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Sandia National Laboratories

Kim Sawyer named a 'Woman Worth Watching' by *Profiles in Diversity*

Executive VP and Deputy Labs Director for Mission Support Kim Sawyer has been recognized for her accomplishments by *Profiles in Diversity Journal,* which named her one of its 2012 Women Worth Watching. Every fall, the magazine celebrates distinguished senior female executives. See **page 4.**

Traumatic brain injury patients, supercomputer blast simulations being jointly studied to improve helmets

By Heather Clark

Researchers at Sandia and the University of New Mexico (UNM) are comparing supercomputer simulations of blast waves on the brain with clinical studies of veterans suffering from mild traumatic brain injuries (TBI) to help improve helmet designs.

Paul Taylor and John Ludwigsen of Sandia's Terminal Ballistics Technology Dept. 5431 and Corey Ford, a neurologist at UNM's Health Sciences Center, are in the final year of a four-year study of mild TBI funded by the Office of Naval Research. The study is the only TBI research that combines computer modeling and simulation of the physical effects of a blast on the human brain with analyses of clinical magnetic resonance images (MRIs) of patients who suffer such injuries, Paul says.

"Our ultimate goal is to help our military and eventually our civilian population by providing guidance to helmet designers so they can do a better job of protecting against some of these events we are seeing clinically and from a physics perspective," says Paul, Sandia's

(Continued on page 6)

BRAIN POWER — Paul Taylor (5431), right, talks with John Ludwigsen (also 5431), center, and Corey Ford, a neurologist at the University of New Mexico's Health Sciences Center, about their research on traumatic brain injuries. The three researchers are comparing supercomputer simulations of the physical effects of blast waves on the brain with Ford's analyses of patients who have suffered such injuries. (Photo by Randy Montoya)

Veterans Day Celebration

Nov. 8 • Steve Schiff Auditorium

10:30 a.m. — Information fair (local military support groups, Pets 4 Vets Drive, vintage Jeep display

11 a.m. — Guest of honor & speaker presentation by Maj. Drew Dix (US Army, ret.), recipient of the Congressional Medal of Honor

11:45 a.m. — Veteran appreciation presentation

Noon — Informal reception will follow in the lobby

MEDAL OF HONOR recipient Maj. Drew Dix (US Army, ret.) will be the guest speaker at Sandia's 2012 Veterans Day Celebration on Nov. 8.

REMEMBERING SANDIA PIONEER Leon Smith, who passed away recently at age 92. . . . . . **Page 5**

and . . .

Sandia and Navajo Nation continue cooperation with new MOU

NAVAJO NATION PRESIDENT Ben Shelley presents Sandia Div. 8000 VP Rick Stulen, center, and President and Labs Director Paul Hommert, with Pendleton blankets following a memorandum of understanding signing between Sandia and the Navajo Nation at Window Rock, Ariz., in late October. (Photo by Randy Montoya)

As the Navajo Nation seeks ways to develop its rich energy resources, Sandia will continue providing technical and business assistance to the tribe. A formal agreement was signed Friday, Oct. 19, in a ceremony with Sandia President and Labs Director Paul Hommert and Navajo President Ben Shelly at the Navajo Nation capital in Window Rock, Ariz.

The memorandum of understanding builds on the long-standing tradition of cooperation between Sandia and the Navajo Nation. The agreement states that for the next five years, Sandia will help build the Navajo Nation's economy, provide technical assistance, cooperate on issues and activities of mutual interest, and work with the tribe to develop a strategy for Navajo natural resources and communication between the Nation, Sandia, and other NNSA labs under the Strategic Tri-Laboratory Tribal Technical Team. The agreement is set to be automatically renewed for another five years, unless either party opts out at that time.

For the past year and a half, tribal leaders have been carefully developing an energy policy to take advantage of the rich energy resources on Navajo land, such as natural gas, coal, wind, and solar. Tribal leaders wanted to tap into Sandia's vast expertise in harnessing renewable energy resources and encouraging economic development.

— Stephanie Hobby

That's that

Exactly 50 years ago as I write this, I sat in front of a black-and-white TV with my parents and my brothers and sisters, watching President John F. Kennedy tell the American people — and the world — that the Soviet Union had placed offensive nuclear weapons and long-range missiles in Cuba just 90 miles from the shores of the US. In that historic speech, which may have been the high-water mark of the Cold War, President Kennedy, citing U-2 reconnaissance imagery, matter-of-factly laid out the case against the Soviet provocation and outlined the American response.

The US, he stated, would immediately initiate a naval quarantine of military materiel to the island of Cuba and would subsequently escalate as necessary until the missiles and warheads were removed. He said, "We will not prematurely or unnecessarily risk the costs of worldwide nuclear war in which even the fruits of victory would be ashes in our mouth; but neither will we shrink from that risk at any time it must be faced." Nuclear war, in other words, was definitely NOT off the table over this matter.

Thinking back on that evening in October, I remember that I was scared. And why wouldn't I be? I was part of that generation that had grown up "in the shadow of the bomb" (as they used to put it). It's hard to overstate how preoccupied the adolescent mind can be with visions of nuclear holocaust. We literally dreamed it, sharing a collective nightmare that troubled our young sleep.

"Dad, do you think this is the start of World War III?" we kids asked our father. "No, nobody wants another war; they'll work something out," he said, feigning a confidence I now know he didn't have. As a parent now myself, I can imagine that my mother and father were way more scared than they ever let on.

Kennedy wasn't so sure war could be avoided, either: Even if the governments of the US and the Soviet Union managed to reach an accommodation, the military tensions were such that the slightest miscalculation could send events spiraling out of control. "There's always some SOB that doesn't get the word [and starts shooting]," Kennedy said at one point during the crisis.

Miscalculations aside, Kennedy believed that if the Soviets didn't begin to remove the weapons from Cuba, the US would be forced to invade the island. In a phone call to former President Dwight Eisenhower, Kennedy speculated on what an invasion would mean. "General, what if Khrushchev announces tomorrow, which I think he will, that if we attack Cuba it's going to be nuclear war? What's your judgment as to the chances that they'll fire these things off if we invade Cuba?" Eisenhower, a seasoned hand in dealing with the Soviets, replied, "Oh, I don't think they will." "You don't think they will?" "No." Seeking clarity, Kennedy said, "In other words, you would take that risk" if the situation warranted it. Eisenhower replied, "Something may make these people shoot 'em off; I just don't believe this will. . . . In any event, of course I'll say this: I would want to keep my own people very alert."

As things played out, after another tense few days the Soviets began to remove the nuclear weapons and missiles from Cuba and the Cold War returned to "normal."

Is it any coincidence that in the immediate wake of the Cuban Missile Crisis, Kennedy embarked on a highly visible, highly publicized tour of the nation's nuclear weapon installations in the western US? After a tour and briefings at Los Alamos, the president arrived with a large media delegation at Sandia late in the afternoon of Friday, Dec. 7. He was briefed by Sandia Corp. President Monk Schwartz and toured several Sandia facilities. An iconic (for Sandia) photo shows the president and his entourage viewing a Vela satellite, which was designed to detect nuclear explosions from earth orbit. Vela would be instrumental in monitoring Soviet compliance with a nuclear test ban treaty that was signed several months later.

With the Cuban Missile Crisis, the world had come to the brink and stepped back. Never again were relations quite as tense between the two superpowers. A series of treaties, beginning with the Limited Nuclear Test Ban Treaty in 1963, aimed to reduce tensions; the Soviet Union's ruling elite, then called the Presidium, removed Khrushchev from power in 1964, an era of détente ensued, and the likelihood of all-out nuclear war ebbed. Not least, finally, the collective nightmares of a generation gradually, oh so gradually, receded into the realm of bad memories.

See you next time.

— Bill Murphy (505-845-0845, MS 0165, wtmurph@sandia.gov)

New prescription drug manager

Express Scripts will replace Catalyst Rx effective Jan. 1, 2013

Beginning Jan. 1, 2013, Express Scripts will replace Catalyst Rx as the Sandia prescription drug benefit provider for all employees enrolled in Sandia Total Health BCBSNM or UHC. Because Express Scripts is a leader in the pharmaceutical management industry, both employees and Sandia will experience cost savings allowing us to keep the plan design, drug payment structure, and copay amounts unchanged in 2013.

You will receive your new member identification card(s) in late 2012.

What to expect in 2013

Specialty medications with Catalyst Rx (that have refills remaining and are not expired) will be electronically transferred to the Express Scripts specialty pharmacy, Accredo. Mail-order prescriptions with Catalyst will be transferred to the Express Scripts mail-order program (with exceptions of no refills, expired prescriptions, Class II controlled drugs, and compounded meds).

The Rx formulary list will change with the transition to Express Scripts. However, Sandia will provide a grace period through March 31, 2013, when you can continue to fill your 2012 formulary prescriptions according to the 2012 Catalyst Rx formulary list at the preferred formulary price. For members filling their formulary prescriptions through this grace period, beginning April 1, 2013, Express Scripts will fill and bill all prescriptions according to their 2013 Express Scripts formulary list.

More information, including targeted communications to members with formulary prescription changes, will be mailed to your home address in late 2012.

Express Scripts Customer Service is available 24 hours a day, 7 days a week and can be reached at 877-817-1440 (TDD for Hearing Impaired — 800-759-1089).

Rx Changes for BCBSNM and UHC:

- Drugs subject to prior authorizations, step therapy, and/or quantity limits may change through Express Scripts. Refer to your Express Scripts Welcome Kit for more information.
- Supplies associated with Continuous Glucose Monitors and external insulin pumps may be obtained through Express Scripts or your medical coverage. The Continuous Glucose Monitors and external insulin pumps will be covered through the medical portion of your insurance.
- There is no longer a limit on the number of Emergency Allergy Kits (e.g. EpiPen) and Glucagon Emergency Kits covered by the plan.
- Generic oral and emergency contraceptives are now covered at 100 percent in-network for females under the age of 50.

Online Tools

Visit www.express-scripts.com/Sandia today to review information about Express Scripts including:

- General information about Express Scripts
- Pharmacy benefit plan highlights
- Local participating pharmacies
- Comparing prescription medication costs
- Formulary lookup, and
- Signing up for important email alerts

* * *

Beginning Jan. 1, you may register online at www.express-scripts.com. Select "For Members" and follow instructions to register.

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http://www.sandia.gov/LabNews

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Medicare Retirees
Through Friday, Dec. 7 (5 p.m. MT)

Embracing entrepreneurship

AS PART OF THE ENTREPRENEURSHIP seminar's venture capitalist panel, Bill Shelander shares his unique perspective as the entrepreneur in residence at Lawrence Berkeley National Laboratory. Moderator Carrie Burchard (right) and Jason Lettman (left) look on. (Photo by Randy Wong)

By Patti Koning

Technical work at Sandia is all about innovation. While these innovations contribute to the Labs' national security mission, they can also have impact in the commercial sector. Last month, the Sandia Business Development group sponsored an Entrepreneurship Seminar to raise awareness about commercialization opportunities, explore the process of developing a value proposition, and study what it takes to become an entrepreneur or successfully license technology.

Anup Singh, acting senior manager of Biological Sciences and Technology Dept. 8620, believes it is important for interested staff to pursue entrepreneurship opportunities, even if it means leaving Sandia. He and Carrie Burchard (8530) organized the seminar.

"While Sandia may suffer a short-term loss in losing a valuable staff member, there is an overall gain to society and the taxpayer."

— Anup Singh

"While Sandia may suffer a short-term loss in losing a valuable staff member, there is an overall gain to society and the taxpayer," says Anup. "If the departure of a Sandian significantly improves the chances of successful commercialization leading to a product that improves healthcare and generates wealth and employment, it greatly offsets any short-term loss."

In addition, Anup believes that in the long term, there is a net gain to Sandia. "It makes us known as an entrepreneurial culture where we encourage our staff to think independently and take risks, where we help our best people to succeed even if they have to leave Sandia to become a professor or founder of a company. This helps us attract and keep the best talent," he says.

To start the seminar, former Sandians Eric Cummings and Don Arnold shared their personal experiences in founding companies based on Sandia technology. Both worked in microfluidics while at Sandia — Cummings from 1997 to 2005 and Arnold from 1997 to 2000.

This was followed by a venture capitalist panel featuring Brian Atwood, cofounder and managing director of Versant Ventures; Jason Lettmann, a partner of Lightstone Ventures; and Bill Shelander, the entrepreneur in residence at Lawrence Berkeley National Laboratory (LBNL). Malin Young, acting director of Center 8600, provided the closing comments, emphasizing the value of innovation and entrepreneurship. The day concluded with a workshop by Lynn Phillips, a consultant and former Stanford faculty member, on the process of developing a value proposition.

A question of risk

A self-described serial entrepreneur, Cummings is the founder of LabSmith, Cool Earth Solar, and MaxOut Renewables. He founded LabSmith before becoming a staff member at Sandia. His decision to leave a stable job and start another company was driven, in part, by getting cancer at age 35.

He says his last thought before entering surgery for cancer was that if he died, he would have never taken any brave position or made a stand when there was one to be made. "They say when you face death you think about what is really important and people don't wish they'd worked harder, but that was kind of what I was thinking," Cummings explains. "I resolved that if there was a stand to be made, I would make it. If you do nothing, there is a 100 percent chance you will fail in that test. This really changed the equation of risk for me."

Anup pointed out that Sandia employees also have a very low risk option if they want to pursue a startup — entrepreneurial leave. Under this program, employees can take up to two years off and still have a job to return to at Sandia.

The inevitable pivot

In developing Cool Earth Solar's technology, Cummings and his co-founders ran into a problem with power balancing. They eventually invented a new method of power balancing and a technique specialized to large-scale installations. "Cool Earth is not an inverter company, so we sat on the IP for about a year," he says. "But it was such ripe and compelling technology that I left Cool Earth to spin out MaxOut to commercialize it."

This was a common theme throughout the seminar — the shifting, unpredictable trajectory of taking an invention to the marketplace. Entrepreneurs need to be ready and willing to pivot.

Arnold shared how the technology that his company, Eksigent, ultimately brought to market, was not what he and his co-founders envisioned when starting the company. Shelander commented that in more than 50 investments, the final successful product was significantly different from what was originally conceived.

He finds that the translation process is one of the most gratifying aspects of his job as the entrepreneur in residence at LBNL. "The scientists will bring me one technology that was funded for a particular application and just through discussion and brainstorming we will suddenly realize that there is a much greater value in a different application," he says.

Do your homework

The venture capitalist panel stressed the importance of market research. Atwood says that most of the business plans he looks at do not have primary market research and many are rejected for this reason. Primary research means talking to potential customers and suppliers and understanding your business area.

"You need a clean line of sight for your product," says Arnold. "You need to see those pitfalls that you won't be able to get around so you can quickly figure out a way around or another approach."

Lettmann shared his recent experience with turning down a proposal from a medical device company in the gastrointestinal space for lack of market research. "I called 10 GI specialists with some basic questions. Without fail, they all brought up the same three issues that the company did not have answers to. We passed on the deal, but if the company had done some primary research, it might have been different," he says.

The venture capitalist panel recommended talking to many different stakeholders to gain a full understanding of your business area. "I wouldn't go to investors right away. You'll get a reputation for not knowing what you are talking about," says Shelander. "And be open. Sometimes your perceived competitor can become your best partner."

The panelists also recommended taking advantage of the business programs at Bay Area universities, such as the Lester Center for Entrepreneurship [http://entrepreneurship.berkeley.edu] at Berkeley's Haas School of Business and the Stanford Entrepreneurship Network [https://sen.stanford.edu/].

The future

Carrie says she would love to see a function like Shelander's at Sandia. "This is about making our staff successful," she says. "If I spend the rest of my career at Sandia doing this, I think that would be a great use of my time."

Shelander works with scientists and other tech-transfer professionals to explore how and if to commercialize their inventions.

"I'm trying to lead by example," he says. "I personally have started two companies with Lawrence Berkeley and am working with 15 other startups. We've averaged about 1.5 startups a year for the last 15 years. It makes a big difference if someone is proactive and takes responsibility."

He cited data that the value of the numerous startups that have sprung up from LBNL technology in the past 15 years, in terms of jobs, tax revenue, and new business opportunities, have alone justified the federal investment in LBNL. "Over and over, basic research translates into good outcomes for society," he says.

Cummings described his "wild fantasy" that Sandia might dedicate 1 percent of its overall budget to an entrepreneurship group that staff could matrix into to bring inventions to market. Anup pointed to Jay Keasling, associate laboratory director at LBNL and CEO of the Joint Bioenergy Institute (JBEI), as an example of what is possible. Keasling founded Amyris Biotechnologies and recently spun a new company, Lygos, out of JBEI.

"If he can do it, why can't we?" asks Anup.

SELF-DESCRIBED SERIAL ENTREPRENEUR and former Sandian Eric Cummings shares his experiences starting Cool Earth Solar and MaxOut Renewables. (Photo by Randy Wong)

Sandia CaliforniaNews

Early Career LDRD focuses on tunnel detection

By Sue Major Holmes

You'd think it would be easy to use seismic waves to find tunnels dug by smugglers of drugs, weapons, or people.

You'd be wrong.

Sandian Nedra Bonal (6913), who has spent much of her career studying shallow geophysics, is nearing the end of a two-year Early Career Laboratory Directed Research and Development project, "Improving Shallow Tunnel Detection From Surface Seismic Methods," aimed at understanding the environment around tunnels and why seismic data finds tunnels in some cases but not others.

Her eventual goal is to come up with a seismic detection process for the border and other areas where tunnels pose a security threat.

When tunnels are found today, they're found by tips from people rather than by scientific methods, she says.

"It would be great if we could use this to do a better job with tunnel detection, that you could scan an area and know if there is or is not a tunnel and find it and stop it," she says.

If researchers discover the parameters to pinpoint tunnels, the next step would be to develop streamlined seismic methods that would be more practical for the Border Patrol and military.

'I thought we should see these things'

The LDRD arose from earlier work at Sandia detecting tunnels at fairly shallow depths — 10 to 12 meters, roughly 32 to 39 feet. Nedra says she was surprised when standard refraction and reflection processing techniques used in that work could not successfully pinpoint some tunnels.

"I thought we should see these things and we really weren't," she says.

Researchers speculate the difficulty might be due to what's called a halo effect around a tunnel, in which fracturing and other geological considerations create diffuse boundaries and hide the tunnel, she says. The earlier, broader research produced several successes in tunnel detection, but was not focused specifically on what happens in the area where tunnel and earth meet, which might help explain why tunnels can be detected in some cases but not others.

Nedra is looking at whether seismic waves are strongly impacted by fracturing or saturation of pores in rock or soil, as well as varying pressures at different depths. Physical processes change from shallow depths to deeper depths, but it isn't clear just where that change occurs, she says.

In addition, the halo effect is both asymmetrical and complex.

RESEARCHERS DEPLOY instruments for a seismic data acquisition survey parallel to the border fence in Otay Mesa, Calif. Some acquisition equipment including an SUV-mounted accelerated weight drop to generate seismic waves are shown in the photo.

"It depends on the geology or the soil as well as the seasonal variation, rain events, and the relation to the water table," she says. "So it's a pretty complex regime just from the hydrology standpoint."

Anomalous areas may be key

Studies still have to be done, but asymmetry may turn out to be an advantage because an asymmetric area might appear to be more uncharacteristic than a symmetrical one, Nedra says. "These anomalous areas are what we may identify as tunnels in the data," she says.

She began the LDRD project by figuring out what gaps existed in current scientific knowledge, then modeling real-world scenarios based on collected data that would affect hydrology models and in turn, seismic waves — an area's soil and other geology, how deep fracturing goes into the rock around a tunnel in a particular environment, the probable tunnel size, its relation to the water table, and seasonal variations in that relationship.

"We try to get some bounds to this problem," Nedra says. "If we can't see it in the best-case scenario, then there's really no point in trying to see it in more subtle factors that may affect the seismic waves."

The team ran the hydrology models to get some results, then converted those results into seismic velocities that could be plugged into Sandia's 3-D elastic seismic wave propagation simulation code, Nedra says. These results will produce synthetic seismograms that will be compared to field data collected in the real environment and can be used to develop other processing techniques. That will in turn produce data that's expected to look like data collected in a real environment in the field. "We can then compare the effects of a tunnel versus no tunnel and changes in fracturing and saturation of the tunnel halo versus no changes to assess their impact on seismic waves," she says.

'A middle regime where I'm looking . . .'

The standard used to show the relationship of saturation in pores in rock or earth to seismic velocities is an oil industry standard called the Biot-Gassmann theory. Nedra says, however, few experiments have tested that theory at shallow depths where border tunnels are commonly dug.

"The few that have been done have shown that the Biot-Gassmann theory tends to overestimate the velocities for those unconsolidated near-surface materials where the pressures perhaps aren't as great" as at depths where the oil industry operates, Nedra says.

The very near surface behaves one way, but at some point behaviors change because of greater pressures and other factors, she says. The Biot-Gassmann theory holds well at greater depths where pressure is more intense and the rock is more consolidated, while another theory, Brutsaert, describes what happens very close to the surface.

"But there's sort of a middle regime where I'm looking where I'm not real sure either one of them works as well as they need to," Nedra says. She expects to have results soon to compare with prior seismic data to address the issue.

Experimentally verifying at what depth or in what materials competing theories work best lies outside the scope of her LDRD, but she hopes for funding to work on those puzzles. "I think there are still plenty of questions we have that need to be answered but I am very excited about the progress made so far. I have been able to detect a tunnel that I previously had not seen by other analyses," Nedra says.

Kim Sawyer joins the ranks of Women Worth Watching

Sandia's executive VP and deputy director for Mission Support honored by diversity journal

By Nancy Salem

KIM SAWYER

Executive VP and Deputy Director for Mission Support Kim Sawyer says women in any workplace should speak up if they feel unfairly passed over for promotion.

"Have a conversation if you don't understand what differentiated you from the other person," she says. "It could be any number of things, from your level of experience to the chemistry you have with the group. If you don't know, you can jump to the wrong conclusion. Find out what's going on. Go have that conversation, and be open to what you hear."

Kim says it's important to take the information and learn about your blind spots. "My advice is to perform, perform, perform."

Kim was recently recognized for her accomplishments as a female executive. *Profiles in Diversity Journal* named her one of its 2012 Women Worth Watching. Every fall, the magazine devotes an issue to celebrating distinguished senior women executives. Honorees are nominated by colleagues, peers, and mentors for their initiative and achievements.

"These are women of purpose and drive who represent diversity within their spheres of influence," the magazine says. "These profiles . . . serve as an opportunity for the international business community to get to know these women as individuals. The profiles are portrayals, not just resumes, of real women executives with real stories to tell, and they represent the kind of information shared by a mentor with an aspiring novice, particularly someone breaking new ground within an organization or industry."

The 14-year-old magazine focuses on diversity and inclusion in business, government, nonprofits, higher education, and military settings. It publishes the special issue because "embracing gender diversity and inclusion in leadership positions isn't just the 'right thing to do,' it's a strategic business imperative for all organizations."

Kim says Sandia works hard to maintain a diverse, inclusive workforce, and has many successful female role models. "There are a lot of women on the leadership team," she says. "This isn't something new to Sandia. It's important to have role models and to continue to be aware of and develop women leaders."

She says Sandia's diversity goals go beyond just numbers. "Our training programs develop a deep appreciation for what women and minorities bring to an organization."

Kim says the path to leadership can start early, in grade school, where young girls should be encouraged to do well in science and math. "I think there's a shortage of women in STEM (science, technology, engineering, math) professions resulting from not enough emphasis in early education, insufficient support during difficult years, and the stereotyping of women in STEM."

Parents and teachers should make science and math fun, and seek tutoring if a student has low test scores, in the spirit of encouragement not punishment, Kim says. "Popularity and peer pressure are prominent at that time. For girls in particular, being the smartest student in math and science is not always considered 'cool.' I feel it is critical for girls to get more encouragement at home and at school to develop their interest in STEM."

Mentorship is essential, Kim says. Women in STEM should spend time with grade school students talking about what they do in their professions and how rewarding their work is, and mentors should be a requirement in college, she says. "When courses get dry and difficult, it is too easy to change majors and pursue a different path. A mentor can listen to the student's thinking and provide guidance and encouragement to 'stick with it.' This could result in having more women in STEM professions.

"I know many women in STEM who are bright, talented, and glamorous. Their stories are remarkable. More stories need to be told."

From Tinian to Albuquerque

Sandia legend, friend, colleague, leader Leon Smith passes away at age 92

BUT FOR THE TOSS OF A COIN, Sandia pioneer Leon Smith would have served as the weaponeer on the *Enola Gay* on its fateful mission to drop the bomb on Hiroshima that precipitated the end of World War II. Leon, seen here in front of a B-29 at the National Museum of Nuclear Science and History, died in mid-October at the age of 92. (Photo by Randy Montoya)

By Rebecca Ullrich, Sandia historian

At the beginning of his engineering career, Leon Smith was part of the group that carried out the atomic attacks on Japan. In that role, he was totally focused on helping win World War II. And then, for the next half-century, Leon was equally focused on ensuring that the nation's strategic deterrent helped prevent World War III. In the way he did his work and conducted his life, Leon embodied the very best of Sandia, the best of engineering as a profession, the best of America.

Sandia legend Leon Smith died on Sunday, Oct.14, at age 92. He served the Labs for 41 years, rising into management early and overseeing several critical technologies and decisions in Sandia's evolution. Technically insightful, Leon was also an effective manager who deliberately emulated Sandia Corp. President Jim McRae in being willing to step in and help people but always turning the problem back to them to solve.

At his memorial service on Oct. 18, more than 200 people came together to share their loss and their "Leon stories." Themes of patriotism, service, family, and the highest of standards wove through the speakers' remarks. The breadth of his expertise, his excellence, and his warmth were striking. Sandia President and Labs Director Paul Hommert spoke at the memorial, emphasizing Leon's impact on Sandia's systems engineering. In recognition of Leon's extensive contributions to the Weapon Intern Program, Paul also announced that Sandia will name a classroom after him.

Joining the Manhattan Engineer District

Leon was pursuing a degree in electrical engineering at the University of Wisconsin when he was drafted into the US Army in 1943. He was a private in the field artillery until extensive hearing damage caused him to apply for a transfer to the Army Air Forces. He received training in communications at Yale and was commissioned a second lieutenant, then went on to study electronics at Harvard and radar at MIT. Those experiences landed him a special assignment to the Manhattan Engineer District; he was sent to Wendover, Utah, in November 1944 to join the 509th Composite Group and help set up an electrical lab to develop, assemble, and test fuzing systems for the atomic bomb project.

In the summer of 1945, the 509th relocated to the island of Tinian in the far Pacific to continue training and to prepare for the use of Little Boy and Fat Man against Japanese targets. In addition to preparing the weapons for use, a weaponeer was required to go on the flights to connect the bomb to the aircraft wiring system and move it from safe to armed. A coin toss determined that Morris Jeppson would travel on the *Enola Gay* to Hiroshima; Leon stayed on Iwo Jima with a backup aircraft. Phil Barnes served as weaponeer on *Bockscar*, which delivered Fat Man over Nagasaki.

After the war's end, the Los Alamos laboratory wanted Leon's service as a weaponeer for the Able air-drop shot of Operation Crossroads, the first postwar nuclear tests. Crossroads was a weapon effects test series for the DoD, and Leon needed to leave the Army to participate. Getting a discharge from the military was a slow process at that point, but, as Leon related, General H. H. "Hap" Arnold made a call to Lowry Air Force Base and Leon was "mustered out in record time — about half an hour."

After the Crossroads series in the summer of 1946, Leon went to Los Alamos, where his wife, Marie, was working. They returned to Wisconsin and Leon completed his degree. He joined Eastman Kodak in Rochester, N.Y., living in a rented room while Marie, pregnant with their first child, remained in Wisconsin. He was thus tempted when Los Alamos's Z Division offered him a higher salary and an available two-bedroom house on Sandia Base in Albuquerque. He joined Sandia on Oct. 8, 1947, assigned to work on firing sets in preparation for the Operation Sandstone nuclear tests the following spring.

By 1951, Leon's leadership skills were as apparent as his technical savvy, and he was promoted to supervisor of an electrical engineering division. Several electrical systems supervisors formed the Electrical Systems Coordination Group to try to achieve more efficient and consistent designs by sharing information from the systems designed for different weapons. This culminated in Leon's proposal that the organizational structure for electrical systems be changed, with all coordinated out of one department. In 1956, he was promoted to manager of the electrical systems engineering department, which pulled together arming, firing, fuzing, and, later, command and control.

A YOUNG LEON SMITH on the Island of Tinian in the South Pacific not long before the atomic attacks that ended World War II.

Led many key Sandia initiatives

Leon retained this strong leadership role throughout his career. In 1961, he was promoted to director of electromechanical component development, which proved thrilling as Sandia pushed to develop permissive action links and intersected with the Kennedy administration's interest in command and control capabilities. Two years later he transferred to systems development, where he was instrumental in creating an extensive advanced development program in weapon systems, which he then led. Soon, there were 10 advanced systems activities underway, including hardened reentry vehicles, advanced measures for safety and control, and the work leading up to the fuze and warhead for the Poseidon.

Leon led six other directorates before retiring. Along the way, he oversaw the doubling of the satellite program's size. In his final move before retirement, he took over the monitoring systems directorate. He found the effort to develop techniques to support nuclear treaty monitoring exciting, "because it's at the edge of advanced electronic technology."

Leon retired June 30, 1988, but returned a decade later when invited to participate in the Weapon Intern Program established by John Hogan with co-instructor Andy Rogulich (both now retired). On Tinian, Leon had taken advantage of down-time to take pictures and had long since assembled about 70 photographs into a presentation on his wartime experiences. His presentations were always successful and had a wide, welcoming audience both within and outside Sandia. [Readers with access to Sandia's internal website can type "leon smith tinian" into the searchbox on TechWeb; the first search result links to a version of this presentation.]

Andy, who spoke at Leon's memorial service, remembers, "Leon was always impressed by how many people wanted to hear his stories about the Manhattan Project. Everyone who had the opportunity to hear him speak commented on how much they benefitted from hearing his message, and how Leon made them understand how important their contribution was to the nuclear weapons mission of the United States."

According to an obituary published in the *Albuquerque Journal*, Leon "had a passion for fine food and wine and enjoyed sharing it with his family and his many friends." He is survived by Marie, his wife of 71 years, and by several children, grandchildren, and great-grandchildren.

Leon, a dedicated patriot throughout his long, eventful, and consequential life, was laid to rest in Santa Fe National Cemetery.

Traumatic brain injury

(Continued from page 1)

principal investigator on the project. "To do that we've got to know what are the threshold conditions that correlate with various levels of TBI."

Immediately following blast waves, soldiers can be stunned or suffer brief losses of consciousness, but more damage evolves weeks later, Ford says. The symptoms — headaches, memory loss, mood disorders, depression, and cognitive problems — can prevent sufferers from working, he says.

Paul is applying shock wave physics to understand how sensitive brain tissue is affected by waves from roadside bombs or blunt impacts within the first 5-10 milliseconds of exposure. That's well before a victim's head moves any significant distance in response to the blast or impact.

"This stuff is over before you have any chance to react and probably before you even knew it happened to you," Paul says. As teenagers, humans' fastest reaction times are 75-100 milliseconds.

Ford says levels of energy transmitted into the brain by a blast wave "could be part of the injury mechanism associated with TBI and the mechanism by which it happens may not be mitigated by traditional methods of protecting the head with a helmet."

At Sandia, the researchers created a computer model of a man's head and neck. The model includes the jaw — another first in TBI research — because a lot of blasts come from improvised explosive devices (IEDs) at ground level, sending waves traveling at the speed of sound through the jaw and facial structure before they reach the brain, Paul says.

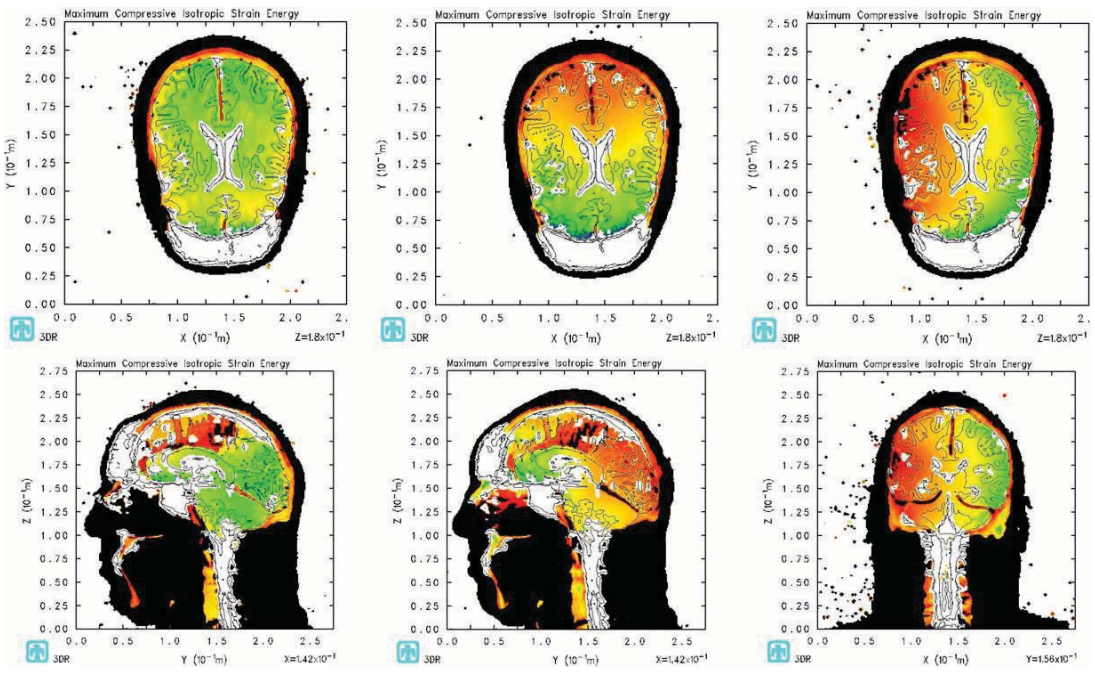
Visible Human Project data used

Sandia's team used the National Library of Medicine's Visible Human Project — established in 1989 to create a digital image library of volumetric data representing complete, normal adult male and female anatomy — as a guide to build the head and neck model.

Using images of the male, whose age was close to that of most military personnel, Paul, with Ford as a medical consultant, created geometric models of the seven tissue types in the human head — scalp, bone, white and gray brain matter, membranes, cerebral spinal fluid, and air spaces. Over a year, they catalogued each of the tissue types seen in about 300 "slices" of a cadaver's head, dividing what they saw into one-millimeter cubes and assigning each a tissue type for the computer simulation.

Paul also imported digitally processed, computed tomography (CT) scans of various helmet designs into the simulations to assess the protective merits of each against blast loading.

In a typical blast simulation, 96 processors on Sandia's Red Sky supercomputer take about a day to process a millisecond of simulated time, Paul says. Since each blast scenario is simulated out to at least 5 milliseconds, each event can take about a week to calculate.



THESE SANDIA COMPUTER SIMULATIONS contain a computer model of a human's head viewed from above looking down (top row) and from the side (bottom row). The images show the deposition of compressive energy in the brain during frontal, rear, and side blasts. These models combined with University of New Mexico clinical observations are being used to identify energy thresholds that should lead to better military and sports helmet designs.

The 3-D simulations are visualized using two-dimensional multicolored images of a man's head that record an enormous amount of data. Paul and Ford have focused three types of energy entering the brain that may cause TBI: compressive isotropic energy associated with crushing; tensile isotropic energy that tends to expand parts of the brain and could lead to cavitation; and shear energy that causes distortion and tearing of soft tissue. The pressure and stress within the brain show up on videos created from simulation colors moving in slow motion through and around the brain cavity.

On the clinical side, Ford studied 13 subjects who suffered mild TBI after IEDs exploded near them. Some were stunned, most lost consciousness at least briefly, and most cannot hold a job, he says.

The research partners hope to recruit more patients, especially active military personnel or veterans, who were exposed to blasts that did not penetrate the skin and who suffered a loss of consciousness, Ford says. Candidates must have no history of other blunt traumas.

A battery of tests measured the subjects' memory, language, and intelligence. These results were correlated with changes in functional magnetic resonance imaging (fMRI) from the patients. The 3-D fMRI studies can detect and map networks in the brain used for processes like movement, vision, and attention. By comparing this data with those of a control group, Ford identified a subgroup of networks displaying abnormal brain activity in the patients. These results were then compared with energy deposition maps predicted by the computer simulations.

The research showed that certain regions of patients' brains are hyperactive, perhaps because they are compensating for adjacent, damaged areas of the brain that were hit with high energy from the blasts. The hyperactive regions were those predicted to experience the least shear and tensile energies, according to the computer simulations, which can be used to predict where the hyperactivity will likely occur, they say.

Validating simulation with clinical reality

The studies also showed problems with how the patients used visual information, which corresponded to their complaints about having difficulty with attention spans, Ford says.

"This is our way to validate what the simulation shows with the clinical reality," he says.

Once Paul and Ford determine exactly how and where the wave energy deposited in the brain gives rise to injuries, they can identify threshold levels of stress and energy that cause TBI for consideration by helmet designers, Paul says.

Eventually, Paul says these thresholds could be used for sports helmets and even to place sensors on helmets that would show whether a blast was strong enough to have caused TBI. Currently, many TBI sufferers experience no immediate symptoms that would tell them there's a problem and cause them to seek medical attention. The sensors could be used to alert them to the problem.

"I want us to be able to understand the physical mechanisms that lead to TBI. It would also be useful if we could make the connection between blast loading and blunt impact trauma," Paul says. "Once we understand that, we can be more comprehensive in how we protect both our warfighters and athletes against these sorts of injuries."

SANDIA-DEVELOPED Advanced Hypersonic Weapon being launched on its first successful test flight.

Sandia's work on Advanced Hypersonic Weapon wins national Lockheed Martin award

The Sandia team that developed the US Army's Advanced Hypersonic Weapon (AHW), which recently completed its successful first test flight, has been awarded Lockheed Martin's highest honor, the NOVA award.

Sandia's AHW Flight-1A team, represented by Eric Schindwolf, deputy director of Strike and Aerospace Systems Org. 5420, is being honored for its work to provide the first complete demonstration of hypersonic boost-glide for DoD's Conventional Prompt Global Strike effort. The DoD program provides conventional payload delivery capability in a short period of time.

Sandia's team was honored along with other Lockheed Martin winners at the 18th annual awards ceremony at the Smithsonian Institution's National Air and Space Museum on Oct. 26.

"Sandia's work on the AHW exemplifies the Laboratory's ability to render exceptional service in the national interest. This award is a tribute to the team's excellence in engineering, its ability to solve the most challenging security problems facing the US today, and the teamwork required to accomplish the AHW's historic first test flight," Sandia President and Labs Director Paul Hommert says.

Sandia led the design, development, fabrication, testing, and fielding of both the booster system and the hypersonic glide body. The test flight represented about four years of work for up to 200 employees across the Labs. The AHW's first test flight took off last November from Sandia's Kauai Test Facility.

The three-stage booster system and glide vehicle were developed by Sandia under the direction of the US Army Space and Missile Defense Command/Army Forces Strategic Command, who also operates the US Army's Ronald Reagan Ballistic Missile Defense Test Site at Kwajalein Atoll. Thermal protection system development for the glide body was the responsibility of the US Army Aviation and Missile Research Development and Engineering Center in Huntsville, Ala.

The test flight had many firsts, says David Keese, director of Integrated Military Systems Development Center 5400. It was the first time a Sandia-developed booster had flown a low-altitude, long-range horizontal flight path at the edge of the Earth's atmosphere; the first time eight grid fins (designed by Sandia and Huntsville-based Dynetics Corp.) were used to stabilize a US missile system; and the first time a glide vehicle flew at hypersonic speeds at such altitude and range.

— Heather Clark

With 42 tons of salt melted, NSTTF upgrades complete

By Stephanie Hobby • Photos by Randy Montoya

Every 10 minutes for three dusty, windy days, workers hauled 250-pound truckloads of nitrate salt from pallets to a broiling roofing furnace nearby. Roped off with flags and conspicuously emblazoned "HOT!" the 600 degree F furnace could melt an entire load of the smooth, BB-sized white beads of salt in eight minutes. What remained — a boiling hot liquid roughly the same consistency and clarity as water — finalized the Molten Salt Test Loop and brought to a close a nine-part, $17.8 million upgrade that spanned two years at DOE's National Solar Thermal Test Facility (NSTTF) at Sandia/New Mexico.

Three decades of intense desert sun, grit-filled spring winds, biting winter temperatures, and even a rare tornado had given the facility plenty of reason to deserve these upgrades. The American Recovery and Reinvestment Act (ARRA) funded the project, which added new state-of-the-art test capabilities, including the $10 million Molten Salt Test Loop (MSTL) and an optical methods laboratory, upgraded the parabolic trough test platform, replaced the original heliostat mirrors aimed at the iconic Solar Tower, and added other critical testing capabilities to the NSTTF. These changes support the nation's growing concentrating solar power industry, which uses mirrors to concentrate the sun's heat onto a receiver during the day to generate electricity either immediately or later when the sun isn't shining.

Storage medium of choice

Molten salt is increasingly the heat transfer fluid and storage medium of choice. It is cheap, abundant, easy to obtain, and can store thermal energy for future use, which provides greater electrical grid flexibility. Salt heated by the sun's thermal energy during the day can power a turbine and generate electricity at night, evening out the problematic peaks and gaps in electricity generated by intermittent resources. Currently, four major concentrating solar power plants are under construction in the US, with plans for more in the works.

Before a company invests up to $1 billion in purchasing thousands or tens of thousands of components for a concentrating solar power plant, it is critical to understand how that system will operate with molten salt, the potential risks, and the interaction of pressure, temperature, and flow rate. Other existing facilities can evaluate one or two of those factors, but the recently completed Molten Salt Test Loop at Sandia is the only one in the nation that can provide real power plant conditions and collect data to assist these companies in their decision-making process.

"This facility is the only one of its kind and can provide an opportunity to test the interaction of all of those components," says lead researcher for thermal energy storage, David Gill (6123), who had technical oversight of the test loop. "It really gives a complete picture of how the system will work on-sun."

Because the MSTL is unique, many of the components had to be designed and manufactured specifically for this construction. Facilities project manager Scott Rowland (4822) was responsible for the overall design, the contractor's scope of work, and the schedule and budget for the facilities' run portion of the overall MSTL project. "This is really a cutting-edge facility, and we couldn't just buy the components we needed," Scott says. "This was truly a team effort through every step of design, construction, and commissioning of the MSTL. The customer, contractor, and Facilities really worked together on this project, and we're pleased to be running on-schedule and within budget."

The test loops are just south of the 200-foot Solar Tower; if you walk around to the tower's north side, you'll see 218 heliostat mirrors spread over five acres. The heliostats can be angled to reflect and focus the sun's light to a point at the top of the tower, and the resulting high temperatures are ideal for testing heat shields and researching solar power tower components and systems. There are 5,700 mirrored panels, known as facets, on the 218 heliostats, and all were original to the 1976 construction. Glass and reflective technology have changed significantly in the past three decades, and $3.8 million of the ARRA investment was allocated to replace the heliostat facets.

The new glass is low-iron with a silver layer sandwiched between glass that is 1.6 mm thick in the front and 4 mm thick in the back. This technology results in an average 96 percent reflectivity, compared to the previous facets' 83 percent reflectivity. The new facets, paired with new canting and alignment techniques, increased the total field thermal power from 5 MW to 6 MW.

Measuring and monitoring devices

"The field facet replacement has given this facility new life," says Cheryl Ghanbari (6123), who was involved in nearly every aspect of the overhaul. "These upgrades enable us to more effectively support our DOE mission, which is to provide flux and power to concentrated solar experiments."

In addition, workers installed measuring and monitoring devices on several of the NSTTF's heliostats. This test bed provides accurate wind and vibration data on the heliostat and associated components. The data will be used by researchers to analyze these effects and enable researchers to provide developers and engineers with software tools to design and build more efficient heliostats.

As power towers increase in popularity and grow in scale, there is a growing need to test heliostat capabilities at a longer range. To address that need, a long-range heliostat target was designed and built. This target will be used to measure the power and beam characteristics of heliostats up to one mile from the tower leading to improved design and construction methods for focusing accuracy.

Concentrating solar power systems rely on the precision of their components, and quality control is essential. A new optical test lab at the NSTTF capitalizes on Sandia's strength in characterizing both optical elements and concentrators to help researchers and industry, and builds on Sandia's past work in finding ways to rapidly measure trough alignment, developing new methods for full-scale, rapid dish alignment, and enforcing quality control of facets coming off the assembly line. This lab addresses industry limitations and supports concentrator designers and optical element manufacturers for all three technologies: trough, dish, and power tower.

A new mobile test system

To assist companies not able to bring their systems or components to Sandia, DOE also funded a new mobile test system that enables Sandia to conduct thermal and optical measurements and tests at industry sites, providing, in most cases, on-site solutions to their needs.

Additional office space and a larger parking lot can now accommodate more visiting researchers and industry partners who support the concentrating solar power industry.

With the 84,000 pounds of salt — equivalent in weight to more than 10 Asian elephants — melted, the construction companies handed over the test facility last summer.

"We are thrilled to have these new testing capabilities and upgrades," says concentrating solar power ARRA project manager and acting manager Bill Kolb (6123). "The testing and analysis we can now support will have a direct impact on our nation's ability to respond to our energy security challenges. These projects were supported by many organizations across the labs and many local businesses; all of these individuals and companies were incredible partners."

MECHANICAL TECHNOLOGIST John Kelton (6123) sifts through salt beads in front of the recently completed, $10 million Molten Salt Test Loop. Molten salt is a popular storage medium and heat transfer fluid for concentrating solar power. (Photo by Randy Montoya)

Old heliostat mirrors pave new roads

When the American Recovery and Reinvestment Act funded a $3.7 million overhaul of the heliostat field at the National Solar Thermal Test Facility, it meant that the new, high-tech glass would produce hotter beams and more power to the top of the tower. It also meant that something had to be done with all the old glass, which had been faithfully reflecting and focusing the sun's rays since the facility was constructed in 1976. With more than 5,700 individual facets on the 218 heliostats, renovation coordinators decided to recycle the more than 250,000 pounds of old glass. The glass was ground into small pieces, which could then be used under asphalt to pave new roads. The work earned the team a Sandia EMS Award of Excellence in Recycling.

ALL 218 HELIOSTATS at the National Solar Thermal Test Facility received new glass as part of the upgrade. The new, high-tech facets are more reflective and can generate hotter beams and more power to the top of the Solar Tower. (Photo by Randy Montoya)