A painstaking pursuit of better glass

Labs ceramics experts seek improved materials, methodologies for better safety and survivability

By John German

For a fraction of a second following a bomb blast, window panes hundreds of feet away become sails in the blast's pressure wave. Then they shatter into thousands of flying, razor-sharp daggers.

That's why shattered glass is often among the most dangerous hazards in a terrorist bombing. During the 1995 Oklahoma City federal building attack, for instance, 200 injured people at locations other than the Murrah building at the time of the blast reported they were hurt by falling or flying glass.

A team of Sandia ceramics experts now is studying glass in a quest to develop windows that are stronger, that survive and fail when they're supposed to, and that shatter into smaller pieces, like grains of sand rather than shards, when they break.

They also want to develop a standard set of methodologies to test samples of many different glass types and configurations so architects and builders have more information at hand when they select glass for a building.

The project is supported by Sandia's Architectural Surety® program and funded through the Laboratory Directed Research and Development (LDRD) program, with past

(Continued on page 5)

GAINING a better basic understanding of window glasses — why they fail, how they fracture, and what might make them stronger — is the objective of a team of Sandia researchers led by Jill Glass. (Photo by Randy Montoya)

Testing acceleration

Every time instrumentation developed by Telemetry and Instrumentation Dept. 2665 is fired in a projectile into targets, it's like the Fourth of July. Read about the department's successes in Chris Burroughs' story on **page 6.**

Sandia LabNews

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Sandia National Laboratories

Labs' licensee unveils explosives-sniffing security portal in Washington, D.C.

Start looking for portals at airports, arenas, office buildings soon

Explosives-detection technology originally developed at Sandia is part of a new security portal unveiled last week in Washington, D.C.

Barringer Instruments (Warren, N.J.) showed off its new walk-through explosives-detection portal, the SENTINEL II, to members of the news media and potential customers May 9.

The portal noninvasively screens about seven people per minute for explosives and a variety of other chemical residues and can be used at airports, office buildings, sports arenas, and other high-traffic areas, according to Barringer.

Sandia developed and licensed to Barringer the sample preconcentrator used in the SENTINEL II. The technology traps particles and vapors from a large volume of air, then directs the concentrated chemical sample to Barringer's IONSCAN® detector for analysis. The preconcentrator makes possible the detection of very low concentrations of chemical compounds of interest, says project leader Kevin Linker (5848).

The company says the device can detect narcotics and some chemical warfare agents as well.

"The recent shoe bomber incident is just one example of the necessity to screen people," says Barringer President Ken Wood. "However, the traveling public expects screening to be quick and nonintrusive. The SENTINEL II solves all of these issues."

BARRINGER'S SENTINEL II walk-through portal can "sniff" seven passengers per minute for residues of explosives and other chemicals.
(Photo courtesy of Barringer Instruments)

Bob Eagan, VP for Energy, Information, and Infrastructure Surety Div. 6000, represented Sandia at the news media demonstration.

"All of us at Sandia are proud to be a part of this effort, and to see what began at Sandia . . . evolve into a public safety product that will give us all peace of mind when we travel," he said.

A Barringer spokesperson says the company hopes for FAA approval to use the device as an airport screening tool within the next few months.

—John German

Latest ethics survey responses up compared to 1999 results

Lockheed Martin survey conducted every two years since 1995

By Bill Murphy

In recent years, Lockheed Martin has invested considerable attention to ethics in the workplace, an effort that appears to be paying tangible dividends.

Surely, everyone remembers the Dilbert training sessions and the sometimes-hilarious ethics sketches starring actor Patrick Warburton. Well, those fun-with-a-purpose exercises must have sunk in with employees. The numbers prove it.

A comparison of Lockheed Martin ethics survey data between the 1999 survey and the November 2001 survey indicates that employees, Sandians included, have a more positive view of ethics in the workplace now than they did two years ago.

(Continued on page 4)

What's What

Strolling absently down a hall, papers in hand, brow furrowed in seeming concentration doesn't necessarily mean someone is focused on a challenge. A colleague was wandering around our office like that recently, holding a sheaf of papers, and someone remarked that he must be pretty busy, with so many reports.

"Naaa," he answered. "I just got these out of the recycle box."

* * *

Well, the developers may be on-target and the residents may be happy, but whoever painted the lovely blue sign on southbound Eubank that proudly announces Sandia's Science and Technolgy Park is probably a little red-faced.

After pointing out the miscue recently, Roxie Jansma (5931) wondered if there might soon be "groundbreaking for our Remedial Spelling Center."

* * *

A recent story in the *Boston Globe* announced that researchers at the US Army lab in Natick, Mass., have reached a long-sought goal: a sandwich that can lie undisturbed and unrefrigerated for up to three years. It might be a bright spot for the researchers, but I bet the troops whose packs that baby's headed for could add at least a couple more un's — unappetizing and unopened.

Of course, it might work out if the Army could have Emeril Lagasse standing by every time one of the indestructible sandwiches came out of its four-layer shroud. He'd just add a handful or two of garlic cloves and . . .

* * *

Sometimes you see a name that might be better if it was different, just because of the initial impression it could make on someone encountering it for the first time. One such showed up last Friday in the *Sandia Daily News*. It was an announcement from Guild Copeland (1112) about an upcoming meeting of the New Mexico Chapter of the American Vacuum Society.

Being a non-techie, the first thing I thought of was Oreck, Hoover, Kirby, Dirt Devil, Eureka. Then I thought: Isn't a vacuum . . . ??

(Apologies to Guild and his colleagues; just too good an opportunity to pass up.)

* * *

And while we're on the subject of words, self-described "amateur geneologist of Scotch-Irish extraction" Gary Phipps (5713) sent along a little etymological clarification about a program the Advanced Concepts Group prepared for Take Our Daughters to Work Day. The ACG tagged the program — about the Arab world and the roles women might play there — "Beyond the Veil."

Gary opines that that is a variation on "beyond the pale," which, he writes, comes to us from the early 17th century when the English occupying Ireland cleared a protection area around their fortified enclaves that they called "the pale." And, he explains further, going "beyond the pale was leaving civilization to mix with the 'mere Irish.' "

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

Sandia LabNews

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LOCKHEED MARTIN

Unity in Freedom: Asian Pacific Islander American Heritage Day

Sandia's Asian Leadership & Outreach Committee and the National Atomic Museum in Old Town on Saturday, May 18, are teaming up to celebrate Asian Pacific American Heritage Month. Activities will include exhibits, puppets, martial arts demonstrations, Feng Shui, food samples, and more. The cost is free with museum admission, $4 for adults, $3 for children, students, seniors, and active-duty military.

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Keep America strong – Buy US Savings Bonds

Bond drive is May 20-June 7

By Iris Aboytes

The events of Sept. 11 woke us up and made us take stock of many things. We may be trusting people by nature, but we became mistrusting as we started looking over our shoulders. The words "Let's Roll" became our motto as our country became more determined than ever to prove that we are still the strongest and the most powerful.

To be the strongest and the most powerful takes people, money, and might. The people are our trained armed forces, standing ready to serve. The might are the powerful weapons made to deter our enemies. The money you and I can try to furnish by purchasing US Savings Bonds. Bonds are an investment not only in our future, but in our country's future.

Sandia's annual Bond Drive begins on May 20 and ends June 7. Now it is easier than ever to purchase bonds. From your computer you have many purchasing options, so select one or two and make it work for you. It is that easy. If you decide you don't want to keep them for the future but for a rainy day, that works too!

Bonds, "baby bonds," were first offered in 1935. The current Series EE bonds came into being in 1941. They played a major role in financing World War II. What role will the current EE Bonds, I Bonds, and especially the new Patriot Bonds play on our nation's War on Terrorism? Only time and history will tell.

Treasury offers the inflation-indexed I Bond, which provides all Americans the opportunity to protect the purchasing power of their savings from inflation. The Bond offers a fixed rate above inflation for up to 30 years. I bonds are sold at face value. Series EE bonds are sold at half their face value and earn rates based on five-year Treasury securities.

New interest rates on bonds are announced each May 1 and Nov. 1. Bonds earn competitive rates of return compared to other forms of saving. The interest earned on savings bonds is exempt from all state and local income taxes. Federal income taxes are deferred until the bonds reach final maturity, or when you redeem them.

With the stock market the way it is, perhaps the time to think about purchasing bonds is here. Why not do both? Financial analysts are now recommending bonds for your portfolio. For more information on the new Patriot Bond and interest rates go to www.savingsbonds.gov, or better yet call your organization's bond drive representative or Juanita Sanchez, our Sandia savings bonds guru, at 844-1307.

Americans recognizing the seriousness of the Sept. 11 event have rallied in many ways. One of the ways is purchasing bonds. Since Sept. 11 a record number of Bonds have been purchased nationwide. What do you say? In the words of Todd Beamer, "Let's Roll."

For the record

CAPTION CORRECTION — A caption on page 5 of the May 3 issue misidentified a participant in the 12th Annual International Arms Control Conference. The caption should have read: "Ambassador Ahmad Kamal (left), retired representative of Pakistan to the United Nations, and Maj. Gen. Mohammad K. Shiyyab of Jordan have an intense conversation during a break."

Sandia manages W80 Life Extension program, the first weapons project located in California this decade

By Nancy Garcia

It has been said that weapons reliability requirements are akin to storing a Camaro in your garage for 20 years, then expecting it to start the first time you turn the key in the ignition.

Sandia/California is managing a program to refurbish a substantial fraction of the W80 warheads in the stockpile to extend their life and to increase both safety and security — without underground nuclear testing.

The Life Extension Program for the W80 was assigned to Sandia/California and Lawrence Livermore National Laboratory in part to balance the nuclear weapons workload between Lawrence Livermore and Los Alamos.

The first major weapons engineering development program at the site for a decade, the Life Extension Program for the W80 was assigned to Sandia/California and Lawrence Livermore National Laboratory about 18 months ago in part to balance the nuclear weapons workload between Lawrence Livermore and Los Alamos. The W80 was originally developed by Los Alamos and Sandia/New Mexico, with the first units fielded in 1982.

Los Alamos retains responsibility for the existing W80 weapons in the stockpile. It worked on the Life Extension feasibility study with Sandia and Lawrence Livermore in the late 1990s.

Of the National Nuclear Security Administration's $76 million budget for the W80, Sandia has about $37 million, says Doug Gehmlich, Manager of W80 System Engineering Dept. 8241. Managed from the California site, the project funds about 80 researchers and support staff at Sandia/New Mexico and an additional 40 at Sandia/California. In California, a project group has been handling systems engineering and systems integration. Component work on the gas transfer system and surety also takes place in California.

Since December, Life Extension Program-specific activities have been on hold pending congressional budget authorization. Overall, the Life Extension Program is envisioned to lead to the first production units entering the stockpile in 2006, with production continuing into FY 2012-2013. Production is expected to involve plants in Kansas City, Pantex, Savannah River, and Sandia's neutron generator facility as well.

THE FIELD PORTABLE gas analyzer was designed, fabricated, and fielded to obtain internal dew point measurements on W80 warheads while in their stockpile locations. Here, Harry Cincotta (12332) performs a dew point measurement on a warhead using the device. This photo was taken in 1998 during a previous project involving the W80 warhead.

The Air Force, Doug says, expects to keep cruise missiles another 20 to 30 years (and the B-52 until the year 2040). The current project focuses on the Air Force cruise missiles, although the Navy is also equipped to use the W80 on the nuclear-capable version of the Tomahawk land attack cruise missile.

Refurbishing the W80 carries many constraints. For example, the US can no longer perform underground nuclear tests, so the labs are constrained to not change anything that would compromise nuclear certification. Yet they need to develop new components for the refurbished warhead — firing set, stronglinks, gas transfer system, etc. As Doug points out, "The rule is, don't change anything, and yet change everything," meaning that components that are being switched out need to resemble the original features in the way that they interface to the rest of the system.

Doug added that the challenges of a project of this scale also serve to "train another generation of nuclear weapons designers."

Sandia CaliforniaNews

Sandia/California-sponsored Science Bowl team from Fremont, Calif., places third in national competition

AND THE WINNER IS — Members of the Mission San Jose Science Bowl Team from Fremont, Calif., representing Sandia/California, placed third for the second year in a row in the National Science Bowl national competition held between regional finalists in Washington, D.C. Here, they receive their trophy and $1,000 prize. The only games that Mission San Jose lost during both the round robin and double elimination rounds in the tournament were two games to Thomas Jefferson High School (Virginia), the eventual champions. Boulder High School (Colorado) placed second. DOE sponsors the National Science Bowl.

Feedback

Is this charging practice a tax?

Q: *There is a charging practice that is used by some managers at Sandia that I feel should be scrutinized for its ethical implications. Some managers charge a percent of their time (and even their secretary's time) to those projects/tasks their staff is working on. I would suggest that this might be ethically improper if the manager is not actually contributing work to a given project/task. The mere use of a percent suggests a tax rather that any actual work performed. As a project leader I have no objection to any manager charging my project if they are actively working on the project or if they are performing some supervisory activity on their staff who are working on my project. But to pay a tax while the manager may be off doing almost anything seems unethical. Of course if the manager is supervising their staff 100 percent of the time, then the percent plan works out okay.*

A: The issue that you describe is a time-charging issue and not an issue with the time allocation tool. The optional time allocation system was implemented in 1999 and has received widespread acceptance across the Laboratories as an accurate and appropriate tool for time charging. The tool enables a manager to have automated the calculation they go through for their supervisory time.

It is an appropriate option, as you have stated, when the manager's time that day is that of performing a supervisory activity. It can also be selected for portions of a day along with direct charges on that other part of the day. The appropriate charging allocation is still determined by each person, as they record their time.

The only ethical question would be like for any Sandian, is there another project that benefited from a manager's effort that was not receiving the appropriate charge? If you feel that time is inappropriately being charged to your project/task, you may approach your management or the Ethics office. — *Bonnie Apodaca (10500)*

Ethics survey

(Continued from page 1)

The 2001 survey, like those conducted every two years since 1995, asked employees 21 questions in an attempt to gauge their perceptions and concerns about ethics in Lockheed Martin's business operations. Because of the way the survey was conducted, Sandia-specific responses were able to be pulled out and analyzed separately. (Every Sandian — indeed, every Lockheed Martin employee throughout the corporation — was able to participate in the survey, either electronically or through a hard copy form mailed directly to their home address. A total of 2,727 Sandians participated in 2001, a rate of 33 percent. Thirty-two percent participated in 1999.)

Labs Ethics Deputy Director Jerry Hands and Ethics manager Linda Vigil-Lopez spent a lot of time studying the survey data — and they're pretty pleased with what they found.

"One of the things you'll see with this data," says Jerry, "is that all indicators are up over the 1999 survey data."

Consider this response to a question, new for the 2001 survey: "Over the last two years, do you think Lockheed Martin's commitment to ethical business conduct has: Increased [34 percent of Sandians said yes]; stayed the same [60 percent of Sandians said yes]; or decreased [six percent said yes]."

In addition, a very large majority of Sandians reported that they think Lockheed Martin's ethical principles of honesty, integrity, respect, trust, responsibility, and citizenship are applied in daily business operations at Sandia. For each of the principles, the numbers were up over the responses in 1999.

Another important ethics issue was addressed in this survey question: "Do you ever feel pressured by other employees or management to compromise Lockheed Martin's standards of ethical business conduct in order to achieve business objectives?" Sandians' response? 90 percent said "No/rarely." Eight percent said "occasionally." Two percent said "frequently." In 1999, five percent of Sandia responders said "frequently." Among those who felt standards of ethical principles were occasionally compromised, the biggest factor cited was "overly aggressive business objectives."

Thirty-one percent of Sandians reported that they "occasionally" (27 percent) or "frequently" (4 percent) observed conduct that they believed might violate Lockheed Martin's ethical principles. Those numbers indicate a slight improvement over 1999 figures.

Employees' personal actions in the wake of these observations constitute the biggest area of concern. Just 39 percent of those who reported witnessing questionable ethics chose to report that concern. (In other words, 61 percent chose not to report anything).

Here are some of the reasons cited for not reporting:

- Didn't believe action would be taken
- Feared management retaliation
- Didn't trust higher-ups to keep reporting confidential
- Wasn't completely sure the witnessed activity was misconduct
- Didn't want to be known as a whistleblower

Jerry says that some of the perceptions listed above, particularly the concern that action wouldn't be taken, appear to be based on a lack of trust and/or information. Managers, he notes, can't always tell an individual about specific actions that might have been instituted against another employee because that information is confidential. Sometimes, the most that can be said is "appropriate action has been taken," or words to that effect. Jerry says that managers can learn to communicate responsiveness more effectively, while still respecting individual employees' privacy.

Helping managers learn to communicate better and increase trust are the focus of an action plan developed in response to the survey data. Some specific elements of the action plan, which has been approved by Executive VP Joan Woodard, include:

- Providing material for management-initiated discussion of an ethics case on a quarterly basis at departmental or center-wide all hands meetings.
- Discussion of the highlights from the ethics survey and action plan expectations from senior managers to line managers during the annual Spring Leadership Forum.
- Incorporation of recurring Sandia values-based messages or lessons learned from cases in the *Sandia Daily News* and the *Porcelain Press*.

Jerry says it's difficult to pinpoint exactly why the survey results are up — sometimes markedly — over 1999 results. Some of the positive improvement could legitimately be credited to increased effectiveness of the annual ethics training. Indeed, the survey data indicates that Sandians — and employees throughout Lockheed Martin — think the training is getting better.

But, gratifying as it would be for an ethics officer to think that ethics training is the main cause for the uptick in positive perceptions, Jerry thinks there's more to it than that.

"[Here at Sandia] there was definitely a renewed sense of mission in the days and weeks following 9/11," Jerry says, noting that the survey occurred just weeks after the terrorist attack. "That attack gave people a new sense of being part of something important, of something bigger than themselves. They had the sense that Sandia was doing the right things. They felt a new appreciation for everything it meant to be an American and a sense that their troubles and complaints paled in comparison to what the victims and families of the 9/11 attack had to endure."

Annual ethics training to begin

The annual ethics training for 2002 (required for employees throughout the Lockheed Martin Corp.) will occur between June and September. All employees must complete the training by Sept. 6. This year, the training is built around the theme "Perspectives," with an emphasis on seeking different points of view prior to making a decision. The focus will be on communicating and listening openly and actively to different viewpoints. During the training, participants will focus on two case studies addressing the issues of procurement and use of company assets. Other case studies may also be addressed.

Managers will establish times for the training for their individual departments.

National Atomic Museum opens doors in new Old Town location

EIGHT MONTHS to the day after being closed down due to to security measures established at Kirtland Air Force Base in the wake of the 9/11 terrorist attack on the US, the National Atomic Museum re-opened to the public in Albuquerque's Old Town on May 11. Albuquerque Mayor Martin Chavez, shown in the photo at lower right viewing a weapon exhibit with his son, was on hand to cut the ribbon officially opening the facility. The museum's new digs are in the former REI building, synergistically located on Old Town's "museum row." The National Atomic Museum's new neighbors are the Albuquerque Museum, the New Mexico Museum of Natural History and Science, the Lodestar planetarium, and the Explora children's science museum. In the photo above, Junior ROTC students from Manzano High School check out a model of the Fat Man bomb that was dropped on Nagasaki, Japan, to end World War II. In the photo above right, a museum volunteer explains X-ray imagery to a group of young first-day visitors. Museum Director Jim Walther says the new location could result in a 50 percent increase in attendance, attracting up to 150,000 visitors per year. (Photos by Randy Montoya)

Better glass

(Continued from page 1)

support from the US Air Force Blast Mitigation Action Group and Halliburton Energy Services, a Labs industrial partner.

"Glass is everywhere, and until now looks and energy efficiency have been everything," says project leader Jill Glass (1843). "Few building designers have considered the security and safety advantages better glass might offer."

Building Glass 101

Glass is a brittle material, she says, and its strength is highly sensitive to surface defects that often are too small to see. Once stress on the glass exceeds that required to activate a flaw, the pane fails, usually at the spot of the most severe defect.

"It's like when your windshield has a tiny chip or crack in it — one day it's fine, then the next day it goes zing," she says.

Every piece of glass is different, she adds. Its age, the way it is framed into a building, its position relative to the sun, or microscopic dings from wind-borne particles can significantly affect its strength.

That's why building glass fails over a wide range of stresses.

A better understanding of glass behavior under dynamic loading conditions (sudden pressures, like those from a blast), and an ability to modify the fracture properties of glass, will ultimately bring stronger and safer windows, she says.

What we don't know

In the lab, Jill and her team have subjected various glass types to dynamic and static (constant or slowly increasing pressures) loads to characterize their strengths and behaviors in blast and other environments.

They've studied when and where cracks begin, how large flaws must be to reduce a pane's strength, what forces are at work within a pane when it fails, what size fragments are created when panes shatter, and how far and fast they fly in varying overpressure environments.

"Architects are making modifications and decisions about glasses based on little or no supporting scientific evidence that they are safety improvements."

They're looking into how water affects glass strength.

They're examining behaviors of several variations of glass compositions, thicknesses, configurations, and engineered features, including glasses manufactured with strength-enhancing stresses stored within the material, such as automobile safety glass.

"What we've discovered is that there is a lot we don't know about glass behaviors in a blast environment," she says. "Architects are making modifications and decisions about glasses based on little or no supporting scientific evidence that they are safety improvements." (See "Rushing headlong into the glass problem" right.)

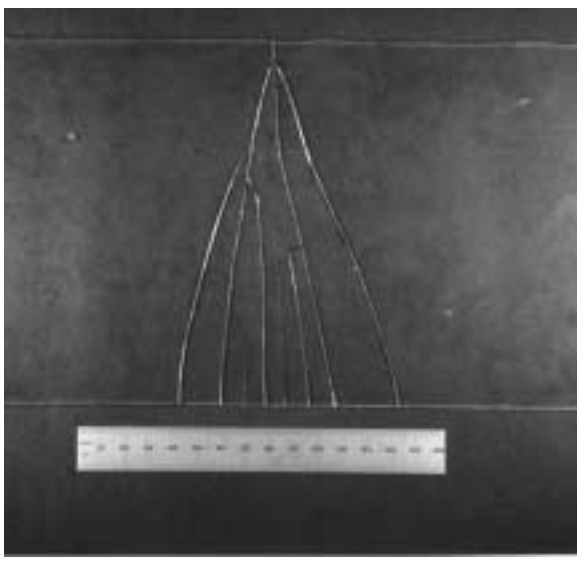
An oxymoron, reliable glass

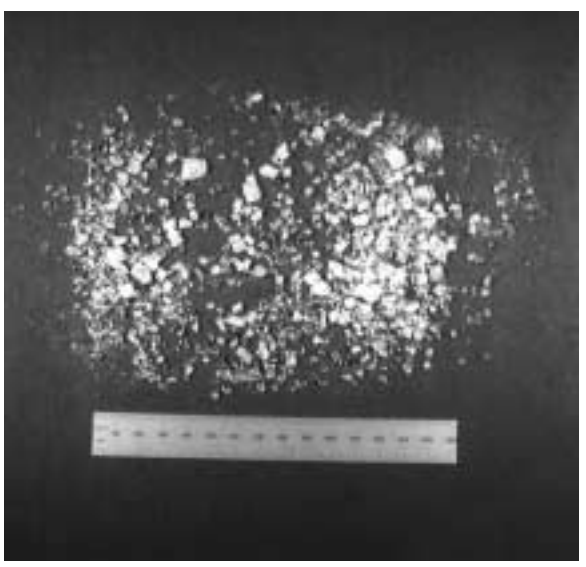
One needed improvement, says Jill, is glass that survives and fails very reliably.

"*Reliable* and *glass* haven't often been used in the same sentence," she says.

Toward that end her team and researchers at Penn State University and the Universita' di Trento in Italy are experimenting with a specialized family of glasses called Engineered Stress Profile (ESP) glass that offers high strength, reliability, and control of fragment size through modifications to the glass following production.

The team is refining the two-step ion exchange process used to make ESP glass to carefully manipulate the glass composition at the surface. The process creates glass with peak compressive stresses 10-20 microns under the surface rather than right at the surface, like automobile safety glass.





COMPARISON of the different fracture characteristics of two types of glass. In the left image, regular plate glass fragments resemble large dagger-like shards. In the right image, pre-stressed, ion-exchanged glass breaks into smaller fragments, more like small pebbles and sand. (Photos courtesy of Jill Glass)

(A pane of auto safety glass incorporates compressive stresses at the pane's surface that are counteracted by tensile stresses at the pane's center. A surface crack or bending strain destabilizes these competing stresses, and the pane fails catastrophically. These tensile stresses cause the "dicing" behavior associated with the fracture of safety glass.)

This new processing trick results in a stress profile within the ESP glass that initially arrests penetration and growth of networks of surface cracks, then releases the stored compressive and tensile stresses when a critical stress value is reached.

The result is crack tolerance and failure at predictable, narrowly defined stress loads. (Safety glass offers control of fragment size but is highly sensitive to surface flaws and, thus, fails over a wide range of stress loads.) In addition, the surface crack density increases dramatically prior to failure, serving as a warning mechanism, says Jill.

Sandia, Penn State, and Halliburton have filed several patents on the processes to produce modified ESP glass and its applications.

"For the first time we have glass types that are both strong and dependable, that crack noncatastrophically, and that fracture into small fragments," she says.

"For the first time we have glass types that are both strong and dependable, that crack noncatastrophically, and that fracture into small fragments."

Scientifically valid comparisons

Currently no standards exist for selection of blast-resistant glasses for nongovernment buildings, says Jill.

She has worked with the US Air Force's Force Protection Battle Lab in San Antonio to compare the blast performances of large panels of ESP glass with those of conventional glasses under varying overpressure conditions.

The tests were conducted in a shock tube, providing carefully controlled test environments. Free-field blast tests at Sandia's Explosives Components Facility are planned for this summer using smaller-scale glass samples.

"Even under nominally similar conditions, glasses perform differently from one day to the next," she says. "The goal is to come up with a set of protocols that allow engineers, manufacturers, researchers, and end users to make scientifically valid comparisons under rigidly controlled, standardized conditions."

"I believe the research being accomplished here and at Penn State with the ESP glass will revolutionize the application of glass as a structural material for buildings and infrastructures," says Rudy Matalucci (5862), Sandia Architectural Surety® program manager and chairman of the Engineered Glass Committee of the American Society of Civil Engineers' Architectural Engineering Institute.

"I find a new excitement within the industry for using glass differently as a construction material now that the internal stress profile can be altered to meet a variety of strength requirements," he adds. "Many of the architects and engineers I talk with daily are encouraged to know that Sandia is investigating the basic performance of ESP glass."

And building glass is just one market for better glass, adds Jill.

"There are many other uses, including weapons and automobile applications, that would benefit from a glass you can trust," she says.

Rushing headlong into the glass problem

Sept. 11, Oklahoma City, a string of terrorist bombings at overseas US facilities, and the suicide-bombing crisis in the Middle East are motivating US government agencies — particularly the military branches and the State Department — to urgently consider ways to curtail "the glass problem."

So far the most widely adopted retrofits to make a building's windows more blast-resistant include laminating or filming glass panes to keep them intact in their frames when they break, adding mesh curtains or blast bars to windows to keep laminated or filmed glass from flying into occupied rooms, and using thicker glasses, laminates, and transparent plastics to prevent glass fracture altogether.

But these approaches might not be the best, or safest, responses, says researcher Jill Glass.

In fact, some evidence suggests that films and laminates intended to make a pane stronger can lead to larger and more dangerous flying sheets of glass in a blast, or they may hamper rescue and firefighting efforts, a difficulty encountered by emergency workers at the Pentagon on Sept. 11.

Also, in the dynamic pressure environment of a bomb blast, shattering windows provide pressure safety valves ("weak links") that might, by their failing, prevent damage to or failure of the building's superstructure.

"Sure you can make glass stronger," she says. "But you might end up causing structural failure or other unexpected problems. We don't yet know enough about glass and its effect on the overall building response in a blast to make that decision.

"We'd like a one-size-fits-all solution," she adds. "But windows in different locations and in buildings with a wide variety of construction methods need to be considered both individually and as a component of a larger system using the principles of Architectural Surety."

Testing acceleration data recorders leaves Sandia department feeling like it's the Fourth of July

Instrumentation being miniaturized so it can go into smaller projectiles

By Chris Burroughs

Every time instrumentation developed by Telemetry and Instrumentation Dept. 2665 is fired in a projectile or bomb into concrete, rock, water, or earth targets to support a customer's test, it's like the Fourth of July.

So says Dept. 2665 Manager Mike Partridge.

"It's both exciting and nerve-wracking," Mike says. "The team works hard to get the instrumentation right, but the worry is that something might go wrong. And when the experiment is a success, everyone feels a sense of elation."

That feeling of exuberance was evident April 30 when the Penetrator Instrumentation Team participated in an experiment at Sandia's rocket sled track. They put instruments designed to monitor acceleration inside a casing of a test unit, which was rocket propelled along the track into a water target — Styrofoam blocks containing a two-foot-deep water trough. When the test unit hit the target, it was traveling at more than Mach 2.

The instrumentation survived the test.

Acceleration data gathered from the instrumentation will be compared with computer simulations to determine how accurate the models are.

For nearly three decades Dept. 2665 has been designing, building, and fielding flight instrumentation data recorders that are put into various size projectiles and used to measure acceleration and velocity as a projectile is fired and penetrates targets.

What's new is the development of recorders that are smaller, more sensitive, and more rugged than any of their predecessors.

"Our new acceleration recorders use a microcontroller-based architecture for test flexibility, while maintaining electronics and packaging techniques developed over many years of penetrator testing at Sandia," Mike says. "Because of their small size, they can go where no recorders have gone before."

There are several versions of the new small recorders: the 2.5-inch-diameter-by-6-inch AdPen2, the 2-inch-by-3.5-inch MinPen2, and the 1-inch diameter-by-1.8-inch MilliPen. The design team for these versions was led by Tedd Rohwer, former member of the Earth Penetrator Instrumentation Team who is now in Dept. 2131. A next-generation MilliPen is being developed by Tony Mittas (2665).

MONITORING ACCELERATION — Dave Faucett (2665, right) connects a data readout cable to an acceleration recorder while Phil Reyes (also 2665) uploads data following an April 30 experiment when a test unit was rocket-propelled along Sandia's rocket sled track into a water target. (Photo by Randy Montoya)

"It's both exciting and nerve-wracking. The team works hard to get the instrumentation right, but the worry is that something might go wrong. And when the experiment is a success, everyone feels a sense of elation."

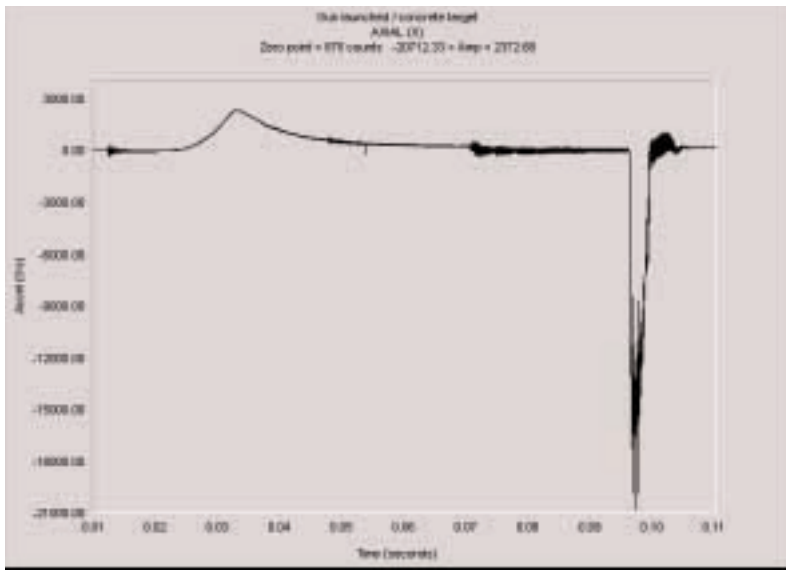
The small size and weight of these modern acceleration recorders allow their use in smaller and more compact projectiles, which greatly reduces testing costs.

Tom Togami of Applied Engineering and Technical Development Dept. 15414 says his department uses the instrumentation "on the majority of our penetration tests," which "usually means a few full-scaled tests and multiple mid-scale tests per year."

"When we obtain data they are always compared with pretest simulations and are also used to further the development of our predictive models," Tom says. "We have performed suites of experiments with the MilliPen that provide comprehensive data sets for the DOE/DoD community to benchmark their modeling and simulation efforts."

Tom's colleague in Dept. 15414, Danny Frew, says, "Much of the test data collected over the past few years has been outstanding, and we are using this data to benchmark existing computer codes."

And, he adds, Dept. 2665 is the only organization at Sandia that can do this work.



GRAPH shows data obtained using a MilliPen recorder in a test where a penetrator went through concrete. The deep dip on the right is when the penetrator hit the concrete.

Another customer that frequently uses Dept. 2665's instrumentation is B61 System Engineering Dept. 2111.

"We have used instrumentation packages from Mike's department in B61 testing over the past eight to ten years," says Steve Pink (2111). "We have been extremely happy with the performance of their recording systems and the responsiveness of Dept. 2665's personnel in meeting aggressive schedules and supplying quality data. During the B61 Alt 354 program, for example, we flew 13 flight tests and did not lose so much as one channel of data during the test series."

Ed Henry (2665), who leads the Earth Penetrator Instrumentation Team, says among the biggest challenges in building the small and highly sensitive measuring instruments is to make them rugged enough to survive impacts of as much as 40,000 Gs. Over many years of field experience, his team has learned numerous "tricks."

One advantage to the new recording technologies is that they are designed to operate with minimal support equipment in remote test areas.

"Only a small interface box and a laptop computer are needed to initialize the recorder for the test or download and plot the data after the unit is recovered," Ed says.

After the projectile is dropped, it is retrieved and the recorder is removed so that data can be downloaded. Researchers in Dept. 2665 have designed a version using radio frequencies — still in the experimental stage — that will allow for real-time data recovery without having to wait for penetrator recovery.

The small recorders have been used in supporting a wide range of deployment methods. They have been fired from a cannon, flown on rocket sleds, and dropped from aircraft like F-16s, B-2s, B-52s, helicopters, and even a hot air balloon.

Most of the time Ed and his crew are given a full definition of mission requirements and objectives, but sometimes they are not.

"The amazing part is that we can design electronics that routinely survive such extreme environments."

"Occasionally a customer will come in with a request for instrumentation for a project they can't talk about" Ed says. "We're given specs — like the instrumentation must be built to withstand certain levels of Gs — and that's all we know."

Over the years Dept. 2665 has had many successes. One they like to talk about was an experiment conducted several years ago when a projectile containing an acceleration data recorder was fired into 18 feet of concrete.

"It was interesting to see the 'before scene' when the target was six concrete blocks solidly stacked together and afterwards when it was all in pieces," Mike says. "The amazing part is that we can design electronics that routinely survive such extreme environments."

Working on the penetrator instrument team are Ed, Tony, John Heise, Phil Reyes, Dave Faucett, and Randy Lockhart (all 2665).

Sandia's rapid prototyping expertise could help surgeons alleviate chronic back pain

By Bill Murphy

Who doesn't know someone with a bad back?

It's one of those universal physical complaints doctors deal with all the time, a condition experienced by millions of Americans. For most of those so afflicted, occasional back pain is a fact of life, something to tough out and endure. For thousands of others it is literally unendurable, a pain so intense and relentless as to become incapacitating.

When it gets that bad, physicians will try "a," they'll try "b," they'll try "c"— and *then*, if nothing else helps, they'll look at surgery as an option.

Back surgery involving spinal fusion, which is called for in the case of intractable back or neck pain related to disc degeneration and/or instability that doesn't respond to other therapies, is problematic: it can and does succeed in reducing pain and restoring mobility for lots of patients. But it's a tricky, difficult, unforgiving procedure that doesn't always work.

Now, with the help of Sandia rapid prototyping expertise, these spinal fusion operations may become a more consistently successful and effective treatment, thus delivering thousands of people from lives of chronic pain.

THIS IS SPINAL TAP — Terry Litts (14184) demonstrates a template developed using rapid prototyping technology. The template, which fits precisely over the target area of a patient's spine, allows an orthopedic surgeon to precisely control placement of the pedicle screws that are commonly used in spinal fusion surgery. (Photo by Randy Montoya)

Maintaining proper alignment

As an orthopedic surgeon at University Hospital in Albuquerque, Dr. George Brown has done his share of back surgeries. Dr. Brown explains that the biggest challenge in the surgery is maintaining proper alignment of the so-called pedicle screws. These are, as the name suggests, actual screws that are inserted into the spine. These screws are used to correct deformity, and/or treat trauma. Similar to other bone screws, pedicle screws may be used in instrumentation procedures to affix rods and plates to the spine. The screws may also be used to immobilize part of the spine to assist fusion by holding bony structures together.

Many techniques — including lots of hi-tech computer-assisted processes — have been developed in recent years to help docs get the best possible alignment of pedicle screws. Brown realized, though, that none of the techniques were as effective as surgeons would like them to be. He wanted something better.

Clint Atwood turned him on

About the time Dr. Brown was pondering the challenges of pedicle screw alignment, he heard a talk from Sandia rapid prototyping evangelist Clint Atwood (1314) and soon became a true believer. (If you've heard Clint talk about his passion, you will understand how he wins converts.) Rapid prototyping is an advanced manufacturing technology that enables you to generate real-world 3-D models from virtual 3-D computer renderings. In the post-Cold War era, with DOE downsizing its manufacturing capabilities, rapid prototyping was seen as a way to streamline the development cycle for certain weapon components. Dr. Brown wasn't interested in the weapon application, of course. He immediately saw rapid prototyping as a solution to the pesky pedicle screw alignment problem.

To appreciate the difficulty, visualize a spinal column. It's not solid bone. Rather, it's hollow in the center where the spinal cord travels from the brain down through the spine. The column is a series of articulated vertebrae. The front and back sections of each vertebra are connected by bone structures called pedicles. When you perform a fusion surgery, you're trying to rigidly link these front and back portions of the column together. Where are you going to put the screws? Why, through the pedicles. Straightforward — except that the pedicles aren't really all that big, and they're canted at an angle. They didn't evolve with a surgeon's needs in mind.

How could they *not* miss

And consider this: when you're operating on the patient, you can't *see* the pedicles. You're drilling down through them from back to front, not into them from the side. A surgeon does a prodigious amount of planning before going into a fusion surgery, devising the angle for the screw placement based on MRI imagery. That's helpful, but on the operating table, it's still in the surgeon's hands to get the screws in the right place. And sometimes, even the very best surgeons miss. When you weigh the technical complexity of the operation, you have to ask yourself, "How could they *not* miss from time to time?"

Back to Dr. Brown: He envisioned a way to use rapid prototyping to make a 3-D model — a jig — in which the pedicle screw placement would be almost foolproof. Armed with some R&D funding from UNM, he came to Sandia with his concept, hoping to partner with the Labs on an effort to apply this industrial technology to the healing arts.

Alan Parker, Manager of Mechanical Engineering Dept. 14184, thought Brown's concept sounded like a good challenge for his team. Researcher Mark Ensz and technologists Daryl Reckaway and Terry Litts were assigned the project. They're experts at turning computer models into real objects.

Mark explains how the process works: The doctor orders an MRI or CAT scan for the patient. He or she then works with the data from the scan, tweaking the bit-mapped MRI images (to compensate for certain limitations in MRI imagery) and highlighting the region of interest. The process is done layer by layer, as the MRI data come in swaths of 2 mm to 5 mm — you stack them together to get the whole picture. After the doc has cleaned up the image to his or her satisfaction, the layers are combined together as a 3-D computer model (using off-the-shelf Mimics software from Materialize, Inc.). This model, virtually a perfect image of the area of the spine where the surgery will occur, enables the physician to pre-plan the trajectory of the pedicle screws.

A perfect replica of the spine

So far, there is nothing unfamiliar here; similar techniques have been in use for some time. However, it's at this point that things start to depart from current practices. Up to now, the MRI/Mimics data has been used as a visualization tool. In the UNM/Sandia approach, the doctor takes the process to the next step: he or she actually "drills" the holes through the pedicles in the computer model of the spine, carefully indicating on the image precisely where the holes will be. Mark then takes these images with the "holes" drilled in them, and converts those holes — i.e., the trajectories through the pedicles — into separate, mathematically defined files. Then, the original 3-D file of the spine and the new file of the trajectory are combined into a rapid prototype-compatible file. This file is then "printed," either on a stereolithography machine or a selective laser sintering machine, as a solid real-world model of the spine, with the pedicle screw trajectories in place. (The machines build, layer by layer, a solid model of the computer file, using an epoxy or nylon material.) The model is a perfect replica of the patient's spine at the area where the surgery will occur. Now, the next step is where the real beauty of Brown's original concept shines through.

Mark, Daryl, and Terry make a second model, a reverse image of the spine model, one that slips over the vertebrae of the spine as snugly as a dainty foot in a glass slipper. This model also has trajectory holes in it — and they align perfectly with the holes in the first model. In other words, what you have is a perfect jig. It can fit in only one place on the patient's spine and, because it has trajectory holes in place, it guides the surgeon's drill with computer-aided precision. When you drill through the jig, you *have* to have perfect alignment, because it's already been worked out in the 3-D model.

More precise, less invasive surgery

The process, in addition to allowing more precision than any alternative method, should also make spinal fusion surgeries much less invasive — the surgeon needs to open only a small area in the immediate area of interest.

Brown and his Sandia partners have been perfecting the technique over the past couple of years. The tests done with cadavers, Mark says, have been highly successful and the interest level in the orthopedic community has been high. Brown is pursuing a National Institutes of Health grant to further refine the technique, including doing the procedure on real patients, alleviating real pain with a real-world 21st century solution.

Sometime in the next few years, if Brown's research continues to advance as successfully as it has so far, every major hospital in the nation could have its own rapid prototyping shop, manufacturing not just spines, but hips, shoulders, and other body parts that wear out due to age or trauma.

Student Internship Program intensifying focus on converting students to future Sandia employees

By Ken Frazier

Converting student interns to future Sandia employees is a renewed focus of the Labs' Student Internship Program, says Don Blanton, VP for Human Resources and Protection Services Div. 3000.

Don was the leadoff speaker at the Student Intern Program's May 9 forum for managers, technical advisors, and social mentors at which the "filling the pipeline" idea was a major theme.

"How can we better fill the pipeline for new employees?" he asked. "The student intern program is a very important part of that. We want to turn the Student Internship Program into an effective program for recruiting for the long-term needs of the Labs," he said.

"We have [through the program] supplied the nation with wonderfully trained scientists and engineers," and that has been one of its missions, he said. "But we've never really taken the program seriously as a pipeline to employees for us."

He and the program's management and staff want to change that. How? They ask Sandia managers and technical advisors to begin selecting students both for how the experience at Sandia will benefit the students but also for their likelihood as candidates for future permanent employment at the Labs. "We want to begin selecting students for the employment pipeline," Don says.

Part of that is identifying skills the Labs will need five years and more into the future and part is in helping students add elements to their internship experience that will broaden their skills so that when the time comes, they will be well-prepared and justifiably sought-after as candidates for permanent Sandia employment.

Throughout the course of a year Sandia typically employs about 800 student interns. About 400 are year-round interns and about 400 come aboard just for the summer.

Don said in FY02 Sandia has already hired 326 employees, and 45 of them were former interns. That shows the potential for leveraging interns — young people who already have good experience at Sandia — into future employees. "We're really talking about building the future workforce of the Laboratories," said Don.

BJ Jones, Manager of Workforce Management-Planning/Staffing Dept. 3030, says the new focus fits well with the Labs' new Integrated Enabling Services (IES) initiative. One of the components of the IES's Create the Future work package is "Make People Investments," and the Student Internship Program is a key aspect of that. "We have the end in mind of creating the talent pool of the future," she said.

Susan Harty, Manager of Staffing/Recruiting/Placement Dept. 3031, says the biggest problem right now is in "marketing these great students to the line management. We need your help with that," she said. She also said Recruiting now has a database that can track the conversion of students to regular employees, something that was difficult to do before.

Two improvements for students were pointed out by Sharon Ortiz (3031), a member of the program's staff: Students are now given basic medical coverage in Sandia's medical plan, and agreements have been completed that will provide students an opportunity to work a 9/80 work schedule.

Following the brief presentations at the forum, Rochelle Lari and Heidi Welberry (both 3053) led an informal workshop session soliciting suggestions for what works well and what needs improvement. Topics discussed (many of which are being addressed by the program) include shortening the time between application and decision, speeding up the lengthy clearance processes, and making sure the students always have meaningful work.

Pace VanDevender, the intern who got away (from LLNL)

Pace VanDevender (9400), Sandia's Chief Information Officer and the 1992 recipient of DOE's prestigious E.O. Lawrence Award for his work on pulsed power, was once a student intern at a national lab. But it was Lawrence Livermore National Laboratory, not Sandia.

"How did Lawrence Livermore lose him?" VP Don Blanton (3000) asked rhetorically at the Student Intern Program's forum last week. Pace was in the audience and had just told Don about this. "They lost contact with him when he went off to Europe for graduate school" — a three-year PhD program at Imperial College of Science and Technology, London.

The lesson? "We lose potential Pace VanDevenders by not staying in touch with student interns" once they end their programs at Sandia, Don said. In Pace's case, LLNL's loss was Sandia's gain. But Don clearly hopes that the future leaders of Sandia will be identified in the Labs' Student Intern Program and nurtured, encouraged, and tracked until their education is completed and Sandia can make them permanent employees.

Adventure to Mars was theme of Space Day

SCIENCE MADE FUN — More than 500 students from Albuquerque area schools took part in the sixth annual Space Day held at the National Atomic Museum and Lodestar Center May 2. Pictured are several of the students participating in the interactive and fun activities centered around this year's Space Day theme, Adventure to Mars! The elementary and middle school students were challenged to learn and explore their world and how it relates to space and other planets. Astronaut and Sandian Sid Gutierrez spoke to students about his experiences in the NASA space program. Lockheed Martin was the major sponsor of Space Day in New Mexico. As a global celebration, similar Space Day programs were being held around the country simultaneously.

(Photos by Randy Montoya)

Recent Patents

Gerard Sleefe (2614), James L. Novak, and Thomas Rudnick: Sensor System for Web Inspection.

John Feddema (15211), Brian Driessen (9124), and Kwan Kwok (15221): Convergent Method of and Apparatus for Distributed Control of Robotic Systems Using Fuzzy Logic.

Todd Christenson (1743), Terry Garino (1843), and Eugene Venturini (1122): Batch Fabrication of Precision Miniature Permanent Magnets.

Take Note

Retiring and not seen in *Lab News* pictures: **Martha Padilla** (10502), 32 years; and **Marlene Smith** (2000), 20 years.

Sympathy

To Mike Patton (3114) on the death of his wife, El Freda Patton, in Albuquerque, March 1.

Poster series wins major international design award

Over the past several months, the *Lab News* from time to time has published a full page poster highlighting various aspects of the Labs' Stockpile Stewardship efforts. The poster on the facing page (page 9) is the fourth in a series of 10. Now, we've received word that the poster series, representing the design work of Mike Vittitow (12610) and the photography of Randy Montoya (12640), has won an Award of Exellence in the informational poster design category of the Society for Technical Communications international technical art competition.

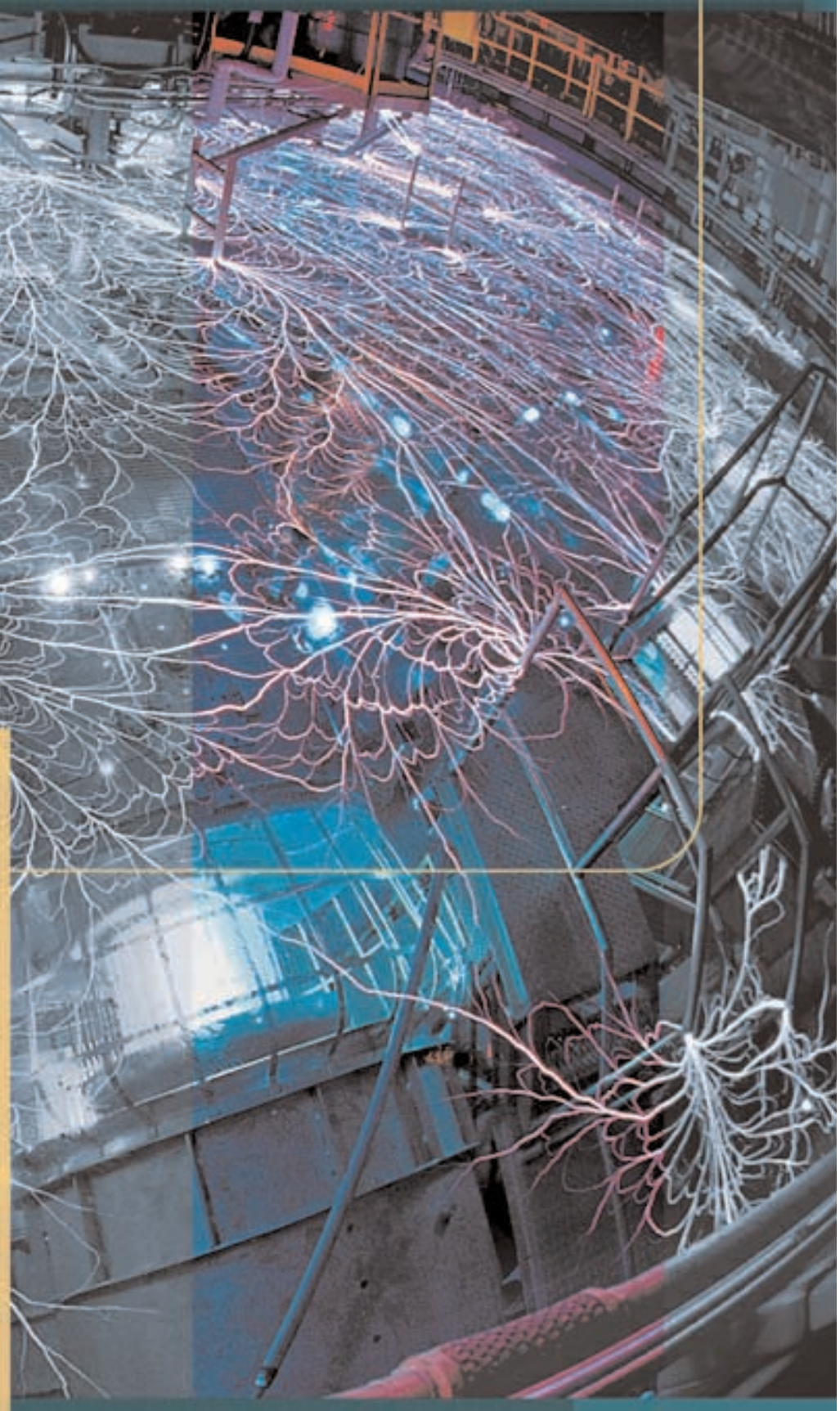
Over the next weeks and months, we'll continue to reproduce other posters in the series as space allows.

Pulsed Power Gives Insight into Radiation Effects

For a fraction of a second, the Z machine produces 80 times the entire world's output of electrical power.

The intense radiation and heat help us to understand whether weapons components will survive high-radiation exposures, and to develop better computer models of the effects of these environments.

Scientists also are using the Z machine to help us better understand black holes, neutron stars, and the evolution and eventual expiration of the universe. And Z is supporting the development of fusion (the kind of energy that the sun and other stars produce) as an energy source.



Sandia's Z machine is the most powerful producer of X-rays in the world.

Mileposts

New Mexico photos by Iris Aboytes


Johnny Duncan
40 2152


John Guth
40 6420


Kazuo Oishi
40 2113


David Skogmo
40 5852


Joseph Allen
35 10821


Curtis Hines
35 9810


Jeffery Lawrence
35 1674


Allen Stanley
35 3111


Alfred Watts
35 15426


Frederick Brown
30 9126


David Haaland
30 1812


Dannie McNeill
30 15425


Dennis Berry
25 6800


Ricardo Garcia
25 2331


Ronald Greene
25 15426


Kathleen McCaughey
25 14400


Gerry Mitchell
25 2952


Donald Noack
25 11


Regina Simpson
25 1822


Craig Tyner
25 6216


George Wagner
25 5861


Merle Benson
20 9334


Charles Fink
20 3121


Donald Funkhouser
20 6536


Jeffery Green
20 5735


Wahid Hermina
20 9113


Roberto Mata
20 5714


Rosemae McKillip
20 2305


Elizabeth Sorroche
20 1835


Steven Ulibarri
20 5853


Anthony Aragon
15 3110


Anthony Bentley
15 2338


Thomas Brown
15 12333


Paul Claassen
15 5735


Mark Derzon
15 1740


Philip Green
15 5713


Susan McRee
15 9517


Bradley Parks
15 5854


John Schroeder
15 1811


James Stromberg
15 9513

Sandia Classified Ads Sandia Classified Ads Sandia Classified Ads Sandia Classified Ads

MISCELLANEOUS

SOUTHWEST AIRLINE VOUCHER, expires July 7, 2002, $120 value, asking $65. Locher, 266-2021.

SOFA, 3-section recliner, w/corner pc., neutral color fabric, $250. Deepesh, 238-9381.

ROLL PAN, rear, for '80-'95 Ford F-150 pickup, replaces rear bumper for custom look, $40. Buteau, 856-7705.

SPEAKERS, JBL Eon, 15-in., 400W, bought new Dec. 01, $1,050; amps: Mackie 2600, NIB, $750; QSC 3402, NIB, $1,000. Brooks, 228-4996.

PIMENTAL GUITAR, steel strings, made '81, $500; push-reel-type lawn mower, $35. Aragon, 888-3473.

DINING TABLE, oak, w/6 chairs, $350; double bed w/brass headboard, mattress, box spring, rails, $150; sofa, $250. Dye, 299-2250.

SPRINKLER VALVES, 1-in., 24V, brass, new condition, cost $85, asking $39. Marron, 345-4006.

DOUBLE SECURITY DOOR, wrought iron, $75; 2 bar stools w/backs, chrome footrest, $80. Gomez, 291-1062.

POND LILIES, $10 ea. Lenberg, 238-0362.

LA-Z-BOY, 2, excellent condition; hide-a-bed loveseat, $1,200; recliner/rocker, $400. Davis, 837-1184.

WORD PROCESSOR; Nissan pickup door; 7-1/2-hp, 3-phase electric motor; 3-phase hydraulic power unit; Subaru/Kia ski rack. Everett, 268-7818.

STROLLER, Graco Duo Glider, double tandem, navy w/yellow pattern, excellent condition, paid $165, asking $100. Johns, 858-1430.

BARK MULCH, medium, Western decorative from Rowland's, 35 cu. ft., any amount, free. Brunner, 856-7651.

LAWN MOWER, Briggs & Stratton, rear-bagging, 3.5-hp, old but still functional, free. Guilinger, 299-6680.

BOY'S BICYCLE, Huffy, 18-spd., 24x2 tires, orange & black, 15-in. frame, w/helmet, like new, $30 OBO. Drotning, 821-9598.

DINING TABLE, cherry, TEMA, 3' x 6', excellent condition, must sell before move, originally $600, asking $200. Varley, 323-7809.

PAINT BOOTH, Binks; Linde 3-phase MIG welder; Clark 4000-lb. cap. propane fork lift; key machines. Highland, 301-9403.

SATELLITE, Internet/TV system (dish, receiver, PCI card, software) $200; waterbed, super-single, $100. Hott, 865-1859.

BEARDED DRAGON, almost full-grown, 1-1/2-yr.-old male, $100; custom 4' x 2' cage, $50 OBO; March home gym, $50 OBO. McCrory, 401-4412.

UPRIGHT PIANO, antique, dark wood, very good condition, $500 OBO. Santana, 294-0536.

'60's MARTIN TITAN-1, 18-in., SM-68 model; Martin Zippo lighter; four USAF Titan ICBM ashtrays, $350. Anderson, 232-2167.

SONY TV, 19-in., 6 yrs. old, excellent condition; 4-head Phillips VCR, 7 mos. old, barely broken in, $100. Jackson, 268-5966, ask for Pere.

EXERCISE BICYCLE, Tunturi Ergometer, gently used, 40-lb., flywheel promotes smooth, even riding, $75 OBO. Keck, 237-0392.

PC MONITOR, 17-in., Sony tube, $50; HP DeskJet printer, $20. Celina, 232-8023.

POOL, KD, 4' x 6', above ground, w/Jacuzzi pump & filter, cleaning kit, winter & solar covers, $500. Lanes, 856-6237.

MOVING SALE: oak entertainment units, maple bedroom/dining sets, tables, rugs etc., May 18, 9 a.m.-1 p.m., 1237 Sasebo NE. Lagasse, 298-0977.

COOLER MOTOR, 1/3-hp, 2-spd., 115-volt, new in box, $20. Thalhammer, 298-8521.

SHOPSMITH MARK V MODEL 510/520, w/accessories, excellent condition, details upon request, $7,500 investment, asking $3,500. Cook, 323-2588.

PLANKS & DOORS, solid oak, perfect for crafts, $100 for all; Craftsman table saw w/stand, $40; Craftsman radial-arm saw, $40. Nelson, 459-9115, ask for Dave.

GRAVEL, 1.5-in., gray river, free for the taking, you haul from street. Fernandez, 822-0377.

BEDS: 2, platform bed/frames, 1 queen, 1 full, Sealy mattress for full, $100/frame or $299 frame/mattress. Otto, 242-6199.

SOUTHWEST AIRLINE GIFT CERTIFICATES, redeemable as cash only (through Southwest agent), valued at $350, asking $300 OBO. Chavez, 323-9343.

COMPUTER, IBM Aptiva, Pentium 166, 1GB, 32MB, CD-ROM, Zip, 14-in. monitor, modem, best offer or donation. McClellan, 828-1881.

KITCHEN TABLE, rectangle, glass top, w/4 gray velvet chairs, $275. Sandoval, 866-6991.

MOVING SALE: sewing machine table w/6 drawers, camping gear, antique wicker doll furniture, much more, May 17-18. Adams, 881-4351.

COMPUTER, operational DEC 350 Pro computer, w/accessories & printer, POS & TSX operating systems w/documentation, free. Azevedo, 898-7700.

TREADMILL, GE dishwasher, Panasonic camcorder, all work, $100 ea.; 2 refrigerators, electric Rascal wheel-chair, brand new. Brewer, 293-7192.

TABLE, white resin, 40" x 74", w/crank umbrella & stand, $60. Palya, 881-2720.

ROTARY SAW, 7 1/2-in., Craftsman, used 1 hour, in case w/manual, $35. Guttmann, 888-5114.

COUCH, 4 seats, beige/earth-tones, Southwest-style, $275; rust velour chair, w/wood accents, $60. Oberkampf, 292-4366.

GAS DRYER, Sears Kenmore, good working condition, $75 OBO. Campbell, 294-1374.

DISHES, Victorian, rose chintz, John Brothers, London, 8 place settings, extras, 62 pcs. total, unused, $375. Martin, 296-6727.

KITCHEN DINETTE SET: table, w/6 upholstered, white metal chairs, 2 swivel bar chairs, like new, $350. Sansone, 296-7945.

GARAGE SALE: baby items, toys, clothes, May 18-19, 9 a.m.-3 p.m., 9414 Euclid NE. Falls, 323-1958.

REFRIGERATOR, side-by-side, GE, 22 cu. ft., ice dispenser, white, new condition, $500; basketball goal, backboard & pole, excellent condition, $50. Dwyer, 271-0741.

LANDSCAPE TIMBERS, various lengths, you haul, free. Jones, 797-4894.

POOL, Dough Boy, 16-in. diameter, 4-ft. deep, no rust, no leaks, includes everything you need & more, $1,100. Penn, 883-4195.

COLOR TV, Sony, 20-in., w/remote, great picture, $75. Bessette, 798-9067.

DORM REFRIGERATOR, 2.4 cu. ft., white, barely used, $75; Emerson dorm microwave, .75 cu. ft., $35. Furry, 281-1024.

YARD SALE: things for dogs, clothes, dishes, lamps, table, shoes, usable articles, May 17, 7:30 a.m.-4 p.m., May 18, 7:30 a.m.-3 p.m. Coe, 266-6579, ask for Nina.

GARAGE SALE, May 17-19, 3008 21st Ave., Rio Rancho (off 528 next to Haynes Park, follow signs). Simmons, 891-2475.

ENTERTAINMENT CENTER, 5' x 6', oak w/glass & tambour doors, DVD/CD/VHS storage, TV opening: 32" x 25", $250. Morris, 292-5112.

CD PLAYER, JVC 6-disk changer, excellent condition, $30. Hill, 299-4060.

BEDROOM SET, solid wood, antique brass bed w/mattress, Southwest-style hide-a-bed couch, all high quality. Burgin/Arcement, 872-0471.

DINING ROOM CHAIRS, 4, nicely upholstered, $75. Dietz, 286-8244.

GOLF CLUBS, steel garage shelves, shelf brackets, lifting weights, car-top ski rack, Waterpic, toaster oven, etc. Leeman, 281-7949.

TOOLBOXES, Craftsman, 10-drawer upper, 9-drawer lower, w/retractable shelf & heavy duty casters, $225. Fleming, 293-9421.

VACUUM PUMPS, 2, includes 3 liters of pump fluid, call for details, $75 both. Malcomb, 294-6975.

TWIN SPEAKERS, Fisher, walnut-finish boxes, 24" x 14", beautiful sound, can demonstrate, $40 ea. Sherwin, 275-9134, ask for Ted.

REFRIGERATOR, GE, 15 cu. ft., top freezer, 4 yrs. old, white, $200; stacked full-size washer & dryer, $350. Jones, 296-2796.

WINDOWS, 7, 3' x 8" x 6', double-pane; 6, 32-in., bi-fold metal doors; 100 2,625-Btu phase-change thermal storage rods. Talbert, 298-9036.

How to submit classified ads

DEADLINE: Friday noon before week of publication unless changed by holiday. Submit by one of these methods:

- **E-MAIL: Michelle Fleming (classads@sandia. gov)**
- **FAX: 844-0645**
- **MAIL: MS 0165 (Dept. 12640)**
- **DELIVER: Bldg. 811 Lobby**
- **INTERNAL WEB: On Internal Web homepage, click on News Center, then on Lab News frame, and then on the very top of Lab News homepage "Submit a Classified Ad." If you have questions, call Michelle at 844-4902. Because of space constraints, ads will be printed on a first-come basis.**

Ad rules

1. Limit 18 words, including last name and home phone (We will edit longer ads).
2. Include organization and full name with the ad submission.
3. Submit the ad in writing. No phone-ins.
4. Type or print ad legibly; use accepted abbreviations.
5. **One ad per issue.**
6. We will not run the same ad more than twice.
7. No "for rent" ads except for employees on temporary assignment.
8. No commercial ads.
9. For active and retired Sandians and DOE employees.
10. Housing listed for sale is available without regard to race, creed, color, or national origin.
11. Work Wanted ads limited to student-aged children of employees.
12. **We reserve the right not to publish an ad.**

WATERBED MATTRESS, free to good home, mattress only, no heater. Reno, 296-6290.

TWO ARMOIRES, new, unfinished pine, 6' x 40" x 26", w/closet rod, $100 ea. OBO. Henderson, 254-1803.

HOME GYM WEIGHT MACHINE, Marcy, complete workout, similar to Nautilus, w/manuals & video tapes for assembly & training, $350 OBO. Yesner, 858-3463, ask for Steve.

TIMESHARE, 5-star resort, plan your vacation, 1,800 resorts to choose from, $742/wk. to $770/wk. Givens, 292-2058.

REFRIGERATOR, GE, 18 cu. ft., harvest gold, top freezer, 15 yrs. old, good condition, $100. Duvall, 881-4406.

SOFA (90-in.) & CHAIR (46-in.) matching, TEMA, off-white, textured fabric pillows, 2 yrs. old, $300 OBO. Aas, 856-6674.

SOFA (96-in.) & LOVESEAT (72-in.), matching, light earthy colors, loose pillows, great condition, $325. Mares, 268-0285.

TRANSPORTATION

'00 CORVETTE COUPE, 6-spd., performance additions, CD Bose sound, immaculate, 8K miles, great car, great price, $39,000. Gillingham, 281-1842.

'95 TRANS-AM, manual, all power, leather, T-top, bright red, 80K miles, must see. Strauch, 259-3423.

'89 SUBURBAN, 4X4, 350 V8, AC, rear heat, PW, PL, tow package, great shape, $4,200. Arrington, 296-6467.

'00 GMC SONOMA PICKUP, 3-dr., ext. cab, 4-cyl., bed liner, 31K miles, very good condition, $11,200. Williams, 352-9097.

'87 HONDA PRELUDE, AC, PS, sun roof, CD, 213K miles, good shape, needs carb rebuild, $1,200. Prior, 281-5532.

'91 JEEP CHEROKEE LAREDO, 4.0L, 4-dr., PS, PL, CC, white, winch, roof-rack, external spare, 132K miles, $5,275 OBO. Holbrook, 828-1316, after 5 p.m.

'88 TOYOTA COROLLA HATCHBACK, new timing belt, radiator, 117K miles, good condition, $1,500 OBO. Bangs, 505-471-6277.

'97 HANDICAP DODGE GRAND CARAVAN ES, lowered floor, ramp, fully loaded, new brakes & tires, excellent tires. Townsend, 856-7808.

'89 CHEVY S10, extended-cab pickup, V6, AT, PS, PB, AC, $1,495. Evans, 281-3864.

'85 MERCEDES 180E, $3,500. Benson, 293-3551, ask for Theresa.

'93 SAAB 9000 CDE, loaded, AT, leather/wood, sun roof, CD, heated seats, runs well, solid, safe comfort, 100K miles, $5,900. Keegan, 323-8823.

'85 CHRYSLER LEBARON, runs well, $1,400. Vaughn, 792-0126, ask for Alex.

'92 FORD EXPLORER XLT, 4-dr., 4WD, 121K miles, one owner, all records, just serviced, $4,900. Davis, 345-9868.

'92 CHEVROLET G20, conversion van, 83K miles, excellent condition, 2nd owner, never wrecked, $5,450. Anaya, 897-3967.

'96 CHEVY C1500 PICKUP, x-cab, V6, black, 51K miles, good looking truck, great graduation gift, $10,400. MacAlpine, 505-266-1794.

'89 BMW 325ic, convertible, 5-spd., PS, PB, PW, PL, AM/FM/CD, leather, 112.5K miles, excellent condition, $6,500 OBO. Kaneshiro, 861-1766.

'77 MERCEDES 450 SL ROADSTER, loaded, beautiful condition, both tops, 147K miles, records & manuals, $12,800. White, 294-5692.

'96 CADILLAC DEVILLE, V8, AT, all power, NorthStar, burgundy, tan leather seats, garaged, 83K miles, excellent condition, $9,990. Loubriel, 268-1341.

'01 EXPLORER SPORT, 4WD, all power, spotless, non-smoker, alloy wheels, anti-theft, 6 disc, 57K miles, mostly highway, $16,800. Rodgers, 452-8353 or 877-5872.

'94 PONTIAC TRANSPORT, minivan, $5,000 OBO. Herrera, 298-8439.

'00 TOYOTA 4RUNNER SR5, V6, 4WD, AC, PW, PL, AM/FM/CD/cassette, cruise, garaged, exceptional condition, $28,000. Martin, 792-2137, ask for Mark.

'99 SATURN SL1, 23K miles, PS, PB, AC, AT, cassette player, excellent condition, $9,100. Konkel, 565-8199.

'94 GMC VANDURA, wheel-chair van, Braun lift, tie-downs, automatic doors, runs well, $8,500 OBO. Eatough, 792-4803.

'94 DODGE DAKOTA PICKUP, extended cab, AC, bed liner, white, new tires, 126K miles, great shape, $4,300. Pritchard, 293-5297.

'97 DODGE CONVERSION VAN, excellent, 105K miles, $6,000; '98 Ford Explorer, excellent, 69K miles, $11,500. Winowich, 610-0631, ask for Mike.

'95 CHEVY S10, ext.-cab pickup, V6, manual, AM/FM/cassette, bed liner, great condition, $6,500 OBO. Trujillo, 922-1589.

'93 HONDA ACCORD SE, AT, AC, cruise, sun roof, champaign, leather, 100K miles, clean attractive, dependable, $6,500. Hughes, 296-8940.

'00 VW PASSAT GLX, 4motionAWD Tiptronic transmission, leather, sun roof, CD, ski rack, 20K miles, excellent condition, $24,500. Ambabo, 266-2383.

'94 VOLVO 940 TURBO SEDAN, AT, PW, PL, heated leather, 80K miles, solid car, $7,500 firm. Sukla, 980-0604.

'92 TOYOTA 4RUNNER, 4WD, V6, fully loaded, CD, moon roof, ski rack, 131K miles, excellent condition, $7,500. Trujillo, 975-1163.

'95 EAGLE VISION, all power, climate control, AM/FM/CD/cassette, garaged, 142K miles, mostly highway, excellent condition, $4,500. Kercheval, 266-5833.

RECREATIONAL

'98 HARLEY DAVIDSON 1200, Sportster, excellent condition, $7,500 OBO. Stevens, 299-7651.

'82 YAMAHA VIRAGO 750, only 15K miles, $950 OBO. Potter, 299-6053.

'00 HARLEY ELECTRA GLIDE CLASSIC, very nice, w/extras, touring bike, 6K miles, $20,500. Tarango, 232-9543.

'98 SUZUKI MARAUDER CUSTOM, C/A red w/inlay, custom sport package, 5,300 miles, $5,600 OBO. Lance, 299-6594.

'01 KAWASAKI NINJA 250, yellow, great starter bike, 550 miles, excellent condition, just serviced, $2,700 OBO. Peek, 286-4258.

'86 WINNEBAGO LESHARO, 20-ft., gas engine, self-contained, AC, good condition, $4,000. West, 873-4245.

'97 KAWASAKI VULCAN CLASSIC 1500, w/full windshield, saddle-bags, garaged, 2,600 miles, excellent condition, $6,000. Koller, 869-0845.

SAILBOAT, 26-ft., '91 MacGregor 8-hp outboard, easy to sail & trailer, sleeps 6, excellent condition, $8,500. Barthel, 266-8191.

MOUNTAIN BIKE, ProFlex Beast, dual suspension, Mavic221 rims, Shimano LX/XT derailleurs, hydraulic brakes, 24-spd., good condition. London, 281-0296.

'92 PALOMINO FILLY, pop-up camper travel trailer, tandem axle, new tires, hardly used, excellent condition, $3,500. Chavez, 681-4545.

'00 KAWASAKI JET SKI 900 STX, yellow, seats 3, w/trailer, less that 50 hrs., excellent, call for more info. Sanchez, 864-3505, after 3 p.m.

'96 SPORTSMAN, 41-ft., Park Model trailer, living room, bedroom, washer/dryer, central air, additional amenities, $17,500. Peterson, 866-9046.

REAL ESTATE

1/2 ACRE, fenced, in Sandia Knolls, East Mts., $25,000. Keller, 837-2858 or 505-744-4701.

2-3-BDR. FURNISHED HOME, Aug.-Dec., FP, DW, WD, garage space, TV, owner on sabbatical, damage deposit, some utilities, $1,100/mo. Morgan, 505-343-9498.

1/2 ACRE, fenced, telephone & electrical hook-ups, shared well, $25,000. Crosby, 260-1070.

40 ACRES, subdivided into 4 10-acre tracts, 9 miles south of I-40, must sell ASAP, 40 at $139,000, 30 at $105,900 OBO. Rowe, 286-5432.

WANTED

FEMALE ROOMMATE, share Sandia Heights home, must be neat, animal lover, healthy habits, $400/mo + utilities. George, 798-9329.

QUEEN-SIZE HEADBOARD, willing to strip & re-varnish, cheap, $25 or less. Johnson, 792-9432.

GOOD HOME for female pit bull, 4 mos. old, housebroken, gets along w/kids, cats, & dogs, owner allergic. Wickham, 247-4547, ask for Jenn or Jill.

FEMALE ROOMMATE, spacious North Valley home, w/yard, garage, hot tub, clerestory windows, pets OK, non-smoker, $400/mo. + 1/2 utilities. Brito, 344-6768.

BABY WALKER, w/wheels, to buy cheap or borrow for a couple of months. Veltkamp, 271-0325.

BABY ITEMS: bassinette, crib & bedding, infant car seat, receiving blankets, playpen, dresser, changing table, newborn clothes. Bogdan, 332-3179.

PICKUP TRUCK, w/automatic transmission, runs well & dependable, any year, any size, under $2,000. Kureczko, 286-4426.

GOOD HOME for blonde cocker spaniel, neutered, w/all shots, 1-1/2 yrs. old. Forster, 293-7231.

GOOD HOME for 3 lovely, gray kittens, 2 mos. old. Tapia, 292-7043.

TREADMILL, incline feature, good condition. Lindsay, 299-7454.

GOOD HOMES for kittens, 7 wks., looking to keep together, black/white & gray/white. Chavez, 265-7331.

WORK WANTED

HOUSE/PET SITTING, soon-to-be West Point graduate, to stay out of Mom's way, available mid-June through mid-August. Donnell, 299-7123.

Labs-conceived 'touch' software goes where no one has gone before — into the womb

Former Sandia entrepreneur and wife get to know their unborn baby with new software

By John German

Tom Anderson and his wife Kari are expecting to meet their first son in July in the real world. In the virtual world, they have already met him.

"I have touched my son's cheek, and he is not born yet," says Tom, a former Sandia data-visualization and haptics expert who is now CEO of Novint Technologies, Inc. in Albuquerque, which specializes in advanced human-computer interfaces.

Haptics are interfaces that simulate the sense of touch.

HAPTICS HANDS — The sensation of touch is imparted through a special robotic "mouse" that provides resistance as the user guides the robotic hand over the baby's virtual features. (Photo courtesy of Novint)

"It was such an incredible moment to touch him for the very first time," adds Tom. "I will never forget it. I know what my son's face looks like, and I have spent hours already touching his nose and lips and face."

Novint's prenatal e-Touch software uses 3-D ultrasound data gleaned from a mother-to-be's visit to the doctor, then adds mathematical algorithms that simulate the texture and feel of skin.

This sensation of touch is imparted to the parents through a special robotic "mouse" that provides resistance as they guide the robotic hand over the baby's virtual features.

"It not only gives parents the first glimpse of their child, but also the lifelike contact that enables bonding with their child," he says.

"The ability to touch may also aid early diagnosis of medical problems," he adds. "Previously neither parents nor the medical community have had such hands-on interaction with a fetus in utero."

Novint launched the product last week in honor of Mother's Day.

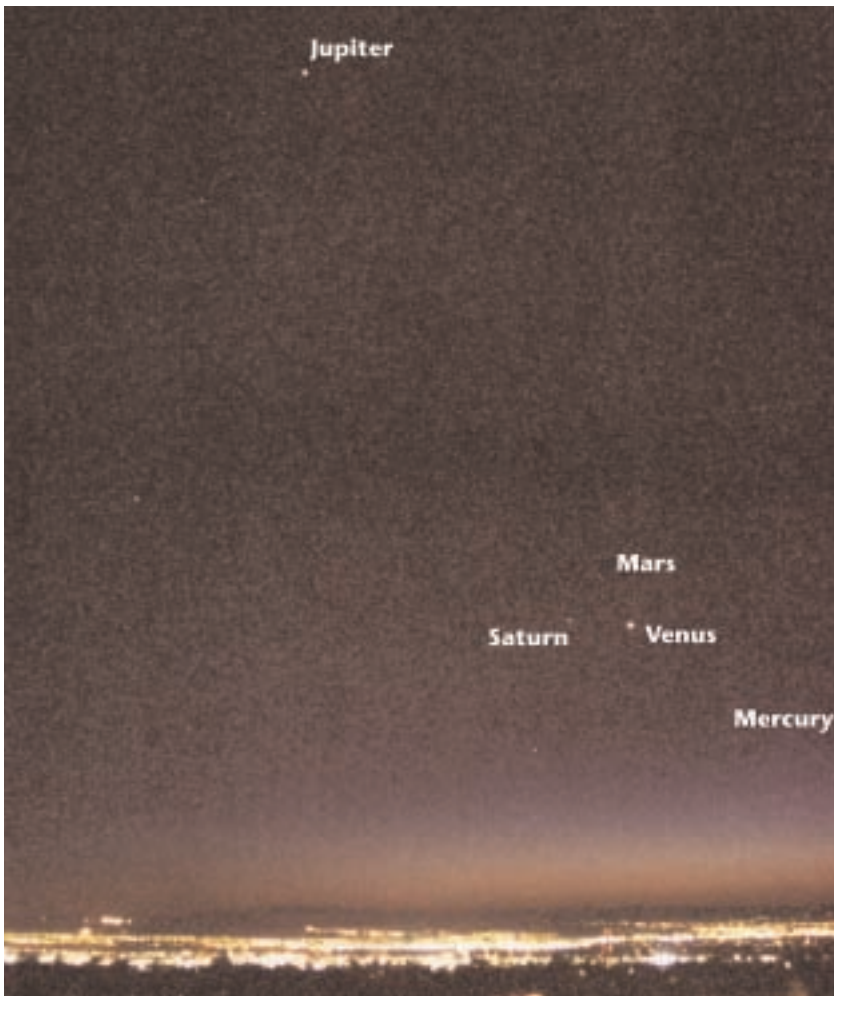
Tom says the e-Touch software also could be used in a wide range of medical procedures, such as exploring breast tumors or doing pre-operative surgical planning.

Novint licensed from Sandia a predecessor of e-Touch, then called Flight, in 2000. Since then the company has used haptics and data visualization to help auto companies design dashboards, tire companies prototype new treads, oil and gas companies drill into imaged reservoirs, and underwater vehicle manufacturers develop submersible robots for archaeological digs, among other projects.

3-D ULTRASOUND REPRESENTATION of Tom and Kari Anderson's unborn son, as seen through the e-Touch software. (Image courtesy of Novint)

The company's major current focus, says Tom, is developing software to train medical and dental students.

Photograph captures six planets



SIX PLANETS — The rare arrangement of all the visible planets in the western sky was captured by *Lab News* editor Ken Frazier from his home in far northeast Albuquerque the evening of May 5. Mercury, Venus, Saturn, Mars, and Jupiter were all clearly visible. Bright Venus, Saturn (to its left), and Mars (above) together formed an almost perfect equilaterial triangle. Mercury is well below and to the right of Venus. Jupiter shines brightly high up in the western sky. The sixth planet? Earth, of course, specifically here the city lights of Albuquerque and the dark horizon of the West Mesa. The next time Mercury, Venus, Saturn, Mars, and Jupiter will all converge far enough from the Sun to be seen as easily will not be until 2060.

Gender Differences in Work and Communication Styles

Presented by Dr. Pat Heim

Tuesday, May 21, 2002

9:30–11 a.m. , Steve Schiff Auditorium

Sponsored by the Corporate Diversity Team and Corporate Training & Development

This is a humorous presentation that addresses central factors that drive gender-related communications problems

Feedback

Q: *A new law was passed in 2001 that enables pre-tax "catch-up" contributions to 401(k) plans for contributors age 50 and above. I believe a Sandia policy has not yet been crafted. I would like to suggest that Sandia support both periodic payroll deductions and one annual contribution (non-payroll deducted) directly to the fund. Also, catch up funds should not be subject to percentage of income limitations that are in effect for the annual pre-tax maximum.*

The letter and spirit of the law supports pre-tax contributions by dollar amounts without regard to income. The catch-up contributions are phased in over time to reach $5,000/year by 2007, which may be a significant amount for some households. I think Sandia should do everything possible to help employees benefit from the catch-up provision. Therefore, I recommend allowing annual contributions under the catch-up provision; perhaps the funds will have to be submitted through payroll for record keeping. This would enable non-base compensation, tax return proceeds, or any other windfall encountered in a given year to be applied under the catch-up provision. Is this type of flexibility being seriously considered for implementation?

A: You suggest a separate accounting "bucket" be set aside for those age 50 or older so funds received during the year, over and above regular salary, can be deposited on a discretionary basis until the catch up limit for that year is reached. There are a variety of ways this "catch up" provision can be legally handled, but it is a system issue between Sandia and Fidelity. If the "catch up" provision is approved by the Sandia Board of Directors, then it will be implemented on a level basis, meaning a portion of the additional amount will be deducted from your paycheck each biweekly period. This provides an even contribution stream from which to draw funds instead of the participant periodically notifying payroll to move funds from one place to another. Your suggestion for a manual process is not feasible with our current systems resources and there is no way to bypass Payroll since the deductions are made on a pre-tax basis. — *Ralph Bonner (10300)*