Labs Director Paul Hommert lays out timeline for TotalComp deployment

It took a lot of dialogue among this leadership team for me to get comfortable and convinced that this is the direction we need to go. I believe that firmly today. I am committed to this; it is the right direction for the laboratory."

— Labs Director Paul Hommert on implementation of the TotalComp system

VPs share stage at all-hands session to describe aspects of Labs' new compensation system

By Jim Danneskiold

Sandia's new system of job families, job descriptions, and salary bands will be fair and consistent, ensure that employees are paid for what they actually do, and greatly improve the Labs' ability to attract quality staff with market-based pay, executives said at an all hands meeting on Tuesday, May 24, at the Steve Schiff Auditorium.

TotalComp is the project to replace the Integrated Job Structure, which is now nearly 15 years old. Sandia executives have stressed repeatedly that the project will create a market-based compensation system that can better respond to business and market conditions.

More information is available at http://totalcomp.sandia.gov.

Sandia President and Laboratories Director Paul Hommert told employees that TotalComp will help reform challenges to Sandia's compensation system that include the following:

- A need for more accurate descriptions of what employees do and of the pay they receive for their performance in those roles;
- the tradition of mobility for Sandians in filling a wide variety of jobs during their careers; and,
- the need for a compensation system that recognizes the wide range of professions and skills required to execute the Labs' mission.

(Continued on page 4)

Composite characters

With the growing use of composite materials in aircraft and wind turbine blades, Sandia researches are working to define damage tolerances and test both existing and advanced nondestructive inspection (NDI) techniques to ensure the materials' safety. Story on **pages 8-9.**

Sandia LabNews

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Sandia National Laboratories

National Academy of Sciences panel visits Z to determine possible fusion energy funding

Results could help extend Z's role beyond materials testing and stockpile stewardship

By Neal Singer

A humorous, though bitter, analogue to the proposition that the speed of light remains constant (no matter how fast its source recedes), has been the fate of those waiting for the arrival of nuclear fusion-generated electricity. Though decades pass, success remains always (say it with me) 30 years away.

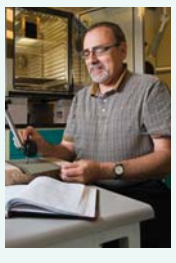
But a National Academy of Sciences (NAS) review panel that has met three times in the past six months has entered a new factor in the fusion equation. The 25-person panel, chartered by former CalTech physicist and provost Steve Koonin (now undersecretary for science at DOE) and including physics luminaries like Richard Garwin, has been charged by DOE Secretary Steve Chu to distinguish which of a number of ongoing efforts in inertial confinement fusion are suitable to explore as a possible energy source — a step beyond seeking only a controlled fusion reaction.

More important, perhaps, the committee's focus recognizes the possibility that pulsed-power efforts produce an energy output, rather than serve solely to provide data for supercomputer simulations of nuclear weapons.

(Pulsed power sends nanoseconds-long bursts of

(Continued on page 7)

WORKERS in Z's central vacuum chamber do technical checks to make sure the huge machine is up to snuff for its next 'shot.' (Photo by Randy Montoya)



Thermal battery

A new thin-film coating process invented at Sandia for manufacturing thermal batteries used in nuclear weapons and other munitions will be industrialized under a new corporate partnership with a Maryland company. See **page 6.**

Inside . . .

Water quality

CANARY Event Detection Software developed by Sandia in partnership with the EPA is being used to protect public water systems by enhancing the detection of these threats to drinking water. See **page 5.**

That's that

Do you remember the scenes in *Star Trek* – sure you do! – where Dr. McCoy, usually in frustration, would spit out some theme and variation of "Blast it, Jim, I'm a doctor, not a bricklayer." . . . "I'm a surgeon, not a psychiatrist." . . . "I'm a doctor, not an escalator." (Yes, he really said that in one episode). . . "I'm not a scientist or a physicist, Mr. Spock, I'm just a country doctor."

Well, Bones, that is, Dr. McCoy, may have been just a little ol' country doctor, but he worked with some pretty advanced tools, most memorably, perhaps, the medical tricorder, a handheld scanning device he used to diagnose patients with just a quick pass of his hand. It was a nifty gadget, but it lived strictly in the realm of science fiction.

But science fiction writers have an uncanny way of anticipating the future in ways that even egghead futurists don't get. Or, maybe "anticipating" isn't the right word here. Maybe what happens is that certain concepts developed in science fiction drive certain developments in technology. And that brings me back to the medical tricorder, a tool that seemed preposterously implausible to most of us back in 1968. Cool? Yes. Believable? No.

But, given a convergence of enabling technologies, maybe the concept isn't so crazy after all. Mobile communications giant Qualcomm and the X PRIZE Foundation – the folks who kick-started the private manned spaceflight initiative – are offering $10 million to whomever can invent "a mobile solution that can diagnose patients better than or equal to a panel of board-certified physicians." They're calling it the Tricorder X PRIZE; details of the competition and the governing rules are being worked out now and the contest is expected to start in 2012. A successful tricorder is likely to combine advances in expert systems, wireless sensors, medical imaging, and microfluidics. Reading through this list of enabling technologies, I kept saying to myself, "Hey, we (Sandia) do that. And we do *that*, too."

So all of this made me think, wouldn't it be cool if a team of Sandians pooled their intellectual capital and technical know-how together to jump into this X PRIZE thing? I'd love to be part of the effort, but . . . Blast it, Jim, I'm just a writer, not a bloody physicist!

* * *

Speaking about predicting the future, how viable a field, really, is futurology? There's a whole body of futurists – scholars, writers, and consultants – who make a pretty good living prognosticating where we're going technologically, culturally, politically, religiously, environmentally, and so on. And sometimes, surely, they're right. But if you look back at the world 100 years ago, would anyone have predicted the specifics of the world we now live in. The global map has been completely redrawn and redrawn again. Great nations have literally disappeared, dissolved. One could go on and on citing all the ways the world has developed that no one could have predicted.

It strikes me, though, that the future is a strange mix of the mundane and the surprising, the ordinary and the astonishing. And maybe the most astonishing thing to me is that in the most important aspects of our lives – that is, in our relationships with our families, friends, and communities – things haven't really changed all that much over the past century. Today's biggest industries and the jobs that support them didn't even exist as ideas a century ago. So, certainly, what we *do* has changed. Who we are, though? That hasn't changed at all.

* * *

I guess I'm on a futuristic kick, but here's a little data point that reminds us of how fast some things move along in the technical marketplace. *Lab News* photographer Randy Montoya, going through his desk the other day, came across a receipt for a compact flash card he purchased in 2003 for a Nikon camera. You may recall that compact flash cards were first-generation removable solid-state media. About the size of a matchbook, they were tiny by the standards of the day. . . and you paid a price for that small size: A 2 Gb card, purchased from a local merchant, cost $714. Today, a 2 Gb microSD card – if you can find one that small – costs about ten bucks. It's about the size of the fingernail on your pinkie finger.

This is an excellent example of the convergence of the mundane and the amazing: On the one hand, our ability to take and store and display and share photographs just keeps getting cheaper, more accessible, and more capable. On the other hand, we still take pictures – a lot of pictures! – of our kids at the Grand Canyon or blowing out the candles on their birthday cakes. Because that's who we are. And that's what we do.

See you next time.

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

Charles McMillan tapped to lead LANL

Charles F. McMillan has been named the new director of NNSA's Los Alamos National Laboratory (LANL). McMillan, who started his career as an experimental physicist at Lawrence Livermore National Laboratory (LLNL) in 1983, was chosen after a rigorous, nationwide selection process that attracted more than 150 applicants.

CHARLES MCMILLAN

Beginning next month, McMillan will serve as the 10th LANL director and as the president of Los Alamos National Security, LLC, the management and operations contractor responsible for its operations.

"Los Alamos National Laboratory is one of the crown jewels of our nation's scientific enterprise and one of the Department of Energy's most important, accomplished and prestigious laboratories," said Energy Secretary Steven Chu. "As we work to accomplish the department's vital national security missions and make the critical investments required to transform the energy economy, I know we have an outstanding partner in Charlie McMillan."

NNSA Administrator Tom D'Agostino said, "Having known and worked with Charlie McMillan for more than a decade, I know Los Alamos is in excellent hands. As we work to invest in the future and build the modern, 21st century nuclear security enterprise required to implement the president's nuclear security agenda, Los Alamos will continue to play a vital role in pushing the frontiers of science and discovery. I congratulate Charlie on his selection, and look forward to working with him to secure our nation and build on the legacy of excellence built at Los Alamos."

McMillan replaces Michael Anastasio, who announced his retirement in January after serving as LANL's director for the past five years. Anastasio, who previously served as director of LLNL, led two of the nation's premier national security research facilities at the frontiers of science and innovation.

McMillan has more than 28 years experience managing weapons science and stockpile certification activities, including hands-on experience in both experimental physics and computational science, and demonstrated success at balancing mission performance with security and safety. Since 2006, he has served as LANL's principal associate director for Weapons Programs, where he was responsible for directing the science, technology, engineering, and infrastructure that enables the laboratory to deliver on its core mission of ensuring the safety, reliability, and performance of the nation's nuclear deterrent. McMillan was elected by peers to lead the Nuclear Security Enterprise Integration Council.

Prior to joining Los Alamos, McMillan spent more than two decades at LLNL in California. He holds a doctorate in physics from the Massachusetts Institute of Technology and a bachelor's degree in mathematics and physics from Columbia Union College.

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Recent Patents

Note: Patents listed here include the names of active and retired Sandians only; former Sandians and non-Sandia inventors are not included. Following the listing for each patent is a patent number, which is searchable at the US Patent and Trademark Office website (www.uspto.gov).

* * *

Darren Branch (1714): Active Micromixer Using Surface Acoustic Wave Streaming. Patent No. 7,942,568.

Dale Huber (1132) and Todd Monson (1112): High-Yield Synthesis of Brookite TiO_2 Nanoparticles. Patent No. 7,943,116.

M. Kathleen Alam (2555) and Randal Schmitt (1128): Modular Initiator with Integrated Optical Diagnostic. Patent No. 7,942,097.

Randal Schmitt (1128) and Philip Hargis Jr. (1128): Passive Background Correction method for Spatially Resolved Detection. Patent No. 7,940,377.

Michael Mangan (1725), Matthew Blain (1725), Chris Tigges (1725), and Kevin Linker (6630): Microfabricated Linear Paul-Straubel Ion Trap. Patent No. 7,928,375.

Keith Underwood (1422) and Karl Scott Hemmert (1422): Multiple Network Interface Core Apparatus and Method. Patent No. 7,929,439.

'Great to be part of the leading edge' in combating nuclear terrorism

Sandia coordinates international collaboration on nuclear detection architectures

By Patti Koning

Bringing together 48 different nations is no easy feat — especially to tackle topics as complex as nuclear counterterrorism and corresponding nuclear detection architectures (NDA). But that's exactly what a team from the US Department of Homeland Security's Domestic Nuclear Detection Office (DNDO) and Sandia, including Chad Haddal, Stacy Mui, and Jason Reinhardt (all 8112), were able to pull off this past March in Córdoba, Spain.

"We looked to the international community to set the agenda topics," says Jason. "We wanted a true roundtable of different players with no distinction given to size, expertise, or resources."

Formally titled the Global Initiative to Combat Nuclear Terrorism's (GICNT) Nuclear Detection Working Group session on Education, Training, and Exercise (ET&E), the workshop was the third in an ongoing series of international workshops funded by DNDO's Systems Architecture Directorate. The first two were held in Garmisch, Germany, in April 2009 and March 2010.

US and Russia are co-chairs

GICNT is an international partnership of 82 nations and four official observers committed to working individually and collectively to implement a set of shared nuclear security principles. The mission of the GICNT is to strengthen global capacity to prevent, detect, and respond to nuclear terrorism by conducting multilateral activities that strengthen the plans, policies, procedures, and interoperability of partner nations. The US and Russia serve as co-chairs of the GICNT, and Spain serves as coordinator of the Implementation and Assessment Group (IAG).

To date, GICNT partners have conducted more than 30 multilateral activities and six senior-level meetings in support of these nuclear security objectives. Sandia's involvement began about four months after the initial Garmisch workshop, when DNDO asked Sandia to edit and restructure a high-level best practices document on nuclear detection architecture. Titled "Model Guidelines Document on Nuclear Detection Architecture," the document was released in December 2009.

SMART TECHNOLOGY — Sandia's Sensor for Measurement and Analysis of Radiation Transients — or SMART — is a radiation detection approach that has potential application in combatting nuclear terrorism.

Sandia was then charged with creating an agenda for a second Garmisch workshop to collaboratively develop a series of topics for more focused follow-on best practice documents related to the development, enhancement, and implementation of NDAs. The intent was to take the high-level strategic framework, as outlined in the initial Model Guidelines Document for Nuclear Detection Architectures, and focus subsequent follow-on discussion on the collective practical applications of those principles and high-level strategic objectives.

"I like to think of this effort as the collaborative development of an encyclopedia for NDAs," says Stacy. "If you're going to stand up a capability in the next three years, how do you leverage existing infrastructure within a country or region?"

The second Garmisch workshop led Jason, working with Karen Jefferson, who recently retired from Sandia, to home in on three topics: awareness, training, and exercise; planning and organization; and the role of technology. The goal is to develop a best practices document on each topic over the next three years. The Córdoba workshop was the first meeting to brainstorm critical concepts related to education, training, and exercises. The workshop series, says Jason, is in some respects an international outreach effort to get as many countries as possible involved in the discussion.

By all measures, that effort is a roaring success — attendance more than tripled between the 2010 and 2011 workshops. More than 150 representatives from 48 nations and observing organizations, such as the International Atomic Energy Agency and Interpol, attended the Córdoba workshop compared with 40 representatives from 18 nations in Garmisch in 2010.

PHYSICIST Nick Mascarenhas (8132) prepares a neutron scatter camera detector for a test. The device detects radiation at significant standoff distances and through shielding, and pinpoints radiation sources, making it an ideal tool in the effort to counter nuclear terrorism. (Photo by Randy Wong)

Sandia CaliforniaNews

"Both DNDO and Sandia wanted to make sure that the international community was well represented in the Córdoba workshop. Because of the overwhelming response, there was not a single US presentation outside of the opening remarks," says Stacy. She says it was extremely gratifying for her and Jason to help draft the closing remarks that were given by Mohan Matthews of Australia and Mark Wittrock of DNDO.

Eye-opening discussion

Among the attendees were Afghanistan, Australia, China, Croatia, Finland, France, Germany, India, Japan, Morocco, the Netherlands, Romania, Pakistan, Russia, Serbia, and Spain. The 46 nations and observers all brought different perspectives and experiences related to NDAs. Jason and Stacy describe the discussion as quite eye-opening.

"The United States tends to look internally first, and then to the international community to augment what we are doing as a nation," says Jason. "Other countries may look outward first. Some countries see themselves as part of a region, which changes the way they monitor their borders. Island nations have a whole different set of challenges."

There were also differences on training — should your first line of defense simply operate equipment or have a broad understanding of the threat? The use of technology, which will be the focus of year three, is another differentiating factor.

"In the United States, technology is inexpensive compared to labor, so technology is an obvious part of the solution for us," says Stacy. "But that's not the case in many other countries. You design a system that fits, based on your circumstances."

Another key theme throughout the course of the discussions was that technology is only a facilitator for enhanced detection; human decision-making is the central element. For this reason, the Córdoba discussions sought to build on existing law enforcement frameworks that virtually all countries have.

Among the representatives from each country there were also different points of view. The workshop brought together a mix of people that Stacy and Jason termed "implementers" — the military, national police, and border guards — with diplomats from ministries of foreign affairs and departments of state.

In the many discussions that ensued over the three-day Córdoba workshop, Jason says the goal was always to explore and share different methods. "It's all about achieving a set of agreed-upon objectives and goals. How you get there doesn't matter," he says. "Countries ultimately will choose what is best for them, but exploring that space as a collective whole is the real goal. The best-practices documents are meant to be a menu, so that everyone understands the options and we can all learn from one another."

Jason and Stacy also think the lessons from the workshop will inform their work as systems analysts back at Sandia.

"We have a lot to process but we learned a lot along the way about how we can better think more systematically and broadly," says Stacy.

Follow-on conference in Croatia

Now they are working on turning 50 pages of notes from the Córdoba workshop into a rough draft on which the international drafting group will build. Sixteen nations signed on to the international drafting group.

"Because we have a bigger drafting group than we expected, we envision an overall methodology with call-out case studies so nations can talk specifically about what they've done in the past and what works for them," says Stacy.

That draft will then be sent to the 82 members of the GICNT. The document will be finalized in a follow-on workshop in Croatia in October. Ideally, says Jason, Sandia will facilitate four GICNT engagements a year on behalf of DNDO, two workshops like Córdoba and two bilateral meetings. The project is funded through the next fiscal year and Jason expects a third year of funding to come through soon.

"As systems analysts, the rewards come few and far between. You write a report and a few months later someone calls with questions. A few years later, an idea from that report might catch on and in five years there might be a program based loosely on what you wrote, so you really have to dig for the credit," says Jason. "With the Garmisch and Córdoba workshops, we did something with immediate impact. I think we are in a new era of national security and global engagement. If we do this right, the national labs could play a larger role in international efforts. It's great to be part of the leading edge."

TotalComp

(Continued from page 1)

"We don't do 'easy' here," he declared. "We do hard. The country expects us to do hard and that means we have to have the talent to do that."

That means, he said, that Sandia must recruit highly talented people to jobs that reflect the wide variety of mission requirements. Those jobs must have accurate descriptions and pay that will make the Labs more competitive.

MTS, MLS designations go away

TotalComp will do away with MLS and MTS (member of the laboratory staff and member of the technical staff) job ladders and substitute "more formalized" job descriptions and a number of salary bands within each job family instead of the current ladders, said Kim Sawyer, deputy director and executive vice president for Mission Support. The system also should enhance recruiting because potential staff will get a clear picture of the qualifications and duties of the jobs for which they are applying.

"A lot of time and care have gone into construction of the descriptions for these various job families, and that's certainly true for the R&D job description."

— Div. 1000 VP Steve Rottler

"We're not just doing this piecemeal," Kim said. "We're taking a look at it from a systems view." She added that the transition to TotalComp will include revisions to all Labs' policies and procedures related to compensation.

By next spring, managers will assign each employee to the job description most appropriate to his or her work. Those serving in rotational or temporary jobs will be mapped to the jobs they are doing. Subsequent rotational assignments will be handled under a revised policy. Managers are scheduled to complete job mapping for TotalComp by April 2012.

After managers assign employees to job descriptions, Kim said, a cross-divisional review will make sure job assignments are consistent from one organization to the next, followed by a second look by management and, finally, an independent review.

Employees who don't think their job description is accurate for the work they do will have a chance to ask for reconsideration.

Kim said managers will ask one question when they review TotalComp decisions: "Are the job descriptions reflective of the jobs that we're doing in the division?"

The TotalComp system has only one job family for R&D, to aid recruiting, to meet changing customer needs, and so that staff members have the maximum possible flexibility of movement within the R&D area, always a major element in Sandia's ability to meet mission objectives. The single R&D family is consistent with the practices of companies against which Sandia benchmarks compensation.

Time and care

"The mission of the Laboratories is technically oriented," and the single R&D job family and new R&D job descriptions are fundamental to the TotalComp system, said Steve Rottler, chief technology officer and VP for Science and Technology and Research Foundations Div. 1000. The job titles and descriptions cover the scientific and engineering work at the Labs, from basic research to engineering development, he said.

Keep up to date on TotalComp news

Sandians can keep up to date on the status of the TotalComp development effort by periodically visiting the TotalComp website at http://totalcomp.sandia.gov. Information on the site will be updated frequently. The site currently contains links to the all-hands session discussed here, as well as a link to frequently asked questions and an implementation timeline.

TOTALCOMP ALL-HANDS — Labs Director Paul Hommert, right, emphasizes a point during a May 24 meeting to discuss Sandia's implementation of the TotalComp system, which will replace the Labs' Integrated Job Structure, a compensation system designed almost 15 years ago. Joining Paul on the stage and also sharing remarks with a live and videolinked audience, are from left, Div. 8000 VP Rick Stulen; Div. 4000 VP Mike Hazen; Div. 9000 VP (acting) Pat Smith; Div. 1000 VP Steve Rottler; Div. 3000 VP John Slipke; and Executive VP for Mission Support Kim Sawyer. (Photo by Randy Montoya)

TotalComp timeline

May 24, 2011

- Executive leadership team officially introduces TotalComp to the Laboratory

May 2011 – October 2011

- Divisions work to refine and validate job descriptions
- TotalComp team continues to make policy and process decisions
- Leadership holds communication meetings

October 2011 – January 2012

- Offer employee info sessions (after job structure design is complete and policy/process decisions are made)
- Work out systems modifications

February 2012 – April 2012

- Employees notified of job mapping and compensation information
- Job mapping employee reconsideration process

April 2012

- TotalComp goes live

However, not all highly technical jobs are within the R&D job family.

"A lot of time and care have gone into construction of the descriptions for these various job families, and that's certainly true for the R&D job description," Steve said.

He used project management jobs as examples of where the R&D line will be drawn. Staff members who use "integrated technical judgment" to drive scientific and engineering projects to completion typically will see their job definitions in the R&D family, while project managers whose decisions don't have a major impact on the technical content delivered to customers will not, Steve explained.

Integrity of process is key

Echoing Paul's opening remarks, Pat Smith, acting VP for Enterprise Transformation Div. 9000, said the transition to a TotalComp system will be principled.

"This is really about integrity," Pat said. "This system will not be successful unless we bring integrity to it."

She added that one goal of TotalComp is to recognize the value of each worker's contributions, and the professionalism of all who are contributing to mission success — directly or indirectly.

"Each of us is valuable in this organization," Pat said. "And our function — the purpose of this is to tie that function to a market reference."

Mike Hazen, VP for Infrastructure Operations Div. 4000, said he was initially concerned about how TotalComp might impact his staff. But after learning that other labs had successfully transitioned to a market-based pay structure, he declared, "I absolutely believe at this point that we're doing the right thing."

"We're not just doing this piecemeal. We're taking a look at it from a systems view."

— Executive VP Kim Sawyer

Many of the questions asked following the executives' presentation were about possible changes in pay. John Slipke, VP for Human Resources and Communications Div. 3000, emphasized that employee salaries will not change when TotalComp takes effect.

"There is no intention at the time of transition where, if you fall into a different pay band from the structure you're in today, that anybody is going to have their pay reduced," John said. "That's not our intention at all."

Traditional job levels retained

John also said that employee salaries in New Mexico will be based on national benchmarks but that salaries in California may be pegged to regional benchmarks due to special pay issues there. This is one of many policies that are being reviewed during the development of TotalComp.

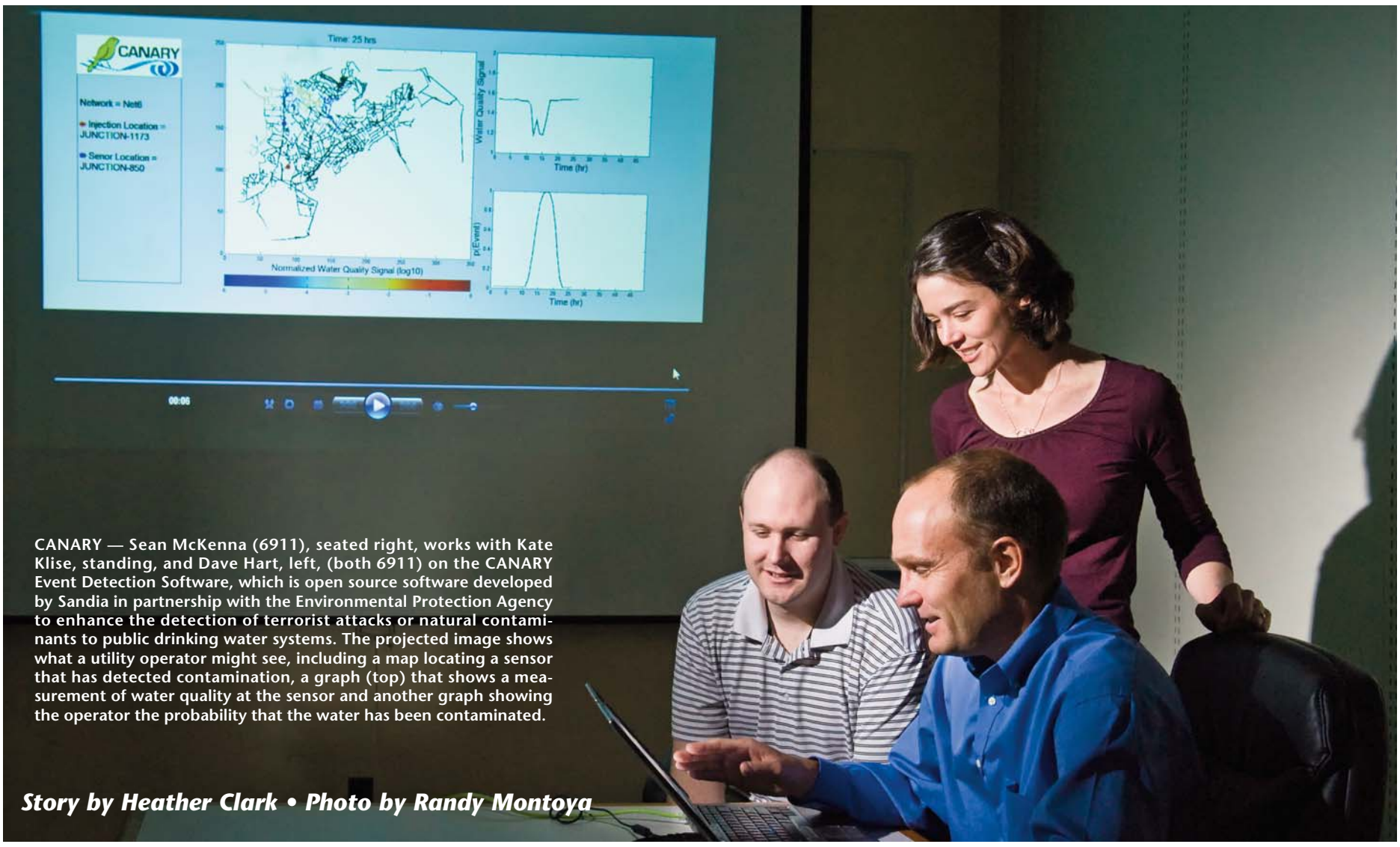
The traditional Sandia job levels — member, senior, principal, and distinguished — will be retained in the new job structure, as well as pay differences between those levels. The Labs will continue to use the current ladder structure and occupational descriptions until the TotalComp project is fully implemented.

Paul said the management team has worked long and hard to reform Sandia's compensation system in the best interests of employees and the institution.

"All of us have had to take a personal journey to a level of commitment moving forward. We're committed to these principles," Paul said of the TotalComp effort. "I want to ask you to walk down this path with us. I believe this will take us as a laboratory to a better place."

Paul pledged transparency in communications about the project in the coming months and re-emphasized that the core principles that motivated management to reform the Integrated Job Structure and adopt TotalComp will inform all future modifications to the new structure, including job titles and descriptions.

"I prefer to think of it [job titles] as Sandians: essential to execute our mission," Paul said.



CANARY — Sean McKenna (6911), seated right, works with Kate Klise, standing, and Dave Hart, left, (both 6911) on the CANARY Event Detection Software, which is open source software developed by Sandia in partnership with the Environmental Protection Agency to enhance the detection of terrorist attacks or natural contaminants to public drinking water systems. The projected image shows what a utility operator might see, including a map locating a sensor that has detected contamination, a graph (top) that shows a measurement of water quality at the sensor and another graph showing the operator the probability that the water has been contaminated.

Story by Heather Clark • Photo by Randy Montoya

Sandia's CANARY software protects water utilities from terrorist attacks and contaminants, boosts quality

Americans are accustomed to drinking from the kitchen tap without fear that it might harm them, even though water utilities could be vulnerable to terrorist attacks or natural contaminants.

Now, CANARY Event Detection Software — open source software developed by Sandia in partnership with the Environmental Protection Agency (EPA) — is being used to protect public water systems by enhancing the detection of these threats to drinking water systems.

"People are excited about it because it's free and because we've shown that it works really well. We would love to have more utilities using it," says Regan Murray, acting associate division director of EPA's Water Infrastructure Protection Division at the National Homeland Security Research Center.

The software tells utility operators within minutes whether something is wrong with their water, giving them time to warn and protect the public. And, it's improving water quality by giving utility managers more comprehensive real-time data about changes in their water.

Greater focus on water security

CANARY is being used in Cincinnati and Singapore, and Philadelphia is testing the software system. A number of other utilities in the US are evaluating CANARY for future application.

Sean McKenna (6911), the Sandia researcher who led the team that developed CANARY and lived in Singapore for two years to install the software there and train water authority staff how to use it, says people began to pay attention to the security of the nation's water systems after 9/11. Other team members included: Dave Hart and Kate Klise (both 6911); Eric Vugrin (6921); Mark Koch (5448); and Shawn Martin and Bill Hart (both 1464).

"We wanted to help make things more secure. Water systems in particular are designed to provide water to customers and there was less consideration of security previously, but there's greater focus on security now," Sean says.

Sean and Murray say that CANARY could have lessened the impact of the largest contaminated public water source ever reported in the United States. In 1993, Milwaukee's cryptosporidiosis outbreak hastened the deaths of dozens of citizens, made more than 400,000 residents ill, and cost more than $96 million in medical costs and productivity losses, according to reports about the tragedy.

"If you don't have a detection system, the way you find out about these things is when people get sick," Murray says.

Sandia had worked on water security before 9/11. So when the EPA was looking for help early in the last decade to better monitor water utilities, they contacted Sandia.

Reducing false alarms

A Sandia-developed risk assessment methodology for water focused on infrastructure physical security, but did not address how to detect and assess the impact of contamination in the water itself. Sean says his team initially received funding through Sandia's Laboratory Directed Research and Development program to address that gap in the technology and then teamed with the EPA to develop CANARY and other software tools designed to focus on security threats to water.

CANARY, which runs on a desktop computer, can be customized for individual water utilities, working with sensors and software already in use, Sean says.

While some utilities monitor their water using real-time sensors, many still send operators out once a week to take samples, says Dave, the lead software developer for the CANARY project.

Compared to weekly samples, CANARY works at lightning speed.

"From the start of an event — when a contaminant reaches the first sensor — to an event alarm would be 20-40 minutes, depending on how the utility has CANARY configured," Sean says.

The challenge for any contamination detection system is reducing the number of false alarms and making data meaningful amidst a "noisy" background of information caused by the environment and within the infrastructure itself.

CANARY researchers used specially designed numerical algorithms to analyze data coming from multiple sensors and differentiate between natural variability and unusual patterns that indicate a problem. For example, the Multivariate-Nearest Neighbor algorithm groups data into clusters based on time and distance, says Kate, a numerical analyst. When new data is received, CANARY decides whether it's close enough to a known cluster to be considered normal or whether it's far enough away to be deemed anomalous. In the latter case, CANARY alerts the utility operator, Kate says.

The software looks at subtle changes in water quality, using multiple sensors and time series analysis, which tracks data over successive time intervals to obtain meaningful characteristics, Kate says.

"We wanted to move beyond the idea where there are certain thresholds of water quality. We wanted to consider multiple signals at one time because contaminants could affect different measures in different ways," Kate says.

The computer program uses a moving 1.5- to two-day window of past data to detect abnormal events by comparing predicted water characteristics with current observations. But to minimize costly and inefficient false positives, the alarm is not sounded when only a single outlier is noted. CANARY aggregates information over multiple 2- to 5-minute time steps to build evidence that water quality has undergone a significant change, Sean says.

"We've taken techniques from different fields and put those together in a way they haven't been put together before and certainly the application of those techniques to water quality monitoring hasn't been done before," Sean says.

CANARY also provides information about gradual changes in the water, Sean says.

The unintended benefit of the software is that when utility operators better understood the data being sent by their sensors, they could make changes to the management of the water systems to improve its overall quality, Sean says.

"A better-managed system is more secure and a more secure system is better managed, is what we found from utilities we work with," Sean says.

A 'quantum leap' for Singapore utility

Harry Seah, director of the Technology and Water Quality Office at the Public Utilities Board (PUB), Singapore's national water authority, wrote in a letter supporting CANARY that the software provided a "quantum leap" in the utility's practices.

In the past, Seah wrote, the utility depended on preset limits of three water characteristics to determine water quality.

"With the implementation of CANARY, relative changes in the patterns of these three parameters can be used to uncover water quality events, even if each individual parameter lies within the alarm limits," Seah wrote. "This dramatically improves PUB's ability to respond to water quality changes, and allows PUB to arrest poor quality water before [it reaches] the consumers."

As the software is increasingly being installed at water utilities, researchers are working on new application areas for CANARY, such as computer network traffic logs and geophysical log analysis used by oil drillers to analyze rocks at different depths.

New thermal battery manufacturing method to be developed under Sandia, ATB research agreement

By Heather Clark

A new thin-film coating process for manufacturing thermal batteries used in nuclear weapons and other munitions that was invented at Sandia will be industrialized under a new corporate partnership with a Maryland company. The process could lead to lighter batteries in a variety of shapes for future applications.

A thermal battery is a nonrechargeable, single-use energy source that can remain inert for years at room temperature before becoming activated at temperatures as high as 1,100 degrees (600 degrees Celsius). The thin-film coating process changes the way some thermal batteries have been made since the 1950s.

Sandia researchers also are looking into whether a patented binder used in the new thin-film coating process has commercial applications, for example in lithium-ion batteries in electric and hybrid vehicles and in batteries used in the petroleum industry when drilling deep underground in hot geothermal environments.

Sandia and ATB Inc., a Cockeysville, Md.-based manufacturer of thermal batteries, recently signed a cooperative research and development agreement (CRADA) to test Sandia's new thin-film coating process for large-scale industrial production.

"We can take the developments that we've had in the lab, scale up the quantities of materials that we use and instead of producing tens of batteries we can produce hundreds of batteries in ATB's facility," says Tom Wunsch, manager of Sandia's Advanced Power Sources Research & Development Group 2546. "It's beneficial to us to have an industrial partner to work with on these issues and for them to have this new technology."

Guy Chagnon, CEO of ATB, says his company and Sandia had been working independently on changing the process for producing thermal batteries.

30 thermal battery designs since 1975

"The goal of the CRADA is to industrialize a new process, and to manufacture, build, and test the battery," Chagnon says. "Sandia and ATB have the same vision with the thin-film coating. We're putting our resources together to reduce the size and the cost of thermal batteries."

Sandia's expertise in thermal batteries stems from their use in nuclear weapons and other munitions. They are designed to be extremely reliable, remaining inert for 30 years at room temperature and then springing into action on a moment's notice. Sandia has developed about 30 thermal battery designs since 1975.

Sandia researcher Frank Delnick (2546) led the effort to make the thermal battery components as thin-film coatings instead of pellets. Working with him were: Denise Bencoe (1815); Chris Apblett and Eric Branson (both 1815-2); Bill Averill and Linda Johnson (both 2546); Nick Streeter (2547); Martin Bachicha (2548); James Patrick Ball, Robert Knepper, and Alex Tappan (all 2554); and Judy Odinek, who is retired.

Traditional thermal batteries are made by pressing powdered materials into electrochemically active pellets used as the anode, cathode, and separator of the battery. The pellets must be a certain thickness to maintain mechanical integrity and prevent them from falling apart when handled. The amount of material needed to achieve mechanical stability can be up to 10 times greater than what is needed to make the battery work. Therefore, considerable reduction in size can be achieved by making the components thinner, Frank says.

Relatively inexpensive equipment used

Frank's process uses relatively inexpensive equipment, common in the paint industry, that coats the battery components as thin films onto stainless steel foils. The coatings are held together and bonded to the foil using a patented binder. He says the process will work best for thermal batteries that last from a fraction of a second to a few minutes.

The binder must withstand temperatures of about 660-1,100 degrees (350-600 degrees Celsius), the operating temperature required to melt the salt electrolyte and activate the battery. Once activated, the binder must remain chemically and mechanically stable throughout the discharge of the battery without emitting gas or producing other side reactions that could adversely affect the performance of the battery, he says.

Frank overcame a lot of challenges in processing the binder needed for the thin-coating process.

In the early days, for example, the coatings would peel off after thermal processing or they would emit enough gas to extrude the molten salt electrolyte from the battery cells. Other formulations would cause the binder to deactivate the electrodes and the battery would fail, Frank says.

SANDIA RESEARCHER Frank Delnick (2546) invented a thin-film coating process that changes the way certain thermal batteries have been made since the 1950s. Sandia and its industrial partner, ATB Inc., think the invention will reduce the size of certain thermal batteries and lower the manufacturing costs. (Photo by Randy Montoya)

"There were many challenges along the way where the work could have stopped at any one of a number of points, but Frank kept going."

— Dept. 2546 manager Tom Wunsch, speaking of researcher Frank Delnick

Coated materials much tougher

Tom says Frank had the technical savvy to overcome these complexities.

"There were many challenges along the way where the work could have stopped at any one of a number of points, but Frank kept going," Tom says.

The goal of the agreement with ATB is to jointly develop thin-film coatings that will slash the time and materials needed to make thermal batteries.

On average, thermal batteries made with thin-film coatings would use one-fifth to one-half the materials needed for their conventionally manufactured counterparts, Frank says.

The coated materials in the batteries are much tougher than those in current models, Frank says. He expects that thin-film thermal batteries also will perform much better in high-shock environments and will be much more amenable to automated manufacturing.

"Since the parts are more robust, you don't have to handle them as gingerly," Frank says.

The new process also could allow manufacturers to produce different shapes of thermal batteries, Frank says. Currently, thermal batteries are cylindrical and range in size from a man's thumb to a one-pound coffee can.

The first thermal battery made using the new process was slightly thicker than a postage stamp and about the size of a quarter, he says.

ATB employees have visited Sandia to learn more about the process and the company is busy readying its facility to begin developing the new manufacturing process. Chagnon says if the research and development are successful, large-scale manufacturing could begin by late 2012.

The thin-film coating process could be used for select thermal batteries that are being replaced in the B61 thermonuclear weapons as part of a Life Extension Program now under way at Sandia, Tom says. That project, the largest weapons refurbishment effort in the US nuclear weapons complex, currently involves hundreds of Sandia employees and is scheduled to begin production by 2017.

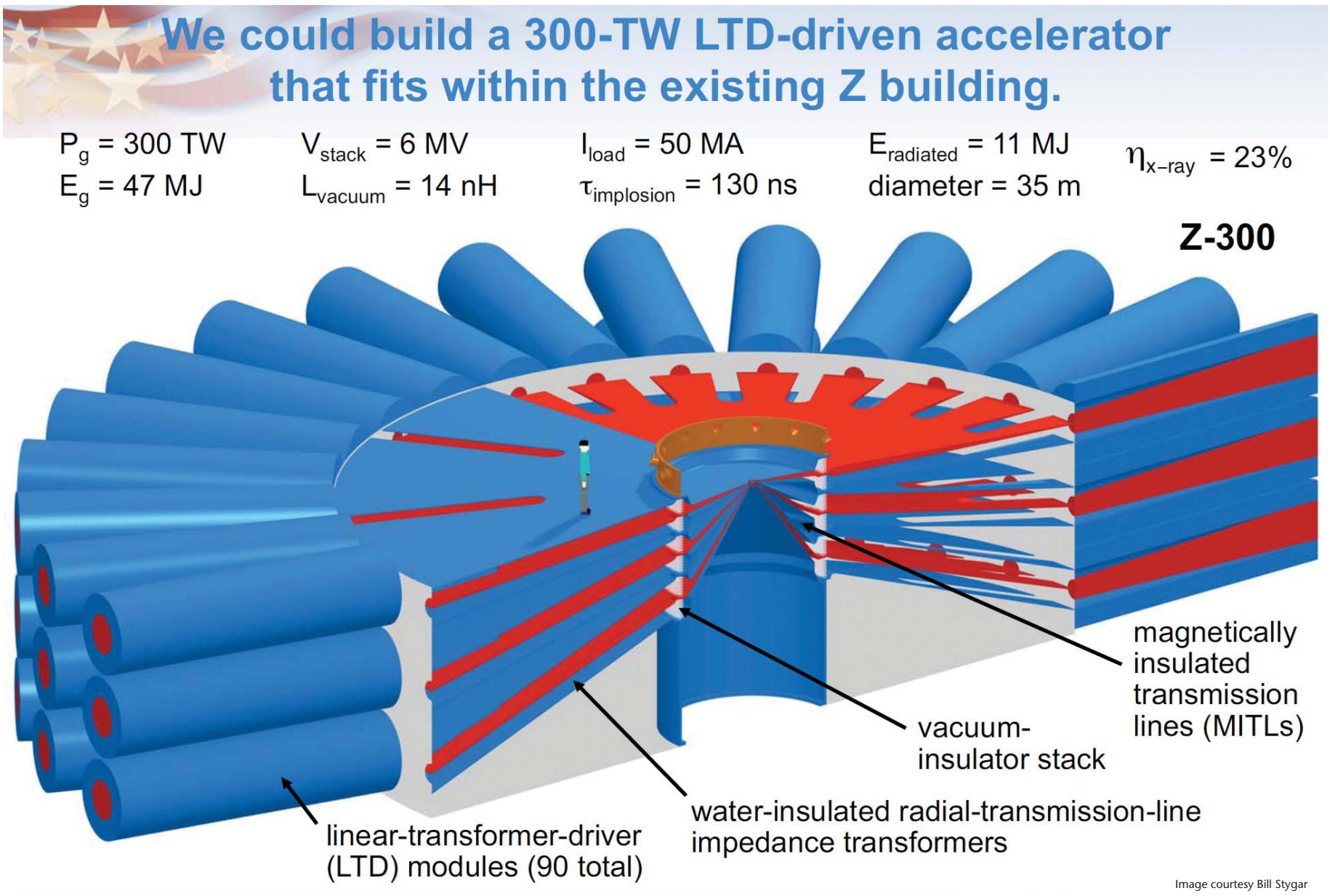


Image courtesy Bill Stygar

This would be the first LTD-driven machine that generates > 10 TW.

Z machine

(Continued from page 1)

energy to compress targets the size of a BB. The other main branch of fusion energy research — magnetic confinement, which aims to keep a fusion cloud six times hotter than the sun corralled for 15 minutes — is already well-supported by an international effort headquartered in Cadarache, France.)

"Recognizing the imminence of fusion ignition at the National Ignition Facility (NIF) at Lawrence Livermore National Labs," says second-level pulsed power manager Mark Herrmann (1640), "DOE has sent the NAS committee to see what approach to follow up on to produce an energy-producing fusion machine for civilian use."

"DOE isn't doing this on a whim," says Mike Cuneo (1643), leader of the effort to show the distinguished NAS panel why money spent at Sandia to prove the Z machine's method as a possible energy source would be money well spent. "It takes an enormous amount of effort to do this review — about $2 million to assemble 19 experts across academia and industry, along with six physicists for classified targets, and keep them reviewing programs for months. This is a serious attempt at a fresh look at the fusion energy problem."

'The country can't afford to let this go by'

Specifically, the review panel's charter is to prepare a report to "assess the prospects for generating power using inertial confinement fusion; identify scientific and engineering challenges, cost targets, and R&D objectives associated with developing an IFE demonstration plant; and advise DOE on its development of an R&D roadmap aimed at creating a conceptual design for an inertial fusion energy demonstration plant."

"We're not looking at this as a competition to win all the money," Mark says, "but we could return a good investment on some of it."

Div. 1000 VP Steve Rottler mentioned the Z facility's many uses in performing isentropic and radiation-effects experiments, and as a resource for outside researchers, when the NAS panel met at Sandia's Tech Area 4 in early May.

But as for fusion, he says, "This is something the country can't afford to let go by."

Z, he says, is "an alternative path to fusion energy, an ordered and reasonable way to translate from science to an energy-delivering system, where the engineering challenge is as great as the science to deliver something for the public good."

THE Z TEAM poses with Sandia's Z machine.

The challenge, he says, is, in fact, so great that it cannot be handled by any single institution, national lab, or industry.

Z, like NIF, has invested in inertial confinement fusion (ICF), a method that gets its unobvious name because it relies upon the momentary inertia of its central pea-sized target under huge compressive forces generated over nanoseconds by radiation, photons, ion beams, or magnetic fields. For energy production at Z, this would require incineration of target after target in a process similar to the sequential firing of cylinders in a gasoline engine. Others pursuing ICF methods include the Laboratory for Laser Energetics at the University of Rochester and the Naval Research Laboratory in Bethesda, Md.

Operation of a plant a different matter

While no one disputes the current primacy of NIF's 192 gigantic lasers in the race to achieve fusion ignition, actual operation of a power plant is a different matter.

As presented by Mike, Dan Sinars, Charlie Nakhleh, Stephanie Hansen, Bill Stygar, Mark Herrmann, Mike Mazarakis, and others, Z has these advantages:

1. It employs a reliable, cost-effective technology with roots stretching back to the 19th century. The method relies on the undeniable fact and achievable capability that an electric current creates a magnetic field around it. Nothing fancy there, but no surprises either — a conservative approach suitable for a power plant.

2. Z researchers have shown they can observe and potentially control a plasma instability called Rayleigh-Taylor formerly thought endemically destructive to their method. Observations are now made through images similar to dental X-rays and taken every two nanoseconds, documenting the birth and growth of the instability. With testing, this may permit informed changes in experimental conditions to delay the appearance of the instability.

3. A modular circuit called a linear transformer driver, or LTD, (see image above) imported from Russia, with a firing system created by Sandia researchers, that permits firing of the circuit every 12 seconds, a rapidity of critical importance for a fusion energy producer. Money is needed to test fire modular circuits in series to see whether any problems arise. Sandia currently owns 10 such circuits, each capable of transmitting 1 million amps.

4. A plan to recycle transmission lines destroyed each time the machine fires. (This is, after all, a fusion reaction, not a gasoline engine.) Simulations have shown that the system could work, but much more testing remains to be done.

5. Seven years ago, Z fused deuterium and released fusion neutrons. But because the aim of the machine heretofore has been chiefly to test materials for the nuclear stockpile, further fusion energy experiments were not done. More funding would permit further experiments.

"We have a promising technology, but we need the funding to prove it out," says Mike Cuneo. "No one [in the 1920s] could have anticipated the development of a BMW incorporating 60 microprocessors."

We can deliver lots of energy

"We're not saying we're the only path," says one Z researcher, "but we don't think there should be a down-selection to one means today. We can deliver lots of energy. And Z's efficiency in converting incoming energy into [ultimately] electrical energy is far higher than most methods."

The problem now, however, is the economy. "We are all aware of the budget challenges being faced in Washington," says Keith Matzen, director of the center of pulsed power sciences (1600). "Any funding for inertial fusion technology now seems unlikely until after the NAS study has provided its recommendations. These investments are needed for fusion to move towards becoming a viable energy source."

COMPOSITE *Characters*

Surge in composite material use prompts new inspection technique studies

STEPHEN NEIDIGK (6624) uses a probe to hunt for defects in one of the wind turbine blades being used for a study of advanced nondestructive inspection techniques for composite materials. Results of the study could help the expanding wind energy industry operate more efficiently by signaling early the need for blade replacement. (Photo by Randy Montoya)

Stories by Renee Deger

Dennis Roach (6620) keeps a scary photo collection of airplanes hit by lightening, birds, airport vehicles, or other planes. The damage ranges from chips in the engine housing to holes in the fuselage to the complete unraveling of a nose cone, as if it were a woven basket coming apart or not yet finished.

A major go-to guy on the aviation airworthiness circuit, Dennis has always had plenty of proof his work developing and validating the techniques used to monitor the structural health of airplanes comes with job security. Lightning, birds, hail, foreign objects, environmental exposure, and human mishaps will always pose a threat in the aviation industry.

USING A PROBE roughly the size and shape of a stethoscope, Dennis Roach (6620) examines composite materials used to make parts of an airplane fuselage to determine how well the device picks up defects in the fibers. (Photo by Renee Deger)

New materials, new challenges

What's different about his latest batch of photos, however, is that they depict the challenges posed by a host of new materials being adopted by airplane manufacturers and myriad other industries, from car makers to defense systems designers to wind turbine builders.

Dennis, a senior scientist and central contributor to Sandia's Federal Aviation Administration-sponsored Airworthiness Assurance NDI Validation Center (AANC), is working on a series of projects to define the damage tolerance of these composite materials and test both existing and advanced, custom nondestructive inspection (NDI) techniques. The center works with industry and the FAA to study and validate nondestructive technologies and help establish guidelines for their use by industry. The knowledge is also being used to support other groups within the Labs, like the wind energy group. The AANC is a core component of the Critical Asset Protection program within the International, Homeland, and Nuclear Security strategic management unit.

"Traditional airplane materials, like aluminum and alloys, have fasteners and joints, so we know where to look for the corrosion, fretting wear, disband, or fatigue cracks that must be detected," Dennis says. "With these new composite materials that are being used to fabricate entire fuselages and wings, problems can occur deep within the material, invisible to the eye, or anywhere across a wide area."

To understand composites and their inherent challenges, picture your papier-mache volcano from fifth grade. Instead of layering strips of paste-soaked newspaper over a chicken-wire cone, composite parts are made by layering sheets of woven carbon fiber, which resemble a coarse cloth, over a mold, then infusing it with an epoxy resin and baking it in an industrial strength, pressurized oven. This would be the process for manufacturing a laminate. Composites can also come in a honeycomb construct, which includes an inner layer of hexagon-shaped fiberglass cells encased in solid, perpendicular composite skin layers.

Composite benefits

Composites provide several benefits over metals. They have a great strength-to-weight ratio, they don't rust or corrode, they can be custom designed to address strength needs in particular directions, they're fairly resistant to fatigue, and they can sustain some level of damage and remain sound. Further, the fiber materials, including carbon, quartz, Kevlar, and fiberglass, can be manipulated in the manufacturing process to meet specific industry or environmental demands. They can be made to be more conductive, or the fibers can be aligned and spaced to create specific strength and density profiles.

Airplane manufacturers have been the most aggressive adopters of the new materials, in part because they weigh less than metal and so can reduce fuel consumption. Dennis says it's not uncommon for composites now to represent as much as 80 percent of an aircraft's main structural components.

Among the big commercial aircraft manufacturers, composite use is increasing. Boeing and Airbus, for example, have both touted composite materials as integral to their next-generation commercial airliners. Boeing has announced that most of the primary structure of its 787 Dreamliner, scheduled for its first delivery to All Nippon Airways later this year, is made of composite materials, including the wings and fuselage. The primary structure of the Airbus A380, already in use, is about 25 percent composite materials, according to that company's website, while in development is an A350 that will have roughly the same composite parts as the Dreamliner.

Now back to Dennis' scary impact damage photos. How well these composites absorb impact, ranging from manmade mishaps to lightning, birds, hail, and other random debris is a major concern, Dennis says. One airline he's working with reported an average of eight composite damage events per aircraft, with 87 percent of those from some kind of impact. That costs about $200,000 per aircraft in repairs, and doesn't factor in safety concerns.

Key initiatives

One of the key initiatives Dennis and fellow team members Randy Duvall, Stephen Neidigk, and Kirk Rackow (all 6624) have untaken involves a systematic study of how these materials absorb impact, and just how small an impact does it take to produce damage onset and normally detectable damage, which may be two separate things.

The group is wrapping up a canvass of major airline repair shops to establish how likely it is that inspectors in the field will find certain defects with standard methods, a probability of detection experiment. They also have a joint program with the University of California at San Diego, where they are using a high-velocity pneumatic gun to pummel composite samples with ice balls.

WATCHING A MONITOR for blips that could signal aircraft structural problems, Randy Duvall (6624) is part of the team studying a series of emerging new nondestructive inspection techniques aimed at composite materials. (Photo by Renee Deger)

But impact is just one source of possible damage to composites that needs examination. Composites are susceptible to changes in flight loads, moisture penetration, erosion, heat, ultraviolet light, and corrosion in metals associated with carbon-fiber-reinforced polymers. In addition, a range of things can be less than perfect in the manufacturing process and create tiny defects in the materials that become big problems later on.

The group has begun in earnest examining how well new nondestructive inspection techniques pick up a range of defects compared to the baseline they established through the POD experiment, and how well they pick up damage inflicted during the impact studies. Kirk says they're looking at ultrasonic methods, including pulse echo, which uses ultrasound to send a pulse into the material and measures the echo, and phased array, which uses a probe with multiple elements capable of sending individual pulses at carefully choreographed intervals. Infrared techniques — which heat materials and then measure the change in temperature over time — optical shearography, microwave, terahertz, laser ultrasonics, and a host of other advanced NDI methods are also being studied. Kirk points out that not only is the team trying to

COMPOSITE MATERIALS increasingly used in the manufacture of key airplane components respond differently than traditional aluminum to environmental hazards. This photo, taken anonymously but used in the industry, illustrates how hail can literally chip away the composite material.

measure effectiveness but they're also working to identify when each method can best be used, based on the kind of damage, kind of surface, material composition, thickness, and other design variables.

"There are quite a few engineering and economic benefits to composites that will continue to accelerate their use by all kinds of industries. The work we're doing will prepare airlines to deal with any damage scenario," Dennis says. "The good news is that we have discovered a range of both conventional and advanced inspection techniques that will help us ensure these materials are safe and aircraft are airworthy."

Defect-ridden samples

This team is using defect-ridden samples they designed and fabricated in Sandia's Organic Materials Department. The dense, thick slabs feature wrinkles in the layers of fiber, which create tiny voids, dry spots devoid of epoxy resin, and other problems. The samples substitute for airplane parts as well as for wind turbine blades for research the NDI and Infrastructure Assurance team is doing for Sandia's wind energy technologies group. NDI techniques are increasingly in demand in the wind energy business as the power supply matures and gains greater acceptance, and companies have to be more reliable, according to Josh Paquette (6121).

Josh, a wind energy engineer, heads the Blade Reliability Collaborative, a consortium, much like a group Dennis leads for airworthiness initiatives, comprising personnel from wind energy industry, academia, and national labs working to improve turbine blade quality and ensure . . . let's call it spinworthiness. He tapped Dennis and his team of NDI specialists to study composite inspection techniques suitable for wind turbine blades.

Turbine blades

Changes under way in the wind energy business are driving the demand for more portable and accurate inspection technologies, Josh says. For one thing, operators want longer turbine blades, which pump out more power than short ones. Turbine blades now can be as long as 200 feet. As they get longer, these turbine blades will require higher-quality materials and improved manufacturing standards because their very weight will become the largest source of load.

The expansion of the wind energy industry also means more turbines are being installed in a wider range of physical environments, so some are exposed to more turbulent winds or other environmental concerns, like bird strikes and sand. Because these differences produce variable levels of wear on the blades, simple age of the blades is no longer the best determinant for replacement, Josh says. As a result, the industry is adopting as-needed part repair and replacement practices that require regular inspections and maintenance only when necessary, instead of predefined intervals.

"Blades are one of the primary sources of turbine failure, so we're focusing our efforts on their design, manufacture, and overall quality," Josh says. "Turbine blades are also the best point in the system to look for innovation to improve the cost of energy. That has led to changes in their design, calling for different material compositions that in turn may introduce new challenges for inspection and maintenance."

A POSTER CHILD FOR COMPOSITES, the Boeing 787 Dreamliner, shown here in an unofficial flight test photo by an individual, will rely on composite materials for most of its primary structure, including the wings and fuselage.

Sandian working on composite innovations

To the folks at the Kansas City Plant, the plastic sheet encasing the composite parts they were making was just a bag. To Sandian David Calkins (1833), it was all the difference.

Show some more respect for that big baggie and what happens in there, he told them, and they would produce higher-quality parts. They followed his advice, treating it more gently to avoid tiny holes and tears and carefully controlling how the plastic molded to the part, and they reduced the number of parts that failed inspection because of misshapen surfaces, resin-starved dry spots, and porosity.

Raising the level of respect given to the plastic bag encasing composite parts during the key vacuum stage and the pressurized curing process that follows is perhaps further evidence that sometimes the simplest of solutions to a problem can be the most evasive. It's also just one of the contributions that David has made to some key composite manufacturers since demand for his expertise has surged.

David, one of Sandia's few resident composites experts, works in the Organic Materials Department. A central resource for all of Sandia's research centers, the group manufactures specialized samples, design prototypes, and finished parts. The group works with a wide range of materials and while composites still represent a small portion of their workload, it's growing at an increasing rate.

"We're very busy in our composites area these days," says Mike Kelly (1833), who manages the department. "We started off doing small projects working with composites for military and defense systems but are now seeing composite projects from all over the Labs as other industries adopt the materials."

Adopting composites

Among the most active adopters of composites in industry have been airplane manufacturers and wind turbine makers, so groups connected to related industries have upped their demands, but so have the weapons and satellite teams. "Composites are often the only way to achieve a higher level of performance and engineers are starting to use them more," says David. "We do a lot of collaboration with Sandia engineers about how to use them and what sorts of variables their use introduces into the design."

David, who, by the way, designed and built the composite body of NM Tech's 1993 solar car, helps engineers understand both the limitations and the range of new possibilities introduced by the use of composites. For one, they're much lighter than commonly used metals so swapping out one metal part for one made of composites can affect other parts of the design. Also, what role the part will play in the overall design can dictate how it should be manufactured. This, in fact, leads into another of David's painfully simple contributions to the manufacture of composites, which was in manufacturing prep.

Like parts cast in metal, composites require a mold. To make it easier to separate the mold from the finished part, in metal casting and composites, engineers expand surface areas, angle flat surfaces, or round corners when designing the mold. Then the part is machined down to match the final specs.

Composites are made of sheets of woven fiber impregnated with pre-catalyzed epoxy resin systems specifically engineered for the tasks. The sheets look and feel like stiff cloth. Using a cutting machine like what textile manufacturers use to cut out their cloth pieces, David cuts out pieces that are exactly or almost the size and shape of the final piece, demonstrating to industry that it's feasible. This allows the tailoring of properties to better match and stresses the component will experience in use. And it produces final parts that require less skill and training to make and less machining.

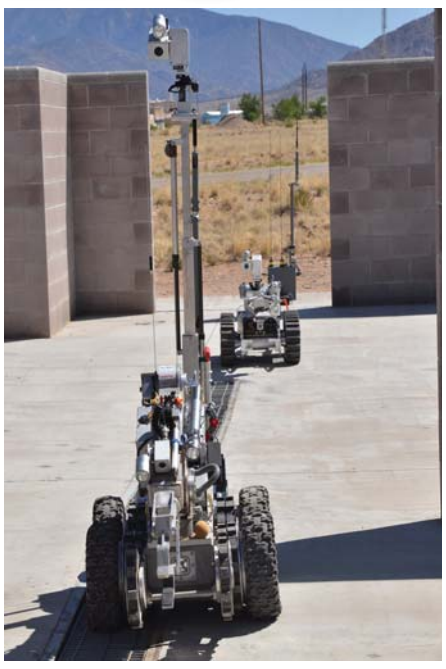
To revisit an earlier point, the most important elements of a part constructed of composite materials should be made to require very little machining. So in working with engineers, David establishes the role certain parts will play and then helps develop specs so they require less finish work.

This decision to cut out the pieces that would then be layered into a finished part more true to size was groundbreaking for manufacturers that had cast metal parts then merely shifted the techniques to working with composites.

"Composites are still new and people are still learning about how and where to use them and inventing new fabrication techniques that will further expand how they're used," David says.

ROBOT Rodeo

Photos by Randy Montoya



Bomb squads from around the region — and a squad from New Jersey — converged on Sandia late last month to participate in the demanding Robot Rodeo.

The annual event rotates between Sandia and Los Alamos National Laboratory (LANL). The rodeo challenges bomb disposal teams to guide their own robots through a variety of scenarios that represent various threats to public safety.

In the top photo, a robot collects an item at an Albuquerque rail yard as part of a scenario to collect 20 "munitions" scattered in an accident. The robots, guided by their handlers, had to search in and around four rail cars to find the devices.

In the photo at right, a robot in a nearby tunnel complex prepares to demonstrate its ability to work in a darkened environment, take X-ray images, and locate a possible "rad" source.

At bottom right, a robot works through a scenario that replicates some of the challenges faced by responders at the Fukushima Daiichi nuclear reactor complex in Japan after the March earthquake and tsunami.

At bottom left, members of the Los Alamos County/LANL team are intent on their displays as they navigate a robot through a scenario.

At left, a robot prepares to enter a "reactor" environment in another simulation of a nuclear reactor incident.

This year, five teams representing six bomb squads (the LANL and Los Alamos County bomb squads combined their resources to form one team) competed in the Robot Rodeo. The wild card team — the team representing the New Jersey State Police bomb squad — won the rodeo; the Dona Ana County bomb squad took second place, and the New Mexico State Police squad claimed third.

According to Robotics and Security Systems Dept. 6532 Manager Jake Deuel, a good time was had by all at this year's event.

"The rodeo was great. The teams were really challenged; they loved the scenarios," Jake says.

Next year, Jake says, competitors will face a new suite of scenarios when the competition moves to LANL.

And next year, Jake adds, a new competitor may join the fray. An observer from the Pentagon at this year's rodeo indicated that next year, the Pentagon's bomb squad may want to get in on the action.

Grooming a new generation of systems engineers

Collaboration between Sandia, Stevens Institute of Technology offers graduate-level program

By Bill Murphy

In an institution where systems engineering is coded into its DNA, it makes perfect sense to offer an on-site graduate certificate/master's degree program in the interdisciplinary engineering field.

To that end, Sandia and the Hoboken, N.J.-based Stevens Institute of Technology are now offering a systems engineering and architecting graduate certificate program leading to a master's degree in systems engineering. The program is offered through Stevens' School of Systems and Enterprises by Sandia's Corporate Learning and Professional Development Department.

Sandia participants in the program can choose to obtain the four-course, 12-credit graduate certificate, which is offered on-site at Sandia, or continue on to the 30-credit master's degree in systems engineering, which is conducted largely through Stevens' advanced online course delivery system.

The program, says HR and Communications Div. 3000 VP John Slipke, "supports a culture that is passionate and supportive of continuous learning. Sandians who have participated in the program, originally offered by Corporate Learning & Professional Development's Technical and Compliance Department, have provided us with a lot of positive feedback, having found the program content useful and relevant to their work and Sandia careers."

Div. 1000 VP Steve Rottler, Sandia's chief technology officer, was an early champion of the new program. He says the partnership with Stevens is a natural fit for both organizations.

"A number of Sandians were taking classes at Stevens," Steve recounts, "and were very pleased with the experience."

> "The discipline of systems engineering is vitally important to the broad array of Sandia's national security missions. While we provide numerous solutions to the most demanding national security problems faced by a large and diverse customer set, the unique character of Sandia's approach is fundamentally systems engineering underpinned by deep science."
>
> ***— Deputy Labs Director and Executive VP for National Security Programs Jerry McDowell***

And that fact didn't go unnoticed at Stevens. The dean of the institute's School of Systems and Enterprises, Dinesh Verma, noting the number of Sandians enrolled in some of his programs, "saw an opportunity and he approached us, asking about building a relationship," Steve says.

As that relationship matured, Verma floated out an idea, one that ultimately led to establishment of the systems engineering and architecting certificate/master's degree program.

"We're always open to a good idea," Steve says, "so we were happy to hear what Dinesh had to say."

As Verma outlined his vision of a program that Stevens could offer specifically for Sandians at Sandia, Steve was interested but cautious.

"The integrity of the credentialing process is very important to us. We don't want degrees on the cheap," Steve says, "and we made that clear to Dinesh. He listened very carefully to our concerns and addressed every one of them. When he made his final presentation to us, he was so well-prepared, he made it easy for us to say yes."

With the nod from Sandia, Verma and his Stevens team rolled up their sleeves and went to work with Sandia's Corporate Learning and Professional Development professionals to get the program up and running.

"One of the biggest reasons for our enthusiasm for partnering with Sandia National Laboratories," Verma says, "is our belief that collaborating with premier engineering organizations such as Sandia challenges us and makes us better, while allowing us to work with incredible students."

Steve says he hadn't known much about Stevens, but after doing some research and conducting a site visit, he's come away impressed.

"It's a lesser known school but it's been around a long time. [Stevens was established in 1870.] It has an impressive history, an impressive program, and a great reputation. I was struck, too, by the caliber of the faculty, the students, and the alumni."

As an example of the quality of its programs, Steve notes that Stevens' systems engineering program is a DoD University Affiliated Research Center, or UARC.

The systems engineering programs being offered to Sandians come at a good time, Steve says.

"We have a long and proud history of systems engineering at Sandia. We hire outstanding engineers from multiple engineering disciplines," he says, "and we bring them here to do systems engineering 'the Sandia way.' That's served us very well, but our relationship with Stevens will give our people an opportunity to learn systems engineering in a more formal way."

While there is as yet no universally agreed upon set of principles that constitute the systems engineering equivalent of "best business practices," organizations such as INCOSE — the International Council on Systems Engineering — and academic programs such as that at Stevens are bringing a new rigor and discipline to the field. Sandians who become adept in this maturing field will find that it serves their careers well, Steve says, giving them an important set of skills and an expanded body of knowledge in an area that is vitally important to the Labs' future.

For his part, Verma says Stevens couldn't be happier with the relationship.

"The students from Sandia are among our best," he says. "The program has been very enthusiastically received by them, and we continue to get input from them that will allow us to evolve appropriately in the future."

More information

Sandians interested in taking the course can find more information at http://sse.stevens.edu/sandia/. The website includes links to a detailed brochure and an enrollment form. Courses offered through Stevens are eligible for tuition assistance via Sandia's Tuition Assistance Program or the University Part-Time Program. For detailed information, review Corporate Procedure HR100.2.13, Participating in University-Based Education Programs, or contact Bernadette Montano, University Programs administrator at 505-844-1004.

Kettering University students find wealth of experience at Sandia

By Stephanie Hobby

An internship at Sandia Labs isn't a typical summer job. Students here have the opportunity to learn their trades in state-of-the-art facilities and be mentored by world-class scientists and engineers. And while most of them return to their campuses in the fall with a summer's worth of experience and knowledge under their belts, a few universities offer the chance for students to continue their hands-on training year-round.

Kettering University is one such institution. Its unique co-op program requires students to rotate between industry and university in 11-week terms, and in the last decade, 23 future mechanical, electrical, and computer engineers and statisticians have left their classrooms in Flint, Mich. to work in Sandia's laboratories.

"Three months here, three months there was great because you come here and practice your knowledge and learn industry," says Fred Snoy (6623), a Kettering graduate who completed his co-op at Sandia. "Every time you leave to go back to class, you come back a little bit smarter and you're able to help out a little bit more."

A career-shaping role

Fred arrived at Sandia as a college freshman in February 2006, preceded by his classmate, Titus Appel (6623) a month earlier. Both Fred and Titus say their experiences at the nation's largest national lab played a central role in shaping their careers. Today, they continue to work at Sandia while pursuing master's degrees — Fred in mechanical engineering and Titus in electrical engineering — at UNM.

Kettering University, formerly known as General Motors Institute, started its co-op program in the mid-1920s as a way to funnel engineers into GM's workforce. Because they had so much prior training, the young engineers could hit the ground running when they graduated and accepted full-time positions at GM. Sandia's involvement began in 1998, when Jim Gover, who earned his master's and doctorate through Sandia-sponsored programs, retired from Sandia after 35 years to pursue a teaching career at Kettering.

"One of the first things I did was to talk to Sandia about taking some of our co-op students," Jim says. Shortly after that, students started their rotations, and the program has proven to be mutually beneficial over the years. "It's an opportunity for a company to take a look at a young person and see if they have the qualities they're looking for as they're getting their education, and also an opportunity for the company to influence the student's education."

EXPERIENCE COUNTS — Fred Snoy, left, and Titus Appel are two Kettering graduates who are now Sandians.

Integral team members

In addition, programs like this facilitate information-sharing from the current workforce to the next generation of Sandians, Jim says.

"This is a good way to transfer knowledge and have the next generation gain experience," says Steve Sanderson (6623), a Sandia mentor to the students. "They run with the projects we've assigned, and we've had opportunities to use a number of their ideas. The students have been integral team members. It's definitely a win-win."

Derek Wartman (6623) joined Sandia as a Kettering freshman in 2002 and has been here ever since. He's now in the Weapon Intern Program, but started work in the Vehicle Systems Department. "It was a great experience. I could come back and reinforce the things I was learning in class in a real-world environment," Derek says. "My senior thesis project was an active cooling system that was actually implemented to provide a cooling capability for the trailer. I was able to do everything from start to finish, and we took it to the Nevada Test Site in the middle of summer to field test it."

With Kettering's strong roots in the automotive industry, it comes as little surprise that many graduates continue to work on technology related to transportation, but as the industry has evolved, so has the spectrum of student projects. In recent years, Sandia has offered students the chance to work on electrical design for transporters, radar systems testing, access control and delay systems, microcontroller embedded design work, power over fiber communications, transportation security and containers, electrical systems to alert drivers going over a certain speed, perimeter breach detection systems, and battery trend analysis, among many others.

'Applying what we learned on a daily basis'

Not every student stays. Some use their experiences to branch out into other lines of work. Kettering graduate Will Sommerville arrived at Sandia in the winter of 2003, and now works for the solar panel manufacturer United Solar and holds two volunteer positions in IEEE. He is on the IEEE Vehicular Technology Society Board of Governors and is current chair of the IEEE GOLD (Graduates of the Last Decade) Committee. In that role, he says he tries to inspire the 55,000 people who have earned their first professional degree within the last 10 years, but he says his ties to Sandia helped shape his career. He is currently reapplying to Sandia and is enrolled in a doctoral program for electrical engineering in January.

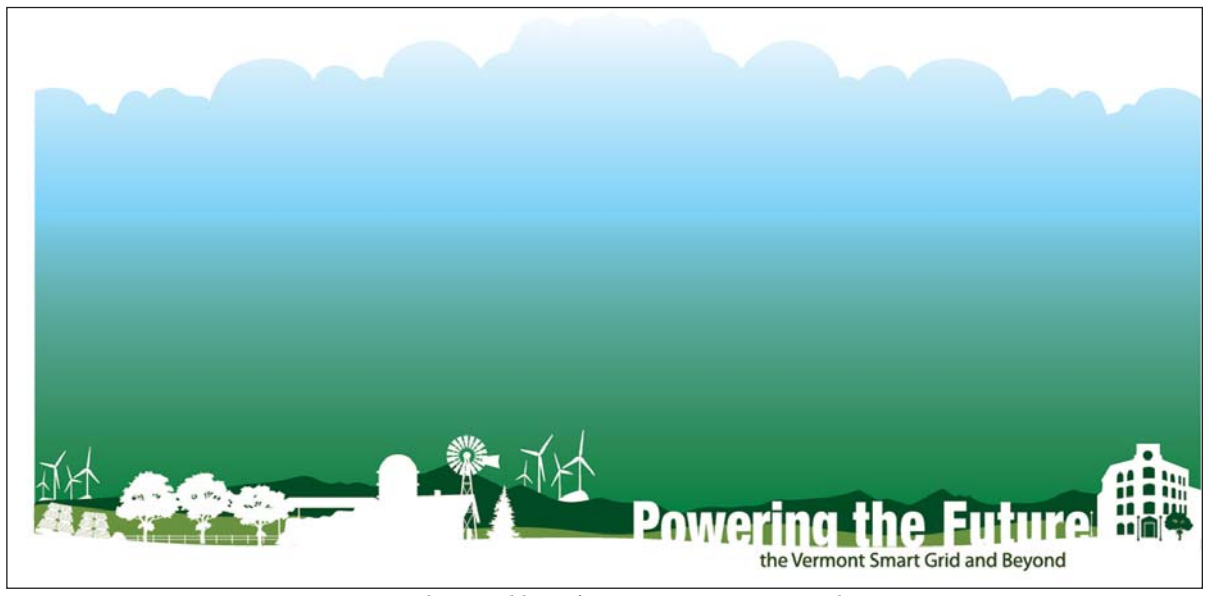
"Sandia as a co-op is exceptional," Sommerville says. "We were really applying what we learned in school on a daily basis. The economy wasn't great when I graduated, and having that real-world experience is invaluable."

Graduates who've worked at Sandia consistently say that the ability to see a project through from beginning to end was one of the most important aspects of their education. Undergraduate senior thesis projects, required by Kettering, actually join the body of academic literature within the student's chosen subject. Titus's thesis project contributed to the design of a power-over-fiber communications cable (currently patent pending). "I can't imagine getting a job right out of college without any experience whatsoever," Titus says. "But this has given us enough experience so that we definitely know what to do."

Conference energizes Vermont-Sandia smart grid partnership

Powering the future: The Vermont smart grid and beyond

By Stephanie Holinka



A few years ago, Sen. Bernie Sanders, I-Vt., attended a field hearing on concentrating solar power at Sandia/New Mexico. The hearing sparked an idea that has blossomed into a nearly unprecedented collaboration to tackle a complex and important challenge to the country's energy future: modernization of the electric power grid.

This week a conference, "Powering the Future: The Vermont Smart Grid and Beyond," brought together a diverse group of 150 researchers and scientists, educators, industry partners, state legislators, and regulators. Sandia and the University of Vermont (UVM) sponsored the conference to provide a forum to discuss Vermont's deployment of smart meters to 85 percent of the state, and how to build on this to create a statewide "smart grid."

Smart meters are an initial and important component of a smarter grid. They can provide enhanced information to customers and to power companies, and incorporate real-time or near real-time sensors, notification systems, and power quality monitoring. Smart meters make it possible to better use distributed energy technologies and offer more active consumer participation.

"Vermont was a natural choice for this project. . . . The unique consumer culture in Vermont . . . made this a good fit: Vermont consumer culture is attuned to energy issues, and is interested in participating actively in efficiency activities."

— Div. 8000 VP Rick Stulen

Vermont received a $69.3 million e-Energy American Recovery & Reinvestment Act (ARRA) grant to fund the smart meter implementation program. Vermont's utility companies are matching the grant, for a total of $139 million.

The US electric power infrastructure is rapidly running up against its limitations. The systemic risks associated with relying on a frequently overtaxed grid grow in size, scale, and complexity every day.

Creating a smarter, more responsive electric power grid is not just a technical challenge; it's also a cultural, policy, and logistical challenge.

"Forging close partnerships between government, industry, and education will allow our nation to tackle this complex problem and prepare us to tackle future challenges," says John Evans, senior adviser to University of Vermont President Daniel Mark Fogel.

"Vermont was a natural choice for this project," says Rick Stulen, vice president of Sandia's California lab (8000) and leader of the Energy, Climate and Infrastructure Strategic Management Unit. "The state is further along in regulatory reform, and its utilities have all collaborated to further the advance of smart metering in the state. The unique consumer culture in Vermont also made this a good fit: Vermont consumer culture is attuned to energy issues, and is interested in participating actively in efficiency activities."

And it's not just Vermont power consumers who believe in mindful stewardship of the nation's energy.

"My passion is in creating a smarter, cleaner, greener, more effective energy future for Vermont," says Mary Powell, president and CEO of Green Mountain Power, one of the Vermont utilities that collaborated on the ARRA Smart Grid grant that brought smart metering to the state.

To enhance collaborations further, Sandia received a nearly $1 million DOE Electric Power Fellowship Grant to fund internships for nine Vermont students to travel to Sandia/New Mexico this summer to work on electric power-related projects. The grant also supports the visits of eight UVM professors who will come to Sandia to collaborate on projects related to smart grid implementation.

"The Vermont-Sandia partnership, when fully realized, will conduct advanced research that will bring us closer to energy self-sufficiency in this nation that will greatly increase energy efficiency, and that will help develop a new green economy," Sanders said. "This partnership will work with businesses and academia to develop new technologies, new policies, and new procedures to move our nation forward in the 21st century and create good-paying jobs in the process."

Grid modernization requires a new generation of field engineers, control-room operators, and others who understand not only the technical complexities of intelligent communications systems, dynamic load management, and renewables integration but also the larger policy and economic implications of these systems.

Sandia researchers have also held technical talks at UVM on such topics as smart grid, solar energy, climate change technology, and cybersecurity. And the exchanges will be ongoing. More energy-related UVM short courses will take place at the end of the summer on cybersecurity, grid integration of renewable, and global smart grids.

Many conference participants expressed hope that this partnership will lead to innovations that prepare the nation to successfully modernize and enhance the capability of the US electrical grid.

Sandia supports the NNSA in nuclear security alignment

By Renee Deger

Sandia is supporting NNSA in a high-level nuclear security initiative to harmonize across all agencies in the nuclear enterprise the approaches to how protection standards are defined, threat intelligence is used, vulnerabilities are assessed, and risk management measures are applied. The initiative will address how multiple agencies implement security for nuclear weapons and materials.

Part of Labs' core mission

Providing leadership for physical security for the nation's nuclear assets has been core to Sandia's mission for more than 40 years. Because of this legacy, the new initiative will draw on expertise and insight generated from the more than $1 billion the US has invested in Sandia in advanced research and development, state-of-the-art testing facilities, specialized analysis and assessment tools and customized solutions.

"The project establishes a consistent, set strategy for protecting our nuclear weapons," says Joe Sandoval (6612), a security systems analyst. "Integrating security practices will make providing the optimal levels of security more straightforward and cost-effective for the organizations charged with these responsibilities."

The Labs' role in the initiative resulted from a project that Joe, along with Consuelo Silva (6612), both part of the Critical Asset Program in the International, Homeland, and Nuclear Security strategic management group, completed earlier this year. The Physical Security Technology Management Plan, which earned an NNSA Defense Programs Award of Excellence, laid out a master blueprint for planning, purchasing, implementing, and managing physical security technologies across the NNSA.

Three key areas and a timeline

The goal of the technology management plan was to identify existing site security infrastructure, understand site needs, and optimize technical solutions across the enterprise, versus a site-centric approach. Integrating the use of technology, protective forces, and vulnerability assessments, requires focusing on guiding policies, principles, and risk management approaches that govern the entire nuclear weapon complex.

The harmonization project was initiated by the Nuclear Weapons Physical Security Subcommittee of the Nuclear Command and Control System Committee of Principals, and includes representatives from the NNSA leadership and its sites, agencies within DoD, DOE, and the Nuclear Regulatory Commission. In kicking off the project, the committee identified three key areas and set a rough timeline for next steps:

- **Threat Assessment:** DoD and DOE plan to produce an interagency threat capabilities assessment to establish a common threat picture by November.
- **Vulnerability Assessment:** The committee will begin this fall applying the threat assessments against known vulnerabilities and will create a shared assessment to identify best practices and lessons learned.
- **Risk Management:** The committee began last month working with the US intelligence community to develop credible threat scenarios, with the primary focus of the protection strategy being on the "most likely" threat scenario versus the "worst case," that will support uniform risk assessments.

Sandia's systems approach a hallmark

"Our systems approach is a Sandia hallmark and we're evaluating all of the moving parts in the physical security systems built around our nuclear weapons, taking into account how they interact and what operations they need to enable or allow so that ambiguities or uncertainties are minimized in the system," Consuelo says. "As the NNSA moves from a nuclear weapons complex to a 21st century nuclear security enterprise, becoming more efficient and cost-effective is critical and physical security is a major contributor to both concepts. Furthermore, optimization of resources, life cycle planning, and risk management across the nuclear weapons enterprise is essential to current and future protection strategies, funding allocations and overall interagency collaboration for security of nuclear weapons and material."

Sandia's program to donate recycled computers to local schools is reinstated

By Iris Aboytes

Sandia recently reinstated the K-12 donation program that had been halted in 2007 because of budget restraints.

Last week, representatives from 19 local schools lined up to pick up some of the 900 computers and laptops that were available for donation.

"These are surplus computers and laptops that are sent to Reutilization [formerly Reapplication])," says Reutilization and Disposition Dept. 10264 Manager Melissa Armijo. "Most of the computers donated were two to three years old.

"School representatives were very excited about the quality of the equipment. They said many of their computers are eight years old or older. Some of the schools don't even have a computer center for the students to use."

VEHICLES from local schools line up at Sandia's Reutilization yard waiting to pick up computers donated as part of the K-12 Donation Program.

Surplus Sandia computer hard drives are removed prior to donation. Computers used in classified environments are not accepted for the program.

"The successful reinstatement of this program is due to the successful teaming of the Reutilization group," Melissa says. "Their efforts will make a real difference in the lives of children in our community. Team leader Jan Wallner and program administrator Cindy Padilla, both from Dept. 10264-1, spearheaded the event.

Questions about schools eligible for this program should be directed to Cindy Padilla at ctpadil@sandia.gov.

SURPLUS COMPUTERS AND MONITORS are ready for donation to local schools.

Sandia's ANGLE North American Young Generation in Nuclear (NA-YGN) selected as Best Chapter in West Region

ANGLE
Acquiring the Next Generation of Leadership Excellence

POWER GENERATION — Students gather and watch as water is heated and converted to steam that spins a generator to create electricity.

By Iris Aboytes

Sandia's ANGLE (Acquiring the Next Generation of Leadership Excellence) recently received the North American Young Generation in Nuclear (NA-YGN) Best Chapter in West Region award. The award is based on activities conducted by the chapter. It is given annually to the chapter that best exemplifies NA-YGN's mission to unite young professionals who believe in nuclear science and technology and are working together throughout North America to share their passion for fields that are alive and kicking.

The ANGLE group is the local Sandia chapter of the national organization, NA-GYN. "We started in 2007 as a means for young professionals at Sandia to get together and work on professional development, outreach, and knowledge transfer," Allison Barber (1384) says. "All of these areas are important to new hires in developing their careers. Fostering knowledge transfer is especially vital to the Labs right now given the number of people retiring."

ANGLE has hosted a variety of events for professional development.

"One of ANGLE's most successful events so far was a social networking event where senior staff were paired with new hires to discuss any questions new hires had and discuss their own experiences at Sandia." More than 80 people attended this event.

"After the scheduled rotations, people mingled among the refreshments," Virginia Cleary (1931) says. "We plan to continue offering it in the future. It serves as a great way to meet a large number of people working on a wide variety of projects."

ANGLE's community projects have included participating in the first-ever National Nuclear Science Week and providing activities for surrounding schools to participate and encourage nuclear science education. ANGLE participated in the annual School to World event, which is focused on exposing middle school children to a variety of careers, including careers in science and engineering.

During the annual Take Our Daughters and Sons to Work event, ANGLE had an interactive booth for youngsters to learn hands-on about the basics of nuclear science that underlies their parents' work.

"NA-YGN has been extremely successful in educating the young generation of nuclear scientists and engineers at power plants; however, they have not had much success with developing chapters in other areas," Virginia says. "Sandia's chapter is the only active chapter located at a national laboratory. It's a real success for us to continue leading the way of non-nuclear plant associated chapters. Hopefully someday this will gain momentum in the R&D world, and we will be known as the first."

STUDENTS learn how a Van de Graff generator strips electrons from atoms to gather an electrical charge during National Nuclear Science Week at the museum.

Mileposts

***New Mexico** photos by Michelle Fleming*

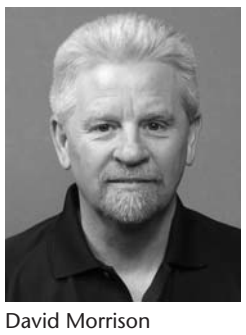

Art Ratzel
35 4800

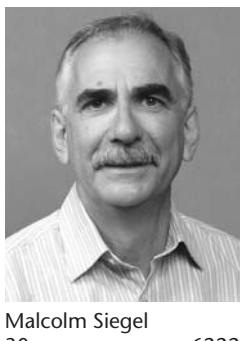

David Borns
30 6912


Thomas Essenmacher
30 5416


James Grossman
30 6916


Mary Anna McWherter-Payne
30 5422


David Morrison
30 5098


Malcolm Siegel
30 6222


Mark Ekman
20 6813

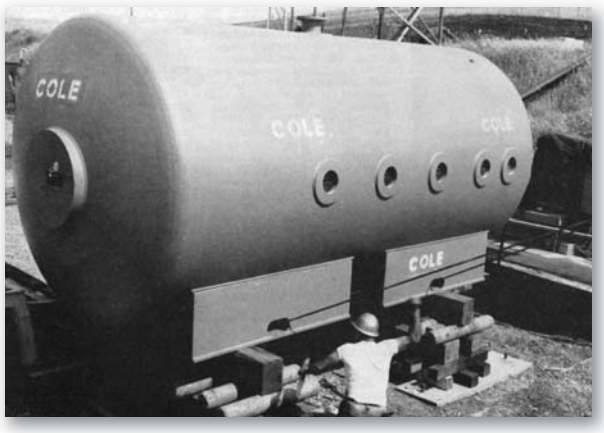

Nathan Sommer
15 10659

Recent Retirees


Richard Wavrik
25 2548


Lois Lauer
17 5564

50 years ago . . . Testing of high explosive detonators and other explosive-actuated devices is being conducted at Livermore Laboratory inside a specially constructed tank recently installed at Area 8. The 80,000 pound tank can contain detonations of as much as five pounds of explosives, although there are no plans to detonate charges weighing over one pound.



FIRING CHAMBER for explosives studies at Livermore Laboratory is unloaded at Area 8.

Walls are made of one-inch steel plate and special baffling to muffle the noise and ground shock explosions. The charges will be detonated electrically by remote control from a nearby instrumentation trailer. Special high speed cameras and oscilloscopes will record test data. One special feature will be a three-channel pulse X-ray machine that will shoot pictures of the "heart" of the explosion before the explosive's container is ruptured.

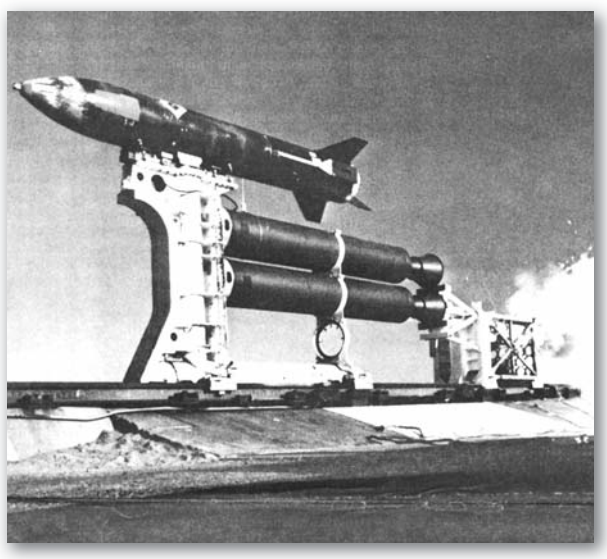
40 years ago . . . A milestone for Tonopah Test Range was achieved when Sam Moore (7370), range manager, flipped the switch to bring commercial power onto the range for the first time. Since the range went into operation in 1957, diesel generators have provided all electrical power. The new power system includes 16.2 miles of power lines strung from the Sierra-Pacific Power Company's Rattlesnake Junction transmission line, a 1,500 KVA three-phase 55KV to 13.8 KV substation, 78 distribution transformers, and 36.9 miles of overhead power lines on the range.


COMMERCIAL POWER comes to Tonopah Test Range. Sam Moore (7370), range manager, flips the switch. At left is Art Carey (7373). Cliff Rudy (4543), plant engineering project engineer, is in the center.


AT SANDIA LIVERMORE, the country's newest nuclear weapon — the B83 — is being readied for production following extensive development and testing. Here an F-111 heads toward Tonopah Test Range to make a test drop of the externally carried unit.

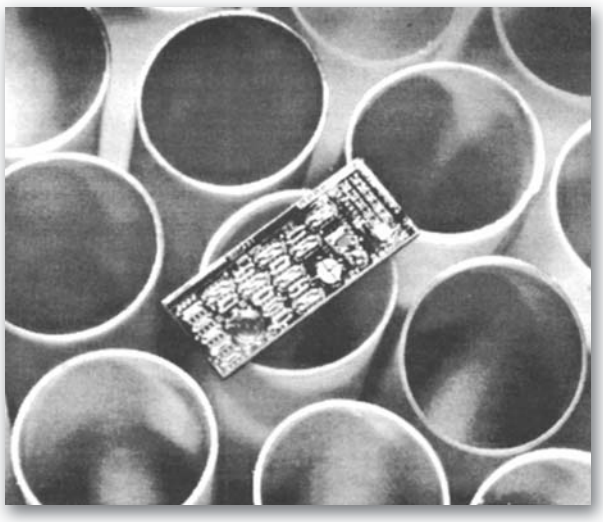
30 years ago . . . The development of the nation's newest weapon, the B83 strategic bomb, is proving to be a challenging and rewarding task for Sandia Livermore. This megaton-class bomb has recently entered Phase 4 status where development and preparation for production are proceeding. The project team at SNLL is designing the bomb structure and integrating the nuclear design provided by LLNL; components from both Sandia Albuquerque and Livermore are being used to produce this major new weapon.

Tossing a 2,400-pound test unit 250 feet into the air at Mach 1.4 velocity is a new test operation now routinely performed on Sandia's 5,000-foot sled track in Area 3. Compressed air powers the ejector mechanism that tosses the test unit, while Zuni and Nike rockets in two stages provide the push to achieve Mach 1.4. This is 1,100 mph, and is reached within 4.2 seconds after ignition some 3,500 feet down the track. The tests are performed for Parachute Systems Division 5632, which is developing the nylon/Kevlar parachute for the B83 bomb.


AT IGNITION, the first-stage Zuni rockets fire, followed by second-stage Nike rocket motors. In 4.2 seconds the sled accelerates to Mach 1.4, then a compressed air charge drives the test unit 250 ft. into the air for a B83 parachute deployment test.

20 years ago . . . The Department of Energy issued its report on the Tiger Team's assessment of environment, safety, and health programs at Sandia, Albuquerque, and the press release accompanying the report commended the Labs for implementing a "new safety culture." Tiger Team leader Dave Spence said that "if Sandia Albuquerque carries through with its environment, safety, and health initiatives, it could well serve as a model Department of Energy lab."

10 years ago . . . Inexpensive silicon microteeth that open and close like jaws to harmlessly deform red blood cells have been developed at Sandia. The prototype device offers the possibility of considerable mechanical intervention at the cellular level because it operates rapidly and is so small that many units could operate in parallel in a small space. An immediate goal of Murat Okandan (1749), who developed the device with Paul Galambos, Sita Mani, and Jay Jakubczak (all 1749), is to see whether the masticated red blood cells absorb fluorescent material. If the material is readily absorbed, it means that Sandia researchers have created the first example of a continuous flow, mechanical cellular-membrane disrupter ever reported.


EIGHT SEPARATE cell-altering devices fit on the tiny module resting, to provide scale, on these 1/4–inch-diameter soda straw ends. (Photo by Randy Montoya)

D.C. trip a BLAST!

Sandia-sponsored ACTSO team takes fourth place in Washington, D.C.

By Iris Aboytes

The Sandia-sponsored Albuquerque Academic, Cultural, Technological and Scientific Olympics (ACTSO) team, made up of Caryss Hathorne, Lana Kimmel (daughter of Mark Kimmel, 1672), Nicole Van Der Wal, and Teaghan Smith (daughter of Norm Smith, 5644), known as Girls Are Always Right (GAAR), were awarded fourth place in the annual Team America Rocketry Challenge (TARC) in Washington, D.C.

ACTSO is a year-round educational outreach program that encourages students to participate in science, humanities, and visual and performing arts. This year, the ACTSO team competed against more than 600 other teams from across the country involving more than 7,000 students who took part in the preliminary contest. The Albuquerque team was also selected to be one of 12 teams to present a talk to members of the Aerospace Industries Association, a primary TARC sponsor.

THE SANDIA-SPONSORED ACTSO TEAM, from left to right, Caryss Hathorne, Nicole Vanderwal, Teaghan Smith, and Lana Kimmel. (Photo by Glenn Feveryear)

TARC challenges middle and high school students across the country to design, build, and flight-test a rocket capable of completing a specific mission. This year's mission was to build a rocket capable of carrying a raw hen's egg to an altitude of 750 feet and safely return it to earth. The rocket was also required to use a 15-inch diameter parachute and have a 40- to 45-second flight duration.

Hathorne, the original team member, suggested to Sandia mentor Colby Davis (2616) the idea of having an all-girl rocketry team, and GAAR was born. In addition to Colby, Mark and Norm are mentors for the team. The team typically meets most Saturday mornings for four hours, or longer if needed.

"The team began by learning about the various forces that act on a rocket during flight," says Norm. They performed experiments on how to best protect the precious egg payload that was traveling at a specific velocity by dropping eggs from various heights using material they selected. GAAR used RockSim, a software program, to design and model the flight behavior of the rockets.

WE HAVE LIFT-OFF — Members of the Sandia-sponsored ACTSO team stand safely back as they watch their own self-designed and built rocket fly in the annual Team America Rocketry Challenge.

Two rockets were built with two different designs, a boat-tail design for low drag and a tubular fin design for better stability. GAAR selected the tubular fin design based on the flight data they recorded.

"There were more than a few interesting experiences along the path to qualifying that resulted in scrambled eggs," says Norm. "The team recognized that with all the needed steps to prepare and fly the rocket, little details were easy to overlook."

GAAR had more than 15 practice flights before the qualifying event. "The hardest part for the team was getting the altitude correct while fighting the spring winds," adds Norm.

Once the team was selected as one of the top 100 finalists, they designed and flew a rocket they calculated would perform better in the Virginia environment.

"Trying to predict the rocket performance in Virginia based on New Mexico flights required the team to make other calculations and adjustments," says Norm. "Fortunately, the team had some practice flights in Virginia."

The second practice flight landed in a tree and the girls never did recover it.

"On the day of the competition, the backup rocket was inspected by officials and GAAR was ready to place it on the launch pad, when they noted the launch lug (a critical part of the rocket) was missing. Ingenuity and masking tape allowed them to successfully fly their rocket. It flew to 729 feet and had a 40-second duration, giving them a score high enough for the final fly-off. They flew their second backup rocket in their final flights. It flew to 754 feet and had a 40-second duration. Their score was the third best out of 100 teams, but there was a tie between second and third, giving the girls a fourth-place finish.

Teaghan Smith is an eighth-grader at Jackson Middle School. Caryss Hathorne is a seventh-grader at Victory Christian School. Nicole Van Der Wal is a ninth-grader and attends East Mountain High School. Lana Kimmel, the team captain, is a tenth-grader and also attends East Mountain High School.

"Winning feels great," says Smith. "I was interested in rockets since my brother worked with them in Cub Scouts. Winning, feels great, just great."

"With a proud smile," Norm says, "their motto is shopping, nail polish, and rockets."

Panel: Retaining women in science and engineering

The Sandia Women's Action Network (SWAN) is hosting a brownbag event Wednesday, June 8, 11:30 a.m.-1 p.m., in the Bldg. 823 breezeway for a panel discussion featuring Sandia directors Carol Adkins (1800), Karen Daugs-Gardner (3500), and Margie Tatro (6100).

The panel will discuss recommendations for retention presented in the 2011 report, "Stemming the Tide: Why Women Leave Engineering."

Attendees also will have the opportunity to provide input to an ongoing Labs-wide study on retention and engagement.

For additional details on this event and a link to the "Stemming the Tide" report, go to the SWAN website at https://sharepoint.sandia.gov/sites/New_SWAN/.

For more information, contact Marcey Hoover (1516) at 505-844-9424 or Lori Parrott (0261) at 505-844-2745.

STEMMING THE TIDE:
WHY WOMEN LEAVE ENGINEERING

An angel for Margaret Palumbo

By Iris Aboytes

Going home late one afternoon about a month ago, Margaret Palumbo (4142) met an angel. It was windy and cold and Margaret was having problems with her car and pulled into the Coronado Club lot.

"I own a Honda Fit," Margaret says. "As I was leaving work, a dragging and loud pinging sound caused me to pull over. I got down and was on my hands and knees in front of my vehicle when this lovely young woman stopped and asked me if I needed help. I sure do, I responded. My guess was that I needed duct tape to secure the piece of rubber that I discovered was flapping.

(Photo by Randy Montoya)

TECH SERGEANT DAVIDAD HOLMES

"The rubber panel that prevents you from driving too close to cement barriers had gotten loose. Apparently in this case, the prevention had not been successful."

The young woman told Margaret she would be right back and returned shortly with the tape. She got out of her car and instead of giving the tape to Margaret, got on her hands and knees, and attached the tape. This prevented the rubber protector from dragging and which would have allowed dirt to get into the undercarriage of Margaret's car.

"The name of this wonderful angel in the guise of an extremely helpful individual I found out was Tech Sgt. Davidad Holmes," Margaret says. "She has been in the service 20 years."

Holmes had picked up her two children and was on her way home when she came to Margaret's aid.

"I noticed a woman on her hands and knees wearing a skirt," says Holmes. "I thought she was changing a tire. There were lots of cars going by, but nobody had stopped. I don't know how to change a tire, but I knew I could get someone to stop and help. I pulled over and asked if she needed help. She wasn't changing a tire. She was checking to see what was wrong with her car. She told me she needed tape, so I left and brought it back. Instead of giving it to her, I just fixed it for her. It was no big deal."

"I thank her for her kindness, generosity of time, and spirit," Margaret says. "Most especially I want to let others know just how super the members of our armed forces are. We have soldiers in Iraq and Afghanistan, and some are flying over the skies of Libya, but they are also here on KAFB."