K. Paulus (73) .....March 18
James H. Metcalf (66) .....March 18
Robert G. Fueger (79) .....March 18
Jennie T. Spann (95) .....March 19
L. Virginia Glass (87) .....March 20
Robert E. Thompson (91) .....March 21
Howard T. Stump (92) .....March 22
Chenault Davison (90) .....March 27
Gilbert H. Weaver (82) .....March 27
James E. Robinson (79) .....March 27

'Lena Horne' will entertain Thunderbirds at May 14 meeting

"Lena Horne" will entertain and enlighten attendees at the May 14 meeting of the Thunderbird Club (Sandia's retiree organization) at the Mountain View Club on Kirtland Air Force Base. Horne, the legendary jazz stylist, actress, and unique personality, is portrayed by Brenda Hollingsworth Marley. Marley has been performing on stage since she was seven years old at venues as diverse as the African American Pavilion at the New Mexico State Fair, the Grand Canyon, and other Southwest locales. She has performed as a singer with jazz bands, as a puppeteer, and as a storyteller. The May 14 Thunderbirds meeting will be held at 2 p.m. (or come early for lunch). It is open to all with access to KAFB. No charge (lunch is extra). Call Genelia Boenig at 836-6977 for more information.

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Sandia National Laboratories

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LOCKHEED MARTIN

Earth Day 2007

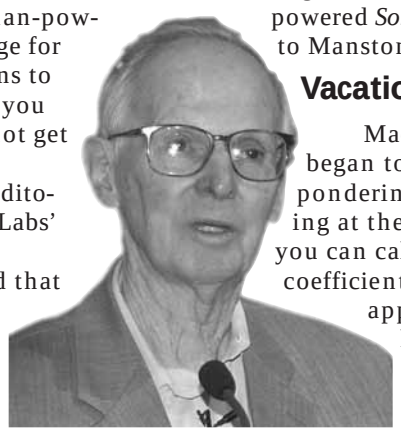
Key to a healthy planet: Do more with less

Legendary designer of Gossamer Albatross ***Paul MacCready speaks at Labs' Earth Day event***

By Will Keener

Paul MacCready, who has brought a string of new ideas to the world's attention in the realms of aircraft, automobile, and human-powered transportation, has a message for Sandians. "You do have the brains to make the world a better place, if you will look at the big picture and not get buried in the details," he said.

Speaking to a Steve Schiff Auditorium crowd of about 300 for the Labs' 2007 Earth Day celebration in Albuquerque, MacCready warned that if America's resource consumption habits don't change, ". . . we're going to be in a lot of trouble." MacCready, who holds a master's degree in physics and a doctorate in aeronautics, chose the analogy of a party balloon to explain the growing world population and resource demands and the need for sustainability. "You can keep blowing into the balloon and it gets bigger and firmer," he said. "But you know sometime it's going to pop."



PAUL MacCREADY

MacCready's talk was a wide-ranging retrospective on his career and how he came to make the contributions he did. As a model plane builder in his teens, he moved from a hobby to a profession in building distinctive aircraft. His early work in cloud seeding technologies in the 1950s actually led him back to an interest in a variety of aircraft, and finally to forming his current Monrovia, Calif., company in 1971.

MacCready said that personal debt — to the tune of $100,000 — was one of his motivations for construction of the *Gossamer Condor*, the first human-powered aircraft. While he spent $65,000 to win the $90,000 Kremer Prize, the development led to yet another aircraft, the *Gossamer Albatross*, which claimed an even larger prize of nearly $200,000 for a 22.2-mile crossing of the English Channel. A follow-up aircraft, the solar-powered *Solar Challenger* flew 163 miles from Paris to Manston, in the UK.

> *"You do have the brains to make the world a better place, if you will look at the big picture and not get buried in the details."*
>
> **— Paul MacCready**

Vacation inspiration

MacCready told his audience that he began to study birds on a vacation trip while pondering the *Gossamer Condor*. "I was looking at the bank angle of the birds and realized you can calculate the turning radius and the lift coefficient of the wings from that," he said. He applied his calculations to his first human-powered vehicle. "Had I gone to an aerospace company or an academic institution, I would not have come up with the very different idea I did for the *Gossamer Condor*," he said.

MacCready and his company developed pterodactyl models for use in the IMAX film "*On the Wing*." He developed the 1987 *Sunraycer* with GM, which won a cross-Australia challenge running on solar power. This led to the *EV-1*, later demonstrated as the GM *Impact*, an electric passenger car capable of acceleration from zero to 60 in less than eight seconds. In 2001, the *Helios* solar-powered aircraft attained a record 96,863-foot altitude, two miles higher than the previous record. More recent work includes small hand-launched surveillance aircraft for military use.

Preparing for a speech some years ago, MacCready boiled down his life's efforts. "I realized that it really all fitted with the thought that ideas and technology can be harnessed to do more with less," he said. "We can't continue to overstress the world's resources all the time."

MacCready: Think creatively to solve 21st-century transportation challenges

Although the subject of Paul MacCready's talk on Earth Day was land transportation, he cast a wide net of observations and ideas for consideration by the Sandia researchers present. Among them:

• Aircraft competition is so stiff that efficiency is the byword for any plane or helicopter carrying more than eight passengers. Given two equally performing planes, the one that teases the most miles out of a gallon of aviation fuel will survive. Yet cars are marketed "like toys," based on appearance, not efficiency.

• Hybrid cars can be 10 times as efficient as they are now. Engineers should start with the ideal capabilities and reduce them as necessary. If 100 percent regenerative braking is impossible and 65 percent is reachable, use 65. A concerted effort to build a more efficient car using this approach is needed.

• A hot air balloon is not a good instrument platform for learning about thunderstorms. (MacCready and a colleague from Socorro tried this.)

• The process of refining and burning each gallon of gasoline puts 19 pounds of carbon dioxide into the atmosphere for up to 100 years. Each gallon of gas we buy also provides 40 cents to countries that tend to hate the US.

• Los Angeles could do a great deal to cure its traffic problems by better using aircraft — up to 100,000 of them to move people across the large metro area. Just as passenger pigeons once darkened our metro skies, airplanes could be used by mapping safe, efficient routes. We focus on the car at the expense of considering other transportation modes.

• Although some religions won't agree to it, all children of the world should have an objective course in comparative religion. This would remove many of the misconceptions that have led to modern conflict.

DragonFly TV profiles two Sandia scientists, local sites, in New Mexico episode of 'GPS: Going Places in Science'

By Stephanie Holinka

Sandia scientists Sandra Begay-Campbell and Cheryl Ghanbari (both 6337) appear in an upcoming episode of the high-energy PBS kids' science show DragonFly TV's "*GPS: Going Places in Science*." The episode, filmed entirely in New Mexico, started airing on KNME beginning April 25. It will be repeated several times.

DragonFly TV features regular kids — not actors — pursuing inquiry-based science investigations in a real-world context. The program encourages its viewers to develop scientific interests beyond the limits of the television show by featuring ordinary children making their own science discoveries. The series, which airs on nearly 200 public television stations nationwide, is seen by more than a million people each week. The New Mexico episode was filmed at the New Mexico Museum of Natural History, at ¡Explora!, and in Carlsbad Caverns in southern New Mexico. It premiered at the museum and at ¡Explora! last week.

RESEARCHER CHERYL GHANBARI during filming of an episode of "*GPS: Going Places in Science*" explains how materials testing is conducted at Sandia's solar tower.

Sandra and Cheryl, along with the four young New Mexico hosts, attended the premiere and answered questions about their solar energy work.

Cheryl's daughter Zahra, a senior at Del Norte High School, also attended the premiere. She was thrilled that her mom's segment featured the song "Material Girl" in the background as it showed Cheryl's work supporting materials testing at the solar tower.

Sandra Begay-Campbell was the episode's featured "Real Scientist." The segment traveled to the Navajo Nation with Sandra, who explained her work with tribal energy programs. She explained how her work has helped people living off the electrical grid on native lands get electricity for their homes.

Sandra noted that as a child growing up in the Navajo Nation, she loved math and science and questioning and figuring out things.

The segment showed Sandra's work mentoring young people in alternative energy systems as a way to continue to improve access to alternative energy for people living far from conventional energy sources.

Eric Artell, the host of the show, guides kid scientists through experiments and discoveries in each location, uncovering a "science secret" in each city. (Artell will be familiar to many teens as a recurring guest star on the WB television series, '*7th Heaven*.')

Sandia's solar tower was the "science secret" for the New Mexico episode. The host asked a variety of New Mexicans where the hottest spot in the world was. After many discussions about chile heat and "red or green," they revealed the hottest spot in New Mexico — Sandia's solar tower.

The program showed Cheryl's work at the solar tower, performing important materials testing. Having the crew film her work was interesting, Cheryl says. "Their fascination with the 'bug zapping' capabilities of the standby point for the heliostat beams was interesting to observe.

"The science is very good and the energy level for kids that age is awesome. I hope kids enjoy it as much as I did."

Pulsed power

(Continued from page 1)

deliver enough power to cause high-yield fusion releases — that is, more power emitted than inserted — from hydrogen pellet targets every few seconds, a basic requirement for a nuclear fusion-fueled electrical generating plant.

The system, called a linear transformer driver (LTD), was created by researchers at the Institute of High Current Electronics in Tomsk, Russia, in collaboration with colleagues at Sandia.

"This is the most significant advance in primary power generation since the invention of the Marx generator, my staff and I believe," says Keith Matzen, director of Pulsed Power Center 1600. Marx generators are giant capacitors used to store and discharge Z's 20 million amps of electrical current. They were invented in 1924.

The cherry-lifesaver path to fusion

The circuit — a switch tightly coupled to two capacitors — is about the size of a shoebox and is termed a "brick." When bricks are tightly packed in groups of 20 and electrically connected in parallel in a circular container resembling a large cherry lifesaver, the aggregate, or "cavity" as the physicists would have it, can transmit a current of 0.5 megamperes at 100 kilovolts.

A test cavity has fired in Sandia's Tech Area 4 without flaw more than 11,000 times.

Because the cavities are modular, they can be stacked like donuts on a metal prong called a stalk. Arranged in a suitable configuration, they could generate 60 megamperes and six megavolts of electrical power, enough (theoretically) to generate high-yield nuclear fusion within the parameters necessary to run an electrical power plant.

"This is a revolutionary advance," says Craig Olson (1640), senior scientist and manager of the pulsed power inertial fusion energy program.

The next-generation cavity model, now being tested in Tomsk, transmits 1.0 megamperes at the same voltage and with the same rapidity. Five such units have been built; four have been purchased by Sandia and one by the University of Michigan. The units cost $160,000 each. They too, according to Sandia scientist and project leader Mike Mazarakis (1671), who supervised the tests at the Siberian site, are performing without flaw.

Says Rick Stulen (1000), Sandia VP for Science, Technology, and Research Foundations, "This new technology not only represents a remarkable technical advance but also demonstrates the strong engagement of Sandia's scientists and engineers in the international community."

"This is an amazing achievement," says VP Gerry Yonas, a former leader at Z and of the Labs' Advanced Concepts Group.

Happily for Sandia accountants but sadly to those who love the widely distributed arcs-and-sparks photo of Z firing by Sandia photographer Randy Montoya (3651), the new switch eliminates the need for the hundreds of thousands of gallons of insulating water and oil carried by the present Z structure. It was over the surface of that water that the electrical arcing of Z became a phenomenon as much appreciated by graphic artists as it was loathed by engineers (who saw it as wasted energy). Also gone will be much of Z's intricate switching. All were needed to shorten to nanoseconds the microsecond pulse produced by Marx generators.

RUSSIAN SCIENTIST Boris Kovalchuck (right) discusses design of a new LTD system with Dillon McDaniel (left) as Russian manager Alexander Kim looks on. The photo was taken by Neal Singer (3651) during a 2003 Sandia visit to the Institute of High Current Electronics in Tomsk, Russia.

Advantages of the new technology

The linear transformer driver produces its 100-nanosecond pulse from the get-go. It works so well because its design lowers inductances that ordinarily slow electrical transmission.

It does this in part by eliminating the huge plates and extensive wiring in the current Z machine, all of which generate magnetic fields. In the new system, each brick has almost no wiring. Two capacitors about the size of small thermos bottles are tightly linked to a switch the size of a lunchbox. There is little opportunity to generate magnetic fields that slow the passage of current.

Further, linking the bricks in parallel in a cavity not only adds currents, but decreases inductances to levels significantly less than that of Marx generators.

The subsets are then linked in series to add voltage.

This allows a very powerful machine to fire very rapidly, with only a thin layer of oil bathing the rings and rows of switches.

The LTD technology is 50 percent more efficient than current Z machine firings, in terms of the ratio of useful energy out to energy in. Z is currently 15 percent efficient to its load (already a very high efficiency among possible fusion machines).

There is, however, a small matter of cost.

Funding for Z historically has been for defense purposes: Its experiments are used to generate data for simulations on supercomputers that help maintain the strength, effectiveness, and safety of the US nuclear deterrent. Even without its rapid repetition capability, a powerful LTD machine would better simulate conditions created by nuclear weapons, so that data from the laboratory-created explosion of Z firing could be used with greater certainty in computer simulations regarding nuclear weapons. The US has refrained from actual testing of nuclear weapons for 15 years.

But fired repeatedly, the machine could well be the fusion machine that could form the basis of an electrical generating plant only two decades away. Progress in this arena might eventually require funding from DOE's energy arm.

$35 million and five years

To confirm the new Z concept would take $35 million over five to seven years to build a test bed with 100 cavities.

Funding thus far has come from two US congressional initiatives through DOE-NNSA Defense Programs, Sandia's internal Laboratory Directed Research and Development monies, and Sandia's Inertial Confinement Fusion program.

"It's like building a tinker toy," says Keith. "We think we need 60 megamperes to make large fusion yields. But though our simulations show it can be done, we won't know for certain until we actually build it."

The device was designed by Tomsk pulsed-power head Alexander Kim with the switch developed by Boris Kovalchuk. Its speed-up from a microsecond to 100 nanosecond firing was urged by Sandia manager Dillon McDaniel (1650), and encouraged by Sandia managers Rick Spielman (1676) and Ken Struve (1671). The work was led at Sandia and Tomsk by Sandia researcher Mike Mazarakis (1671). Testing at Sandia was by Bill Fowler (1671) and Robin Sharpe (1676). The Z-IFE fusion energy program at Sandia was initiated and is managed by Craig Olson (1640).

Sandia has filed a patent application on a high-power pulsed-power accelerator invented by William Stygar (1671) that can use an LTD as the primary power generator to replace the conventional Marx generator.

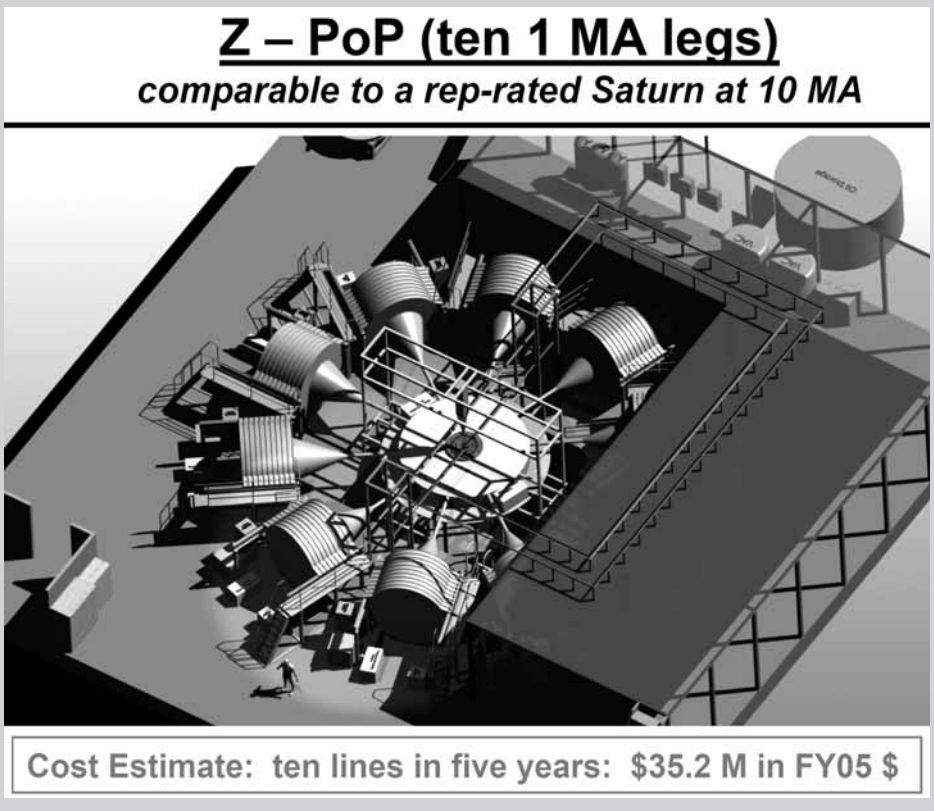
Recent results on LTD development will be presented at the IEEE International Pulsed Power Conference and the IEEE Symposium on Fusion Engineering to be held in Albuquerque in June.

Z-PoP: A concept for using a linear transformer driver to demonstrate repetitive pulsed power operations

Note: A team of Sandia researchers has developed a demonstration project (as yet unfunded) to show how an LTD-based plant might work. The image and explanation here are from their PowerPoint slide.

- Z-PoP (proof-of-principle) is an experiment designed to demonstrate proof-of-principle of the repetitive pulsed power operations necessary for a pulsed power-driven inertial fusion energy (IFE) power plant.
- Z-PoP will consist of a linear transformer driver (LTD) pulsed power driver, connected to a recyclable transmission line (RTL), which in turn is connected to a z-pinch load.
- After each shot, an automated system will remove the RTL/z-pinch load and replace it with a new RTL/z-pinch load.
- The sequence will repeat at about 0.1 Hz (i.e., every 10 seconds), the same as envisioned for an IFE power plant
- Z-PoP will be the first demonstration of a repetitive high current z-pinch, as would be used in an IFE power plant.

R. McKee, Larry Shipers, Finis Long, James Jones, Jeff McDonald, Pete Wakeland



Mold control

(Continued from page 1)

remediation wasn't what we set out to do, but it is effective at killing most micro-organisms, so it's good to find uses beyond our original intent — especially uses that might improve public health."

Large retailers

Two companies hold Sandia licenses to market and distribute products based on the formulation: Modec, Inc., of Denver and Intelagard, Inc., of Broomfield, Colo. Scott's Liquid Gold has an arrangement with Modec to sell Mold Control 500 in retail markets.

"Mold control is an up-and-coming issue," says Modec President Brian Kalamanka. "We felt there was an excellent niche for this."

Scott's existing relationships with several large retail chains helped get the product on store shelves, he says. (The company also distributes wood care and air freshener products, and a subsidiary company, Neoteric Cosmetics, makes and markets skin care products.)

"It's nearly impossible to break into the large retail markets," he says. "Those types of connections are very valuable."

Thousands of stores

Jeff Hinkle, Scott's senior VP for marketing, says developing the packaging and arranging for retail distribution of MC 500, important details for the success of any product, took nearly two years.

With EPA approval newly in hand, shipping to retail outlets began in the fall. Many stores began stocking MC 500 in November, and the product is expected to reach thousands of stores this spring, says Hinkle.

A TV commercial for MC 500, scheduled for airing in the next few months, can be viewed at www.scottsliquidgold.com/mold-control-500.

IN THIS 1999 *LAB NEWS* PHOTO, Mark Tucker (6327) examines two petri dishes: one with a simulant of anthrax growing in it (left), the other treated with the decontaminating foam developed at Sandia (right). The nonhazardous foam begins neutralizing both chemical and biological agents in minutes. Next to Mark is a flask containing about a liter of *bacillus globigii*, the nontoxic simulant of anthrax used in experiments at Sandia. (Photo by Randy Montoya)

Sandia's decon formulation: You've come a long way, baby

During the decontamination formulation's 10-year project life, project leader Mark Tucker (6327) and others have transformed the original chemistry into one of Sandia's top technology transfer success stories.

Sandia's two licensees, Modec, Inc., and Intelagard, Inc., have sold thousands of gallons of the formulation to municipal and state governments, the first responder community, and the US military, among other users.

Over the years it has brought in nearly $300,000 in royalty earnings, according to Craig Tyner, manager of Licensing and Intellectual Property Management Dept. 9104. It also has the distinction of being among a very few Sandia technologies to be made available in the consumer retail market.

Its development began in 1997, funded initially by DOE's Chemical and Biological National Security Program. Other funding contributors over the years have included the DoD and Sandia's internal Laboratory Directed Research and Development program. It has earned two patents, and several more are pending.

The formulation also has been among Sandia's top publicity earners. It first hit the public scene in 1998 when former Sandia chemical engineer Maher Tadros, after presenting its chemistry at a technical conference, got a two-sentence write-up about the foam in an Atlanta newspaper. Its availability and use attracted hundreds of media mentions, including a 1998 spread in the *New York Times'* science section.

The formulation is best known for its role in helping clean up contaminated buildings following a series of mailings of anthrax powder to recipients in Washington, D.C., New York, and Florida in 2001. It was staged in the Middle East in 2003 as part of Operation Iraqi Freedom and has played a role there in helping clean up hazardous chemical sites.

Tests at Sandia and Kansas State University in 2004 demonstrated the formulation's effectiveness for killing the virus that causes severe acute respiratory syndrome (SARS), suggesting its use also might blunt the spread of other viruses such as the Norwalk (cruise ship) virus, avian influenza (bird flu), and the common flu.

The formulation now is being discussed as a potential solution to at least a dozen problems, among them ridding citrus crops of canker (an annual several hundred million dollar setback to Florida citrus growers), hospital sanitization, meth lab cleanup, mold remediation in commercial buildings, and cleaning out agricultural pesticide sprayers in an environmentally benign way.

Need cross-site access or support for NWC engineering applications? Help is just a phone call away

By Chris Burroughs

For Sandians needing access to or support for engineering applications across the nuclear weapons complex (NWC), help is a phone call away.

Engineers across the NWC can now share applications and services, work collaboratively, and receive technical support without having to leave their offices.

A newly instituted access and support process created by the NWC Inter-site Access and Support Team establishes trusted agreements among the NWC sites and plants and maintains these agreements here at Sandia in the NW central repository.

These trusted agreements verify clearance credentials and need-to-know for access. Once the agreements are in place, access can be granted to engineering applications across the complex using group membership.

A primary component of this access process between Sandia, Lawrence Livermore, Los Alamos, Savannah River, Kansas City, Pantex, and Y-12 is the help-desk-to-help-desk model.

"Once established, the success of this cross-site access and support process rests in the hands of the NWC help desks as they follow the help-desk-to-help-desk model created by the team," says Lilia Martinez (4013), who leads the Inter-site Access and Support Team. "When cross-site users experience problems working in the growing number of applications and services shared across the complex, they call their local help desks first to log the ticket regardless of where the application resides. If the problem cannot be resolved locally, then the local help desk personnel involve their NWC-trained counterparts at the impacted site to help work the problem."

> *"If the problem cannot be resolved locally, then the local help desk personnel involve their NWC-trained counterparts at the impacted site to help work the problem."*
>
> **— Team leader Lilia Martinez**

Lilia adds that all the NWC help desks have received special training to respond to NWC application access and support issues.

The Inter-site Access and Support Team, formerly known as the NWC Technical Working Group, began its work in 2003 following a study identifying a need for coordinated user support for the growing number of applications and services shared across the complex.

The team's first accomplishments toward cross-site support were an inter-site service-level agreement and a template for a site-specific addendum. These documents outlined the level of support that would be shared and the specifics that each site could contribute toward the shared support.

The team also maintains a web page containing NWC deployment, application, and services information; NWC alerts; and NWC site scheduled outages and notifications.

Lilia says additional cross-site access can be requested by use of the Synchronized Account Request Automated ProcEss (SARAPE). SARAPE, also established in 2003, is a web application available to the NWC sites to request access/accounts cross site. To date SARAPE has processed approximately 2,700 requests.

For more information, call the Sandia help desk at 845-2243, option 4, or CCHD@sandia.gov. See also http://nwcintersite.sandia.gov or http://sarape.sandia.gov, or contact Lilia Martinez (lmartin@sandia.gov).

Sandia team members

Sandia members of the NWC Inter-site Access & Support Team are Mary Adams (4546), Roberta Jaramillo (4546), Carol Jones (4317), Lilia Martinez (4013), Tom Pratt (4338), Carolyn Quinn (4013), Susie Romero-Sosa (4342), Amy Shrouf (4511), Hal Tidler (4342), and Anita Vasey (4326).

Nanoscience and computer modeling come to the aid of MEMS-scale engineering

"MEMS manufacturing is currently at a fragile state of evolution. In spite of all the wonderful possibilities, very few MEMS devices have been commercialized. In our opinion, the magnitude of the difficulty of fabricating MEMS devices at the manufacturing level is highly underestimated by both the current and emerging MEMS communities."

— Srinivas A. Tadigadapa and Nader Najafi, "Developments in Microelectromechanical Systems (MEMS): A Manufacturing Perspective." Journal of Manufacturing Science and Engineering *125, 4, pp. 816-823 (November 2003)*

Story by Nigel Hey

THINKING SMALL — Sandia scientists and engineers are using advanced modeling and simulation tools (originally developed for the Labs' national security mission) to gain new understanding of physical phenomena at the nano scale. A deeper understanding of such phenomena is vital as the Labs moves into the development of more complex MEMS devices. Pictured here are, from left, Joel Lash (1514), Dan Rader (1513), Channy Wong (1526), Art Ratzel (1500), and Jim Redmond (1525). (Photo by Bill Doty)

Sandia's determination to do big things with tiny technology is evident across the Labs. It has spawned an unprecedented cross-disciplinary surge of interest, attracting new talent in a number of disciplines, from mechanical engineering to microbiology.

At the micro scale, Sandia has pioneered a number of microelectromechanical systems (MEMS) innovations. At the nano scale, as researchers expand their understanding of the science and learn to take advantage of nano's unique properties, the opportunities for innovation are limitless: increased energy efficiency, improved healthcare, and enhanced national security are only the beginning.

The technical community is fairly well agreed that, with time, micro- and nano-scale devices will revolutionize engineering, and that the manufacture of micro-scale devices will be transformed by nano-scale assembly. For now, though, progress in developing complex MEMS devices has been slow, slower than early champions may have hoped or anticipated. To date, the most successful MEMS innovations have been relatively simple devices like mass-produced accelerometers for airbag sensors, inkjet printer heads, and digital mirrors for video projection. In the case of more complex systems with multiple components, unexpected and little-understood problems of reliability begin to appear.

Using modeling and simulation tools originally developed for Sandia's weapons-related work, Labs researches have begun to speed up MEMS development by learning more about the unusual nature of micro-engineered mechanisms and devising ways of turning their peculiarities into assets. Building on this promising approach, continued advances in modeling and simulation are revealing ever more about the world at the nano scale. The latest modeling and simulation results — where nano-scale physical effects can be formulated to describe more general aspects of MEMS systems — are generating a high level of enthusiasm among researches.

NIGEL HEY

Nigel Hey retired from Sandia as a senior administrator in 2001. Since that time, he has published two books, *Solar System* and *The Star Wars Enigma.* He has written scores of articles for publications as diverse as *Smithsonian*, *New Scientist*, and the London *Sunday Times.*

A different world

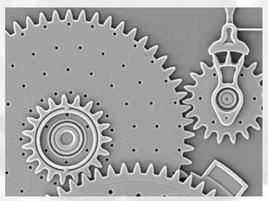
One of the great discoveries of engineering at the micro and nano scales is that the world down there is quite, quite different from the world we can see and touch. Sandia researchers are discovering that if we don't learn to operate in that realm — and essentially that means that engineers and physicists will need to cooperate more closely than ever — then the full potential of MEMS technology will most likely remain beyond our grasp.

In other words, one cannot scale down confidently from macro-dimensional assumptions when the final product is measured in micrometers rather than fractions of an inch. When they attempt to apply traditional methods at such small scales, engineers may find themselves face-to-face with the unexpected — a host of situations in which the experiences of designing in the macro world can no longer provide all the answers.

Because many of the old assumptions don't work and the new ones are much more complex, micro-scale engineering is likely to reap great dividends from the growing interest in modeling and simulation, while relying less on conventional engineering problem solving.

"We are moving from the early, relatively unenlightened days of 'making macro solutions smaller' to doing things a new way, through micro-scale-enabled solutions," wrote Art Ratzel, director of Engineering Sciences Center 1500, in the March 2007 issue of *Mechanical Engineering*, flagship magazine of the American Society of Mechanical Engineers. "Engineering at the micro scale introduces an appreciation of the complex physics at the feature scales of the devices. It demands the appreciation of a ground-up approach to design and problem solving.

"While MEMS has not yet lived up to the optimism of the 1990s, enhanced understanding of scale-dependent physics is helping us to make progress toward the buoyant expectations voiced during those times."



MEMS DEVICES will be more reliable as insights gained via modeling and simulation are incorporated into new designs.

'A lot of new things to do'

As a result, emphasis on computerized design support is increasing dramatically, and modern mechanical engineers are becoming software experts, some arguing that, since MEMS production is an automated two-month process, model-based design verification should be completed before fabrication begins.

"It's exciting that you can review the design and check out the 3-D solid model before it's actually made," says Channy Wong, manager of Applied Mechanics Development Dept. 1526. "You predict the performance, evaluate the responses from different design variations and analyze the results. Applying modeling and simulation allow us to conduct concurrent engineering and optimize the design, reducing cost significantly.

"There are a lot of new things to do," he adds. "I think that's the most exciting thing about working in the micro and nano world. Science and engineering can be very different at that length scale."

Lessons learned: the 1995 micro engine experience

Interest in modeling and simulation blossomed as the result of lessons learned with the Sandia micro engine, an early MEMS product initially developed in 1995. The basic design was simple, and the first micro engines were built under stringent clean room conditions, but proved to be only somewhat reliable. After 477,000 cycles, an electron microscope image clearly showed the reason — accumulation of debris detached from rubbing surfaces (see image in box at far right). The Sandia development team, conceding they had insufficient understanding of the wear mechanisms, accelerated the Labs' research into micro-scale science — and engineering. The "build-and-test" approach, which was relatively expensive, was supplemented with discovery experiments, model development, and computational simulation. This shed new light onto the mechanisms that were causing imprecise precision control and lateral instability ("clamping"), as well as wear.

Since the micro engine experiments, researchers in Sandia's micro-scale modeling and simulation community in 1000, 2000, and 8000 have been occupied with forensics (asking what went wrong?), exploration (can modeling and simulation help ensure that a component will perform up to expectations?), and improved performance (can modeling and simulation suggest better operation and perhaps improved design?). Their next step is to bring about micro-scale-enabled engineering solutions — ultimately a transformation in component design — through shared innovation by individuals specializing in components, engineering, and microelectronics.

Down the rabbit hole

Some engineers compare moving from macro to micro to nano to Alice's trip down the rabbit hole. Physical models must change, sometimes drastically, as length scales shrink. For example, at the world down there gravity is more easily overcome by adhesion; friction models break down; solids melt at lower temperatures; a tiny moving "front" of changing temperature must be described as a quantum effect — as a spreading cloud of ballistic phonons.

Such effects are especially important in polycrystalline silicon (including structures made with Sandia's SUMMiT® V process), which have several levels and have geometry features of 1 to 10 micrometers and grains of 10s to 100s of micrometers.

The fledgling MEMS industry has a limited knowledge of materials physics at micrometer size, and currently commercialized devices are designed for specialized purposes. Partly for this reason, they do not have a broad user base, and therefore have not generated industry standards or the design and process software that would be built based on those industry standards. However, this may change as Sandia's materials science, engineering, and computer sciences organizations develop engineering systems that, while designed for their own use, could migrate into the private sector and revitalize the pace of invention.

While Sandia is seeing a major effort to harness nanoscience for the improvement of esoteric applications such as micromachines, big benefits for everyday products also are visualized by Jim Redmond, manager of Strategic Initiatives Dept. 1525. Jim calls this "the connection of nano-scale phenomena to the engineering of macro-scale solutions for the world we live in, like lighter, stronger, more robust materials."

"For example, carbon black is a 'nano material' that has been used for years to enhance the performance of tires, a product we're all familiar with," he says. "This benefit was determined by trial and error. With modern computing and production tools, we ought to be able to engineer similar improvements for many products."

"As these new perspectives evolve into reality, a new breed of engineer is also coming into existence," says Art in *Mechanical Engineering.* "In fact, the line among the computer scientist, the materials scientist, and the engineer is becoming blurred and indistinct. Mechanical engineering cannot help but benefit from this exciting new horizon. MEMS is here to stay, and it will transform the future."

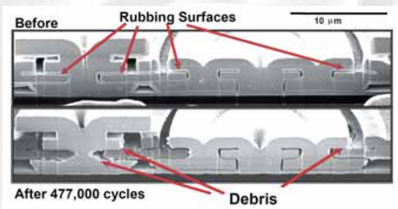
SANDIA will be able to fabricate ever more complex MEMS devices as researchers gain a deeper understanding of phenomena at the nano and micro scale.

SANDIA'S MESA COMPLEX brings together resources in high-performance computing, modeling and simulation, advanced engineering processes, microfabrication facilities, and other capabilities to meet the challenge of building "small, smart things." An understanding of nano- and micro-scale phenomena is central to the long-term viability of the MESA mission. (Photo by Bill Doty)

Some of the challenges of scaling down

The physics of the "normal" world, the macro world we live in every day, begins to break down in odd and unanticipated ways at the micro and nano scale. For example, many surface interaction models depend on a statistical description of the asperity heights — that is, points of roughness — for high-contact forces, since the real contact area increases with load as asperities are flattened and more come into contact. But with light contact, only the outlier asperities are engaged. Thus, at the macro scale, where a surface will have many contacting asperities, the real contact area varies directly with load — the heavier the package, the harder it is to slide along a counter top. But at the micro scale, unfamiliar effects can increase static friction (stiction, the force required to get an object moving), as a result of the interaction between single asperities.

Understanding the effect of asperities is vital, because asperity points are an artifact of MEMS fabrication. MEMS structures are built from depositing and etching away polysilicon at selected areas using a multilayer, multistage photolithographic process. Each deposition and etching process exposes a new surface which, when examined with an electron microscope, can be seen to include a large number of unwanted rough points, or asperities, which project at various heights above the "real" part of that surface. In the macro world, the effect of these asperities gives rise to an averaging-out notion of "slick" or "rough" surfaces and thence to the idea of sliding friction, the force that resists relative motion between two bodies in contact. On the micro scale, friction behavior depends on discrete contacts because each asperity is relatively large and a small number of them will interact and produce effects of their own — for example breaking off and generating debris. The physics of friction at the nano scale is not completely understood. This is still an active area of research.



PHOTOMICROGRAPH of an early Sandia-fabricated MEMS — microelectromechanical system — device, depicting severe wear after 477,000 cycles.

Computational simulation of a Sandia-designed micro-scale thermal actuator provides another example of how size affects how things work. In this device, electrical current passes through four mechanical legs, causing them to expand and displace a shuttle with a reciprocating motion. Remarkably, conventional methods predict the beam temperature at 750 kelvin, whereas Sandia's "non-continuum" calculation, using nano-scale data, puts it at a more accurate 900 K. With some materials, this could make the difference between melting and not melting.

Sandia-mentored students take stock of their chances at Intel International Science and Engineering Fair

By Iris Aboytes

Christian Hammond, Tyrus Sanders, and Quinton Smith are not Sandians, but they could be in the near future. Their science fair project was judged so exceptional, that they not only qualified for the New Mexico State Science and Engineering Fair, they qualified for the Intel International Science and Engineering Fair to be held in Albuquerque May 11-18.

"This is the first time in 57 years that three students of African descent from Albuquerque or New Mexico have qualified to compete in the International Science Fair," says Jaci Hernandez (6332).

Jaci is a volunteer instructor for Sandia's Hands On/Minds On Technology course that prepares students to take standard tests. "All three young men were members of the class and responded positively when I suggested they work as an International Science and Engineering Fair (ISEF) team," she says. "Interestingly enough, the test results showed that these same students had scores at the top of the class.

"Sandia retiree Jim Campbell had been my daughter's mentor so I asked him if he would mentor underrepresented students for the science fair," says Jaci. "He agreed."

Quinton is a senior at La Cueva High School, Tyrus is a junior at West Mesa and a member of the Photonics Academy, and Christian is a senior at Rio Rancho High School.

"Quinton is quiet with a huge sense of responsibility," says Jim. "He wrote the project report. Tyrus is outgoing; he is the cheerleader and public speaker of the group. Christian is the organizer, steady and dependable."

"Factors, Forces, and Forecasting: Stock Market Modeling and Simulation," the subject of the team's project, was Jim's brainchild. "They say that retirement is when your hobby becomes an obsession," says Jim. "Well, I've been interested in the stock market for years but never had the time to take it seriously. After retiring from Sandia last June, I finally had the time to try out some ideas. When Jaci asked me to work with a team of students, I agreed as long as the project was something of interest to me. I discussed the project idea with the students and they also found it interesting, so we started learning together."

ISEF BOUND — Students (left to right) Tyrus Sanders, Quinton Smith, and Christian Hammond, seen here with mentor James Campbell, will compete in the 2007 Intel International Science and Engineering Fair.

The stock market, Jim explains, enables people to own part of a company and benefit from its growth through the buying and selling of shares. There are hundreds of technical indicators used by investors to time their stock trades. The hypothesis for the project was that modern optimization techniques can be used to improve timing strategies for stock trading.

The project team used a simple strategy to time their stock trades. They wrote a computer program to implement their trading strategy along with a genetic algorithm. They selected six stocks without examining the stock's price history. Stocks of the six companies were bought and sold (virtually) throughout the year at times indicated by the optimized trading strategies. The result of the test was that the account made a 20 percent gain over the year, which beat the benchmark S&P 500 index.

Jim's house became the laboratory where the extended team met every Saturday for three to four hours. Jim's wife Judy provided encouragement and snacks. A fourth team member, Jonathan Smith, attended the sessions but did not compete in the science fair. Jonathan's grandmother, Darnell Woodfin, attended the sessions to make sure the boys arrived on time and had their assignments complete.

"The team members had the science project work plus all their school work," says Jim. While all three team members have a good overview of the project, they each had their specific areas of focus. Tyrus wrote the computer program that implemented a genetic algorithm and the stock trading strategy. Quinton wrote the project report and Christian developed the project displays. Christian and Quinton did most of the data analysis. Jonathan kept the project notes.

"I am very proud of them," says Jim. "At the regional science competition in Albuquerque, I was more nervous than they were. We are all looking forward to the international competition with hope and anticipation."

Pauline Bruskas is newest Harriet Goodness Award winner

By Iris Aboytes

Pauline Bruskas (10263) doesn't see volunteering as something you do once in a while. For her, it is a way of life.

As a child she went along with her mother as she volunteered to help disabled children. "You have to have a heart for other people; other people have needs," her mother would tell her.


PAULINE BRUSKAS

Recently Pauline was honored with the Harriet Goodness Award.

The Goodness Award is presented to an employee who has contributed significantly to Sandia's volunteer efforts.

As a member of the Division 10000 Diversity Council, Pauline is the project leader for the Roadrunner Food Bank's Food for Kids drive and the Christmas gift drive supporting Peanut Butter & Jelly Family Services, Hogares, and Share Your Care senior citizens' group. The 2006 food drive totaled 7,943 pounds.

"I was the youngest of seven children," says Pauline. "Whatever free time my mother had, she spent doing volunteer work. Because of my mother, I became aware of the needs of our community at a young age."

> *"Because of my mother, I became aware of the needs of our community at a young age."*
>
> **— Pauline Bruskas**

Pauline was co-leader of the missionary group at Calvary Chapel Albuquerque that served children at an orphanage in Mexico. She attended the first School of Missions sponsored by Calvary Chapel and was part of a group mission that went to Mexico and Guatemala. The six intense months in the mountains prepared her for long-term mission work.

"I was single and decided this is what I wanted to do with the rest of my life," says Pauline. "Before I left to the mission field, my co-leader Larry Bruskas and I realized our friendship had evolved into something deeper, and we became engaged. He would wait for me until I returned from my mission. As luck would have it, I developed a medical emergency and had to return stateside.

"Although I was unable to continue mission work full time in Mexico and Guatemala, the consequences here at home were wonderful. Larry and I got married. We were partners in our passion and became partners in life.

"I know I don't have to go far to do volunteer work," says Pauline. "Like my mother, I can serve and do volunteer work in my own backyard."

"A total of 120,935 hours were logged last year by Sandia volunteers," says Community Involvement Dept. 3652 Manager Bruce McClure. "That equates to a small company of 60 working full time for a year."

Shining Eagle Award Winners

The Shining Eagle Award is presented to a Sandia employee and a retiree who have given the most volunteer hours to their community.

Paul Schlavin (10824) received the Shining Eagle employee award for his work with the Boy Scouts and Soccer Leagues for Youth. Paul coaches two American Youth Soccer Organization select teams, is a scoutmaster for Boy Scout Troop 6, and is an elder in his church. He says his reasons for volunteering stem from his desire to be an example to the youth of New Mexico with respect to teamwork, sportsmanship, dedication, honesty, perseverance, and hard work. Paul volunteered more than 1,600 hours last year.

The retiree Shining Eagle Award winner is David Berry. David volunteered more than 2,000 hours to Alcoholics Anonymous. He has dedicated his life to helping others achieve sobriety. He has served on both the National Council on Alcoholism and Drug Abuse and the New Mexico Commission on Alcohol and Drug Abuse to promote a safe and healthy community. To become more knowledgeable on addiction, David attends lectures and seminars as he continues to help many individuals.

The Shining Eagle Award comes with a $500 check that goes to an agency of the recipient's choice. Paul selected the American Youth Soccer Organization (AYSO). David's choice is St. Martin's Hospitality Center.

Video Services wins awards

Video Services Dept. 3653 has won several awards in the 2007 Videographer Awards competition, which recognizes outstanding achievement in video production. The competition is administered and judged by the Association of Marketing and Communication Professionals. Two productions, *"Electro/Needle Biological Sensor Array,"* based on an R&D 100 submission, and *"Video Streaming,"* which explains uses for and benefits of video streaming at Sandia, earned the Award of Distinction, the highest award for outstanding work. *"Meeting of the Minds,"* a production that features special effects to demonstrate the problems that result when there is a lack of diversity in the workplace, earned the Award of Excellence, which is presented to projects deemed to be written, produced, shot and edited in an exceptional manner. The productions *"Mode-Filtered Fiber Amplifier,"* based on an R&D 100 submission, and *"Shoes for Kids 2007"* earned honorable mentions.

Sandia hosts high school homeland security conference

Even as the nation was still recoiling from the murderous violence that claimed the lives of more than 30 students and faculty at the Virginia Tech campus and left dozens more injured, high school students from New Mexico, Arizona, and California were learning how to deal with disruptive situations in their own communities. The students were in Albuquerque as participants in the inaugural High School Homeland Security Conference.

The April 20-22 conference, hosted by Sandia, was held at the AmeriSuites Hotel. It was preceded by a kickoff dinner and reception at the National Atomic Museum, where Albuquerque Mayor Martin Chavez welcomed the participants. Sandia Deputy Labs Director and Senior VP Al Romig also addressed the students. The conference also included a tour of Sandia's homeland security facilities and a presentation by Bernalillo County Sheriff Darren White.

Conference organizer John Taylor, manager of ITS Strategic Office Dept. 303, says that while the agenda for the conference didn't include specific reference to the Virginia Tech rampage, the scenario-based program asked students to develop ways to deal with a hypothetical emergency event in their own communities.

The High School Homeland Security Program was started in 2005 by John and Needles, Calif., high school teacher Lyn Parker. (John is a native of Needles and has maintained close ties with Needles High School over the years).

Basic principles of homeland security

The program, John says, is designed to enhance the critical thinking skills of high school students and to develop their understanding of the basic principles of homeland security and emergency preparedness. Since the program's inception, participants have been asked to plan for major terrorist incidents, industrial accidents, and natural disasters in their home communities. As a culmination of that planning, students then are presented with a full-scale event in which they must exercise their skills while working through complex emergency situations in near-real time.

"The conference was successful beyond my wildest dreams," says John. "The enthusiasm of the 41 students and five faculty advisors was obvious and palpable; you could actually see the learning and critical thinking skills improve as the students shared their experiences and worked together to resolve questions and solve the new problem they were given on Sunday. In light of the negative publicity given to students these days, this was a definite exception."

Conference attendees came from Needles High School in Needles, Calif., River Valley High School in Mohave Valley, Arizona, the Livermore Valley Homeschool Coalition, and the Southwest Learning Center charter school in Albuquerque.

After being briefed about the program last year, Assistant Secretary of Defense for Homeland Defense Paul McHale said, "This program should be a part of the curriculum in every high school in the country." John says that with appropriate resources, the program is readily expandable to other high schools.

The program is sponsored by the International Technologies & Systems Strategic Management Group and the Homeland Security and Defense Strategic Management Unit.

CRITICAL THINKING — Nancy Buegler (left) from Needles High School, Ashleigh Coon (right) from Southwest Learning Center, Eric Thornton (left rear) from River Valley High School in Arizona, Michael Hamilton (rear right) from Southwest Learning Center, Crystal Guarisco (behind Nancy) from River Valley, and Pete Peterson (far right), a faculty advisor from Needles High School, take on the roles and responsibilities of local officials during a homeland security exercise. (Photo by Denise Dixson, Southwest Learning Center)

Va. Tech alumni

(Continued from page 1)

He says for the most part he was busy studying during his undergraduate years but became a little more relaxed as a graduate student. At one point he worked at the school cafeteria, was active in the Corps of Cadets for one semester, and later taught an introductory finite element course for a semester.

Dan took two classes with Virginia Tech professor Liviu Librescu, who was killed during the shooting. "He was a genius and he cared about students and went out of his way to help them out," Dan says. "He was not a very big guy; what he did for his students [on that day] truly showed that he was heroic."

'A great place to go to school'

Dan says he has participated in several local alumni events and will always have a special connection with his alma mater.

"It's a great place to go to school," he says. "It's just unbelievable to see that it happened there."

Manoj Bhardwaj (6463) also received his bachelor's, master's, and PhD in aero engineering from Virginia Tech and has been close friends with Dan since their early days in college.

"I was deeply saddened as the news unfolded that day," he says. "At first I thought it was an isolated event and then couldn't believe what was happening."

"My family and colleagues will do whatever we can to support Virginia Tech," he says.

Tim Brown (1535) and Nicole Breivik (1524) met at Virginia Tech and both received their master's and PhDs in engineering mechanics in 1992 and 1997. They met in Norris Hall (where most of the shootings took place) when Tim came to her office on the first floor.

"Who would have known years later that I would have sat through Tim's dissertation defense in a conference room on the second floor of Norris Hall with our sleeping six-week-old son," says Nicole.

Remembering Liviu Librescu

"He was a genius and he cared about students and went out of his way to help them out. He was not a very big guy; what he did for his students [on that day] truly showed that he was heroic."

Former student
Dan Hammerand (1524)

LIVIU LIBRESCU

Since the university owns a lot of beautiful land, the campus felt like home, says Tim.

"It was always a nice distraction to unwind in such a beautiful and pristine setting," he says. "It was a great place to study intensely and when it was time to take a break, many of the activities took place on campus or immediately adjacent to campus."

Nicole also knew Professor Librescu and discussed her work with him a number of times.

For junior high school sweethearts from Lubbock, Texas, Eric and Kay Vugrin (both 6711) say their fondest memories of Virginia Tech are centered on the birth of their daughter.

"Our families were more than 1,000 miles away, and as first-time parents, we had our hands full," Kay says. "During the weeks and months following our daughter's birth, we received tremendous help from our friends and professors."

Friends cooked meals for them and babysat, and professors were understanding of the balance between being students and parents.

"It was then that we truly realized how fortunate we were," she says.

They attended Virginia Tech from 2000 to 2004. Eric received his PhD in mathematics in 2004, and Kay received her master's and PhD in mathematics in 2003 and 2005, respectively.

"We keep in touch with several close friends that we met while at Virginia Tech, and periodically communicate with our professors," Eric says. "The close ties between the town of Blacksburg and Virginia Tech are very apparent to anyone who has spent time in Blacksburg."

Chris Cornelius (6338) received his master's and PhD in chemical engineering in 2000 from Virginia Tech. He says when he and his wife were living there they never had to lock their doors.

"It was a very tight community of diverse and welcoming people," Chris says. "I am terribly sad, as we all are, about what has happened to the families and friends at Virginia Tech."

Mother taught in Norris Hall

Anna Snider Lord (6312) was raised in Blacksburg and attended Virginia Tech from 1992 to 1995, where she was a member of the Marching Virginians. She received her bachelor's degree in geology in 1995.

Her father, mother, and stepfather all currently teach at the school.

"They just made it through their first day of classes on Monday and were impressed with how many students have returned to school."she says. "The events hit my mother the hardest since she taught math classes last fall in Norris Hall at the same time and in the same rooms where the shootings occurred."

Although it has been more than 20 years since Chuck Andraka (6337) got his bachelor's and master's degrees from Virginia Tech, he still has a number of friends in the area. His thesis adviser is a professor there and is also a personal friend. "He attended my church while I was there." Chuck says. "Our church was a close-knit group, with students, professors, and families."

Chuck took a number of classes in Norris Hall.

"I imagine myself in the situation, and cannot figure out what I could have or would have done. It brings tears to see Virginia Tech in this light," he says. "However, there are very strong positive stories of heroism and survival, and particularly of faith.

"We look for reasons or patterns or blame," Chuck says. "However, in a free society, you cannot control every person, and we should not give up freedoms to ultimately control every action. Someone bent on destruction will always find a means to perform that destruction. We cannot let the terrorists and other evil people dictate the way we are to live and practice our freedom."

Mileposts

New Mexico photos by Michelle Fleming
California photos by Randy Wong

Carol Mehrhoff
30 2736

Albert Villareal
30 10313

David Wenger
30 1675

Ralph Chapman
25 10756

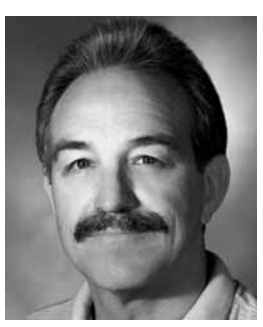
Ray Ortiz
25 5353

Ruth Anne Padrick
25 8521

Matthew Sena
25 5345

Marilyn Sprague
25 2995

Wendy Amai
20 6472



Michael Bell
20 8235

James Hutchins
20 8965

Brad Mickelsen
20 12334

Ted Parson
20 17491

Barbara Reser
20 2916

Karen Cardwell
15 8944

Jennifer Chan
15 8244

Debbie Chavez
15 10532

Wei-Yang Lu
15 8776

Barbara Lucero
15 4531

Elaine Martinez
15 5533

Carolyn Marvin
15 5402

Doug Medlin
15 8756

Ross Miller
15 10328

Susan Schear
15 10531

Annette Sobel
15 303

Michael Strosinski
15 10322

Recent Retirees

Russell Smith
36 4532

Gloria Chavez
28 6121

Brian Kelly
23 12870

Marsha Merillat
23 5500

Nancy Campanozzi
16 1057

Josh Whaley
20 8758

Edward Bujewski
15 2712

IES all-minds meetings scheduled

Joe Polito, director of Integrated Enabling Services Support and Lab Management System Center 10700, will host 2007 IES SMU all-minds meetings in New Mexico and California.

The New Mexico session will be in the Steve Schiff Auditorium May 2, 9-11 a.m. MDT, and the California session will be in the Bldg. 904 auditorium May 10, 1-3 p.m. PDT.

The program will provide those who work in the IES SMU a look at its present and future, especially in the areas of changes in Sandia's business environment and customer service expectations. Sandians in 3000, 4010, 4300, 4500, 4600, 8500, 8940, 9000, 10000, 11000, and 12100 are urged to attend.

A question-and-answer session will follow the presentations. Send questions to Joe Polito or Doug Weaver by close-of-business Monday, April 30. If you want to assure anonymity, submit your question by the deadline to the Corporate Ombuds: Don Noack at 844-2145 or ddnoack@sandia.gov or Gerry Hays at 844-4135 or gnhays@sandia.gov and specify "Question for IES All Minds." If there is not sufficient time to address all questions, answers will be posted on the IES SMU website.

The May 2 session will be video-streamed live. Address questions about the session to Jane Zingelman (10710) at jtzinge@sandia.gov.

The IES Help Desk can cover your service phones. Contact Lee Owen at 845-9989 or leowen@sandia.gov three days before you need the service, or dial YESS (9377).

Sandian Jason Zuffranieri wins silver medal at Sudoku World Championship in Prague

By Iris Aboytes

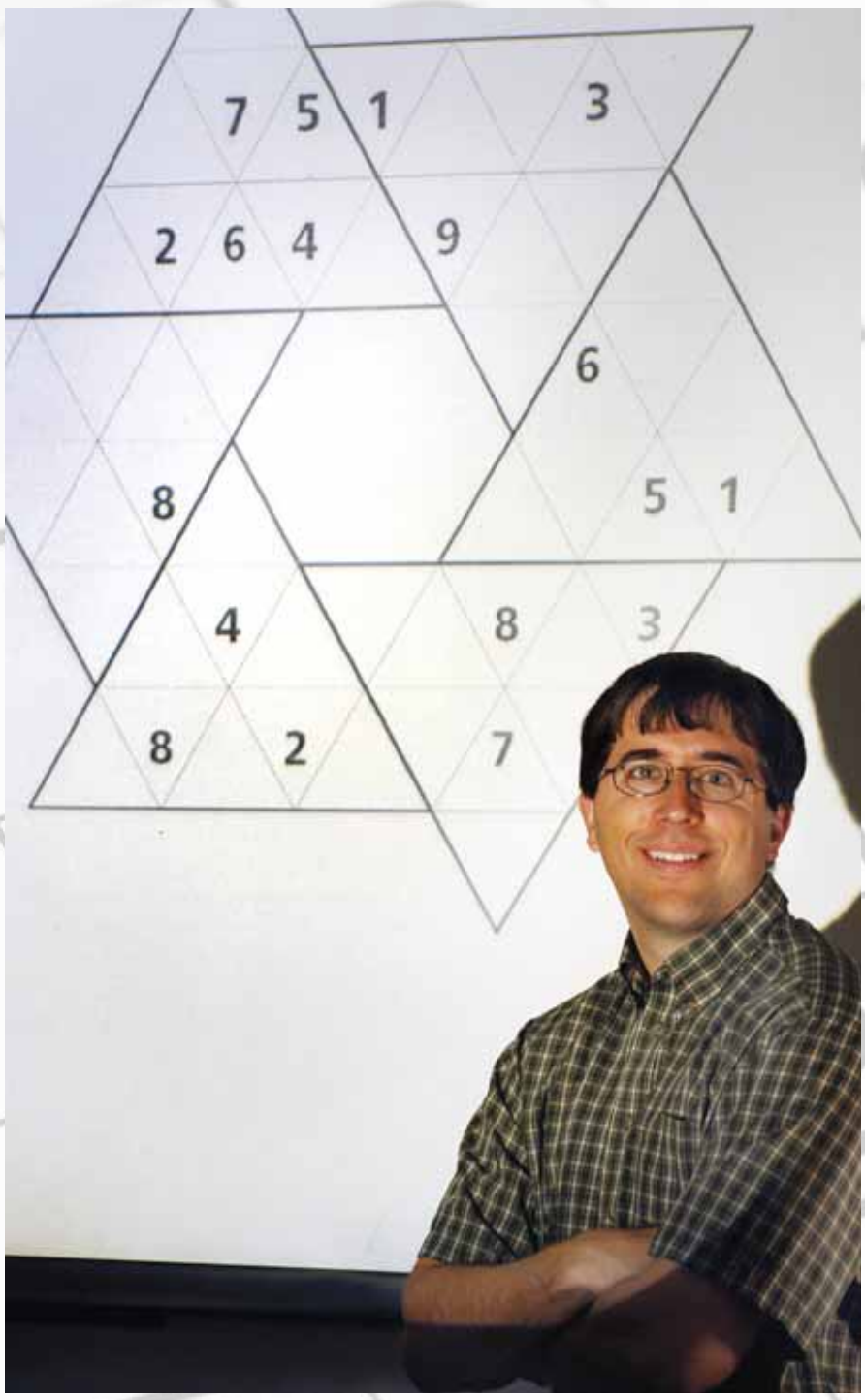
Jason Zuffranieri (6761) began solving puzzles when he was about eight years old. It finally paid off. He was part of the American team that recently won the silver medal at the Second Annual World Sudoku Championship in Prague, Czech Republic. The Japanese team took home the gold.

For those unfamiliar, Sudoku puzzles consist of grids, usually of nine rows and nine columns, with nine square regions drawn into the grid. A puzzle will have some digits initially given in the grid, and the solver fills in the rest of the cells so that each row, column, and region will contain all the digits from 1-9. The puzzles are featured in hundreds of newspapers around the world.

"I had seen Sudoku in puzzle magazines for years" says Jason, "and began to get serious about solving them about two years ago. The more I did the better I got." It takes Jason five minutes or less to solve the daily *Albuquerque Journal* puzzle and a few minutes more for the more difficult weekend puzzles. In addition, he visits websites to download puzzles.

Jason learned that there was a World Sudoku Championship after the inaugural event had taken place. He hoped to be a part of the American team at the next one. Tryouts were announced in January. Contestants reported how long it took to complete a set number of puzzles with the fastest 15 to 20 solvers advancing to the next round.

"The second set was more difficult and intense," says Jason. "We were sent a PDF file and provided its password at a given time. We had 90 minutes to solve 10 Sudoku puzzles, some of which were variations I had never seen. I finished them in about an hour and faxed in my sheets. Later that week I was notified I was one of two finalists who made the American team."



PUZZLED — Jason Zuffranieri (6761) took home a silver medal as part of the American team that competed in the World Sudoku Championship in Prague, Czech Republic. (Photo by Randy Montoya)

Two of the Americans on the team had finished in the top three at last year's championship. All of the members except for Jason had gone to a puzzle world championship before.

To prepare himself for the championship, Jason spent 60 to 90 minutes a day working on Sudoku variations furnished by the organizers.

The championship consisted of six individual rounds, each lasting 30 to 60 minutes. Top performers advanced to an elimination playoff. Jason made a couple of costly errors in the first three rounds, and was in 22nd place, third among the Americans, heading into the second day. The second day went much better for Jason, possibly because of an unexpected reason (weapon).

"We had only fizzy water to drink with our meals," says Jason. "The second day, before the rounds began, I drank a caffeinated soda. I don't know if it was the caffeine or maybe just being less nervous, but I did better." Jason was among the top scorers on the second day and finished in 10th place.

The team medals are determined based on individual points plus points from special team competition.

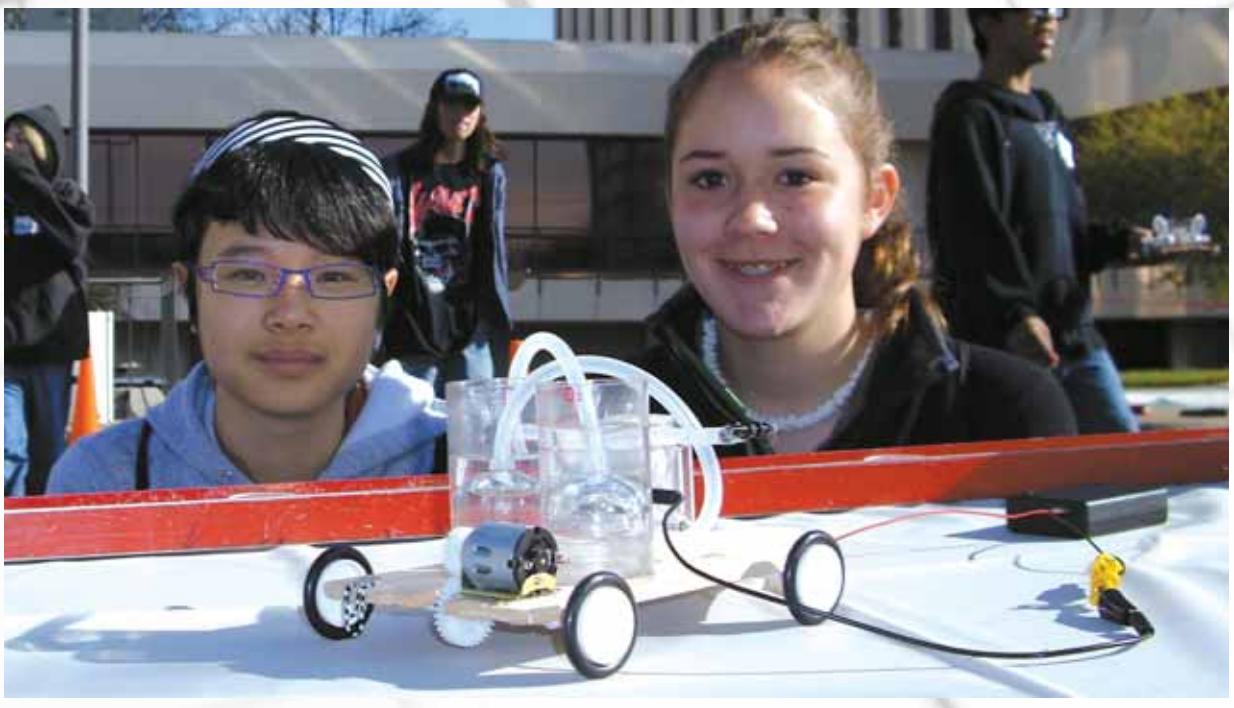
Thirty-one countries were represented in the competition. Jason was one of four Americans who participated in the two team rounds.

American Thomas Snyder, a Harvard doctoral candidate, took the individual title. "Czech President Vaclav Klaus, a fan of Sudoku, came to watch the finals," says Jason.

Next year's championship will be held in Goa, India. Jason says he hopes to qualify again. "It's an honor to be a part of the American team," says Jason. "I hope to be part of next year's American team that brings home the gold."

Jason says he wants to meet with puzzle fans from Sandia in anticipation of this June's US Puzzle Championship. "Look for a *Sandia Daily News* article soon," he says.

Alternative Fuels Challenge



SANDIA PARTNERED with APS and PNM to host the first Alternative Fuels Challenge on April 14. Teams from 15 middle schools competed in essay, oral presentation, hydrogen fuel cell model car design, and car race competitions. "It was a great event that challenged students to explore engineering while learning about the importance and issues involved with the application of alternative fuels," says Bruce McClure, manager of Community Involvement Dept. 3652. (Photo by Amy Tapia)

Sudoku *(Irregular)*

Place a digit from 1 to 9 into each of the empty squares so that each digit appears exactly once in each of the rows, columns, and the irregularly shaped regions.