



December night in Old Town • Photograph by Randy Montoya

Sandia LabNews

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Pension plans update . . .

Plans in shape to meet obligations to retirees, survivors, employees

By Larry Perrine

Although private-sector pension plans for many US companies are in financial trouble today and their retirees won't receive all the money they were originally promised, Sandia's two pension plans are in good shape, says Mark Biggs, senior manager of Sandia's Pension Fund/Savings Plan Management Dept. 10520.

Helping manage Sandia's pension plans since joining Sandia about 17 years ago, Mark says cur-

Sandia management is beginning to think about alternatives to ensure that the plans stay well funded in the future.

rent retirees, surviving spouses, and employees can continue counting on the plans' benefits for their retirement years and needn't be alarmed about the many retirement plan "horror stories" published and broadcast by the media recently.

On the other hand, financial projections show that Sandia's funds can't maintain their current self-sustaining status for many more years, and Sandia management is beginning to think about alternatives to ensure that the plans stay well funded in the future. As most employees know, Sandia maintains two pension plans: (1) the Pension Security Plan for represented employees as required by those employees' bargaining units, and (2) the Retirement Income Plan for most other Sandians. Mark emphasizes that the assets in both plans are mixed together for investment purposes. The two plans have been self-sustaining for years; employees have not made contributions since 1975 and Sandia made its last

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Researchers model nano-size battery to be implanted in eye to power artificial retina

Susan Rempe and team part of a national multidisciplinary effort

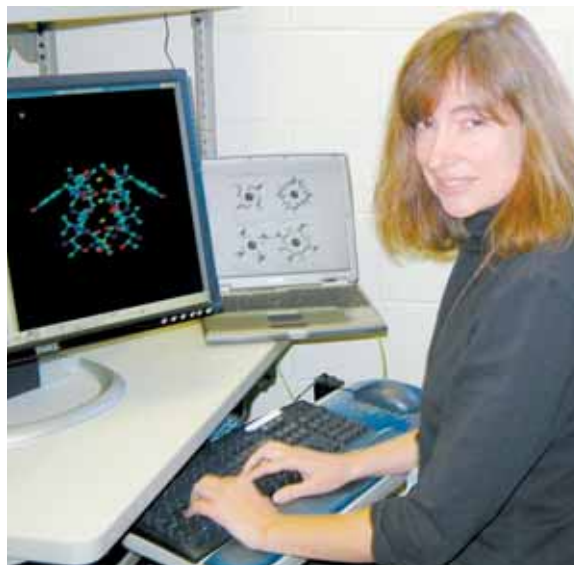
By Chris Burroughs

Several Sandia researchers, led by principal investigator Susan Rempe (8333), are part of a multi-institutional, multidisciplinary team developing a nano-size battery that one day may be implanted in the eye to power an artificial retina.

They are among the recipients of a five-year, \$6.5 million grant recently awarded by the National Eye Institute of the National Institutes of Health (NIH) to establish a new center, the National Center for Design of Biomimetic Nanoconductors. Based at the University of Illinois Urbana-Champaign under the direction of principal investigator Eric Jakobsson, the center is designed to rapidly launch revolutionary ideas in the use of nanomedicine.

The center will design, model, synthesize, and fabricate nanomedical devices based on natural and synthetic ion transporters — proteins

"If you don't understand it, you can't engineer it."



SUSAN REMPE and her team are part of a multidisciplinary, national effort to develop a nano-size battery that will power an artificial retina.

that control ion motion across the membranes of every living cell.

The first task for the center will be to design a class of devices for generating electric power — biobatteries — for a wide array of implantable devices, starting with an artificial retina that has already been developed at the Doheny Eye Institute at the University of Southern California. The artificial retina and accompanying nanobattery will be used to combat certain types of macular degeneration.

(Continued on page 4)



Keeping points-of-entry safe through systems-level modeling of operations. Story on page 3.

- *FIST aims at future combat page 8*
- *Royalty awards banquet honors Sandia inventors, authors page 9*
- *Retirees Carl and Ann Hawk epitomize the spirit of giving page 10*



It was 20 years ago that Z's predecessor machine, PBFA-II, fired for the first time. Story on pages 6-7.

What's what

Recent media stories about big companies renegeing on pension plan promises – reducing and sometimes even eliminating these retiree benefits – have raised concerns among some Sandians about the health, safety, and security of our own Pension Security Plan and Retirement Income Plan. Larry Perrine looked into all this and found that while our plans do face some long-term funding challenges as more and more retirees start collecting pension benefits, they seem to be generally in good shape. Retirees, surviving spouses, and current employees should be encouraged by what Pension Fund/Savings Plan Manager Mark Biggs (10520) has to say about them. Check it out beginning on page 1.

* * *

As a UPI colleague and I strolled toward the old Bullpen during a break from Legislature coverage one sunny Santa Fe day years ago, he pointed out that despite the poor pay, crummy office space, and lousy hours, journalism was a fun job. You go places, learn things, and meet people that wouldn't come your way if you weren't a reporter, he said.



Northern Exposure with scientists instead of moose

He was right and I was reminded of that by the visit to Sandia of a couple of people early last month. They're TV writers and they're spinning up

a series that will be, in the characterization of Media Relations' Neal Singer – who hosted them on their visit – “much like the series Northern Exposure, with scientists instead of moose.”

At that point in their concept of the show, it will take place in a town “like Las Vegas, New Mexico,” and feature a “Santa Fe Institute-like” setting. The writers, Brooke Kennedy and Julie Hebert, visited with several Sandians and seemed to be delighted with the range of technology and expertise – and the chatty friendliness – they found. They also got a look at some “visuals” to help them develop a feel for the atmosphere of a profound scientific institution.

And to top off that feel for the atmosphere, they got lunch at Bea's #2.

* * *

With just a little over two weeks until the holidays, “the boulder” on Hardin Boulevard is looking decidedly drab. No Christmas tinsel or ornaments. No Hanukkah menorah. No Kwanzaa displays. Not at all the festive boulder pictured sunning in the tropics earlier in the year. Or greeting commuters with a jack-o-lantern on Halloween morning.

Maybe the holiday elves are still busy festooning cedars in the I-25 median near La Cienega and Los Lunas. Maybe they'll get to the boulder next. Before we all head home for the winter break.



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

David Haaland wins chemometrics award

Sandia Senior Scientist David Haaland has been awarded the 2005 Eastern Analytical Symposium's Award for Achievements in Chemometrics. The international award is presented each year in the field defined by the International Chemometrics Society as “the science of relating measurements made on a chemical system or process to the state of the system via application of mathematical or statistical methods.”

David, a Sandian since 1972, earned his PhD in physical chemistry from the University of Rochester. He works in Biomolecular Analysis and Imaging Dept. 8332 and has joint appointments with the University of New Mexico Department of Chemistry and Department of Molecular Genetics and Microbiology.



DAVID HAALAND

On sabbatical in 1987, David worked with Professor Bruce Kowalski at the University of Washington; Kowalski is one of the seminal figures in chemometrics.

David's research has focused on applying chemometric methods to the quantitative and qualitative analysis of spectral data, and, more recently, on the multivariate analysis of spectral images from Fourier transform infrared spectroscopy (FTIR) and fluorescence spectrometers.

His current interests involve the application of multivariate curve resolution to hyperspectral imaging from FTIR and fluorescence spectrometers. Most recently, David led a team developing a new 3D hyperspectral confocal fluorescence microscope and is applying his multivariate analysis experience to the resulting spectral images to investigate cell signaling in eukaryotic cells and the photosynthetic processes in bacteria.

David has published more than 110 journal articles and conference proceedings, and presented more than 120 invited talks. He holds 12 patents licensed to US industry and is the recipient of many professional honors and awards. He serves on the editorial advisory boards of *Vibrational Spectroscopy and Chemometrics* and *Intelligent Laboratory Systems*.

Recent Patents

David Menicucci (6521) and Billy Black (6216): Non-Invasive Energy Meter for Fixed and Variable Flow Systems.

Kelly Klode (2618) and Robert Habbit (2624): Three-Dimensional Microelectromechanical Tilt-Platform Operated by Gear-Driven Racks.

Jonathan Weiss (1739): Fluorescent Optical Position Sensor.

John Harrington (6644), James Buttz (6644), Ray Page (6454), Herbert Metcalf (6454), and Alex Maish (deceased): MILES Hand Grenade.

Joseph Schoeniger (8321): Electrokinetically Pumped High-Pressure Sprays.

Retiree deaths

Ernestine Mikles (age 90)October 23

Gordon Jay Miller (82)October 24

Kenneth W. Butler (89)October 24

Elizabeth Bookwalter (87)October 25

Ernest G. Mares (90)October 29

Nabor Rael (83)October 31



Lab News schedule and classified ad deadline

This is final issue of the *Lab News* for 2005. The first 2006 issue will be published Jan. 4. Because production must begin before the winter break, the classified ad deadline for that issue will be noon, Tuesday, Dec. 20.

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

Ken Frazier, Editor 505/844-6210
Bill Murphy, Writer 505/845-0845
Chris Burroughs, Writer 505/844-0948
Randy Montoya, Photographer 505/844-5605
Nancy Garcia, California site contact 925/294-2932
Contributors: Janet Carpenter (844-7841), John German (844-5199), Neal Singer (845-7078), Larry Perrine (845-8511), Howard Kercheval (columnist, 844-7842), Will Keener (844-1690), Iris Aboytes (844-2282), Michael Padilla (284-5325), Julie Hall (284-7761), Rod Geer (844-6601), Michael Lanigan (844-2297), and Michelle Fleming (Ads, Milepost photos, 844-4902). Erin Gardner (intern, 284-8432), Darrick Hurst (intern, 844-8009). Dept. 3651 Manager: Chris Miller (844-0587).
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Advent Solar to employ 1,000 by year 2010

Company founded by former Sandian

Advent Solar, a company started by former Sandian James Gee and based on technology he helped develop at the Labs, will be the first company at the Albuquerque Mesa del Sol development. The photovoltaic cell maker will build a manufacturing plant expected to employ 1,000 by 2010.

James left Sandia two years ago to start Advent Solar. At its new 70,000-square-foot research and production plant, the company will be manufacturing and selling photovoltaic cells based on a Sandia-developed technology that locates all electrical contacts on the back of the solar cell, freeing up the top surface for more absorption of sunlight.

Advent Solar plans to gradually ramp up to the 1,000-employee level over the next five years. It now employs 35 at its office and prototype production line at the University of New Mexico's Science and Technology Park.

— Chris Burroughs

Sandia researchers aim to keep points-of-entry safe through systems-level modeling of operations

By Mike Janes

Carolyn Pura (8115), program deputy for borders and transportation security in the Labs' Homeland Security Strategic Management Unit, is blunt in assessing the nature of her job. "Protecting our borders is difficult and expensive," she says.

Almost as quickly, however, she asserts that Sandia's recent work on border security is well on its way to becoming an enormously valuable national asset by providing federal agencies with a reliable and comprehensive simulation capability that lets officials "test drive" various security solutions before investing in them.

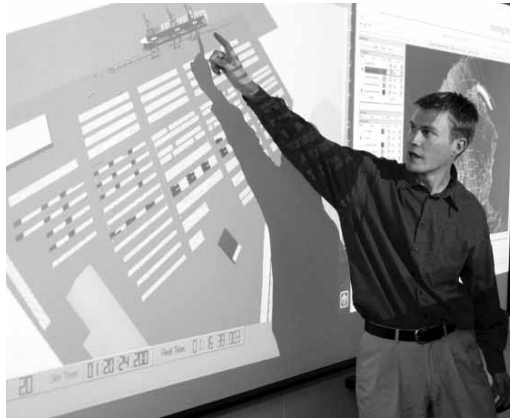
The focus of the Borders Grand Challenge, funded by a three-year, \$6 million Laboratory Directed Research and Development project, was to develop simulation-based systems analyses characterizing the security of the US Border System and the impact of new detection technologies and concepts of operation. The work capitalizes on a range of existing Sandia capabilities, including the Weapons of Mass Destruction Decision Analysis Center (WMD-DAC), the National Infrastructure Simulation and Analysis Center (NISAC), and even the Labs' robotics expertise. Some 21 Sandia researchers from both the California and New Mexico sites worked on the project, with Carolyn serving as principal investigator and Dan Horschel (6221) as project manager.

Models examine flow of people, goods

The interactive analysis that serves as the hallmark of the program has largely focused on illegal smuggling of radiological/nuclear material but can also be applied to other threats such as explosives or chemical/biological agent attack. The work uses detailed models that replicate actual facilities and procedures and examines border operations of all kinds. Of utmost concern is the flow of people and goods through the various border choke points.

"There is a cost-benefit tradeoff associated with any technology that might be used in border security," Dan explains. With commerce, for example, officials must consider the flow of people and goods crossing the border, any delays that may occur due to security provisions, and operational costs that emerge as a consequence of the flow and delay. Sandia's unique systems-level methodologies and tools address these complexities and allow homeland security officials to make data-driven decisions.

Mark Ehlen (6221) served as the lead for economic modeling. Mark points out that a unique feature of the program is its ability to project the economic impact that might be felt if a venue implements certain security options. A typical port whose processing time increases due to a newly configured set of chemical detectors, for example, might expect to increase its on-site inventories and shipments by up to 15 percent, leading to increased business costs and decreased sales. In addition, says Mark, firms that ship through the port will be affected by



ANDY VAUGHN (8227) shows an example of how simulations developed at Sandia can help evaluate new sensor technologies.

(Photo by Bud Pelletier)

delays and increased costs and may take their business elsewhere. Such consequences will fluctuate from venue to venue, of course, depending on the

security measures and the venue's own operational plan.

Sandia's models, by simulating the effects of detector placement, the use of facial recognition software, or the impact of other technology devices and strategies, can give decision-makers specific and reliable data to help make sound decisions about how and where to invest.

Mid-fidelity vs. High-fidelity modeling

The models themselves come in two primary forms.

"Mid-fidelity" models offer a broader, bigger-picture look at a border location that might give users the ability, for example, to view personally owned vehicle and cargo vehicle flows at an actual facility, using that facility's own procedures. A "higher-fidelity" model, seen on the computer screen when the operator "zooms in" on the activity, might focus on security interrogation and feature detailed sensor modeling. High-fidelity models, because of their visualization features and accurate geometries and motion, provide a sound environment for training and can be quickly reconfigured to address border concepts of operation.

Sandia's models have been integrated to include multiple domains, including air, sea, and land. All domains have been built with the capability to analyze the impacts of different types of sensing equipment, from radiation detection to x-ray equipment. Both a land-crossing pedestrian model and an airport, for example, examine the movements of people and look at biometrics technology, while a seaport and land cargo port analyze cargo inspection equipment.

"Hot source" dilemma

One significant issue that security officials face is the problem of "hot sources." These occur when multiple detectors sound alarms simultaneously due to

benign radiation sources. Hot sources significantly disrupt port operations by causing large delays while the source is sorted out and determined to be non-threatening.

Sandia's modeling helps system users address the hot source problem by examining various detection scenarios and options to consider. An "in-situ" option, where traffic is stopped while threat sources are localized with a portable detector and removed from the primary traffic stream, might be suitable for certain venues. Others might choose to maintain a "self-identification pre-sort" traffic lane that allows medical patients or known radioactive shipments to sort themselves out of traffic. Sandia-developed simulations help officials identify the best "encounter geometry" within their facilities and the most "throughput-friendly" detector locations.

Though Carolyn and Dan say the work represents the most comprehensive modeling work available on border security, the research has the potential to go much further. Ideally, Sandia could extend the capability to all ports of entry across the country, creating a complete national model that is able to examine changing security measures and operations and their impact. "What we have now are high-quality, targeted studies," says Dan. "The value a national model could offer decision-makers at the highest level could be immeasurable."

Sandia California News

Steven Chu to deliver Truman Lecture

The Fall 2005 Truman Distinguished Lecture takes place Dec. 15 from 10-11:30 a.m.

in Bldg. 904 (the Combustion Research Facility auditorium). Steven Chu, director of Lawrence Berkeley National Laboratory, will give a talk titled "Molecular Biology as a Solution to Physics Problems."



STEVEN CHU

The Distinguished Lecture Series is intended to help stimulate thinking about the most vital issues confronting the nation and the world by bringing in respected speakers to discuss their ideas. These special events are part of Sandia's Truman Distinguished Lectures, dedicated to fostering the exchange of knowledge on the intersection of national security, science, technology, and public policy. The California site's previous events, featuring William Perry, Michael Nacht, Carla Anne Robbins, and Norm Augustine, were hugely popular.

For more information on the lecture, contact Chris Andreski (8700) or Jennifer Contreras-Bamberger (8761).

CRF symposium celebrates 25th anniversary and explores future energy challenges

By Nancy Garcia

Twenty-five years after its founding, the mission of the Combustion Research Facility (CRF) is as relevant as ever, speakers commented at an anniversary symposium on Nov. 17.

Labs President and Director Tom Hunter pointed to the vision that this facility represents concerning the role of energy and the contributions of new knowledge in science and engineering to national prosperity.

Terry Michalske, director of Biological and Energy Sciences Center 8300, observed, "The challenges in energy are not going away." The challenges in some ways have become more complex, he added, saying, "We began in a world where there was one fuel and our job was to figure out how to use less of it and now we're in a world where there really is less of it."

The opportunities are great, however, noted Ray Orbach, director of the Department of Energy's Office of Science, who addressed the audience in videotaped remarks. "The future may be even more remarkable," he said, noting CRF researchers have made the most complete simulation of combustion the world has seen and discovered a class of compounds in flames that were not known previously to be there.

"You can see that I'm very bullish on your future," he said.

When the CRF began, the concept had been crystallized in the long gas lines of the 1970s, noted Walter Stevens, division head for Chemical, Biological, and Environmental Sciences overseeing programs that directly support scientific research and the user program at the CRF, who represented the Office of Science at the event.

Keynote speaker Paul Roberts, author of *The End of Oil*, was called upon to give a broad perspective. "We've just begun the energy revolution the nation truly needs," he commented.

In Roberts' view, the obstacle in creating a comprehensive, strategic solution to the limited supply of energy has been the faith that the market will address the problem "as if by magic, as needed." Roberts compared these concerns to the devastation of New Orleans, saying the issue "is not hurricanes, it's the system the hurricanes disrupt that is inadequate, out of balance and unstable."

Since "cheap oil is getting to be a thing of the past" he predicted "a sort of Cold War with regard to energy," in which energy-hungry China is not relying on free markets to provide an energy supply on demand, but instead locking in access through alliances.

"China is trying to transform from an inefficient agrarian economy to a post-industrial one in about four years," Roberts said, "They need energy; they

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Nanobattery

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Sandia's role is on the theoretical and computational side of the project, according to Susan.

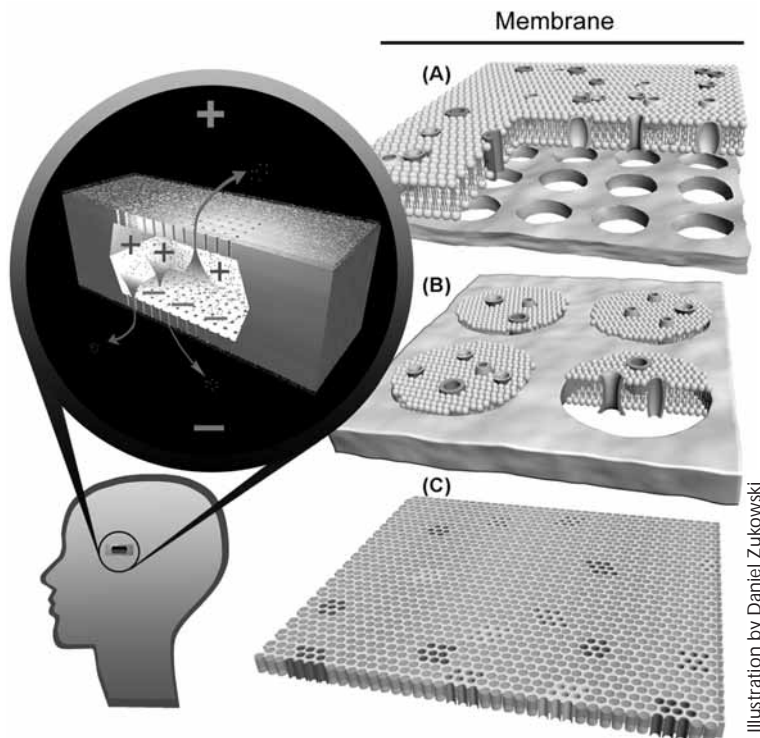
Understanding and predicting

"We will use our expertise in multi-scale modeling to understand and predict how transporter structure leads to function, with an initial focus on specialized transporters found in the specialized electric organs of certain fish," Susan says. "This information will give us a better understanding of how power is naturally created in biological organisms — information to be used for designing and building the nanobattery."

Speaking of the vital role of modeling, she adds, "If you don't understand it, you can't engineer it."

Ultimately the algorithms, software, design expertise, and scientific knowledge gained through the modeling efforts, in which Susan is joined by Kevin Leung (1114) and Steve Plimpton (1412), will be shared with the external community through workshops, seminars, conferences, and collaborations.

Working on another aspect of the project is



SCHEMATIC of nanobattery that would be implanted in or near the eye.

Jeff Brinker (1002), who is affiliated with both Sandia and the University of New Mexico. He will engineer components of the biobattery

using silica technology.

The team plans to translate several categories of biological function into new devices that would treat disease and lead to implantable devices. Properties of interest that appear in the biological ion transporters include electrical signaling, osmotic pumping, and molecular detection.

A multi-institutional project

Sandia is one of the center's participants, as are the Doheny Eye Institute at the University of Southern California, the Illinois Institute of Technology, Purdue University, the University of California-Davis, the University of Illinois at Urbana-Champaign, Oxford University (UK), Wabash College, and Weill Medical College of Cornell University.

The National Center for Design of Biomimetic Nanoconductors is part of a package of about \$43 million for four advanced national centers in nanomedicine announced this year under the NIH's New Pathways to Discovery Program. The NIH program began in 2003 as a Roadmap for Medical Research initiative to spur medial research discoveries from bench to bedside.

The other centers will be at the Baylor College of Medicine in Houston, the University of California at San Francisco, and Columbia University in New York City.

CRF symposium marks 25 years

(Continued from preceding page)

are the second-largest consumer of oil, bypassing Japan last year, and are on track to being No. 1."

The hopeful view that investment will flow in and oil will flow out has been hampered by the reality that the largest oil exporters (with the exception of Norway and Canada) have also been the least stable.

In Iraq, production was supposed to be between 4-4.5 million barrels but is barely 2 million, according to Roberts, and there is no anticipation supply will increase soon. Although prices hovered around \$24 a barrel for two decades, the six-year price is just under \$60 a barrel. Meanwhile, discovery rates have been declining since 1962.

Since fossil fuel is not renewable, industry watchers anticipate one day hitting a historic peak in supply. "The can of worms has been opened," Roberts remarked. "The industry is taking very seriously the notion that the peak is closer than we think it's going to be."

About human or political barriers, he said the outlook had been that the US could intervene, but he believes "it's no longer an option — it may never have been an option. . . . There may not be a nation on this planet powerful enough to stabilize markets."

Given this picture, improvements and alternative technologies need to be brought along, he urged. "We can think outside the box we've been stuck inside for more than a century . . . we need to understand the challenge that's in front of us and have it make sense to a broader public; this takes decades to develop and roll out."

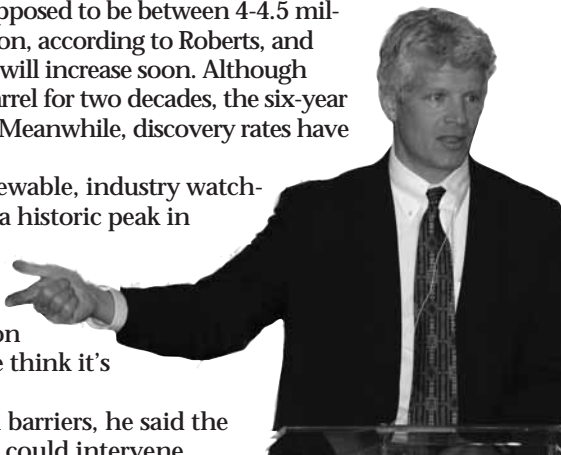
Industry still needs to be moved into a long-term exit strategy, he noted, while conservation could be couched in more strategic terms as a matter of national security. Having had 150 years of cheap energy has incurred social and environmental costs, he added, particularly in carbon dioxide emissions, saying, "The market does not understand that carbon is a cost to be avoided."

Roberts sees a huge opportunity for researchers to be viewed as a conduit to answers for pressing practical questions being posed by businesses. "The people with the checkbooks are finally coming and knocking on the door saying 'help us out' — it's an exciting time for R&D."

A panel discussion followed that was moderated by Energy, Security and Defense Technologies Division 6000 VP Les Shephard. In it, CRF Advisory Committee Chair Greg McRae, Bayer professor of chemical engineering at MIT, said he believes most people given the right information will make the right decisions, and that experts at the CRF are in an ideal position to shape the debate and develop imaginative solutions, looking at the issues as a systems problem.

Focusing on the role of science and engineering will be important to the country's future foundation, Tom concluded in his remarks. "That will only be maintained as a national imperative if we act, if we get engaged, and keep places like the CRF on the national agenda. . . . It all happened because someone had a vision that this is a model to have a user facility where the best people would come and the best work is done."

He acknowledged the strong role of the Office of Science and a half-dozen individuals there, founding director Dan Hartley (followed by Peter Mattern and Bill McLean and now Terry), the leadership of California Lab VP Mim John, several original research staff members, and guidance of the external advisory committee.



THE END OF OIL author Paul Roberts was keynote speaker at the CRF's 25th anniversary symposium.

(Photo by Bud Pelletier)

Feedback

Soon-to-retire Sandian seeks guarantees on pension plans, Labs' plans to address 'crisis'

Q: I recently became aware that Sandia's pension funds are projected to be "in the red" by FY10. A slide in a presentation on Lab Director Tom Hunter's internal web site shows that and indicates that by FY13, the shortage could be as much as \$92 million per year.

As someone who plans to retire soon, this concerns me greatly, and it should concern all Sandia retirees and those who hope to retire someday. I have three main questions and will appreciate straightforward, honest answers:

1. Can Sandia guarantee that eligible Sandia employees will continue to get the pension benefits they have earned?
2. Are there any plans to reduce these pension benefits?
3. Although plans may not be firm yet, how does Sandia plan to deal with this looming pension plan "crisis"?

A: Recent bankruptcies in the airline and auto supply industries and possible legislative changes, have focused media attention on corporate pension plans.

Although better funded than many pension plans, Sandia's plans are subject to many of the same pressures — such as volatile capital markets and historically low interest rates.

As Tom Hunter has reported, our latest projections indicate that it is likely that Sandia will be required to start making additional contributions to the Retirement Income Plan within the next 5 years. The contributions are necessary to assure that there are adequate assets in the plan over the long term to pay benefits to current and future retirees. In response to your questions:

- 1) Federal law requires that the pension benefits earned by an employee are protected and cannot be reduced by the employer. There are currently sufficient assets in the pension plans to cover the expected benefit obligations. Although Sandia's pension plans are covered by the federal Pension Benefit Guaranty Corporation insurance, Sandia's contract with DOE also provides additional protection to pension benefits. If Sandia ceased to exist at some time in the future and the pension plans were terminated with an excess of liabilities over assets, then Sandia's operating contract requires DOE to cover the deficiency;
- 2) No, federal law prohibits reductions in the benefit that have been earned by employees;
- 3) Sandia has already begun to address the probability of future contributions to the pension plans. Although no contributions have been required since 1987, Sandia made contributions to its pension plans from operating expenses from 1950 until 1987.

Sandia's forecasts of the future funded status of the pension plans under different scenarios represent an important first step in managing future pension contributions. This information has been shared with LLT, and they are reviewing a range of possible options to address the issue. In addition, Sandia has used these projections to review the asset allocation of its pension fund and evaluate if alternate asset mixes could impact future funding requirements.

— Jennifer Crooks (10500)

Pensions

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company contribution in 1986.

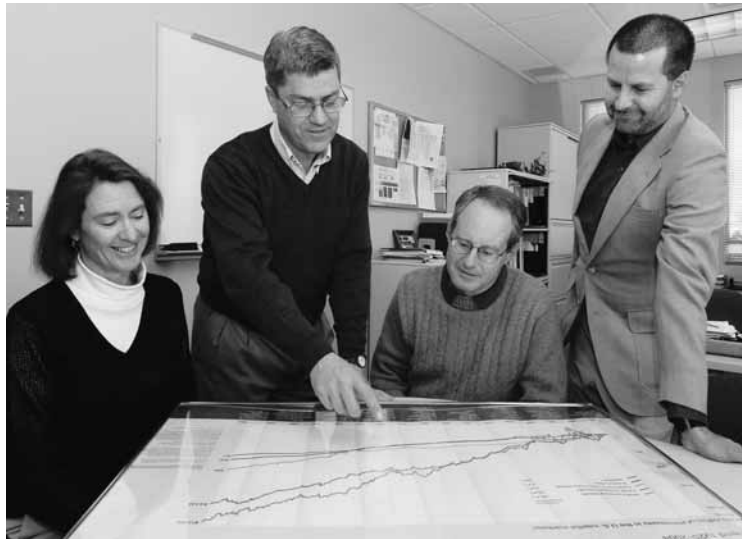
"They are accounted for separately, but managed in the same pool," he says. The returns have in fact been good for several years after booming back in the '90s and dropping along with everything else as the stock market took a dive for several years early this decade.

Making money now, but . . .

The 2004 summary reports, scheduled to be made available to employees by Dec. 15, show that the plans' assets, after subtracting liabilities, totaled nearly \$3.319 billion as of Dec. 31, 2004, up from nearly \$3.103 billion a year before that. This is an increase of more than \$216 million, after increasing more than \$477 million in 2003.

While those gains are good, and in fact exceeded in both years benefits paid out to retirees and surviving spouses, Mark says Sandia dynamics are changing, with resulting concerns that Sandia's management will need to resolve.

One changing dynamic, for example, is the retiree population — it's growing along with the amount of money they collect. More and more Sandians are joining the retirement rolls each year than leave the rolls (die) and get larger pensions since salaries are higher now. For example, the Retirement Income Plan formula considers the highest three consecutive years of salary, along with age and years of service. The Pension Security Plan formula considers job classification. (Employees can get full details by studying the plans and their formulas on the internal web at <http://www-irn.sandia.gov/hr/benefits/retirement/index.htm#pension>. Employees and retirees can also access this and more on Sandia's external web at <http://www.sandia.gov/resources/emp-ret/index.html>; click on Summary Plan Descriptions link.)



FINANCIAL UPS AND DOWNS — Sandia's pension and savings plan management team has the primary responsibility for ensuring the continuing viability of the Retirement Income Plan and Pension Security Plan. Mark Biggs, second from left, is senior manager of Pension Fund/Savings Plan Management Dept. 10520. Reporting to Mark are, from left, managers and investment professionals Jane Farris, Bruce Criel, and Evan Ashcraft. (Photo by Randy Montoya)

Here are numbers provided by Dept. 10520:

- The average annual pension paid to all payees in 2004 was \$21,871 (includes retirees, terminated vested employees, and surviving spouses). The average to all payees five years before that, in 1999, was \$15,020. Part of the reason for the big increase, along with the growing retiree ranks and growing salaries, is that most retirees received ad hoc increases in 2000 and 2002.

- 5,909 retirees and surviving spouses received pension payments in 2004, up from 5,478 in 1999 and 4,904 in 1994. In other words, in 2004 the plans supported more than 430 more people than in 1999, and more than 1,000 more than in 1994.

Sound familiar?

The resulting problem for the pension plans is obvious — more and more retirees drawing ever-larger pensions and living longer lives, eventually leading the funds into the red. Sound familiar . . . as in the Social Security system?

A problem, Mark points out, is that no one knows with certainty when the pension plans' investment growth will no longer keep up with growing financial demands on the plans. Major factors include the composition/size of the future workforce, how quickly Sandia retiree ranks will grow, and how well plan investments do in the future.

Mark says Sandia's best models indicate that the pension plans could require additional contributions of about \$7 million as early as FY10 and possibly larger amounts in future years, meaning that plan funds will need to be supplemented in the future to meet IRS funding requirements. Sandia management is beginning to think about how this could affect Sandia's future budgets.

"The thinking is still in the very early stages," he says. "The first step in managing it is getting comfortable with the projections. We spend a lot of time modeling to get a credible range of projections.

"Once you get out more than about five years, the results get driven by the assumptions you make," Mark continues. "So looking out beyond about FY11 . . . you have to take the projections with a grain of salt. Pension funding considerations are being looked at in the context of other costs as well, such as health-care costs. Management is beginning to review a range of options now, but clearly no decisions have been made."

A management concern that surfaced several years ago was that many experienced Sandians were beginning to leave the Labs early and that the knowledge/experience base was being depleted. That was, in fact, one of the reasons Sandia changed the retirement formula in 2002 — to encourage people to stay working until at least age 62. Many Sandians had been retiring in their late 50s.

The new formula may be making a dent in that, Mark says, but it's really too early to say how much. "The retirement age may be creeping up. The average age [since 2002] appears to have increased by about 6 months, from 60.3 to 60.8, and the median age increased by a little over one year, to 61-1/2."

Private pension plans?

Although the main story should help assure current Sandia employees and retirees that their pension plans are safe and that future benefits are assured, many US workers aren't so fortunate.

Recent media coverage has exposed failings and frailties in numerous defined-benefit plans, leaving hundreds of thousands of employees with little hope for a secure retirement. Many companies are killing their plans and/or going solely to defined-contribution [401(k)-type] plans. Some examples:

Time Magazine's in-depth Oct. 31 article "The Broken Promise" pointed out that the number of defined-benefit pension plans guaranteeing a fixed income for life (Sandia's Pension Security Plan and Retirement Income Plan are examples) has plunged from 112,200 in 1985 to 29,700 today. The article also said from 2001 to 2004, nearly 200 corporations in the FORTUNE 1000 had killed or frozen their defined-benefit plans.

Among other ugly examples, an article in the November *AARP Bulletin*, "Now You See It, Now You Don't," gave the example of one 31-year AT&T employee's pension that was valued at \$350,000 before the company converted from a defined-benefit plan to a cash-balance plan. The value then dropped to \$138,000, reducing his annual benefit from \$47,303 to \$23,444.

A Nov. 15 article by Associated Press business writer Marcy Gordon pointed out that the Pension Benefit Guaranty Corp. (PBGC), the federal agency that insures private-company pension plans, has a \$22.8 billion deficit for FY05. PBGC executive director Bradley Belt said money to pay benefits would one day run out unless Congress acts in several ways to prevent it. (Sandia's pension plans are actually covered by the PBGC, but the Department of Energy also guarantees Sandia's plans; see "Built-in assurances" below.

Built-in assurances

So, why can current employees and retirees count on getting their pensions when some private company employees and even some public-sector employees are losing pension benefits?

There are several reasons, including the fact that any change to Sandia's pension plans must be approved by the Sandia Board of Directors, Lockheed Martin, and the Department of Energy. And changes don't come easily. It took two major attempts spanning several years and some political clout to bring about the plan improvements announced in 2002.

But the main reason Sandians can feel secure about their plans is that the Sandia operating contract between the Department of Energy and Lockheed Martin requires that the plans continue and/or that all liabilities be covered under just about any conceivable circumstance, including the highly unlikely event of plan termination for some reason. Although there's a little "legaleze" in the following, here are two primary paragraphs (verbatim) from the contract that address this issue:

"Contract Termination: If this Contract terminates and there is no successor contractor, the plan shall be terminated. If this Contract terminates and there is a successor contractor, the successor contractor shall assume sponsorship or continued maintenance of the plan. Liabilities for participants so retained and assets equal to the liabilities shall be transferred to another deferred compensation plan of the contractor. Such liabilities shall equal the projected Benefit obligation as defined in Financial Accounting Standards Board Statement Number 87."

"Plan Termination: If the Contracting officer and the Contractor agree to terminate the plan, the termination shall follow IRS and Pension Benefit Guaranty Corporation guidelines and remaining assets and investment return on those assets shall revert to DOE. If, upon plan termination, assets are insufficient to meet liabilities, DOE shall pay the Contractor the amount necessary to cover liabilities."

For more related information, check out the Feedback question and answer on page 4.

Who's minding your pension money and how?

As detailed in the main article, Sandians' pensions appear safe and sound. But who's watching over your pension money — working to make it grow — and how do they go about it?

The "who" begins with a Sandia investment committee appointed by Sandia's Board of Directors to ensure high-level oversight. The committee includes Sandia Deputy Director Al Romig (Org. 4, chair), Sandia Deputy Director Joan Woodard (Org. 2), Chief Financial Officer and VP Frank Figueroa (10000), Director Bonnie Apodaca (10200), Technology Ventures Corp. President and CEO Sherman McCorkle, and Ralph Bonner, who retired from Sandia as a director several years ago after directing Sandia's pension funds and more. Two Lockheed Martin officials also serve on the committee.

"The investment committee is the main fiduciary for the investment function itself," explains Mark Biggs (10520). "My organization is responsible for recommending investment managers to manage the money in the pension plans. I have three investment professionals who analyze, recommend, and monitor our private investment managers. If the managers are underperforming, our investment professionals can recommend terminating them. The investment committee must approve or reject their recommendations."

Eighteen investment professionals currently manage the plans' money, Mark says. "These professionals specialize in managing money for institutional clients like us who have pension plans or endowments. Each has a particular expertise and style, and we hire them to exercise their best judgment. If they perform well, we keep them, and if they don't, we get rid of them."

Exciting beginning, interesting future: Z machine turns 20

'Arcs and Sparks' machine 'boldly went where no one had gone before,' eventually producing signs of fusion

It was a "mere" 20 years ago on Dec. 11, 1985, that a 108-ft.-diameter Sandia machine then called PBFA-II first made the ground shake, lit up the surface of the water surrounding its tiny target area with electrical arcs and sparks, and generated talk of controlled nuclear fusion from jubilant researchers.

Tension had built for weeks in Area 4 as to whether the huge machine, which sent massive electrical currents surging through 36 transmission lines to activate a lithium ion beam, would work as planned. Some thought it might not. Some thought it might explode.

The tension, reported the *Lab News* at that time, was similar to that before the last game of a tight World Series.

Theme music of the TV series "Star Trek" played over loudspeakers with voice-overs reminding the listeners that Sandia "boldly goes where no man has ever gone before."

"Most exciting moment of my life"

This exhilarating message was soon replaced by a dour disclaimer, humorously borrowed from the television show "Mission Impossible": "As always, if you fail, Sandia and DOE will disavow any knowledge of your mission."

"The most exciting moment of my life," said former Sandia VP Pace VanDevender, then director of pulsed power sciences, when the first shot proved successful.

VP Gerry Yonas (7000), one of the machine's founding fathers, listened on a telephone line from Washington, where he was serving as the Strategic Defense Initiative's

chief scientist. He afterwards declared himself speechless, then said, "I could feel the machine's vibrations up my spine all the way across the country."

More measurably, according to Mary Ann Sweeney (1670), who was present at the time, scientists and engineers who could not fit into the building's crowded control room felt the ground shake in Bldg. 960 hundreds of feet away.

Believe it or not

Since then, many things have happened.

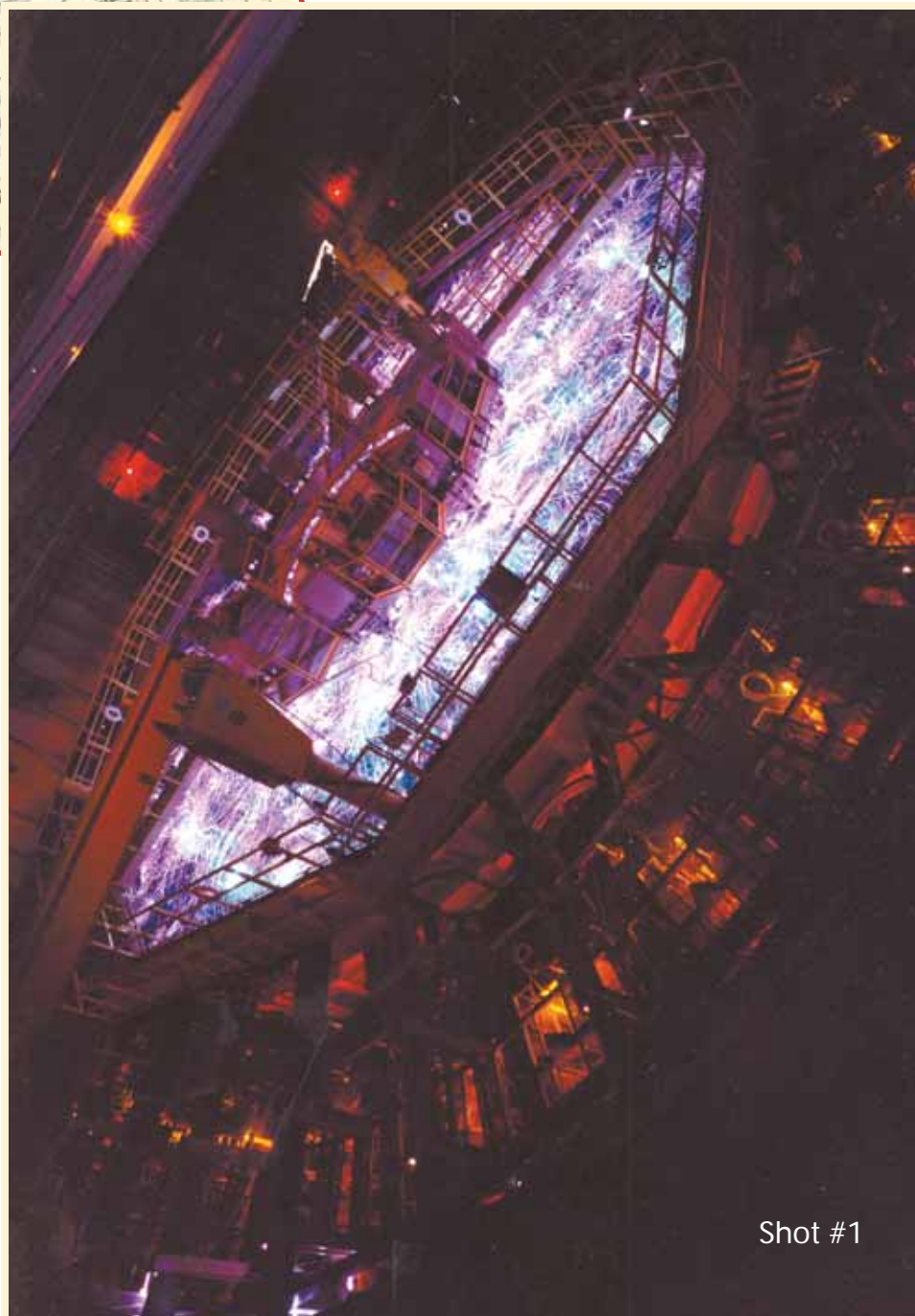
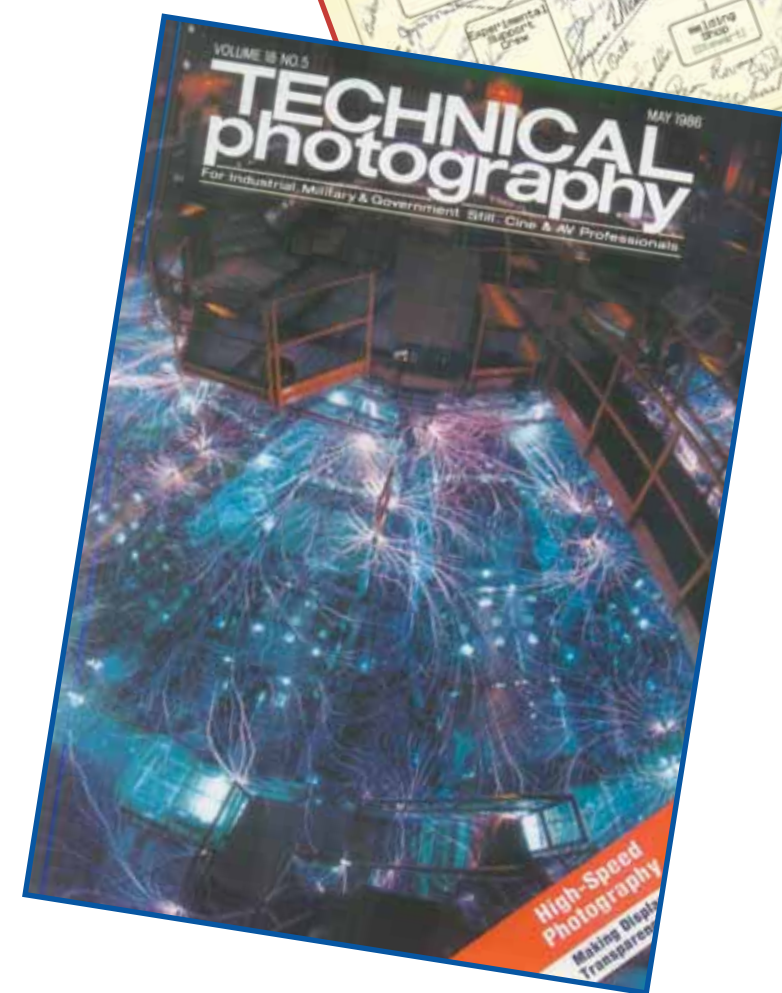
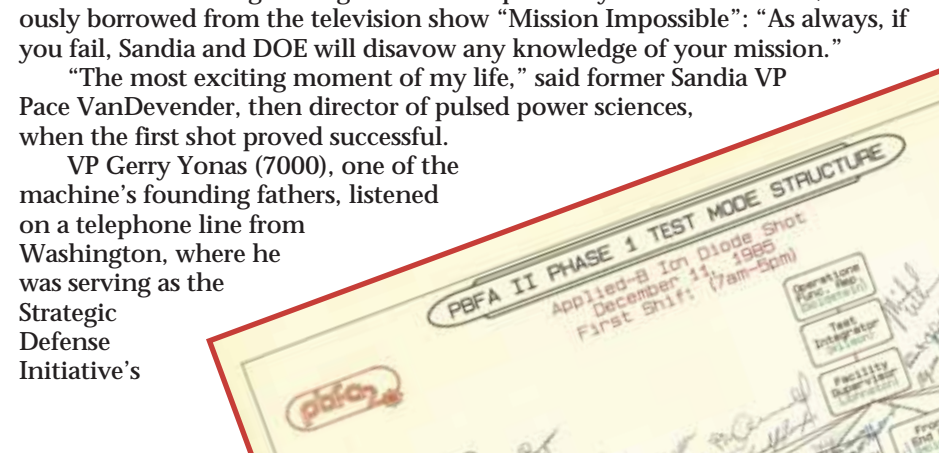
The machine was featured in Ripley's "Believe It Or Not" list of oddities with this somewhat obscure citation: "At Sandia National Laboratories in Albuquerque, N.M., a futuristic research center can make more power than all US utilities produce at any one time dance on the head of a pin."

Ktech technicians Dan Jobe (1670) and Scott Drennan (1654), who took the first photos of PBFA-II firing, found that their photographic techniques lived on. Open-shutter methods they employed were used subsequently by Walt Dickenman (dec.), and nearly a decade later by Sandia staff photographer Randy Montoya (3651) who created the most widely reproduced picture Sandia ever released: the "arcs and sparks" light show of the accelerator firing.

"Dan and Scott knew the pond," says Randy, "and they showed the rest of us where to stand to get the best fish."

The two technicians had experimented with open-shutter photography to aid them in looking for breakdowns in the accelerator when it fired. Among media that published images based on the pair's early expertise was *National Geographic* magazine. Among the many places a Sandia-taken "arcs and sparks" photo appeared was the cover of the book *Physics in the 20th Century*, published by the American Physical Society to celebrate its 100th anniversary.

Story by Neal Singer



Shot #1

ALTHOUGH THE STILL PHOTO guys missed out on getting the first PBFA-II shot, photographer Walt Dickenman, recently deceased, subsequently captured some memorable images of the firings, and even wrote about the process in *Technical Photography* magazine (directly above). The PBFA-II team was so proud of their work that they all signed the org chart as a memento of the project.

sary. The author, former *Washington Post* writer Curt Suplee, learned of Z at a meeting with Sandia media staff.

Probably one of the most significant moments in the machine's later history occurred ten years ago when researchers replaced the lithium ion beam diode with a simple Z-pinch containing many wires.

Soon afterwards, the Particle Beam Fusion Accelerator exchanged its wordy moniker for a single letter — Z — but controlled nuclear fusion remains a goal for Sandia's Z machine.

Sandia refines Z-pinch concept

A Z-pinch wire array is essentially the size of a spool of thread, with tungsten wires about a tenth the thickness of a human hair hung vertically over the spool, rather than wrapped around it horizontally as is the practice with cotton thread.

While wire-array Z pinches had been used for decades, Sandia's innovation was to dramatically increase the number of wires — something that had never been satisfactorily done.

Electrical current surging through the tiny wires obliterates them in what is effectively a massive short circuit. The magnetic field of the current compresses the resultant cloud of tungsten ions like a fist closing on a sponge. When the ions have nowhere further to go — at about the thickness of a pencil lead in the vertical, or Z, direction — their sudden braking from speed that is a significant fraction of the speed of light releases more energy and power in X-rays than ever before achieved in a laboratory.

The immediate surge in X-ray power output at that time led many to wish their stock market holdings produced graphs with such vertical rises in prices.

As the X-ray power output doubled, tripled, and then quadrupled, Sandia researchers were able to produce fusion neutrons — a feat reported at the March Meeting of the American Physical Society two years ago.

The story continues into the present with the addition of one of the world's most powerful lasers, dubbed Z-Beamlet, to image Z's compression of target capsules.

The X-ray intensities needed to drive capsules to the still-distant goal of break-even fusion, researchers say, must be generated by a much larger machine.

Meanwhile, the Z machine will soon take a rest while its 20-year-old capacitors and switches are replaced by more modern technology. And then the flashes and groundshakings and onward march toward fusion will continue, with attendant work in testing materials under huge compression, launching swift flyer plates with magnetic propulsion, characterizing the composition of the cores of planets and the sun, simulating environments around neutron stars and black holes, and observing defense-related tests not suitable for discussion here.

As the wry joke goes, break-even with controlled nuclear fusion is probably still only 20 years away. But given recent progress, along with anticipation of new results made possible by the coming upgrade, the role of Z as a possible avenue to the high-energy future cannot be understated.

Says current director Keith Matzen (1600), "Our intensity and enthusiasm remain high to create a significant fusion burn."



(Photo by Randy Montoya)

STEVE GOLDSTEIN, operations chief responsible for getting PBFA through its first shots, recently wrote the *Lab News* regarding his recollection of those memorable days. Steve, now with Bechtel Nevada, wrote: Of course many articles have been written about the Z Machine (formerly PBFA-II), but while looking through some files recently I was reminded of the upcoming 20th anniversary of the first shot and how exciting it was to take the photo of "the shot seen 'round the world," that is, the first "arcs and sparks" picture of PBFA-II. [Because Sandia's Still Photo Department photographers had prior commitments and weren't able to set up for the first PBFA-II shot] in desperation we decided to deploy our series of 4" by 5" press-type cameras to various locations in the highbay — on handrails and clamped to T-beams on the roof. Some cameras had Polaroid black-and-white film backs, others had black-and-white sheet film, and others color film. Prior to the final phase of the count-

down and after trouble-shooting some of the subsystems Scott Drennan (left) and Dan Jobe (seen today in the photo above) crawled up on the bridge crane in the dark, pulled the dark slides out of the film backs, and opened the shutters. We then evacuated the highbay, charged, and successfully fired the machine. The Polaroid films showed firing gas switches, the incredible dance of lightning strokes over water section, and even some air breakdowns between what were supposed to be electrically grounded handrails. We took the cut film to the photoshop the next morning and got back the following print which is labeled "Shot #1" — the photo at the left of this page — on the back, so I think it's the very first firing. (The ceiling camera was on angle to capture as much of the accelerator activity as possible).

Sandia leads multi-lab Future Combat Systems Integrated Support Team

Accomplishments feature system-of-systems analyses and integration

By Michael Padilla

Soldiers networked to platforms and sensors will have access to information that can provide a much more accurate picture of what's happening in the field.

Linked to a GPS system, the soldier will be able to see troop locations, enemy positions, maps, computer-generated graphical data, and intelligence information; and can employ maneuvering firepower from a multitude of options.

This is the concept of the military's Future Combat Systems (FCS) that will link soldiers with manned and unmanned ground vehicles, air vehicles, and sensors in a secure network of superior combat information. The FCS is a leap-ahead system-of-systems (SoS) that forms the centerpiece of the Army's ground combat force to be fielded between 2015 and 2020.

In support of this concept, Sandia has been leading a Future Combat Systems Integrated Support Team (FIST) for the past four years.

Sandia formed the multi-laboratory, DOE/DoD, and Federally Funded Research and Development Centers (FFRDC) team to provide SoS solutions for the network-enabled, soldier-centric Future Combat Systems.

FIST members have included Oak Ridge National Laboratory (ORNL), Idaho National Laboratory (INL), MITRE, RAND Corporation, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, and the Institute for Defense Analyses.

For the past four years the team has been working with the Army's FCS program office, DARPA, and the Lead Systems Integrator, or LSI (Boeing and



REMOTELY OPERATED unmanned aerial vehicles — in all shapes and sizes — will be increasingly important tools in future combat operations.

Science Applications International Corporation) and its One Team contractor base.

FIST Program Manager Russell Skocypec (6640) says the national lab team is assisting the Army with transforming the way it will be fighting for the foreseeable future.

"The team contributes capabilities and expertise complementary to those in industry and the Army," Russ says. "Many FIST capabilities are providing significant contributions to the Army's Future Combat System One Team effort.

"FCS will be a highly mobile, deployable, lethal, and survivable suite of platforms, incorporating advanced technology components to enable a significant increase in combat effectiveness. It is an

extraordinarily ambitious effort."

The FIST is analyzing designs for communications, small organic air vehicles (OAV), unmanned ground vehicles (UGV), and manned ground vehicles (MGV) for military operations in urban terrain. Urban combat is a significant challenge to the military and for FCS. Therefore, innovative technologies, systems, and operational concepts are needed.

Sandia is developing two prototype systems to potentially be included in the FCS Program. One concept is aimed at remote placement of sensors through Terry Stalker's (5432) Sensor Dart program. The other is developing the concept of electromagnetic coil gun technologies for future mortar launcher applications, led by Bob Turman (5135).

FIST has proposed several new projects for FY06. Two are directed at advanced robotics technologies needed for extreme mobility and tactical maneuvers in urban operations. The others are aimed at further developing SoS concepts and modeling and simulation capabilities to address the impacts of new and emerging technologies proposed for FCS urban operations.

"The FIST supports the Army's FCS Program critical needs by bringing 'best-of-breed' source matter experts from this national lab team to address difficult technology and analytic challenges," says Alan Nanco (6645), FIST Deputy Program Manager.

Strong team effort

FIST tackles problems by applying and integrating analytical and technical capabilities across the DOE labs. The team works closely with the LSI, the Army and DARPA.

(Continued on next page)

Future Combat Systems Integrated Support Team accomplishments

Network Vulnerability

Led by Bob Pollock (5610), the Network Vulnerability team has worked with the Army to assess information assurance and communications paths to ensure that Situation Awareness for the soldiers is available on the battlefield. The team has provided guidance to protect FCS network-of-networks through continuous assessments, simulations, and experiments. The team conducted assessments, simulations and experiments on evolving FCS network-of-networks in support of Army's G6 - Office of Chief Information Officer.

Logistics and Supportability

The Logistics & Supportability team, led by Dennis Anderson (6642), has supported the FCS program One Team, and has worked with numerous Army support organizations to help ensure FCS will meet its performance requirements.

The primary focus has been on SoS analyses for the FCS sustainability requirements, which include maximizing available warfighting capabilities while reducing logistics footprint and maintenance personnel. Dennis says "to accomplish this key support to the FCS Program, the team is further developing a unique SoS Analysis Toolset (SoSAT) — building on previous LDRD investments and projects applications." In conjunction with the continued development of the SoSAT, the team is also applying this analytic capability to generate valuable analysis results that are used in support of major program milestones.

Logistics and supportability are the dominant cost drivers and can significantly impact warfighting effectiveness for traditional military systems. This is a critical performance area for the FCS, which is designed to be deployed and operated initially without major supply teams. The FIST team has conducted mission analyses of more than 1,500 platforms subjected to 72-hour high-operational tempo to evaluate technical and operational measures of effectiveness.

Countermines

Elaine Hinman-Sweeney (6631) leads the Countermines (CM) task for the FIST. This team uses an SoS analytics approach to the countermines problem in order to capture and assess the effects of multi-layered system of systems CM concepts — all the way from predicting intent to the actual mine attack and the potential responses. The emphasis is

on assuring the mobility and survivability of the military's forces.

Results of the first phase showed the critical need for countering side attack mines, as well as impact of conventional mines and coordinated attacks on assured mobility.

Elaine says SoS Analytics is an evolving capability. Sandia has several systems analysis tools that can address portions of the problem.

"A lot of systems engineering is required to ensure the right tools are developed to answer key questions, as well as make sure the inputs to the tools are relevant and coordinated," Elaine says.

Two tools used for analysis of multiple systems are the System of Systems Analytic Toolset, which presents a global view of events at specific slices of time, and Umbra analytic framework and tools, which provides a unique 3D, physics-based, operational simulation and visualization environment.

MOUT Analytics

Led by Eric Parker (6641), the Military Operations in Urban Terrain (MOUT) Analytics team developed modeling and simulation capabilities to assess both current and emerging technologies/systems that could be spiraled-in to the FCS. Initial technology evaluations focused on small Unmanned Air Vehicle (UAV) configurations and operations, as well as unmanned and manned ground vehicle communication protocols in the context of urban environment complexities.

The initial project consisted of two proof-of-principal demonstrations. The first demonstrated the effect of urban terrain on communications between wireless ad hoc network assets. To achieve this goal, a communications model was implemented and was incorporated into a MOUT operations simulation scenario to assess the effects that different routing protocols would have on message latency, which in turn affects situational awareness accuracy needed for command and control of the operations.

The second demonstration involved modeling a small, Class I, UAV with a ducted-fan design and subjecting it to urban winds to assess its flight characteristics and effects on mission effectiveness. Sandia obtained the flight dynamics equations from Honeywell and incorporated them into the Umbra systems analysis environment.

"The analytic framework and proof of concept

analysis results clearly demonstrated the value of conducting detailed, physics-based analysis of emerging technologies and systems being proposed for use in MOUT and helps fill a need for the Army's trade studies," Eric says.

Combat Identification

Led by Glenn Allgood at ORNL and Terry Stalker (5432), the Combat ID (CID) team worked with the LSI the Army to provide support to the development of the initial CID architecture and technology specifications. Combat identification refers to knowing where allied forces, enemy forces, and noncombatant forces are located at any given time.

"For effective operation of an SoS, with platforms and systems geographically distributed across a battlefield, the need to know where our troops are is paramount," says Allgood. "This includes Army, Air Force, Marines, allied, and coalition assets."

The team developed fixed-wing air-to-ground specifications and measures of effectiveness, and evaluated radio frequency tags and other technologies, through SoS analysis.

Advanced Decision Support System

The Advanced Decision Support System (ADSS) team, led by Leon Chapman (6642), has developed a prototype capability for enhanced decision support for the FCS Program leadership by further developing and integrating tools from ORNL, Sandia, and industry. Using the ADSS, the team helps identify gaps and overlaps between basic science and technology projects along with research and development projects scattered across various government agencies, and can then compare and contrast these various technology projects to FCS operational requirements. The prototype ADSS has been installed, and FCS personnel have been trained in its use.

"When the FIST first surveyed and collected highlights of all the potential S&T and R&D organizations and programs that could benefit the FCS Program, it covered an entire wall at INL," says Leon. "When we showed that to the FCS program manager, at that time, he realized the need for a system of tools to help capture, organize and guide informed decision making, and the ADSS project was born."

Royalty Awards Ceremony honors Sandia inventors, authors

More than \$450,000 was distributed to Sandia inventors and authors at the 13th annual Royalty Awards Ceremony Dec. 1 at the Albuquerque Sheraton Uptown Hotel.

The event, which recognizes last year's licensing revenues, focused on Sandia's inventors and authors who serve as the foundation of Sandia's intellectual property management and licensing program.

David Goldheim (10100), Director of Corporate Business Development and Partnerships, hosted the event.

"We at Sandia know that inventions aren't magical," he said. "They are the result of fundamental creativity, perspiration, and inspiration."

Al Romig, Deputy Laboratories Director for Integrated Technologies and Systems, acknowledging Sandia's inventors and authors, said licensing Sandia technology to industry helps provide state-of-the-art technology, at an affordable cost, for critical national needs.

"Nothing makes our inventions more real than real-life production," Al said. "When industry produces millions of your invention, or when your software product has been used a million times in industry to improve a product or process, then we know we can rely on those discoveries for our central mission."

Al said the revenues received from licenses are put directly back into Sandia's science and technology programs, and help maintain an environment this is continually advancing.

— Michael Padilla



INVENTOR WOODY NORRIS shares his passion for discovery, innovation, invention, and entrepreneurship during the annual Sandia royalty awards ceremony for Labs inventors and authors.

(Photo by Ronald Ripp)

Statistics for FY05:

- 340 patent disclosures were submitted to the intellectual property legal staff — bringing the total to 5,090
- 178 patent applications were filed with the US Patent Office — bringing the total to 2,129
- 93 patents were granted, for a total of 1,142
- 93 commercial licenses were negotiated, for a total of 959 such licenses.
- Total income from active licenses was \$2.3 million
- The inventors and authors receive 20 percent of those revenues. This year, that totals just under \$455,000
- The largest distribution to a single individual was \$83,000

The divisions that are responsible for the future application of the technologies for the benefit of DOE missions will receive \$1.48 million.

Another 10 percent of royalty revenues, or about \$227,000, is set aside to acknowledge significant contributors in generating and transferring the Labs' intellectual property, and to recognize individuals responsible for classified inventions.

Since the program's inception in 1992, Sandia has distributed more than \$4.21 million to inventors and authors.

Inventor Woody Norris wows crowd with inventions

An Airscooter, a Long Range Acoustic Device, a HyperSonic Sound System, and the smallest ear radios are a few of the inventions that featured speaker Woody Norris showed the crowd at Sandia's 13th annual Royalty Awards Ceremony.

Norris, holder of 54 US patents and more than 100 patents worldwide, told the crowd that he was in awe of the brainpower in the room.

"Everyone is an inventor," he said. "We all have the ability to invent."

Norris showed a clip of "60 Minutes" featuring the Airscooter, which can be flown under 400 ft. and doesn't require a pilot's license.

The Long Range Acoustic Device is currently being used in Iraq, on cruise ships, and was used during the Republican National Convention. The system is a crowd-control and combatant-deterrent sonic weapon.

With the HyperSonic Sound system, sound is beamed at a wall and bounces back where it is imbedded on top of the ultrasound. A process that happens in the air unimbeds it, or demodulates the two, so the room in itself is used as a speaker box.

Norris invented the Transcutaneous Doppler, a product that evolved into today's sonogram devices used by doctors and hospitals in imaging the human body. He developed and patented the smallest ear radios (AM and FM) with follow-on ear speaker/microphone technology. He developed and patented

Flashback digital recording technology allowing the digital recording of information on non-volatile flash memory rather than tape. He also invented advanced penetrating microwave radar technology capable of seeing plastic mines and other objects.

In 1956 he joined the US Air Force and was trained as a nuclear weapons specialist, specializing in electronic fusing systems. He took an electronics course at the University of New Mexico. After his honorable discharge in 1959, Norris started working at the University of Washington, where he continued his practical education, elevating from technician to becoming director of the Engineering Experiment Station for the campus.

After his first commercial invention in 1970, Norris left the university and began his entrepreneurial career. He invented a phonograph arm that initially was developed for a contest, and was later sold for \$20,000.

His products have received "Product of the Year" awards from *Popular Science* and *Business Week*, as well as the Eddy Award from *MacUser* magazine. Norris received the 1997 *Discover Magazine* Award for "Technological Innovation in the Sound Category" for his role in creating HyperSonic Sound technology. In April 2005 Norris earned the \$500,000 annual Lemelson-MIT Prize, the largest single cash award for invention in the United States.

— Michael Padilla

Future Combat Systems and system-of-systems

In Future Combat Systems, the system-of-systems (SoS) is one large system made up of hundreds of individual systems, from 18 different system types, plus the network plus the soldier. A typical force structure consists of more than 1,500 platforms in a networked unit of action now referred to as an FCS Brigade Combat Team.

FCS will operate as an SoS by networking existing current force systems, systems already under development, and systems to be developed to meet military requirements.

SoS has five common characteristics: opera-

tional independence of the individual systems, managerial independence of the systems, geographical distribution, emergent behavior, and evolutionary development. Emergent behaviors are those that cannot be explained by the behavior of individual systems. SoS can rapidly adapt to changing battlefield conditions and provide very high levels of operational availability and robustness. Successful operation requires monitoring system performance at a sufficient level of detail and enabling rapid "what if" or tradeoff analyses to aid in decision making.

field environment. FIST assesses network vulnerabilities and communications/network architectures and protocols.

David Hetrick, FIST Program Manager at ORNL, says ORNL has been involved in almost every FIST project.

He says the sponsors can go to one integrated team to find out where unique technical capabilities reside rather than go to a number of different labs.

"The FIST is important because we provide a single, integrated, national lab team that provides objective assessment and reviews of the FCS," he says.

Bob Caliva, INL lead for the FIST, says INL focuses on an SoS Engineering and Integration support task. "The majority of the systems engineering support is provided by the INL, along with Unmanned Air Vehicle subject matter expertise," he says.

Future combat

(Continued from preceding page)

"The FIST has helped with redefining ground combat for the 21st century by integrating emerging technologies via "spiral development"— as technologies and capabilities of FCS are developed and validated, they will be spiraled into future increments of FCS and the Army's current forces through Modular Brigade Combat Teams," says retired Lt. Gen. Randy Rigby (5030), who was a key Army decision-maker when FCS was originally conceived in the Army.

The team analyzes concepts and technologies for assured mobility in mined areas, and assured combat identification in a distributed joint battle-

Production Supplier Conference marks fifth quality year



QUALITY TALK — Jessica Weems (left), Matt Senkow, Dan Garcia, Dan Appel, and Vincent Lawless talk quality at Sandia's annual Production Supplier Conference, hosted by Materials Value Stream Dept. 2719. This year's conference was the largest to date. Attendees gained first-hand experience using lean manufacturing tools in the three afternoon workshops. A supplier trade fair was introduced this year, allowing Sandians to speak directly with suppliers. The awards ceremony — the main event — was led this year by Antonio Lara (Purchased Material Team Lead) and Anne Lacy (Tooling Team Lead). The annual conference recognizes outstanding supplier quality and delivery performance over the past fiscal year and provides suppliers with information and improvement tools that they can take back to their companies. Suppliers receive recognition at the Oro (gold) level for quality and delivery performance greater than 98 percent and Plata (silver) level for quality and delivery performance greater than 95 percent. Sandia also recognizes one most-improved supplier. This year, Sandia presented 15 Oro awards and one Plata award.

Retirees Carl and Ann Hawk's CDs become gifts for needy

By Iris Aboytes

The Bill & Melinda Gates Foundation based in Seattle, Wash., has an endowment of approximately \$28.8 billion. Carl and Ann Hawk's "foundation" is based in Albuquerque's Northeast Heights, and its two-person endowment is devoted to making life better for deserving or needy people.

Sandia retirees Carl and Ann Hawk live in the 1,200-square-foot house they bought in 1951 for \$12,000. Carl worked as a tech art illustrator and Ann worked with NiCad batteries in what was then the glass shop. Carl and Ann retired after 23 years at Sandia.

Carl does not like the words lawyer, wills, or probate, so he had not taken any action on their financial status until his hospital stay in March 2002. "It was a real wake-up call," says Carl. "For weeks I thought about a way I could get immediate access to our assets and have them in one place. I wanted to be able to get my hot little hands on every dollar we had, at any given moment. Being in the hospital made this more crucial."

He cashed out six CDs and put them into checking accounts. Carl was cautioned by the bank representative and his friends about the interest he would lose. "We are giving a lot to charity so it doesn't matter," he responded.

Some of Ann and Carl's favorite charities are: United Way, a prostate cancer support association, the Noon-Day Ministries (an agency that feeds the homeless downtown), and recently, a UNM brain research project.

He is known as the Johnny Carson or the Duke from Albuquerque, in Verdigré, Neb., a small town of about 600 people. It was his father's hometown. Like Johnny, Carl is known for his giving. He receives the *Verdigré Eagle*, the town newspaper, and if a need is identified, he does not hesitate to help. According to the *Eagle*,



PARTNERS IN GIVING — Carl and Ann Hawk share a soda at a Sandia retiree picnic several years ago. (Photo by Randy Montoya)

"Call Carl whatever you call him, but put a 'Generous' in front of his name." Carl recently sent another check for the soccer field and for the tuckpointing (new filling between bricks) project on the Bohemian Lodge Hall established in 1903. Carl remembers a program on "60 Minutes"

about a textile mill that burned and the owner was going to rebuild. A reporter asked the 72-year-old owner, "Instead of rebuilding, why not take the \$100 million from the insurance and move to Florida?" The owner glared at the reporter and said, "What would I do in Florida with 100 million dollars?" "Ann and I, like others, have assets," says Carl, "and there is no way we could spend it all ourselves."

Reluctant to tell his story

Carl was a little reluctant to tell his story for fear of it sounding like he was bragging. He decided he would add a disclaimer, saying, "Giving is not a sacrifice for us. It has given me a real purpose and kept me alive for Ann, who is a diabetic." Besides trying to help others, Carl is her full-time caregiver.

"It is only fair to tell you how we accumulated some of our money," says Carl. "We did not use one drop of sweat or muscle. We just bought CDs a long time ago and let them multiply, like cattle in the pasture. Also a little known fact, the longer you live the more you accumulate. I was 82 when I cashed our CDs."

"I have titled my idea, 'The Real Living Will,'" says Carl. "Giving money face-to-face is priceless. We have received many letters from people thanking us.

Remember, it is hard to see smiling faces when you are in your grave. I would not have had the life I have had if it weren't for Ann," says Carl. "Heck, I probably would not have even been in Albuquerque. For more than 50 years we have worked as a team. Our way might not work for everyone, but it works for us."

Manager promotions

Trish Taylor from PMLS, International Physical Protection Operations Dept. 6307, to Manager, Responsive Product Deployment Program Business Office Dept. 2027.

Trish joined Sandia in 2003 in the International Security Program. She has worked in the accounting industry for more than 12 years.

Trish has a bachelor of business administration with a concentration in accounting from the University of New Mexico and a master of business administration from the University of Nevada in Las Vegas.



TRISH TAYLOR

Howard Walther from SMTS, Structural Mechanical Engineering Dept. 1527, to Manager, Modeling and Simulation Dept. 2991.

Howard joined Sandia in 1990 in the Nuclear Containment Technology Department where he assisted with structural and thermal testing of a 1/6-scale reinforced concrete containment building for nuclear power plants.

He transferred to Facilities Engineering in 1992 and worked as a structural design engineer on several in-house building design and construction projects. In 1993, Howard became the design team leader for the Robotics Building, working with a team of design professionals.

In 1996, Howard transferred to the Structural Dynamics Department in the Engineering Sciences Center. Since then, he has worked as a structural analyst and project leader, performing



HOWARD WALTHER

modeling and simulation of a wide range of structural and mechanical components and systems.

Some of Howard's project contributions include the structural analysis of the NIF Target Chamber (at LLNL), the B61 Design-to-Analysis Pilot Project for ASCI Model Development, and the W80 LEP Shock and Vibration program. More recently, he led a project team to help evaluate the mechanical performance of stronglink mechanisms.

Throughout most of his Sandia career, he included younger engineers on his teams, mentoring them on technical and professional development.

Using his analysis experience, Howard hopes to strengthen the bridge between the Design Group 2990 and Engineering Sciences 1500, to encourage integrating analysis with design.

Howard has a BS, MS and PhD all in civil engineering from the University of Illinois at Urbana-Champaign. He also had a Japanese government scholarship to study structural reliability as a visiting scholar at Kyoto University, Japan.

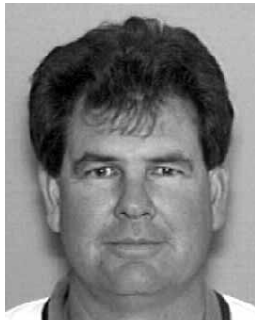
Corey Knapp from Senior Manager, Neutron Generators and Metrology Dept. 2560, to Director, Surety Assessment Center 12300.

Corey joined Sandia/California in 1981 where he designed the W87 Joint Test Assembly Telemeter.

As a manager there, Corey managed technical security, electronic subsystems, gas transfer systems, and dismantlement.

He was promoted to senior manager in February 2000, in the stockpile systems program office, starting in California and eventually moving to New Mexico. For the last 18 months, Corey has been the senior manager of Dept. 2560.

Corey has a BS in electrical engineering from



COREY KNAPP

the University of California, Davis and an MS in electrical engineering from Stanford University.

Mike Schaller from Team Leader, Security Incident Management Program (SIMP) Dept. 4315, to Manager of Classified Matter Protection and Control and SIMP Dept. 4234.

Mike joined the DOE National Training Center in 2001 after retiring from the Albuquerque Police Department in 2000.

As program manager for tactical operations his responsibilities

included revising and developing national special response team programs throughout the DOE complex. He was also responsible for complex-wide oversight of advanced tactical training courses and recertification of site-administered tactical training programs.

In May 2003, Mike was hired at Sandia as the Protective Force (PF) training captain.

In August 2003, he was reassigned as the deputy operations support manager for the Sandia PF. Here, he was responsible for PF training, curriculum development, logistics, supply, procedure development, and all administrative staff associates assigned to Dept. 4211.

Mike assumed responsibilities as the team leader for the SIMP in October 2004. His duties included oversight of day-to-day inquiries into classified breaches and investigations involving violations of security policies.

In May 2005, he became acting manager of the SIMP program. Mike remained manager of the incident program until September, when he was promoted to his current position.

Mike earned an associate's in applied science and a BS in occupational education with specialization in criminal justice. Both degrees are from Wayland Baptist University.



MIKE SCHALLER

Mal Ojo and the Rio Grande Renegades ride again

Several Sandians members of cowboy shooting clubs

By Iris Aboytes

This is the scenario:

A bunch of no good, dirty hombres have showed up in Silver City with land grabbing on their minds. Sheriff Halliday and Lucky Randall are hot on their trail of deception, but, without the help of their fast talking, fleet footed, ever joking friend, Cannonball, justice will never come to this town. Things are a bit rough when one of the nasty hombres overhears Cannonball saying, "We ain't had a good killin' in town since you took over and hung that devil up on the lamppost, Sheriff."

The scenario is not from a western movie. It is one of the scenarios used by Sandian Bill Suderman (10334), alias Mal Ojo (Bad Eye) and the Rio Grande Renegades, a single action shooting club. The club is sanctioned by the Single Action Shooting Society (SASS) which has 67,000 members from throughout the United States, Norway, Australia, New Zealand, and other countries. Many clubs include horse-mounted competitions.

The Rio Grande Renegades meet twice a month for competition against the clock. There is always a scenario, usually involving pistols, lever-action rifles, and double barrel shotguns, also known as coach guns. The club members shoot at steel targets, and points for each miss count against them.

"No loaded guns are carried," says Mal Ojo. "We don't load our weapons until we are ready to shoot, and we unload them when we are finished. We have four

cardinal rules — safety, safety, safety, fun!"

All meets are 100 percent costume events, and each member wears the traditional dress of 1860-1899. Suspenders hold up men's britches, as leather chaps, spurs, and dusty hats complement their outfits.

"We have women members," says Mal Ojo.

"One of the best shooters with international standing is 17-year-old

'Holy Terror.' Some women dress like Miss Kitty of *Gun-smoke* with beautiful

feather hats and petticoats, others like Annie Oakley in beautiful white hats. Costume competitions are held at the regional, state, and national meets."

Cowboy Action Shooting is family oriented; entire families often dress up in character. Many members do not shoot at all. Much of the fun begins when the firearms are stowed for the day.

Last spring the End of Trail event, billed as the Nation's Greatest Wild West Festival, was held at Founders Ranch in Edgewood.

According to Mal Ojo, the international competition pumped about \$2 million into New Mexico's economy from this event alone. Gov. Bill Richardson is an



POSSE THREE — A mixture of Rio Grande Renegades and members of various other groups at the Smoke in the Valley Event held in late August at Founder's Ranch in Edgewood.



Bill "Mal Ojo" Suderman

Honorary Life Member.

"It is like pretend for grownups," says Mal Ojo. "We dress up like cowboys and shoot real guns. There is no money involved in the competitions, just braggin' rights. I have learned to sew, since costumes can be very expensive."

For more information about the Rio Grande Renegades, contact Bill Suderman at 265-1786 and as Mal Ojo says, "Remember a gun is only as safe as the hand that holds it."

The following Sandians are members of the Renegades or other cowboy shooting clubs in the Albuquerque area: Charles Fink (Charlie Three Fingers), Dwight Coles (Garrison Joe), Dave Schweitzer (Dog Biter), Ann Kirk-Schweitzer (Timber Wolf), Ted Simmons (Crosstie), Dave Harrington (Scruffy Dave), Molley Smith (Cotton Pickin' Sallie), and recent retiree Dick Hawkins (Crotchety Ole Bart).



This monthly column highlights Sandia Lab News items from 50, 40, 30, 20, and 10 years ago, but each column does not necessarily include items from each decade.

50 years ago . . . Today's concerns about a shortage of well-qualified scientists, engineers, and other technical employees was a similar concern in 1955, according to the Dec. 2, 1955, *Lab News*. A page-one story led with this: "Sandia Corporation employees are being called upon to help the Employment and Personnel Department locate engineers, physicists, mathematicians, technicians, and draftsmen for possible employment here." The story said a formal program was being started to encourage all Sandians to submit names of prospective employees. A separate page-two story noted that a recent study of 200 employers of researchers had found that half the firms said their expansion was being hindered by the technical-employee shortage.

30 years ago . . . Sandia had just been named to manage a major segment of the Energy Research and Development Administration's National Photovoltaic Conversion Program, according to a Dec. 5, 1975, *Lab News* story. Designed to develop more efficient and economical meth-



SILICON SOLAR CELLS that could produce an output of up to 10 watts were shown in this 1975 photo.

ods of converting sunlight directly to electricity, the program provided \$2.55 million to Sandia to work on "systems definition." Much of that funding went to subcontractors for several photovoltaic (PV) system studies and hardware development. A goal was to bring the cost of producing electricity using PV systems more in line with the cost of power from conventional generating plants. That's still a goal today.

20 years ago . . . Sandia's inertial confinement fusion program had just taken a giant step forward Dec. 11, 1985, with the first firing of the giant new PBFA II (Particle Beam Fusion Accelerator II). The Dec. 20 *Lab News* gave details and explained that Sandia researchers believed PBFA-II was the first machine to have the potential to achieve thermonuclear fusion in the laboratory. (See Neal Singer's related 20th anniversary story and R&D update on page 6 of this issue.)

10 years ago . . . The Labs' new Voluntary Separation Incentive Program (VSIP), announced in detail to employees in a special communication on Dec. 5, 1995, was featured in the Dec. 15 issue. The VSIP was designed to help reduce the number of Sandia employees during a time of tight budgets without using forced layoffs. The program was part of the overall Workforce Realignment Plan to eliminate unneeded jobs and move qualified people into work areas in higher demand. The VSIP gave selected employees an opportunity to apply for a special one-time monetary award and other benefits if they voluntarily left Sandia. Eligible employees could receive up to 1.5 weeks' pay for each year of service, up to a maximum of 27 years, or 40.5 weeks of pay. Although employees successfully applying for the VSIP generally could stay at Sandia until April 15, 1996, they had to make up their minds quickly about applying, as the deadline was Jan. 4, 1996. A total of 533 Sandians applied, but not all were accepted (more on that in this column next year). The program was successful in avoiding forced layoffs.

—Larry Perrine

[Safety First]

Chestnuts
roasting on
an open fire.

- Keep oven and surfaces free from grease build-up, and keep flammable objects away from ovens and open flames. Have extinguisher accessible.
- Have your chimney cleaned annually. Use a fireplace screen to prevent sparks and cinders from flying outward.
- Replace smoke detector batteries every 6 months.

Sandia
Safety

www-irrn.sandia.gov/esh