



(Photo by Randy Montoya)

Sandia wins four R&D 100 Awards

Winners include Sandia Cooler, neutristor, solar glitter, and digital microfluidics hub

Sandia researchers — competing in an international pool of universities, corporations and government labs — captured four prestigious R&D 100 Awards in this year's contest.

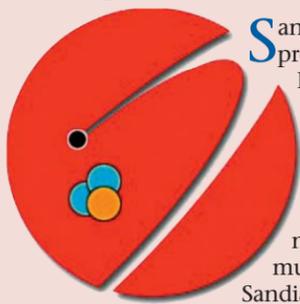
R&D Magazine presents the awards each year to researchers who its editors and independent judging panels determine have developed the year's 100 most outstanding advances in applied technologies. An awards banquet will be held Nov. 1 in Orlando, Fla.

The awards, with their focus on practical impact rather than pure research, reward entrants on their products' design, development, testing, and production. The *Chicago Tribune* once described the contest as "the Oscars of invention."



(Continued on page 5)

Weapon Intern Program



Sandia's Weapon Intern program, a fixture at the Labs since 1998, is evolving to meet changing mission needs. Since its inception, almost 300 individuals from the nation's weapon community — including 175 Sandians — have gone through the program. The 2012-2013 class is now accepting nominations. For more on the program, see the story on page 4.

Sandia LabNews

Vol. 64, No. 12

June 29, 2012

Managed by Lockheed Martin for the National Nuclear Security Administration



Sandians get opportunity to share their voices through annual survey

By Jim Danneskiold

LM Voice, Sandia's employee survey, will be launched the week of July 9 and close on Aug. 3. The survey provides a quick, confidential opportunity for Sandians to assess various aspects of their work environment and let leaders know what they think.

"Your leadership team wants to hear your voice," says Pam Hansen-Hargan, VP for Human Resources and Communications Div. 3000. "We would very much appreciate your feedback on what we are doing well and where we can improve. Your ideas are vital to helping us achieve our strategic objectives and creating a learning, inclusive, and engaging environment for our employees."

Based on comments about last year's survey, limited term employees, postdocs and foreign nationals will be invited along with regular employees to participate. Participants will receive an email invitation from voice.lm@lmco.com with a survey link, instructions and a personal, confidential password.

At the same time, Sandia President and Laboratories Director Paul Hommert is scheduled to post a video message about the value of the survey and how results will be used.

"LM Voice is a way for employees to share thoughts about important aspects of their experience at Sandia on such topics as diversity, ethics, career development, leadership, and job satisfaction," says Pam.

Completing the questions should take less than 20



minutes and, like last year, employees can charge their primary project and task, or ask their managers if they are not sure which project and task to use. For other questions, contact your HR Business Partner.

Like the 2011 LM Voice, survey results will be shared with all employees sometime in September, and executives at the director level and above will then develop and implement action plans to address the feedback received.

"We are strongly committed to act on what employees tell us in the survey," Pam says. "Last year, because of what employees told us, we asked managers to engage in meaningful and more extensive career discussions as part of the performance management process."

Based on survey feedback, Labs leadership also stepped up communications about mission, strategy, and goals to give employees a better understanding of how the work they do every day contributes to Sandia's success, Pam added.

"We will carefully consider your feedback to understand what's going well and where to improve," Pam says. "Please add your voice so we can work together to shape the future workplace and work culture for Sandia."

Smarter travel saves Labs money



Sandians are saving the Labs about \$100,000 per month by making smart decisions about airline travel planning and ticket purchasing. Read the story on page 2.

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That's that

One of the better online publications from around the DOE complex is *Fermilab Today*, which, as the title suggests, serves up a pretty good snapshot in time of what's going on around the laboratory on a day-to-day basis. Fermilab, based in the rural countryside of Batavia, Ill., about 40 miles west of Chicago, focuses on high-energy particle physics. As you can imagine, they do some fascinating work there. I subscribe to *Fermilab Today* for two reasons: First, I like to keep generally informed about what's going on around DOE's labs; and second, *Fermilab Today* is just really well-written. I find it a pleasure to read. I don't read it religiously, but I do read it regularly as time permits.

Anyhow, a couple of weeks back, *Fermilab Today* featured a story about a symposium by Nobel laureate in physics David Gross. As the story described it, Gross "took a large audience in Ramsey Auditorium on a wild ride Tuesday night, explaining connections between the Standard Model and the mystery of the origins of the universe." Sounds like fun, mind-expanding stuff. A wild ride, indeed.

In a reception following the symposium, Gross said something that caught my attention, because it has a direct bearing on what we do here at the *Lab News* and in our media relations efforts. "As scientists," Gross said, "we have a responsibility to tell the public what we are doing, especially since all of this is just human curiosity."

It's clear from the context that Gross was speaking specifically of the work done at Fermilab. But his insight has applicability for us, too. On the face of it, more than just curiosity drives our work at Sandia; we are tasked to anticipate and solve problems of urgent national concern. But isn't it, ultimately, curiosity that motivates all of us in our work? We want to know, whether we are scientists or engineers – or writers – what happens next? What happens if I do x, y, or z? Where does that take me? Why did that happen? What does that mean? If we want and expect to find continued support for what we do, we have to communicate what we have found, what it means, and why it matters. It's my hope that at the *Lab News* and in our media efforts, we're helping and making a difference in that communications effort.

* * *

As an aside, it's been my observation that Nobel laureates are unusually good explainers of their own work. The laureates I've heard speak here at Sandia over the years have been great communicators. That's a skill that has probably served their careers very well.

* * *

A quick observation: Whenever you read instructions for assembling some new appliance or gadget at home that use the word "simply," reach for the aspirin bottle because you're in for a headache. The next step is going to drive you simply nuts. It might as well say "simply grow another hand and eyes in the back of your head."

* * *

You probably saw where SpaceX, the private space launch business started by PayPal founder Elon Musk, successfully launched its Dragon spacecraft into orbit, hooked up with the International Space Station, and then undocked and headed to a mid-ocean splashdown and recovery. This is big, big news for us space buffs.

Musk is one of several young (relatively) entrepreneurs who are putting their money where their dreams are. I have no doubt that Musk and like-minded folks – John Carmack, Paul Allen, Richard Branson, and others – aren't getting into space merely to shuttle supplies to the space station. No way. These guys grew up dreaming about space, and my bet is that they want to get there themselves. All of these individuals got rich by making technology accessible to a large percentage of the world's population. Over the next few years, as their collective vision really takes shape, we're going to find that they are doing the same thing with space. They are each doing it their own way, but the end result will be that space is going to be more accessible, to more people, than ever. Some of us reading this might even get to the moon ourselves. Sign me up.

See you next time.

– Bill Murphy (505-845-0845, MS0165, wtmurph@sandia.gov)

Traveling smarter is reaping savings for Sandia



Sandians are saving the Labs about \$100,000 per month by making smart decisions about airline travel planning and ticket purchasing behavior.

The savings were realized by taking two simple measures: purchasing only nonrefundable airline tickets, and purchasing the tickets at least 14 days in advance. The measures became mandatory March 1.

The savings for the first three months under the new policy — March, April, and May — compared with the same three months in 2011, were \$111,902 in March, \$90,519 in April, and \$99,083 in May, for a total savings of \$301,504.



The Federal Acquisition Regulation (FAR) requires the purchase of the lowest airfare, but Sandia was able to negotiate its application at Sandia since the requirement would have created a hardship on the Labs. "We understand it's not always possible to purchase nonrefundable tickets at least 14 days in advance and it doesn't always make sense to purchase the lowest possible airfare if it creates undue hardship on the employee and Sandia," says Patricia Taylor, manager of Treasury and Travel Services.

Exceptions allowed

Employees are allowed to purchase airline tickets outside of the lowest airfare requirements as long as their travel meets one of several exceptions. The employee must indicate the exception via automated mechanisms in Travelocity Business and in the Expense Reporting Tool.



A list of the exceptions can be found by clicking a link at the top of Sandia's Travel and Treasury Services website at <http://info.sandia.gov/travel/travelhp.htm>.

The goal is to increase trips booked at least 14 days in advance from 47 percent in FY11 to 95 percent, and to increase the purchase of nonrefundable airline tickets from 82 percent in FY11 to 95 percent. In FY11, Sandia spent more than \$21 million in airfare.

Sandia and Lockheed Martin travel offices have developed some additional suggestions to save on travel costs. They include the following:

- Book online through Travelocity and save \$30 compared to speaking to a Travelocity agent.
- Minimize one-day trips for a single purpose unless it's mission-critical work requested by the customer.
- Consider alternative meeting methods that don't require travel, such as videoconferencing and teleconferencing.
- Limit the number of employees traveling to the same meeting to only mission-critical attendees.
- Arrange to share ground transportation such as taxis and rental cars when traveling with other employees to the same meeting.
- When selecting a hotel, evaluate the total value to include room rate, internet availability, and parking and breakfast costs if applicable.



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

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Lab News fax **505/844-0645**

Classified ads **505/844-4902**

Published on alternate Fridays by Media Relations and Communications Dept. 3601, MS 0165



Lab News Reader Service

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

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

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The *Lab News* is on the external web at www.sandia.gov/LabNews. *Lab News Interactive*, accessible on the internal web, is at: www-irm.sandia.gov/newscenter/interactive.

Cyber research facility opens at Sandia/California

CTRL laboratory offers open yet controlled space for cybersecurity practitioners

By Mike Janes

Sandia/California's new Cybersecurity Technologies Research Laboratory (CTRL) now offers an open yet controlled area for cybersecurity professionals from the Bay Area and across the country to meet and discuss critical cyber research issues.

A grand opening for the facility, which resides on the grounds of the Livermore Valley Open Campus (LVOC) and is part of Sandia's Cyber Engineering Research Institute (CERI), was held June 12.

During the ribbon-cutting event, Rep. Jerry McNerney (D-Stockton) talked about the growing national issue of cybersecurity and said CTRL will "bring together a tremendous amount of talent and synergy" from Sandia, neighboring Lawrence Livermore National Laboratory, academia, and industry.

Other speakers at the event included executive vice chancellor Ralph Hexter from the University of California-Davis, Livermore Chamber of Commerce president and CEO Dale Kaye, and Sandia's Div. 8000 VP Rick Stulen and Center 8900 Director Len Napolitano. Following the remarks, guests visited workstations staffed by students from the Center for Cyber Defenders (CCD) and other Sandia researchers, learning about cyber-related project themes such as malware, cell phone tracking, and supply chain security.

"With CTRL, we can run experiments and talk more freely about a wide range of cyber research activities, and we can do so with a variety of US and international collaborators but without some of the unrelated restrictions that are often associated with a national laboratory," says Jim Costa (8950), senior manager of computational sciences and analysis at Sandia/California.

"At the same time, we can do these things in a uniquely controlled environment where we know what activities are taking place and we can monitor who and what else is in the building," Jim says. "We look at CTRL like our own neighborhood hangout for Sandia and visiting cyber professionals who need an open but secure place to meet and collaborate." CTRL will also, as part of CERI, support research initiatives like the Cyber Sciences Laboratory (CSL), a joint DOE and NNSA initiative to drive cyber security research for NNSA and DOE missions.

Broadly, CTRL will promote stronger relationships among industry, academia, and national laboratories in the research and development of cybersecurity solutions through technology, practices, and policy. Specifically, CTRL aims to:

- Develop the science and computing foundation necessary for robust cyber security research and development.
- Develop critical relationships to help understand the full range of technical threat concerns facing indus-



COMPUTER SCIENTIST David Fritz of Sandia (8966), left, explains a cell phone tracking project to guest Karl Barber.



DIV. 8000 VP Rick Stulen, left, Rep. Jerry McNerney (D-Stockton), and Sandia's Owen Redwood (8965, speaking) and Alan Berryhill (8965) discuss the Labs' Center for Cyber Defenders (CCD) program.

try, government (non-classified), and academia.

- Develop, test, and help implement cybersecurity approaches in real-world situations.
- Promote the various technical domains that support the advancement of cybersecurity, essential to the security and stability of the US and the world.
- Develop political and social awareness of the imminent

threat and consequences posed by cyber exploits and attacks.

- Provide a window to the external world on open



Sandia California News



MAKING THE CUT — With Center 8900 Director Len Napolitano, left, and Div. 8000 VP Rick Stulen holding each end of the ribbon, Rep. Jerry McNerney and Livermore Chamber of Commerce president and CEO Dale Kaye officially open the Cybersecurity Technologies Research Laboratory at the Livermore Valley Open Campus. The CTRL offers an open yet controlled area for cybersecurity professionals from the Bay Area and across the country to meet and discuss critical cyber research issues. (Photos by Dino Vournas)

cybersecurity and related work throughout Sandia, along with acting as a Bay Area resource for open work performed at Sandia/New Mexico.

Sandia has a decades-long history in cybersecurity, Jim says, the origins of which lie in the Labs' nuclear weapons program. Most recently, it has received accolades for its successful Center for Cyber Defenders (CCD) program, which has trained hundreds of college students in cyber defense and has seen many go into private industry and government to tackle cybersecurity issues. This summer's Sandia/California CCD interns are housed in the CTRL facility.

As a national security laboratory, Sandia needs to remain active in the cybersecurity arena, says Jim, and Sandia/California is well-positioned to offer a facility like CTRL to Silicon Valley interests, federal and local government, and companies from around the country that need it the most. Virtually every company and organization in existence has issues with privacy, supply chains, exfiltration of intellectual property, malware, and communications, so places where scientists,

engineers, and cyber analysts can gather openly yet securely have become critical.

"The Bay Area is a hotbed for social media and computer companies of every type, and every product or service being developed today must be reliable and resilient," Jim says. "Any of it can be attacked by our adversaries, so the more we can facilitate technical discussions with our cybersecurity brethren, the better."

Access to CTRL, he says, is very flexible, so some non-Sandia personnel could conceivably come for an afternoon or day, stay a week or more, or even have an office set up for long-term use.

In addition to its Center for Cyber Defenders students, the CTRL facility houses a number of Sandia cyber programs funded by multiple sources and is beginning to provide office space for academic and industrial partners. Jim says he envisions even more CTRL users in the coming months and years, potentially from collaborators Sandia hasn't even begun to work with. He also sees the facility as an important contributor to workforce development.

Weapon Intern Program evolves to keep pace with Sandia's strategic requirements

By Bill Murphy

The Weapon Intern Program, it is fair to say, has become an institution, not just at Sandia but across the nuclear security enterprise. Since its inception, almost 300 individuals from the nation's weapons community — including 175 Sandians — have gone through the program. Through a combination of classroom study taught by active and retired weaponeers, site visits, and individual and team projects, weapon interns have honed their skills, broadened their knowledge base, and expanded their network of colleagues in the nuclear weapons community.

As an important strategic component of the Labs' nuclear weapons mission, Sandia's Weapon Intern Program (WIP) has evolved over the years to meet changing mission needs and national policy goals. What began as a two-year program in 1998 eventually became a one-year intense course of study and projects. Starting with the Class of 2012 (14th class) the WIP has changed its format again to stay aligned with the demands of the Labs' weapon work.

In its new iteration, the WIP involves six months of intensive classroom work and a five-month special project. This allows for two classes to be offered each year. Nominations for the class beginning in September are being accepted through July 27. Details are available on Sandia's internal Techweb at (<http://wip.sandia.gov/>). Given the nuclear weapons workload, a firm decision to hold a second class (starting March 2013) will be made in December 2012 taking into account nuclear weapons staffing and budget projections.

More throughput

The motivation for reconfiguring the WIP, says Larry Schoof (2916), is to try to get more throughput in the program.

Larry, who recently took the reins as WIP project lead, notes that Sandia is likely to see a significant increase in the volume of nuclear weapons work over the next few years, with several Life Extension Programs and alteration projects in the pipeline that are intended to keep the stockpile viable for the next several decades.

To accomplish that expanded workload, Larry notes, Sandia has hired a lot of new people. "To help accelerate their learning about the nuclear weapons enterprise," Larry says, "we've been asked by Sandia management to try to essentially double the throughput in the Weapon Intern Program and shorten the amount of time that an individual is away from their home organization." That's important for managers who are reluctant to lose some of their top performers for an extended stretch of time, he says.

In moving from a two-year program to a one-year program and now to a program with six months in the classroom, Larry says a lot of effort was put into consolidating the curriculum, eliminating redundancies and some non-weapon-related material. The consolidation doesn't come at the expense of content, though, Larry says. "We are really fine-tuning the curriculum so that we can get the same content into that six-month classroom timeframe," he says.

Program review drove latest changes

Many of the latest changes to the program came as a result of a WIP review conducted in 2010 at the request of Larry Walker (then Center 2900 director) to a team led by Corey Knapp (then New Mexico Weapon Systems Center 2100 director). Based on extensive interviews with stakeholders and weapon systems managers, this group generated a blueprint for a redefined WIP.

The modified, streamlined curriculum hasn't been all about eliminating content. As a result of the Knapp review, some new material was added to the program, including a course focusing on lessons-learned from the W76-1 LEP, the annual assessment process, and a course addressing customer interactions.

In all, Larry says, "The review identified four or five gaps that we are trying to implement. We addressed some of them this year and will implement others next year."

While for some Sandians, the perception has long been that the Weapon Intern Program is aimed at future managers, that is not the case, Larry says. "Our primary focus isn't for future managers; I would not say that. It's aimed at individuals who aspire to be key contributors to Sandia's weapons program at a variety of

Weapon Intern Program makes its mark

'One of the best years of my working life'



DAN CORDOVA (2541), seen here at the National Museum of Nuclear Science & History, spent a year in the Weapon Intern Program with the class of 2009. Here's what he has to say about the experience: "The Weapon Intern Program was one of the best years of my working life and career. I had been working as a systems engineer on the W76-1 LEP, and the WIP exposed me to the history of the nuclear weapons complex, all of the past and current systems, all the way back to the beginning, to the first nuclear weapon. The WIP gave me a chance to see how the nuclear weapons enterprise works, offered unprecedented access to information about past and current weapon systems, and gave me a perspective as to how Sandia fits into the very big picture. I also know that my experience in the WIP and as a systems engineer were key to my selection into my current job as a technical team leader. I highly encourage anyone at Sandia who is interested to consider participating in the Weapon Intern Program." (Photo by Randy Montoya)

levels. The program is designed to give students a broad perspective of how a system works. From that perspective, you learn how what you're doing fits into the entire system. As you come out of the program, there is no question that you will be a better hardware designer, a better software designer, a better system engineer, a better weaponeer."

Engaging the VPs

Over the years, WIP participants have been nominated by their managers and directors — or even self-nominated (with approval of the management line). This year, that process will change a bit as the program more closely engages Sandia's VPs in the nomination and selection process.

"We took a step back and said, 'This is really a strategic program. Interns ought to be nominated from the top down, from the vice presidents who have the strategic vision of their division.' Other NSE organizations already implement a top down approach to select their WIP participants, so this year we're asking that the division VPs become more involved. Obviously, the names of the nominees are going to come from the bottom up, but we want the VPs to be the ones to say 'Okay, I want this individual to be in the program because that's going to affect the Laboratory strategically.'"

Additionally, a group of Sandia senior managers who serve on the WIP Senior Advisory Panel to WIP line management will play a key role by assisting the Division Offices nominating candidates from their respective division (see box at lower right).

While there's no perfect profile for the "typical" weapon intern, Larry says that the "model" intern is someone who has been at the Labs for one to five years, has some nuclear weapons experience, and has a master's or PhD in a scientific career field — that is the ideal. It's not absolute, though. "We consider every nominee on a case by case basis," he says.

And there's also another important factor about the typical make-up of a class of 24 students: Half or

more of the interns in any given class are from outside Sandia. Participants come from, among other organizations, the Air Force, DoD, NNSA, Y-12, Pantex, LANL, and Savannah River. "We consider each of those applicants on a case-by-case basis," Larry says, adding, "One of the beauties of the program is the diversity we get through the wide range of external people we bring in."

Larry, while new to the Weapon Intern Program, is not new to the field of nuclear weapons training. He spent two years on temporary assignment at the Air War College at Maxwell Air Force Base in Alabama, where he developed a nuclear weapons curriculum for Air Force personnel. Larry, who retired from the Air Force Reserve in 2005, has been at Sandia 22 years, where his career has focused on modeling and simulation and nuclear weapon safety and surety.

As lead for the Weapon Intern Program, he says his time will be spent recruiting, both internally and externally, to ensure that the WIP classes continue to reflect a broad diversity of viewpoints and experience. "I really want to keep a diverse program because of the tremendous advantages that we get when we have so many different perspectives for class discussion," he says. Larry says he also intends to continue to tweak the curriculum to keep its focus on current stockpile issues. He also wants to make sure that the program, as it evolves, continues to incorporate a historical perspective, "to link the past to help us solve current and future issues."

WIP Senior Advisory Panel

Dennis Croessmann (1910), chair	J F Nagel (410)
Mark Hedemann (1230)	Susan Pickering (6230)
Bill Jenkins (5210)	Mark Rosenthal (2620)
Ming Lau (8230)	Pat Sena (2110)
Ajoy Moonka (2910)	Doug Wall (210)
	John Whitley (2916)

Sandia wins 4 R&D 100 awards

(Continued from page 1)

“Congratulations to this year’s R&D 100 award winners,” said Energy Secretary Steven Chu. “The research and development at the Department of Energy’s laboratories continues to help the nation meet our energy challenges, strengthen our national security, and improve our economic competitiveness.”

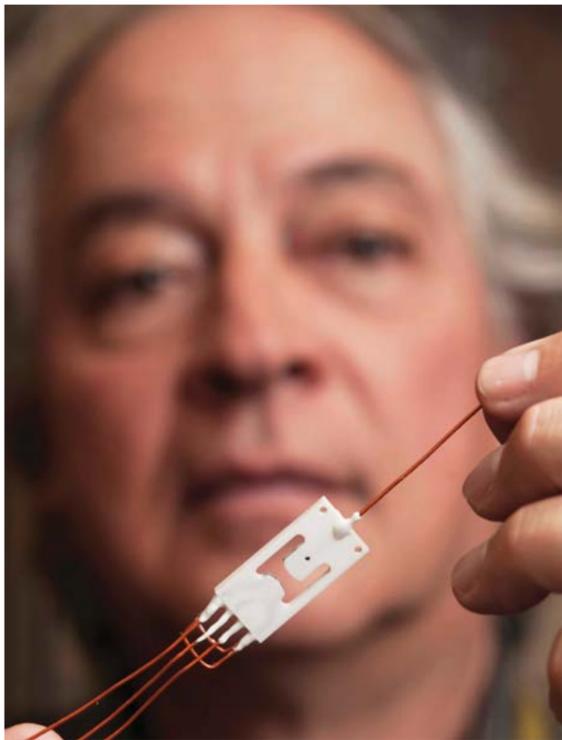
Sandia President and Labs Director Paul Hommert said, “I congratulate our researchers and their entire teams for this outstanding recognition of their work. One of our strategic objectives is to ‘excel in the practice of engineering.’ The work selected for these R&D 100 awards is the perfect expression of that objective. These notable accomplishments also stand as excellent examples of how we have taken

capabilities developed over six decades to execute our core nuclear weapons mission and applied them to new challenges facing the nation.”

Sandia Chief Technology Officer and Div. 1000 VP Steve Rottler said, “I want to congratulate this year’s winners of the R&D 100 awards. These awards recognize four highly innovative technological advancements by members of our staff. These advancements represent enablers for our national security mission, as well as advances at the frontiers of science and engineering.”

Researchers at DOE labs received 36 awards. Sandia’s sister labs in NNSA, Los Alamos and Lawrence Livermore national laboratories, won three and four awards, respectively.

Sandia’s award winners . . .

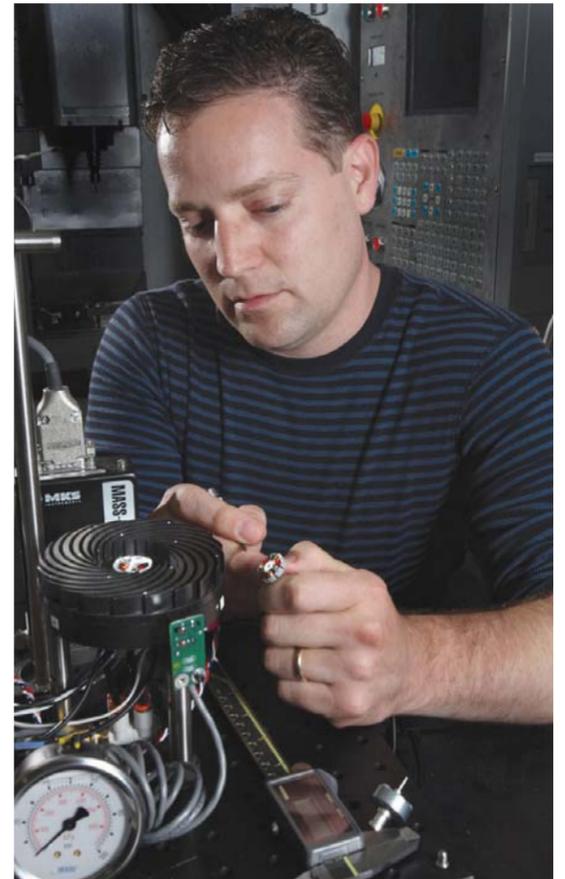


Computer Chip Configuration for Neutron Generators: The ultra-compact neutron generator, dubbed a “neutristor,” is a thousand times smaller than anything on the market today. A three-year Laboratory Directed Research and Development (LDRD) project led by Sandia researcher Juan Elizondo-Decanini (2625) turned away from conventional cylindrical tubes and demonstrated the basic technology necessary for a tiny, mass-produced neutron generator that can be adapted to medical and industrial applications.

“The idea of a computer chip-shaped neutron source — compact, simple, and inexpensive to mass-produce — opens the door for a host of applications,” Juan says. Juan’s vision for the neutron generator of the future is one that uses no tritium and no vacuum and is made in a solid-state package. The technology is ready to be licensed for some commercial applications, but more complex commercial applications could take five to 10 years.

SANDIA RESEARCHER Juan Elizondo-Decanini holds a prototype of a “neutristor,” a new R&D100 Award-winning configuration for neutron generators.

(Photo by Randy Montoya)



MR. COOL — Sandia’s Jeff Koplow makes an adjustment to an earlier prototype of his Air Bearing Heat Exchanger invention, winner of a 2012 R&D 100 Award. The technology, known as the “Sandia Cooler,” significantly reduces the energy needed to cool the processor chips in data centers and large-scale computing environments. (Photo by Dino Vournas)

The “Sandia Cooler,” also known as the “Air Bearing Heat Exchanger,” will significantly reduce the energy needed to cool the processor chips in data centers and large-scale computing environments, says Sandia researcher Jeff Koplow (8366). With the Sandia Cooler, heat from a conventional CPU cooler is efficiently transferred across a narrow air gap from a stationary base to a rotating structure. The normally stagnant boundary layer of air enveloping the cooling fins is subjected to a powerful centrifugal pumping effect, causing the boundary layer thickness to be reduced to 10 times thinner than normal. The Sandia Cooler also offers benefits in other applications where thermal management and energy efficiency are important, particularly heating, ventilation, and air-conditioning (HVAC).

Microsystems Enabled Photovoltaics (MEPV): Sandia’s microsystems-enabled photovoltaics, also known as “solar glitter,” combine mature technology and tools currently used in microsystem production with groundbreaking advances in photovoltaic cell design. Sandia researcher Greg Nielson (1719) led the project, in which the cells are created using mature microdesign and microfabrication techniques. The cells are then released into a solution similar to printing ink and “printed” onto a low-cost substrate with embedded contacts and microlenses for focusing sunlight onto the cells. Each cell can be as small as 14 microns thick and 250 microns wide, reducing material costs while enhancing cell performance by improving carrier collection and potentially achieving higher open circuit voltages. The technology has potential applications in buildings, houses, clothing, portable electronics, vehicles, and other contoured structures.



PROJECT LEAD Greg Nielson holds a solar cell test prototype with a microscale lens array fastened above it that together will help create a concentrated photovoltaic unit. The work won a 2012 R&D 100 Award.

(Photo by Randy Montoya)



Preparation of Nucleic Acid Libraries for Ultra-High-Throughput Sequencing with a Digital Microfluidic Hub builds from Sandia’s RapTOR (Rapid Threat Organism Recognition) Grand Challenge. RapTOR rapidly identifies and characterizes unknown pathogens. It is a digital microfluidics “Grand Central Station” that manages and routes samples. “We’re taking advantage of DNA sequencing technology,” says Sandia’s Kamlesh (Ken) Patel (8125). “Reading the genetic code, the original building blocks, allows you to begin characterizing a pathogen at the most basic level.” Ken leads the Automated Molecular Biology (AMB) research to scale down and automate traditional sample preparation methods such as normalization, ligation, digestion, and size-based separation — methods that traditionally require a skilled scientist and take days or even weeks. The hub functions like a train station for samples, shrinking and enlarging samples as necessary and manipulating their speeds. Samples are cargoed within a microliter-scale droplet that is spatially moved across the Teflon-coated surface of the hub when electrostatic forces are appropriately applied. The hub moves samples from one step to the next with the flexibility to skip or repeat steps on the fly. The hub also manages the size of the sample, extracting the right amount for each process.

TINY BUT GRAND — Ken Patel works on the digital microfluidic hub, the Grand Central Station of RapTOR that manages and routes samples. In addition to winning a 2012 R&D 100 Award, the work earned the Society for Laboratory Automation and Screening’s \$10,000 Innovation Award.

(Photo by Dino Vournas)

Winds of change



A SANDIA TEAM completes installation in the late 1980s of a vertical axis wind turbine test platform in Bushland, Texas. (Photo by Randy Montoya)

Return of the eggbeater

Offshore use of vertical-axis wind turbines gets closer look

Story by Stephanie Holinka

Sandia Labs' wind energy researchers are re-evaluating vertical axis wind turbines (VAWTs) to help solve some of the unique problems of generating energy from offshore breezes.

Though VAWTs have been around since the earliest days of wind energy research at Sandia and elsewhere, VAWT architecture could transform offshore wind technology.

The economics of offshore windpower are different from land-based turbines, due to unique installation and operational challenges. VAWTs offer three big advantages that could reduce the cost of wind energy: a lower turbine center of gravity, reduced machine complexity and better scalability to very large sizes.

A lower center of gravity means improved stability afloat and lower gravitational fatigue loads.

Additionally, the drivetrain on a VAWT is at or near the surface, potentially making maintenance easier and less time-consuming. Fewer parts, lower fatigue loads, and simpler maintenance all lead to reduced maintenance costs.

Elegant in their simplicity

Sandia is conducting the research under a 2011 DOE solicitation for advanced rotor technologies for US offshore windpower generation. The five-year, \$4.1 million project began in January of this year.

Wind Energy Technologies Dept. 6121 manager Dave Minster says Sandia's wind energy program is aimed at addressing the national energy challenge of increasing the use of low-carbon power generation.

"VAWTs are elegant in terms of their mechanical simplicity," says Josh Paquette (6121), one of Sandia's two principal investigators on the project. "They have fewer parts because they don't need a control system to point them toward the blowing wind to generate power."

These characteristics fit the design constraints for offshore wind: the high cost of support structures; the need for simple, reliable designs; and

economic scales that demand larger machines than current land-based designs.

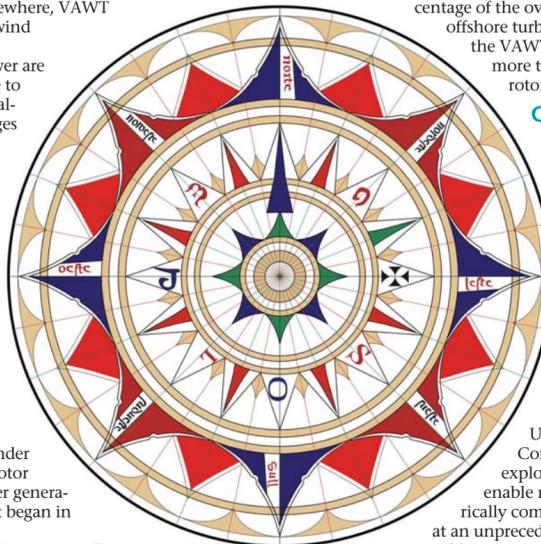
Large offshore VAWT blades, in excess of 300 meters, will cost more to produce than blades for onshore wind turbines. But as the machines and their foundations get bigger — closer to the 10–20 megawatt (MW) scale — turbines and rotors become a much smaller percentage of the overall system cost for offshore turbines, so other benefits of the VAWT architecture could more than offset the increased rotor cost.

Challenges remain

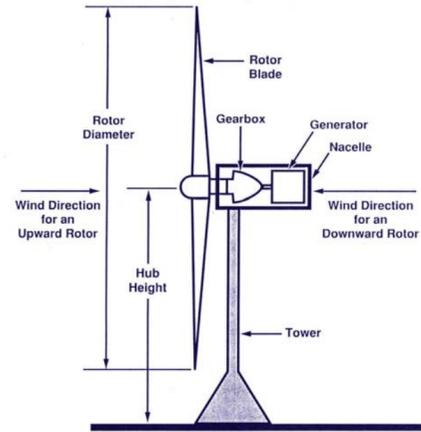
However, challenges remain before VAWTs can be used for large-scale offshore power generation.

Curved VAWT blades are complex, making manufacture difficult. Producing very long VAWT blades demands innovative engineering solutions. Matt Barone (6121) says partners Iowa State University and TPI Composites will be exploring new techniques to enable manufacture of geometrically complex VAWT blade shapes at an unprecedented scale, but at acceptable cost.

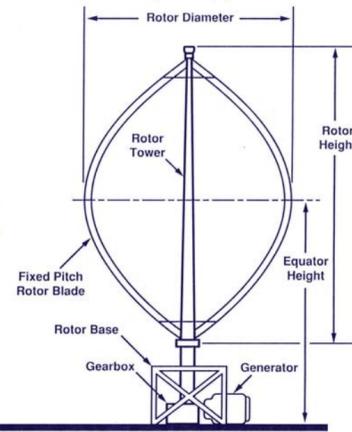
VAWT blades must also overcome problems with cyclic loading on the drivetrain. Unlike horizontal axis wind turbines (HAWTs), which maintain a steady torque if the wind remains steady, VAWTs have two "pulses" of torque and power for each blade, based on whether the blade is in the upwind or downwind position. This "torque ripple" results in unsteady loading, which can lead to drivetrain fatigue. The project will evaluate new rotor designs that smooth out the ampli-



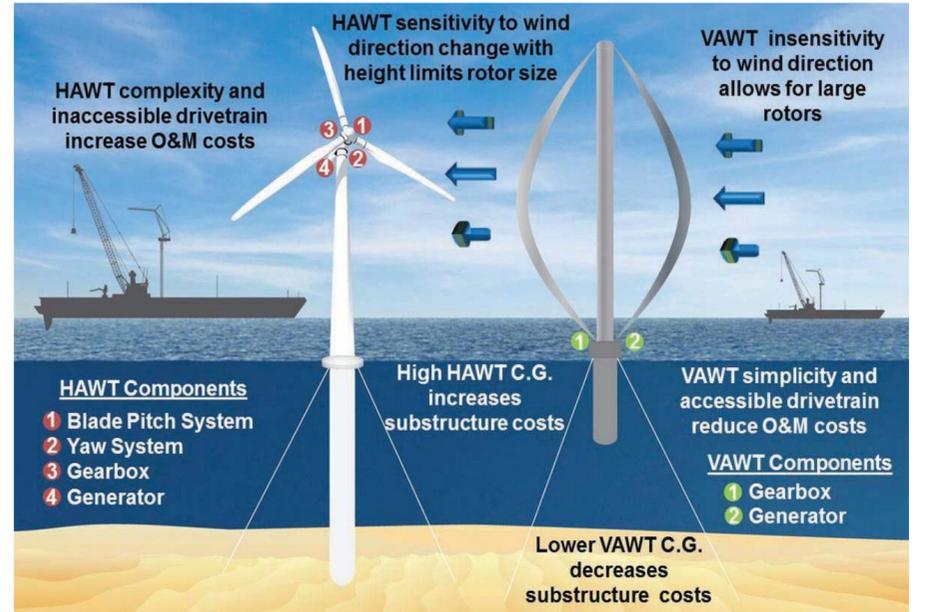
Horizontal-Axis Wind Turbine (HAWT)



Vertical-Axis Wind Turbine (VAWT)



VAWTs' intrinsic characteristics fit the design constraints for offshore wind: the high cost of support structures; the need for simple, reliable designs; and economic scales that demand larger machines than current land-based designs. Large offshore VAWT blades, in excess of 300 meters, will cost more to produce than blades for onshore wind turbines. But as the machines and their foundations get bigger — closer to the 10–20 megawatt scale — turbines and rotors become a much smaller percentage of the overall system cost for offshore turbines, so other benefits of the VAWT architecture could more than offset the increased rotor cost.



tude of these torque oscillations without increasing rotor cost significantly.

Because first-generation VAWT development ended decades ago, updated designs must incorporate decades of research and development already built into current HAWT designs. Reinventing VAWT research means figuring out the models that will help speed up turbine design work.

"Underpinning this research effort will be a tool development effort that will synthesize and enhance existing aerodynamic and structural dynamic codes to create a publicly available aeroelastic design tool for VAWTs," Matt says.

Needed: Aerodynamic braking

Another challenge is brakes. Older VAWT designs didn't have an aerodynamic braking system, and relied solely on a mechanical braking system that is more difficult to maintain and less reliable than the aerodynamic brakes used on HAWTs.

HAWTs use pitchable blades, which stop the turbine within one or two rotations without damage to the turbine and are based on multiply redundant, fail-safe designs.

Matt says new VAWT designs will need robust aerodynamic brakes that are reliable and cost-effective, with a secondary mechanical brake much like on modern-day HAWTs. Unlike HAWT brakes, new VAWT brakes won't have actively pitching blades, which have their own reliability and maintenance issues.

VAWT technology: A long history at Sandia

In the 1970s and 1980s, when wind energy research was in its infancy, VAWTs were actively developed as windpower generators. Some looked like eggbeaters, others looked like rotating insect antennae.

Although strange looking, they had a lot going for them: They were simpler than their horizontal-axis cousins so they tended to be more reliable. For a while, VAWTs held their own against HAWTs. But then wind turbines scaled up.

"HAWTs emerged as the predominant technology for land-based wind over the past 15 years primarily due to advantages in rotor costs at the 1 to 5 megawatt scale," Josh says.

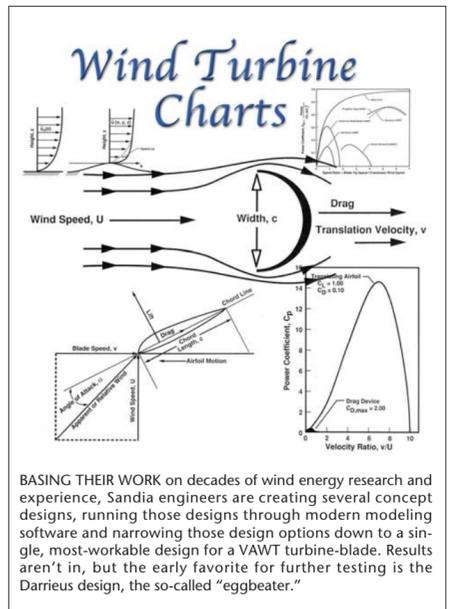
In the 1980s, research focused more heavily on HAWT turbines, and many VAWT manufacturers left the business, consigning VAWTs to an "also ran" in the wind energy museum.

But the winds of change have blown VAWTs' way once more.

Sandia is mining the richness of its wind energy history. Wind researchers who were among the original wind energy engineers are going through decades of Sandia research and compiling the lessons learned, as well as identifying some of the key unknowns described at the end of VAWT research at Sandia in the 1990s.

Phase one of the program will take place over two years and will involve creating several concept designs, running those designs through modern modeling software and narrowing those design options down to a single, most-workable design.

During this phase, Josh, Matt, and their colleagues will



BASING THEIR WORK on decades of wind energy research and experience, Sandia engineers are creating several concept designs, running those designs through modern modeling software and narrowing those design options down to a single, most-workable design for a VAWT turbine-blade. Results aren't in, but the early favorite for further testing is the Darrieus design, the so-called "eggbeater."

look at all types of aeroelastic rotor designs, including H-VAWTs and V-shaped VAWTs. But the early favorite rotor type is the Darrieus design, jokingly termed "eggbeaters."

In phase two researchers will build the chosen design over three years, eventually testing it against the extreme conditions that a turbine must endure in an offshore environment.

In addition to rotor designs, the project will consider different foundation designs: Early candidates are barge designs, tension-leg platforms, and spar buoys.

The project partners will work on many elements. The University of Maine will develop floating VAWT platform dynamics code and subscale prototype wind/wave basin testing. Iowa State University will develop manufacturing techniques for offshore VAWT blades and subscale wind tunnel testing. TPI Composites will design a proof-of-concept subscale blade and develop a commercialization plan. TU-Delft will work on aeroelastic design and optimization tool development and modeling. Texas A&M University will work on aeroelastic design tool development.

"Ultimately it's all about the cost of energy. All these decisions need to lead to a design that's efficient and economically viable," says Josh.

THE IMAGE AT THE CENTER OF THIS PAGE is a replica of a compass rose from the chart of Jorge de Aguiar (1492), the oldest known signed and dated Portuguese nautical chart. It is a 32-point compass rose, meaning that the lines that radiate from its center indicate 32 different geographic directions. The original chart is in the Beinecke Library at Yale University. (Image from Wikimedia Commons by Alvesgaspar)

Employee death

Richard M. Garcia charged ahead full-throttle, full of life and love, with a spirit that wouldn't quit

He was young — way too young — and had only barely started at Sandia. And then he was gone. Richard Michael Garcia was 23 when he died earlier this month. He was a courageous young man, quite literally laughing in the face of an illness, cystic fibrosis, that would ultimately claim his life.

According to an obituary published in the *Albuquerque Journal*, Richard understood that because of his illness, “he knew his time was precious, so he lived his life like every day was his last. He loved everyone to the fullest and did everything at full throttle.”

It was that irrepressible spirit and that laugh, that unforgettable laugh of his, that stick with his colleagues.

“Our workday flew by because we were always laughing and making fools of ourselves,” says co-worker Anthony Chavez (4848). “I’m sure the Bldg. 878 residents can vouch for that. Richard was

always happy and positive regardless of what he had going on personally. His laugh echoed through the halls and it was the kind of laugh that would make anybody’s day. He left a big impression on my life and I’ll always remember to ‘take it easssyyy’ like Richard did.”

Rhonda Rice (4848) remembers that spontaneous sense of joy and good spirits that seemed to follow Richard around. “When I think of him,” she says, “I can see him laughing in front of me. My mind has kept a good memory of a young man ready to smile. He could bring me to tears laughing, because what he said was so hilarious. He was definitely enjoyable to be around.”

Richard (his family called him Michael but to his Sandia colleagues he was always Richard) started working at the Labs in December 2010 as a custodian in Facilities Management. According to his supervisor, Chuck Crawley (4848), Richard thoroughly enjoyed his job at Sandia, “understanding the exceptional service his employment provided to his nation.”

And all kidding around and joking aside, Richard took his job seriously. Says Rhonda, “He was a hard worker and shared his ideas on good cleaning techniques that he had already picked up. I will miss him.”

During his all-too-short time at the Labs, Chuck says, Richard “earned the respect, admiration, and love

of his fellow employees by contributing to Sandia’s mission with dedication, delightfulness, and diligence as a custodian.”

Though it must not have been easy for him, Richard was always ready to step in where he was needed the most, notably as a participant in Operation Deep Freeze in February 2011, volunteering to work as a snow removal team member. Chuck remembers Richard as one who never complained about work and was always willing to work outside of his normal work schedule. “Richard Michael Garcia was simply the best of the best,” Chuck says.

An appreciation of the human spirit

Colleague Roy Cuoco (4848) saw Richard as an inspiration. “He was the true definition of a warrior,” Roy says. “He was in constant battle with his body, always having to dig deep to do what he loved, to enjoy every day of life to the fullest. Almost always he would win. Richard was a kind, sincere, honest, person, who would give me a renewed appreciation of the human spirit.”

Margie Chavez (4848), a colleague on the Bldg. 880 custodial team, recalls Richard as a role model for other custodial workers. “He was such a good person,” she

says. “He was always willing to help out others on the team with extra duties.” Noel Jaramillo (4848) couldn’t agree more. “Richard was a hard worker, a go-getter, and did anything to brighten up the mood and make you laugh. He was a true, genuine guy.”

While Richard had been ill for some time, he didn’t wear his illness on his sleeve. “I never knew how sick he was; he didn’t share the details of his illness,” says friend and colleague Katie Serna (4848). “I only knew he lived a good life and enjoyed many outdoor activities daily, or as his health allowed. He had a great sense of humor and a laugh I won’t forget. I never saw him get mad or frustrated. He took everything in stride. He will be missed very much. In the few months I worked with him we grew close as friends, working daily side by side. He was a very nice young man.”

If it is his laughter and his spirit that his colleagues remember, it is his death at a young age that tears at their hearts. “It doesn’t seem right to have someone so young taken from our presence at such a young age,” Rhonda says. “When I heard the news I felt as though a piece of my heart was taken from me.”

Katie sums up a sentiment shared by everyone who worked with Richard. “We need more people like him. I will miss you, Richard.”



RICHARD M. GARCIA



RICHARD M. GARCIA, left, poses for a team photo with colleagues from Sandia’s custodial program. Richard died earlier this month at age 23 after a long illness. He came to Sandia in December 2010, touching many lives during his short time at the Labs.

Student Intern Program picnic launches summer of activities



(Photo by Randy Montoya)

More than 200 student interns came out for the Student Intern Program (SIP) Welcome Event, a picnic at Ted Hobbs Park at the corner of Innovation Parkway and Gibson Boulevard. In addition to fun and games like volleyball (photo at left), the event provided students a chance to network with other interns, managers, and mentors, while learning about some organizations and community groups that welcome student involvement. The picnic was just the first of several SIP events and activities planned over the summer for Sandia interns.

Coming up on July 2 is the SIP Career Expo, to be held in Bldg. 858EL from 830 a.m.-5 p.m. The expo will inform interns about career opportunities at Sandia in their field of study. Students will register to attend by discipline tracks. Representatives from discipline-specific recruiting teams and intern institutes will present overviews of the research conducted at Sandia.

Also coming up are, on Thursday July 12, a resume writing workshop, and on Thursday, July 19, an interviewing workshop. Both activities will be at the IPOC facility 11:15 a.m.-12:30 p.m.

The SIP Symposium on Wednesday, Aug. 2, at the Steve Schiff Auditorium, 8 a.m.-1 p.m., provides Sandia student interns the opportunity to create a poster detailing their accomplishments during their internship. All student interns, as well as all Sandia employees and contractors, are encouraged to attend the entire event.

Graph500 adds measurement of supercomputing performance

By Sue Major Holmes

Supercomputing performance is getting a new measurement with the Graph500 executive committee's announcement of specifications for a more representative way to rate the large-scale data analytics at the heart of high-performance computing.

An international team that includes Sandia announced the single-source shortest-path specification to assess computing performance last week at the International Supercomputing Conference in Hamburg, Germany.

The latest benchmark "highlights the importance of new systems that can find the proverbial needle in the haystack of data," says Graph500 executive committee member David Bader, a professor in the School of Computational Science and Engineering and executive director of High-Performance Computing at the Georgia Institute of Technology.

The new specification will measure the closest distance between two things, says Sandia researcher Richard Murphy (1422), who heads the executive committee. For example, it would seek the smallest number of people between two people chosen randomly in the professional network LinkedIn, finding the fewest friend of a friend of a friend links between

them, he says.

Graph500 already gauges two computational techniques, called kernels: a large graph that links huge numbers of participants and a parallel search of that graph. The first two kernels were relatively easy problems; this third one is harder, Richard says. Once it's been tested, the next kernel will be harder still, he says.

The rankings are oriented toward enormous graph-based data problems, a core part of most analytics workloads. Graph500 rates machines on their ability to solve complex problems that have seemingly infinite numbers of components, rather than ranking machines on how fast they solve those problems.

A \$270 billion market

Big data problems represent a \$270 billion market and are increasingly important for businesses such as Google, Facebook, and LexisNexis, Richard says.

Large data problems are especially important in cybersecurity, medical informatics, data enrichment, social networks, and symbolic networks. Last year, the Obama administration announced a push to develop better big data systems.

Problems that require enormously complex graphs include correlating medical records of millions of



patients, analyzing ever-growing numbers of electronically related participants in social media, and dealing with symbolic networks, such as tracking tens of thousands of shipping containers of goods roaming the world's oceans.

Medical-related data alone could potentially overwhelm all of today's high-performance computing, Richard says.

Graph500's steering committee is made up of more than 30 international experts in high-performance computing who work on what benchmarks supercomputers should meet in the future. The executive committee, which implements changes in the benchmark, includes Sandia, Argonne National Laboratory, Georgia Institute of Technology, and Indiana University.

Bader says emerging applications in healthcare informatics, social network analysis, web science, and detecting anomalies in financial transactions "require a new breed of data-intensive supercomputers that can make sense of massive amounts of information."

But Richard says performance can't be improved without a meaningful benchmark.

Complements familiar Top500 rankings

"The whole goal is to spur industry to do something harder" as they jockey for top rankings, he says. "If there's a change in the list over time — and there should be — it's a big deal," he adds.

Richard sees Graph500 as a complementary performance yardstick to the well-known Top500 rankings of supercomputer performance, based on speed processing the Linpack code. Nine computers made the first Graph500 list in November 2010; by last November, the number had grown to 50. Its fourth list, released at the conference in Germany, ranked 88. Rankings are released twice a year at the Supercomputing Conference in November and the International Supercomputing Conference in June.

"With these capabilities, a machine on the top of this list may analyze huge quantities of data to provide better and more personalized health care decisions, improve weather and climate prediction, improve our cybersecurity, and better integrate our online social networks with our personal lives," Bader says.

Graph500 Top 20, June 2012

	Installation Site	Machine
1	DOE/SC/Argonne National Laboratory	Mira/BlueGene/Q
1	Lawrence Livermore National Laboratory	Sequoia/Blue Gene/Q
2	DARPA Trial Subset, IBM Devel. Engineering	Power 775, POWER7 8C 3.836 GHz
3	Information Technology Center, University of Tokyo	Oakleaf-FX (Fujitsu PRIMEHPC FX 10)
4	GSIC Center, Tokyo Institute of Technology	HP Cluster Platform SL390s G7 (three Tesla cards per node)
5	Brookhaven National Laboratory	BLUE GENE/Q
6	DOE/SC/Argonne National Laboratory	Vesta/BlueGene/Q
7	NASA-Ames /Parallel Computing Lab, Intel Labs	Pleiades - SGI ICE-X, dual plane hypercube FDR infiniband, E5-2670 "sandybridge"
8	NERSC/ Lawrence Berkeley Laboratory	XE6
9	NNSA and IBM Research, T.J. Watson	NNSA/SC Blue Gene/Q Prototype II
10	STE Lab, Nagoya University	PowerEdge R815 Opteron 6174
11	Intel Dupont / Parallel Computing Lab, Intel Labs	Endeavor; Dual-socket 2.6GHz SNB-EP
12	Lawrence Berkeley Laboratory	Hopper
13	Moscow State University	Lomonosov
14	GSIC Center, Tokyo Institute of Technology	TSUBAME
15	Forschungszentrum Jülich	Jugene
16	DOE/SC/Argonne National Laboratory	Intrepid/BlueGene/P
17	Inst. of Computing Tech., Chinese Academy of Sciences	I950-G
18	Moscow State University	MPP
19	Lawrence Berkeley Laboratory	Cray XT4
20	SGI	SGI Altix ICE 8400EX

Sandia's Red Sky computer ranked No. 24 in the latest Graph500 tests.

NMSBA named Manufacturing Advocate of the Year

By Nancy Salem

The New Mexico Small Business Assistance (NMSBA) Program received the 2012 Manufacturing Advocate of the Year award from the Manufacturing Extension Partnership (MEP) under the US Department of Commerce.

NMSBA is a public-private partnership among Sandia, Los Alamos National Laboratory, and the state of New Mexico that connects small business owners with scientists and engineers who give their companies technical assistance. The program provided \$4.6 million worth of help last year.

The MEP award recognized the program's "commitment to the business growth and transformation of US-based manufacturing through work in the manufacturing sector." The NMSBA was specifically cited for its significant impact in helping drive new product innovation among New Mexico small businesses and contributing to state economic growth.

"The NMSBA Program truly appreciates this national recognition and we really want to thank all the principal investigators at Sandia, Los Alamos, and NM MEP for providing their skills and expertise to help small businesses throughout the state," says Jackie Kerby Moore, manager of Sandia's Technology and Economic Development Dept. 1933.



Solving New Mexico's Small Business Challenges

Through the NMSBA, small businesses with technical challenges can seek assistance from laboratory scientists or engineers for projects that require testing, design consultation, or access to special equipment or facilities.

The award was presented last month at the 2012 Manufacturing Innovation conference in Orlando, Fla. The Manufacturing Innovation 2012 awards committee received more than 75 nominations highlighting work in manufacturing throughout the country. Ten awards were given.

Through the NMSBA, small businesses with technical challenges can seek assistance from laboratory scientists

or engineers for projects that require testing, design consultation, or access to special equipment or facilities. For selected businesses, assistance takes the form of laboratory staff hours valued at up to \$20,000 per calendar year if located in rural New Mexico counties and \$10,000 for those in Bernalillo County. The total amount of assistance is capped at \$2.4 million annually for each of New Mexico's two national laboratories.

"The NMSBA team is comprised of dedicated individuals who assist companies with overcoming their obstacles to growth," Jennifer Sinsabaugh of the New Mexico MEP said in her nomination of NMSBA for the award. "In addition to their technical resources, the NMSBA team creates partnerships to provide other resources businesses may need. They realize that business needs vary significantly, and they strive to ensure that they have the best solutions to promote business growth and vitality."

Since its inception, the NMSBA has provided 1,876 New Mexico small businesses with nearly \$30 million in technical assistance. The program has helped create and retain more than 2,300 jobs at an average salary of \$38,000, increase small companies' revenues by \$107.6 million, and decrease their operating costs by \$63.6 million. These companies in turn invested \$35 million in other New Mexico goods and services and received \$41 million in new funding and financing.

Mileposts

New Mexico photos by
Michelle Fleming
California photos by
Randy Wong



Billy Brock
35 5345



Philip Rodacy
35 2555



Larry Walker
35 200



Mike Daniels
30 6814

Recent Retiree



Deborah Payne
18 10012



Nick Dereu
30 2112



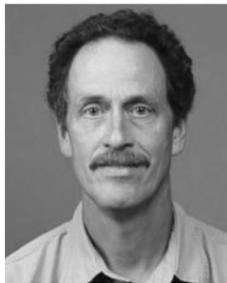
Kenneth Gwinn
30 1524



Sandy Ballard
25 5736



Jim Brown
25 5578



Randolph McWilliams
25 5742



Curt Nilsen
25 8237



Tim O'Hern
25 1512



Lane Yarrington
25 5635



Lozanne Chavez
20 1932



Nancy Davis
20 10200



Kevin Kartchner
20 10542



David Schoenwald
20 6113



Rusty Elliott
15 11100



Danny Rintoul
15 1465

What I found at Reutilization: Salt fog chamber

EDITOR'S NOTE: This is one of an occasional series of articles about machines, instruments, and equipment now at Reutilization and Disposition that have been part of Sandia's history. If you see something intriguing you'd like to know about at Reutilization — and it has an asset number that might be traceable — contact Sue Holmes at Media Relations & Communications, 505-844-6362.

By Sue Major Holmes

Rudy Sedillo (1527) doesn't miss Sandia's old salt fog chamber, not even a little bit. He says the chamber that replaced it can perform a lot more tests and is far easier to operate.

The old chamber, now sitting on the asphalt outside a tent at Reutilization and Disposition, was used for just what its name hints at — it blanketed materials and components in a salt fog, similar to an ocean-front environment, to test their resistance to corrosion.

The salt fog chamber is a squat grayish-beige box with a triangular plastic lid that looks a little fogged up itself. On the outside of the lid is a sign, "NaCl. (Table salt). Not harmful." A notice on the side of the machine warns that the chamber must be operated by authorized personnel only.

Rudy says the chamber worked this way: Operators put together a combination of salt and de-ionized water in an external tank, and used air pressure to force the mixture through an atomizer as a spray, which turned into a fog in the slightly heated chamber. Researchers subjected their test items to salty fog long enough to see corrosion.

Such environmental tests derive from mil standards — DoD test protocols for equipment — and the auto industry, which needed to find out how metals and paint held up to various types of corrosion, Rudy says. Here at Sandia, researchers from groups all over the Labs used the salt fog chamber to test different types of metals, plastics, fiberglass products, and glass, as well as entire components, he says.

"We even tested some cards in there one time, a special type of card which resembled a credit card but was used for security purposes," Rudy says.

Operators mixed the salt and water in an external tank, and had to check the temperature inside the chamber via a thermometer on the side of the chamber.

Rudy, who has been in the Program & Test Integration organization for about eight years, estimates the chamber dates from the 1980s. Sandia replaced it a little over a year ago.

Rudy's enthusiastic about the modern chamber.

"It's cyclic; it can go from one environment to the next. You can have salt spray, humidity, rain, or you can go back to a dry environment," he says. "The old salt fog chamber went straight to a salt fog and that's what you had."

The new chamber has a data acquisition system and an integrated solution tank that still has to be mixed manually. It also has a modern control system instead of the rheostats operators once used to turn up the voltage to heat up the old salt fog chamber.

Compared to the replacement, Rudy says, the salt fog chamber was "much more of an antique."

"It was effective for the one thing it did do, which was a salt fog," he says. "It was old, but functional."

OLD SALT — Rudy Sedillo (1527) looks at the old salt fog chamber that Sandia once used to test the resistance of various materials to corrosion. Sandia replaced the chamber about a year ago with a modern version, and the old salt fog chamber was moved to Reutilization and Disposition. (Photo by Randy Montoya)



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

MISCELLANEOUS

JAPANESE KIMONO, 1951; Chambers SS stove. Chavez, 298-4250.
 UPRIGHT FREEZER, 20.5-cu. ft., Kenmore, new, 2/17/12, half price, \$450 cash. Jesse, 296-1709.
 CHAIR, black leather, swivel barrel, comfortable, custom-made for living room, excellent condition, \$125 OBO. Roesch, 281-9751.
 AIR HOCKEY TABLE, 44" x 86", good condition, \$40. Swiler, 332-0547.
 DIGITAL CAMERA, submersible, FujiFilm FinePix, \$120; Flip HD video recorder, 4GB/1 hr., \$60; both in box. Cruz-Campa, 915-760-3291.
 SKIS, Atomic BetaCarv X, 180 cm, Salomon bindings, carbon profile, used, \$20. Sotelo, 298-0358.
 ONE-YR. MEMBERSHIP, Defined Fitness, valued at \$595, asking \$500. Flores, 681-7078.
 ACOUSTIC GUITAR, 6-string, Dean 771, spalted maple back/sides, spruce top, built-in pickup/pre-amp/tuner, hard-shell case, \$350. Witzke, 281-1520.
 EXERCISE MACHINE, NordicTrack ski-style, new, never assembled or used, will deliver, \$150. Schuster, 263-3087.
 ROWING MACHINE, WaterRower, Natural series, Ash wood, w/honey oak stain, photo at waterrower.com, \$1,095 new, asking \$450. Grady, 720-5364, ask for Deb.
 AUTOMATIC SWIMMING POOL CLEANER, Dolphin, w/caddy, \$200. Novotny, 505-296-7167.
 LCD TV, Sony Bravia, 32-in., 720, 50/60Hz, HDTVs: 2 w/cables & remotes, perfect condition, \$295 ea. Montano, 450-7378.
 UNINTERRUPTIBLE POWER SUPPLY, CyberPower CP1500AVRLCD, 1500VA, 900-W, great for desktop computer, \$100. Kucera, 402-212-9690.
 WOMEN'S SLEEPING BAG, North Face Blue Kazoo, 3 season, great condition, retails for \$250, asking \$120. Hennessey, 505-506-7936.
 GARTER SNAKE, w/20-gal. tank & habitat, free. Townsend, 401-6118.

BATHING BENCH, transfer type by Aurora, straddles tub, never used, \$40. Stevens, 293-5704.
 MICROWAVE, GE, over-the-range, black, new, never used, \$200 OBO. Tucker, 480-208-9528.
 CHANDELIER, adjustable height, dark brown metal, small leaf accents, holds 3 bulbs, photos available, \$60. Walton, 897-0092.
 ELK ARCHERY TAGS, 2, bull or cow, unit 12 (south of Grants), discount for 2. Marron, 345-4006, ask for Jack.
 WASHER & DRYER, Maytag Performa, 4-spd./16-cycle washer, 7-cycle dryer, both oversized, heavy-duty, great shape, \$350/pr. Williams, 505-903-6397.
 MIDSUMMER'S FANTASY FUNDRAISER, speaker Judge Willow Parks, food, music, June 30, <http://fabulousFelines.org>. Stubblefield, 298-2991.
 FULL HEADBOARD, carved, white butterfly, dresser w/mirror, white w/color accents, perfect for kid's room, \$125 ea. Villegas, 480-6290.
 WASHER & DRYER, front-loading, Kenmore, white, great condition, \$500 ea. Valdez, 934-3331.
 VIDEO GAMES: PlayStation 2, \$15; Xbox 360, \$20-40; child Jeep, \$150; car, \$20; swing set, \$75; picnic table, \$10. Dotson, 281-9057.

TRANSPORTATION

'08 TACOMA TRD, off-road, ProComp lift, 33-in. tires, low miles, 48.3K miles, photos on craigslist, \$25,000. Evans, 505-615-1296.
 '07 JEEP LIBERTY SPORT UTILITY, 4x4, manual, silver, 1 owner, 70K miles, very good condition, \$10,500 OBO. Lechtenberg, 440-9556.
 '95 LINCOLN TOWNCAR, mechanic/electric excellent condition, body fair, 23-mpg actual hwy, \$2,000 or trade. Willis, 280-6040.
 '99 CHEVY TAHOE, Sport model, 4WD, 2-dr., all power, leather seats, 110K miles, good condition, \$4,500. Noe, 268-6620.

How to submit classified ads

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

- EMAIL: Michelle Fleming (classads@sandia.gov)
- FAX: 844-0645
- MAIL: MS 0165 (Dept. 3651)
- DELIVER: Bldg. 811 Lobby
- INTERNAL WEB: On internal web homepage, click on News Center, then on Lab News link, 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 (If you include a web or e-mail address, it will count as two or three words, depending on length of the address.)
2. Include organization and full name with the ad submission.
3. Submit 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 Sandia members of the workforce, 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 any ad that may be considered offensive or in bad taste.

'05 HONDA CIVIC COUPE EX, 2-dr., AT, silver, spoiler, grandma's car, only 23K miles, excellent condition, \$12,850. DuBay, 268-0307.
 '95 CHEVROLET C2500, turbo diesel, stakebed truck, 130K miles, very good condition, \$7,000. Browning, 340-5787.

'08 TOYOTA TUNDRA TRD, off road, 4x4, running boards, new front brakes, new Michelins, 55K miles, \$24,900. Hennessey, 915-241-8634.
 '07 CORVETTE CONVERTIBLE, power top, only 46K miles, w/warranty, great condition, <market, \$33,950. Shelton, 505-908-1013.
 '03 VW NEW BEETLE, 6-spd. turbo, leather, moon roof, new tires, 76K miles, great condition, fun, \$8,095. Konkel, 298-4403.
 '02 FORD EXPLORER XLT, 4x4, V8, rear AC, 3rd row seat, roof rack, tow pkg., running board, 139K miles, Kelly lists \$6,759, asking \$6,100. Trujillo, 269-8395.

RECREATIONAL

'08 SUZUKI RMZ450, bought brand new in '10, low hours, lots of extras, excellent condition, \$4,000. Pohl, 480-3720.
 '07 FUNFINDER TRAVEL TRAILER, 16-ft., many extras, sleeps 6, light truck/SUV towable, excellent condition, \$8,499. Mulville, 459-6790.
 BOAT, 17-ft., '98 Larson model SEI-176, 135-hp stern drive, extras, lake ready, 1 owner, \$6,000 OBO. Harris, 301-6804.
 '07 HARLEY-DAVIDSON SPORTSTER XL1200R, pearl yellow, fuel injection, many performance upgrades & accessories (negotiable), \$6,500 OBO. Delhotal, 505-659-1492.
 '67 V35 BONANZA, 285-hp, 4380 TT, excellent paint & interior, Garmin 530+496, new 406ELT, fresh annual in May, \$90,000 OBO. Schneider, 934-5806.
 '04 BWM R1200C MONTAUK, leather bags, passenger comfort seat, garage-kept. ~15K miles, beautiful condition, \$9,895. Lopez, 505-898-7761.

REAL ESTATE

3-BDR. TOWN HOME, 2-1/2 baths, 2,200-sq. ft., garage, Los Alamos, \$275,000. Fraser, 806-341-7252.

4-ACRE HOME SITE, prime, Sandia Park, 10 Harms Lane, level, well, electric, phone, fenced, ready-to-build, \$240,000 terms. Mihalik, 281-1306.
 3-BDR. HOME, 1-3/4 baths, 1,630-sq. ft., NE, lots of extras, Sandia school district, \$170,000. Carrington, 505-263-0284.
 HISTORIC SOCORRO ADOBE, 3+ acres, new propane system, heaters, tankless water heater, carpet, detached garage/workshop, \$150,000 negotiable. Alexander, 505-797-7750.
 WILLOW WOOD HOME, open house, July 1, 1-4 p.m., 11508 Kings Canyon Rd. SE. Dinger, 818-8933.
 4-BDR HOME, 2 baths, refrigerated air, new windows/roof/heater/water heater, many updates, Four Hills, MLS#736417, \$275,000. Mayer, 306-4377.
 3-BDR. HOME, 1-3/4 baths, 1,907-sq. ft., Foothills, whole house remodel, large kitchen, <1 block from park, \$259,900. Skogen, 612-308-4246.
 3-BDR. HOME, 1-3/4 baths, 2,260-sq. ft., large corner lot, cul-de-sac, 260-sq. ft. sun/pool room, Comanche/Juan Tabo, FSBO, \$197,500 OBO. Torrez, 505-489-1478.
 4-BDR. HOME, 3 baths, w/attached in-law apt., horse property, barns, fruit trees, 2+ acres, MLS#733961. Talandis, 505-250-9431.

WANTED

HIGH SCHOOL OR COLLEGE STUDENT, assist w/yard work over the summer. Mozley, 884-3453.
 MOVING BOXES, clean, good condition, will pick up. Sutton, 217-621-6046.

WORK WANTED

HIGH SCHOOL JUNIOR, responsible, available for yard work, pet sitting, baby sitting etc. Woodall, 249-1179, ask for Tyler.

Paul Cooper

(Continued from page 12)

was a pivotal team and a critical turning point. It was a fantastic time to be there."

A year and a half later, the Branch Davidian compound in Waco, Texas, burned down at the end of a 51-day siege involving the US Bureau of Alcohol, Tobacco and Firearms, the Federal Bureau of Investigation, and sect leader David Koresh. Seventy-five people died in the fire, including Koresh. Paul was named to a presidential commission that investigated ATF and FBI participation in the incident after surviving Branch Davidians alleged the FBI started the fire.

"We determined that the Davidians were making explosive devices and set the fire in bales of hay," Paul says. "The ATF and FBI acted legally and within normal procedures."

Paul also was called upon by the state of Oklahoma to look at technical evidence in the trials of Timothy McVeigh and Terry Nichols in the April 19, 1995, bombing of the federal building in downtown Oklahoma City that killed 168 people.

"It was two years after the actual bombing in Oklahoma City, so I went through tons of files and studied photos of broken windows, overturned cars, and the crater. Those are passive pressure gauges that give insight into the explosives," Paul says. "I was able to

closely match the amount of explosive material McVeigh and Nichols had bought in Kansas and Texas with the damage. That calculation had not previously been done, and was used in the state trial."

Paul helped investigate the July 1996 explosion of TWA Flight 800 over Long Island, N.Y., that killed all 230 people on board. The complex, four-year inquiry concluded that the probable cause of the accident was an explosion of flammable fuel and air vapors in a fuel tank, most likely due to a short circuit.

"When I got there, the plane's pieces were being reassembled and I could walk through the fuel tank," Paul says. "I looked around and could see where it started and where it detonated." His calculations became part of the final report.

Bringing education to life

Paul did other accident and criminal investigative work for outside agencies, particularly the FBI. He says his field experience improved his explosives classes at Sandia. And teaching made him a better engineer. "The more I talked the more I learned," he says. "What I learned in setting up and doing those classes I applied to my work, which got better and better."

Rus Payne (54341), who took all Paul's courses, says Paul's experiences and stories brought the material to life. "He didn't just lecture on how an application works. He told how it worked and gave an example from real life," Rus says. "He tells great stories. And he loves to talk to people. He has a way of bringing the curriculum to the level of every individual in the class.



OKLAHOMA CITY — Firefighters form a line to remove rubble from the explosion site of the Albert P. Murrah Federal Building. April 21, 1995. (DoD photo by SSgt. Mark A. Moore)

He can speak to any PhD at that level and also to the lay person in an enlightening way."

Paul's class notes turned into a book, *Explosives Engineering*, begun in 1982 and published in 1996. To this day it is the definitive text on explosives, used in university and industrial engineering programs worldwide.

Paul says his approach to teaching is to make it fun. He brought history to the classes, gathering tidbits about the people behind the equations. "When I talk about Hooke's Law, the basis of mechanical engineering, I mention that Robert Hooke's blood enemy was Isaac Newton. There was a war between those two!" Paul says. "I love the history."

Paul continued to teach the explosives courses for the CL&PD organization after retiring in 1997. Why stop now? "It's 30 plus years, and I'm tired," he laughs. "My feet hurt. My back hurts."



TWA FLIGHT 800 — A photograph of the large three-dimensional reconstruction, with the support scaffolding visible. (Photo from National Transportation Safety Board accident report for TWA Flight 800, May 20, 1997)

He says there are three successors who will continue to teach the classes, which gives him peace of mind.

Paul's retirement plan is unstructured: drives in his 1950 MG and 1970 Fiat 500, home maintenance, time with his family, and consulting for Sandia.

He might even pop his head into an explosives class now and then.

"After all this time, I'm not sure I can stay away forever."



BRANCH DAVIDIAN COMPOUND in Waco, Texas — Smoke from second floor bedroom increases and spreads across back of building. April 19, 1993. (Federal Bureau of Investigation)

A blast! Explosives legend Paul Cooper hangs up his teaching hat

By Nancy Salem

Paul Cooper first stood in front of a Sandia class in 1977. His topic was explosives safety and his goal was to make it pop, but not literally. He wanted to grab the students' attention and hold it.

Paul was a natural. He taught with expertise, humor, and a dash of irreverence. "If I wasn't an engineer, I would have been a comedian or actor," Paul says. "I feel like a performer in front of the group."

He held the stage for 35 years, teaching nearly 1,000 Sandians everything they needed to know about blowing things up. His classes filled fast and his reputation grew, both as a teacher and an internationally recognized explosives engineer.

"Paul is an acknowledged expert in the explosives community with over three decades of extraordinary accomplishment. He also has taught explosives courses to hundreds of Sandians during that time," says David Keese, director of Integrated Military Systems Center 5400. "We owe a great debt of gratitude to individuals like Paul Cooper who not only excel in their chosen professional field but also put forward the time and effort to pass along their skills and knowledge to others who will follow in their footsteps."

Paul taught his final class offered by the Corporate Learning and Professional Development (CL&PD) organization on May 24. Students stuck around and friends stopped by for a slice of pizza and to witness the end of an era at Sandia. "We are very sad to see him go," says Belinda Holley, manager of Technical and Compliance Training Dept. 3521. "He has had a sustained commitment not only to teaching but shaping the explosives training program and supporting education at Sandia. He is a rarity when it comes to that level of dedication and passion."

Paul's explosives safety course spawned four more classes, all focused on technology: Chemistry and Thermochemistry of Explosives; Shock and Detonation; Initiation Theories and Design of Initiators; and Scaling, Engineering Design, and Applications of Explosives.

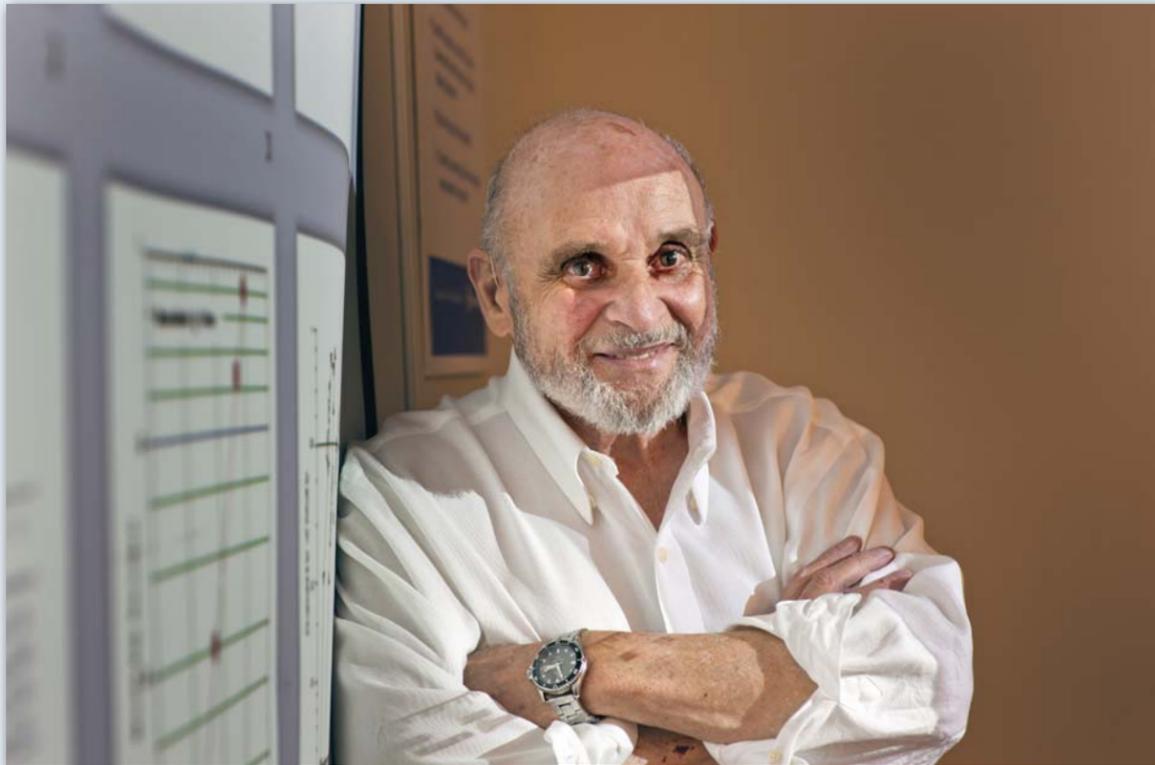
"We felt people would be much safer if they understood the materials and processes they were working with," he says. "We went deeper into the engineering."

Paul says the classes took on a life of their own because of the scarcity of formal explosives training in the US. Paul himself learned explosives from "what I read, what I did, who I talked to, and from experience."

Colleague Jerry Stofleth (5434) says the only thing



PAUL COOPER (9333), seen in a 1990 photograph published in a special *Lab News* issue largely focused on the USS *Iowa* investigation, explains the half-scale test apparatus used for impact-ignition experiments. Small black cylinders near his left hand are propellant pellets, which are arranged on a large plastic cylinder that simulates the mechanical properties of more layers of pellets.



AN ENERGETIC CAREER — Paul Cooper built a global reputation as an explosives engineer and passed his knowledge to hundreds of Sandians in courses he taught for more than 30 years. "It was fun," Paul says. "And I'm proud of what I accomplished." (Photo by Randy Montoya)

Paul enjoys more than teaching is engineering. "His passion in life is for knowledge, not just explosives, but every discipline of engineering, and not just engineering, but for nature and humanity as well," Jerry says.

Paul's professional career is the stuff of legend. He built a global reputation, searching for nuclear weapons in Iraq and investigating disasters ranging from the explosion of a gun turret on the USS *Iowa* in 1989 to the crash of TWA Flight 800 over New York in 1996.

Paul describes his Sandia career with typical humility. "Along the way, wonderful things happened," he says. "I was just in the right place at the right time."

Come to Albuquerque

Paul is a native of Brooklyn, N.Y., and a 1958 chemical engineering graduate of the Brooklyn Polytechnic Institute, where he studied under rocket-engine expert Paul Torda. He followed his mentor to Chicago for a job when Torda was named director of research at the Illinois Institute of Technology's Armor Research Foundation.

"When I got there I looked at all the different places I could work," Paul says. "There was an explosives department. I was like a little kid. Here was a place where they pay you to go out and blow stuff up. That's how I officially got into the explosives business."

A colleague was recruited to Sandia in 1964 and sent Paul a message: Come to Albuquerque. I have a place for you. "The minute I stepped off the plane I didn't care what the offer was, I'd take it," Paul says.

He worked in explosive components until 1977 when he was recruited by the Underground Nuclear Testing arming and firing group, where he stayed until he retired in January 1997. His work focused on the design of explosive systems. "It's not all bombs," he says. "There are lots of things we do with explosives."

In 1979, Paul joined the national Nuclear Emergency Search Team, NEST, an atomic bomb squad of sorts. "If the FBI or somebody got a lead there was a clandestine or homemade atom bomb somewhere, NEST had to locate and disarm it," Paul says. "It was very exciting."

Paul was a NEST member until the mid-1990s when its work transitioned to the military.

An explosives dream team

The USS *Iowa* gun turret exploded on April 19, 1989, in the Atlantic Ocean, killing 47 crewmen. A Navy investigation concluded a suicidal crew member who died in the blast deliberately caused it. Members of Congress were critical of the investigation,

and Sandia was asked to review the findings.

The Labs put together a dream team of about two dozen engineers headed by Dick Schwoebel and including Paul. It found evidence that propellants were pushed into the 16-inch gun barrel too fast and too far, hitting the base of the 2,700-pound projectile instead of stopping a foot away as required.

"Karl Schuler, looking at scratch marks on the mechanical equipment, established that the powder bags had been rammed right up to the base of the bullet and so hard that they compressed three inches," Paul says. "I showed that propellant pellets, when hit, can crack and throw burning pieces, and set off an explosion."

The Sandia report was delivered in dramatic testimony before the Senate Armed Services Commit-



USS *IOWA* — The No. 2 turret of the USS *Iowa* exploded on April 19, 1989, killing 47 members of the turret crew. The left gun of turret one in the background is fully elevated as its crew tries to clear a misfire that occurred earlier by trying to coax the powder bags to slide backwards against the primer.

(Photo courtesy of Defenseimagery, by Lt. Thomas Jarrell)

tee. Paul was among those testifying. The Navy reopened the investigation after Sandia concluded the explosion was likely caused by an accidental overram of powder bags into the gun's breech. The Navy said the cause of the explosion could not be determined and closed the investigation, but withdrew accusations against the dead crew member. Both reports remain in the record.

In October 1991, following Operation Desert Storm, Paul was named to a United Nations/IAEA inspection team sent to Iraq to look for evidence of weapons of mass destruction. "In early October the Iraqis denied having a nuclear program," Paul says. "When we left at the end of October, they declared officially they had a nuclear program. It

(Continued on page 11)