A burning question

Sandia explores aggressive high-efficiency sparkplug-free gasoline auto engines

By Michael Padilla

Researchers at Sandia’s Combustion Research Facility are playing a key role in developing sparkplug-free engines that will help meet ambitious automotive fuel economy targets of 54.5 miles per gallon by 2025. They are working on low-temperature gasoline combustion (LTGC) operating strategies for affordable, high-efficiency engines that will meet stringent air-quality standards.

Sandia researches Isaac Ekoto and Benjamin Wolk (both 8632) say the goal of the LTGC project is an engine in which chemically controlled ignition initiates the combustion of dilute charge mixtures.

“The use of dilute mixtures avoids high flame tempera-
tures that can lead to nitrogen oxide formation,” Isaac says. “LTGC operation increases engine efficiency relative to con-
ventional spark-ignited gasoline engines through reduced heat transfer and pumping losses, along with increased con-
version of fuel chemical energy into usable work via higher compression ratios and mixture-specific heat ratios.”

Overcoming slow burn-rate misfires

The research challenge has been to achieve effective auto-
ignition control when an engine is idling or at other low-load operating conditions, where slow burn rates can cause frequent misfires.

The research was published in the September 2015 issue of the SAE International Journal of Fuels and Lubricants in a paper titled “Detailed Characterization of Negative Valve Overlap Chemistry by Photoionization Mass Spectroscopy.” The work was recognized by the Society of Automotive Engineers of Japan (JSAE) as the best paper of 2015.

(Continued on page 4)

Sandia helps spread lessons learned from Japanese reactor accident

By Stephanie Holinka

When you’re an operator or engineer at a nuclear power plant, there are things you want to know long before you’re faced with an emergency.

The Technical Support Guidelines (TSG) Skillset Workshops, developed by the General Electric Boiling Water Reactor (BWR) Owner’s Group, bring together experts from Sandia and other places who share with engineers/operators the lessons learned in the wake of the Fukushima Daiichi nuclear accident and other severe accidents at nuclear power plants that pushed the facilities past their conceivable limits.

The workshops seek to demystify what actually happens during an accident, to help engineers/operators learn what types of decisions might need to be made in the event of an accident at their plant, and to provide insights into the non-intuitive nature of accidents. To date, workshops have been held in Taiwan, Japan, and the US, with additional workshops planned for Switzerland, Mexico, Spain, and the US.

What to expect next

“By walking participants step by step through what happened during a real-world accident, operators/engineers can use that information to know where they are in the accident process, so they know what to expect next, particularly when the accident could progress in ways that are unexpected,” says Randy Gauntt, manager of Severe Accident Analysis (NRC). Sandia brings decades of experience to the workshops. The Labs’ analytical software, developed for the US Nuclear Regulatory Commission (NRC), was used by Sandia to advise the NRC, DOE, and TEPCO, the Tokyo Electric Power Company, on the accident progression at the

(Continued on page 4)

Lessons from Fukushima

NUCLEAR ENGINEER Douglas Osborn (6232) shows student intern Anastasia Fox (6234) the results of an experimental setup that resulted in the zirconium cladding of a fuel cell catching fire. Douglas is one of the Sandia engineers sharing the lessons learned from mining Fukushima data with nuclear plant operators, to give them the knowledge they’ll need in the unlikely event of an accident.

(Continued on page 4)
That's that

Graduation! It's a rite of passage associated with caps and gowns and cookouts...and words, words, words. Commencement speaker words, valedictorian words, principal and doting grandparent words. And words, words, words. Commencement speaker words, valedictorian words, principal and doting grandparent words.

But there's more. Graduation is also a time to reflect on your years in school, to look back at the challenges you've faced and the successes you've achieved. It's a time to consider your future, to imagine what you want to do and where you want to go. It's a time to think about the people who have supported you and helped you along the way.

So here's my graduation speech: you have maybe 70 years on this planet to sort through your experiences, to learn from them, and to make the most of the time you have. It's not easy, but it's not impossible. You can learn from your mistakes and make better decisions in the future.

Here are some thoughts to consider:

1. Embrace change: The world is constantly changing, and you need to be able to adapt. Learn new skills, take on new challenges, and be open to new experiences.

2. Find your passion: It's important to find something you热爱, something that makes you happy and fulfilled. Whether it's a career, a hobby, or a personal interest, pursue what you love.

3. Be kind: Treat others with compassion and respect. Whether you're dealing with your friends, family, or strangers, be kind and considerate.

4. Take care of yourself: Make time for self-care, whether it's exercise, meditation, or just taking a break. Your health is important.

5. Give back: Find ways to give back to your community, whether it's through volunteering, donating, or simply being a good citizen.

I hope you find these thoughts helpful as you move forward in your lives. Remember to stay curious, to be open to new experiences, and to find joy in the journey.

See you next time.

— Bill Murphy (MS 1468, 505-845-0845, wtmurph@sandia.gov)
Honoring math, science excellence

Recognition program for high school girls celebrates 25th year at Sandia/California

By Patti Koning

Celeste Rohlfing, chief operating officer at the American Association for the Advancement of Science (AAAS), presented Sandia’s 25th annual Math and Science Awards to 28 young women from San Francisco Bay Area high schools. Rohlfing, a chemist at Sandia for 11 years, was one of the founders of the awards.

“I am very proud of the hard work and academic accomplishments of this year’s winners,” said Marianne Walck, vice president of Sandia’s California site. “I hope this award and the connections made with Sandia mentors will inspire and encourage them throughout their professional journeys.”

The Math and Science Awards program encourages high-achieving young women to continue studying STEM (science, technology, engineering, and math) subjects and creates mentoring opportunities with Sandia employees. Teachers from 15 northern California high schools in Livermore, Dublin, Pleasanton, Tracy, Lathrop, Manteca, and Oakland nominated students they deemed outstanding in math and science.

“Twenty-five years ago we realized that while young women were excelling in their high school math and science classes, we weren’t seeing them in similar numbers in senior positions in industry or academia. The Math and Science Awards was our way of helping to address that problem,” said Cathy Branda (8633), one of the awards organizers and manager of the Systems Biology group.

The winners were recognized with certificates from Sandia and State Assemblywoman Catharine Baker.

Open mind, innovation keys to future success

Honorees, families, and teachers mingled with Sandia researchers and learned about careers in math and science. Kicking off the ceremony, Rohlfing spoke about the history of the awards program and her career path, which also included serving as the assistant director for physical sciences at the White House Office of Science and Technology and deputy assistant director at the National Science Foundation.

“I gave the inaugural address at the first Math and Science Awards 25 years ago,” said Rohlfing. “I am overjoyed to see that these awards have not just endured but become bigger and better.”

Rachelle Hamblin (8633) shared her journey from Math and Science awardee to college intern to technologist in the Systems Biology group. She credited her exposure to the people and research at Sandia with inspiring her to pursue a dual medical degree and master’s degree in public health at the University of Texas at San Antonio.

She imparted some advice to the awardees for taking advantage of the exciting years to come.

“Keep an open mind, never take ‘no’ for an answer, be innovative” said Rachelle. “And network, network, network.”

The winners of the 2016 Sandia Math and Science Awards are:

**Outstanding Achievement in Mathematics**
- Alyse Coonce, Amador Valley High School
- Ana Lapota, Coliseum College Prep Academy
- Lashauna Klindzuk, Dublin High School
- Emily Allendorf, Granada High School
- Rania Ibrahim, John C. Kimball High School
- Ayber Ocsona, Lathrop High School
- Samantha Dukes, Livermore High School
- Audrey Kurz, Livermore Valley Charter Preparatory
- Jazmine Jaring Angeles, Merrill F. West High School
- Dayanara Salinan, Millennium High School
- Margaret Austin, Oakland Tech High School
- Eunice Han, Skyline High School
- Alexandra Uskov, Tracy High School

**Outstanding Achievement in Science**
- Sandhya Kalavacherla, Amador Valley High School
- Nauni Montenegro, Coliseum College Prep Academy
- Naya Peddireddy, Dublin High School
- Allison Kifer, Granada High School
- Autumn Armstrong, John C. Kimball High School
- Farhat Khairzadah, Lathrop High School
- Raina Jaing, Livermore High School
- Shannon Meyer, Livermore Valley Charter Preparatory
- Jordan Hensley, Manteca High School
- Jennifer Lukban, Merrill F. West High School
- Alexis Diaz, Millennium High School
- Merisa Bridgeeman, Oakland Tech High School
- Miranda Beezner, Sierra High School
- Tiffany Wong, Skyline High School
- Erika Pulliam, Tracy High School

**Making Their Mark** — In the photo at top right, guest speaker Celeste Rohlfing, third from left, front row, is joined by the organizers, speakers, and mentors involved in this year’s Math and Science Awards ceremony recognizing young women from San Francisco Bay area high schools. Rohlfing, chief operating officer of the American Association for the Advancement of Science, worked at Sandia for more than a decade and was one of the founders of the award 25 years ago. In the center photo, Rohlfing, at left, joins recipients of math awards and in the bottom photo she stands with young women recognized for achievements in science.

(Photos by Randy Wong)
Lessons from Fukushima

(Continued from page 1)

Fukushima Daiichi site

Sandia began its studies of responses to severe nuclear accidents shortly after the Three Mile Island incident in Pennsylvania in 1979, an event that radically altered the future of nuclear power in the United States. Since then, Sandia has provided domestic and international industry as well as US and foreign governments regulatory research support into severe reactor accidents for more than 40 years, and serves as the NRC’s principal contractor for severe accident research.

Accidents progress in surprising ways

Not all plant accidents are the same. Some things about the Fukushima incident were surprising.

“The pumps that should have failed in a few hours ran for days, well beyond their expected design basis,” says Douglas Osborn, a technical staff member in Sandia’s Severe Accident Analysis Dept. 6232.

Doug says that in the Fukushima incident, the expected reactions that create hydrogen led to explosions in the Units 1, 3, and 4 reactor buildings.

“As the core heated to temperatures of about 1,832 F (1,000 C), the fuel cladding metal reacted with the steam in an exothermic oxidation reaction, leading to rapid temperature increase to the point where water didn’t provide sufficient cooling and created large amounts of hydrogen. The cladding and fuel began to melt, while cladding oxidation continued,” Doug says.

Doug says the reactor core material fails at the bottom of the reactor vessel, and the molten core material freely water, hydrogen, carbon monoxide, and carbon dioxide from the concrete as well. When the core material mixed with zirconium and steel oxidizes on the concrete, large quantities of combustible gas, hydrogen and carbon monoxide, can be generated while generating additional heat. The combustible gases may burn above the molten pool or may accumulate with the other gases to pressurize the containment.

Many of these accident progressions are still being analyzed with the data from the Fukushima accident to determine the conditions of the core and provide insights for engineers/operators for preventing another accident.

Characte...
PECASE is highest US honor for early-stage researchers

Melissa Teague awarded Presidential Early Career Award

By Neal Singer

Materiales engineer Melissa Teague (1851) has been awarded a Presidential Early Career Award in Science and Engineering (PECASE), the highest honor the US government bestows on scientists and engineers in the early stages of their independent research careers. While awards are acknowledged for their strong commitment to improving the quality of life for African Americans in Albuquerque, thereby causing a perfect match for my interests," says Yvette Kaufman-Bell, executive director of the Department of African American Affairs. "My work at Idaho National Laboratory was done at the mesoscale level, a relatively underexplored range compared with atomistic and macroscopic investigations of fuel behavior. Melissa signed on at Sandia less than a year ago, and looks forward to exploring a wide range of materials here. But she’s no stranger to Sandia. As an undergraduate in ceramic engineering at the University of Missouri-Rolla, she was mentored by Tina Nenof (1106) and Margaret Gordon (6721) in summer 2004, growing and testing zeolite membranes, and by now-retired Ron Lieberman in 2005, with whom she tested a variety of glass-steel seals. She also met and as a member of the Health Sciences Center board of directors. In his nomination letter, Ron Wallace, editor of The Albuquerque Journal, described Theresa as “innovative, dedicated, and as a member of the Health Sciences Center board of directors.”

Two Sandians have been named recipients of 2016 Outstanding Service Awards from the New Mexico Office of African American Affairs (OAAA). Accomplished research engineer Conrad James (1714) and supply chain management engineer Melissa Teague (1851) have been acknowledged for their strong commitment to improving the quality of life for African Americans in the community. The OAAA’s annual service awards recognize dedication to education, community development, health care advocacy, and economic advancement for African Americans.

New network brings people together

Theresa is acknowledged for creating a professional networking group to benefit African Americans in Albuquerque. There’s a lack of community here for African Americans, thereby causing them to seek job opportunities in other states. We found it important to create a network to connect the 2 percent of African Americans in our city to network and share information about cultural services and become involved in community activities.”

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“Thence through his work as a legislator, Conrad has been dedicated to the community at large and all communities of color,” says Veerka Kaufman-Bell, executive director of the Office of African American Affairs, who nominated him for the award. “He is a champion for education, and has made an impact on policy for our youth, our elders, and our local business owners,” she says. Kaufman-Bell adds, “Conrad is just such a great spirit embracing our new residents is rewarding enough.” In the Albuquerque community Theresa has served as a member of the Albuquerque Academy Board of Directors. For the past two years she has volunteered as co-chair for the National Museum of Nuclear Science and History’s Discover STEM program and she also serves on three Calvary of the Southwest boards.

State office honors Conrad James, Theresa Carson

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From learning how a full-scale optical engine works to touching actual munitions destroyed by the Explosive Destruction System to watching predators munch on algae in a photobioreactor, the community got a rare glimpse into Sandia/California at an event in downtown Livermore on May 21.

The more than 500 community members who attended viewed 18 displays and met with more than 30 Sandia researchers, engineers, and scientists. The program included remarks from Sandia President and Labs Director Jill Hruby and Marianne Walck, VP of Sandia's California site and the Labs' Energy and Climate program. US Rep. Eric Swalwell, D-Calif., Assemblywoman Catharine Baker, Alameda County Supervisor Scott Haggerty, Livermore Mayor John Marchand, and Lawrence Livermore National Laboratory Deputy Director Thomas Gioconda all congratulated Jill and Marianne on the anniversary and shared their connections with Sandia/California.

Sandia systems analyst and engineer Jarret Lafleur (8118) gave a talk on "The Perfect Heist" and Cybersecurity R&D Manager Levi Lloyd (8965) spoke on "Cybersecurity: Challenges and Opportunities in the Digital Age."

The event brought together Sandia's education outreach programs with hands-on scientific activities from Family Science Night and Expanding Your Horizons volunteers. A local Girl Scout robotics team demonstrated its favorite robots and Livermore High School Green Engineering Academy students displayed their "Seniors helping Seniors" engineering projects. Activities included making molecules using miniature marshmallows, creating miniature robots, and, one of the most popular activities, making paper glow using copper tape, LEDs, and watch batteries.

Sandia recruiters discussed careers and job opportunities at Sandia/California with visitors. Erin Chandler (3553) says the best part of the day was seeing all the young adults interested in internships at the site in the near future.

"Seeing their excitement about engineering and science and the possibility of working at our lab made for a very rewarding day," she says. "Everything went so smoothly and I don't think we should wait another 60 years to have another community event."

This first-of-its-kind event greatly exceeded expectations, both in the number of attendees and the level of interest from the general public.

"This was the first time that we have had a lab-wide event out in the community," Marianne says. "It was terrific to see so much passion and dedication for our work displayed at the event, and I look forward to our continuing outreach in the community."

By Michael Padilla
The wild blue yonder

Photos by Randy Montoya

Tens of thousands of New Mexicans turned out on Saturday and Sunday, June 4-5, to help Kirtland Air Force Base celebrate its 75th anniversary with an air show and ground displays. Aircraft on the field, many of which were opened to allow visitors to walk through and even sit in the pilot’s seats, included the latest, most modern planes in the Air Force inventory as well as vintage aircraft that earned a proud heritage of defending the nation during times of war and peace. KAFB has been the home of Sandia dating back to the days when the Labs was known as Z Division and was still part of Los Alamos Laboratory (as it was then called).

In the photos here clockwise from top, *Sentimental Journey*, a World War II-vintage B-17G, makes a memorable flyover; a T-6 Texan trainer, introduced in the 1940s and in active service until the 1970s, performs aerobatic maneuvers; two C-130s, which have been in the Air Force inventory since the 1960s, fly in close formation; crowds of people explore the cavernous cargo space of a C-5 Galaxy, one of the world’s biggest planes; a futuristic-looking B-2 stealth bomber makes a pass over the airfield; and a member of the Wings of Blue parachute demonstration team makes a dramatic entry onto the airfield.
Small companies grow with a technical leg up

By Nancy Salem

Imagine driving a car down the highway with no fuel gauge and no idea how big the gas tank is. You want to go as far as possible before filling up but not so far that you spotlight to a halt. "That’s what it’s like to operate an electric plane or robot or other device that relies on a lithium battery," says Albuquerque businessman Greg Walker. "I wanted a technology to show how much power such a battery has at any particular time."

Walker is the chief operating officer of Silent Falcon UAS Technologies Inc., which makes electric-powered drone aircraft. The company found four other small New Mexico businesses that use battery technology in everything from robots to motion picture filming. They joined forces to develop a technology to monitor the health of battery packs for all kinds of unmanned vehicles. "Lithium batteries in aircraft and robots are big," Walker says. "Our challenge was to push the battery as far as possible but not crash."

The group needed help and reached out to the New Mexico Small Business Assistance (NMSBA) Program, a public-private partnership among Sandia, Los Alamos National Laboratory, and the state of New Mexico that connects small business owners with scientists and engineers who provide technical assistance.

They were teamed with Sandia electrical engineer Von Trullinger (5315) and materials scientist Dan Weskolowski (2545) who, during the past year and a half, have improved lithium-ion battery technology to show how much power such a battery has at any particular time. (Photo by Norman Johnson)

"NMSBA has been bringing small businesses together in a small-business cluster at the Alamogordo Science and Technology Park want to capture a piece of that market by developing advanced unmanned mobile robots. Two of the companies, Emerging Technology Ventures Inc. and North Alabama Robotic Systems Inc., make unmanned vehicles for land, air, and sea. Motion Picture Marine Inc. uses unmanned vehicles to create sequences for motion pictures like X-Men, Armageddon, and Star Trek. American Lithium Energy Corp. makes lithium-ion batteries that power unmanned vehicles. Walker says the battery management technology would not have been possible without the help of a Sandia team assembled by Von working in software, hardware, programming, and battery chemistry. "The first year was about getting the hardware together and building circuits," Walker says. "This year we’re looking at what breaks a battery. How healthy is it? How do you know when a battery is being worn out?"

Walker says the Smart Battery Manager is being used by American Lithium Energy Corp. to help with its battery chemistry. "Smart Battery Manager helps these business people realize their dreams, and stimulates our state’s economy."

A market for unmanned vehicles

The global market for unmanned vehicles was $2.29 billion in 2015 and is estimated to reach $4 billion by 2020. Silent Falcon and four companies in a small-business cluster at the Alamogordo Science and Technology Park want to capture a piece of that market by developing advanced unmanned mobile robots. Two of the companies, Emerging Technology Ventures Inc. and North Alabama Robotic Systems Inc., make unmanned vehicles for land, air, and sea. Motion Picture Marine Inc. uses unmanned vehicles to create sequences for motion pictures like X-Men, Armageddon, and Star Trek. American Lithium Energy Corp. makes lithium-ion batteries that power unmanned vehicles.

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Walker says the Smart Battery Manager is being used by other partners and will be in place in his company’s planes later this year. "Everything about the technology is getting better," he says.

Powerful transformers

Tibbar Plasma Technologies Inc., the other Ben Lujan Award winner, worked with Los Alamos National Labora-

(Continued on next page)
Transforming tragedy into good practices

Los Alamos Lab accident focus of lessons learned forum during Electrical Safety Month

By Karl Masse

May 3, 2015, an electrical substation was undergoing maintenance and cleaning at Los Alamos National Laboratory (LANL). An electrical worker, intending to do a thorough job, opened a panel he didn’t realize was energized. When he sprayed a cleaning fluid on the equipment, an electrical breakdown resulted in an arc flash and blast. The worker received third degree burns over 30 percent of his body and was airlifted to Albuquerque for emergency treatment. Eight other individuals at the substation were also hospitalized. After an extended recovery period, the critically injured worker recovered and has returned to work at LANL.

Since that incident, much work has been done to understand what led up to the event and how such accidents can be prevented in the future across the DOE complex.

This year, during an electrical safety fair at the Steve Schiff Auditorium on May 18, Sandia hosted Lloyd Gordon, LANL’s chief electrical safety officer, to share lessons learned and discuss the enhancements that were made to its safety program as a result. Five other LANL workers also attended to share information about the incident.

Just as many people clearly remember what they were doing when the Challenger exploded in 1986 or the events of Sept. 11, 2001, Gordon said, and especially the fact that fellow LANL employees were injured, perhaps critically, was seared into his memory.

In the investigations that followed, among the findings were weaknesses in worker practices, confusion related to look-a-like equipment, and the lack of robust zero-energy verification. In addition to improvements to LANL’s electrical safety program and its training regimen, the increased focus on Human Performance Improvement (HPI) concepts have also strengthened the safety culture across the lab.

“Our goal is that every employee sets the example. We are encouraging ‘leadership for all,’” Gordon said, adding that LANL is working to fully implement other HPI tools. In addition to encouraging workers to have a questioning attitude, stopping work, and recognizing hidden hazards, the Lab is employing both pre-job risk assessments and real-time risk assessments.

“This different approach to looking at risk assessments is going to change the way we approve electrical work and prevent injuries,” he said. “Workers and planners all need to apply risk assessments at the site while the work is being done.”

“Lessons from this accident are also just as relevant to researchers,” Lloyd added. “You can make the same mistakes no matter what work you do.”

Dan Pellegrino, assistant manager of the NNSA Sandia Field Office, also addressed the audience during the forum.

“I’m hopeful that during this focus time on electrical safety, you will hear something that will stick and it will be just enough to prevent an accident” he said.

Dan also added, “Sandia’s desire to share lessons, and more importantly, the desire to learn from mistakes — their own and others — have helped drive improvements in safety.”

Electrical safety incidents at Sandia were reduced by nearly 50 percent from 2014 to 2015. “We’ve made great strides in preventing injuries from electrical events,” ES&H acting deputy director Natalie Cutter (4130) said. “That is why commemorating Electrical Safety Month is one way to maintain that momentum.”

...
Celebrating innovation

Former EMCORE CEO Hong Hou was honored as Sandia's first Entrepreneurs Hall of Fame inductee during a ceremony at the 7th annual Innovation and Intellectual Property Celebration last month at the Hotel Albuquerque. The annual event, sponsored by Sandia's Partners Group, honors the innovative culture and intellectual property generated by Sandia's scientists, engineers, and technologists.

Hong Hou has been named the first inductee in Sandia's Entrepreneurial Hall of Fame. The former Sandian was CEO of EMCORE for many years of growth. Patents and Trademark Office website (www.uspto.gov).

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).

**Recent Patents**

Shawn M. Dirk (2241): Polymer Scaffold Degradation Control Via In situ Chemical Control. Patent No. 9,228,042.


James G. Chow (5349) and Mark W. Koch (5448): Terrain Detection and Classification Using Single Polarization SAR. Patent No. 9,239,431.


Kevin H. Brown (5553), Peter G. Stromberg (5556), Mathew Napper (5556), Tammy D. Henson (5783), and Seforine Krolet (5786): Gibbied Multispectral Imaging System and Method. Patent No. 9,244,264.


Michael D. Boyd (5350) and Jeffrey Farrow (8113): Protocol for Communications in Potentially Noisy Environments. Patent No. 9,258,244.


Mark J. Monda (6512), Clintion G. Hobart (6512), and Thomas S. Gladwell (6532): Precision Disablement Aiming System. Patent No. 9,261,317.


SANDIA CHIEF TECHNOLOGY OFFICER and Div. 1000 VP Rob Leland (left) with Up and Coming Innovator award recipient Miguel Alejandro Aguil Valentin.
Great pickings for a locksmith

Over the next 15 years, Steve practiced his craft and continued to hone his skill set. By 1990, he had earned his "certified master locksmith" designation from the Associated Locksmiths of America. The company he worked for did some contract work for Sandia; that was Steve's introduction to the Labs. For a locksmith, Sandia — with its 10s of thousands of locks on vaults, safes, doors, vehicles, desks, and cabinets — was fertile ground. There was always plenty to do and lots to learn. And keeping up with rapidly changing lock technology was always demanding.

Eventually, with his growing expertise, Steve moved from the Labs fulltime, while his wife and son continued to run Sandia's Steve Highland Locksmith, to doing familiar, if demanding, locksmith duties — everything from removing building locks to responding to emergency calls to helping a distressed employee who somehow locked himself in his office.

'A challenge every day'

Eventually, with his growing expertise, Steve moved from day-to-day locksmithing chores to Sandia's Access Delay and Structural Assessment organization, which designs safeguards to deny access to critical resources. With his broad knowledge of locks and safes, Steve brought a unique real-world perspective to the team. He knows how locks work and he knows how the bad guys defeat them. He often helps train his coworkers on the other side of the lock, and not pleasant surprises.

Steve makes clear, too, that there is really no such thing as an impregnable system — that's the premise behind access delay: You want to have a system that prevents access to the controls that operate the lock. But the bad guys defeat every electronic lock.

...the 'master' certification is very tough to achieve, he says. "I'm proud to be the only CMST in New Mexico, and I am a Sandian!!"

Steve reflects on that fork in the road that led him to where he is. As a high school senior, he had an opportunity to apprentice in the hospitality industry at a local Holiday Inn, but opted for the locksmith program. Looking back, he's glad he did. "It's my living and my calling," he says.

During the course of his career, Steve Highland has had to learn about safe technology through the years, from antennas like this 1880s Diebold safe to the most modern high-tech digital devices. (Photo courtesy Steve Highland)

In 1993, Steve started his own locksmith business and continued to do contract work for Sandia. In 2000, he joined the Labs fulltime, while his wife and son continued to run the locksmith business. In Sandia he spent several years doing familiar, if demanding, locksmith duties — everything from removing building locks to responding to emergency calls to helping a distressed employee who somehow locked himself in his office.

Getting a lock on it

Sandia’s Steve Highland becomes New Mexico’s only Certified Master Safe Technician

For Steve Highland, that epic snowstorm in southern Illinois in 1984 was the last straw. As he recalls it, there were 2 feet of snow on the ground in Carbondale, the wind was crazy bad, and the temperature — not the wind chill factor but the actual air temperature — was minus 20 degrees. And oh, the sewers froze.

The soundtrack of Steve's life at this point could have been Eric Burdon and the Animals' iconic "We gotta get out of this place." Burdon sang in his distinctive, gravelly voice, "We gotta get out of this place / If it's the last thing we ever do / We gotta get out of this place / Got, there's a better life for me and you."

The young family man knew just what Burdon meant; he and his high-school sweetheart wife were ready for a change.

Steve, who had learned the locksmith trade in the early 1970s through a high school apprenticeship program, started looking around for other opportunities in the trade — in someplace warm.

In a trade publication, he learned about a job opening at a safe and lock business in Albuquerque. After looking the place up on a map, and noting that it was well south of Carbondale, he mailed off his resume. The owner was impressed enough that he decided to fly Steve out for a first-hand look. Meeting the young man and assessing his skills, he offered Steve a job.

Great pickings for a locksmith

Over the next 15 years, Steve practiced his craft and continued to hone his skill set. By 1990, he had earned his "certified master locksmith" designation from the Associated Locksmiths of America. The company he worked for did some contract work for Sandia; that was Steve's introduction to the Labs. For a locksmith, Sandia — with its 10s of thousands of locks on vaults, safes, doors, vehicles, desks, and cabinets — was fertile ground. There was always plenty to do and lots to learn. And keeping up with rapidly changing lock technology was always demanding.
Getting a lock on it  Sandia’s Steve Highland becomes New Mexico’s only Certified Master Safe Technician

By Bill Murphy

For Steve Highland, that epic snowstorm in southern Illinois in 1984 was the last straw. As he recalls it, there were 2 feet of snow on the ground in Carbondale, the wind was crazy-bad, and the temperature — not the wind chill factor but the actual air temperature — was minus 20 degrees. And oh, the sewers froze.

The soundtrack of Steve’s life at this point could have been Eric Burdon and the Animals’ iconic “We gotta get out of this place.” Burdon sang in his distinctive, gravelly voice, “We gotta get out of this place / If it’s the last thing we ever do / We gotta get out of this place / Gof, there’s a better life for me and you.”

The young family man knew just what Burdon meant; he and his high-school sweetheart were ready for a change.

Steve, who had learned the locksmith trade in the early 1970s through a high school apprenticeship program, started looking around for other opportunities in the trade — in someplace warm.

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The Illinois native moved his family to the sunny Southwest, with an emphasis on sunny.

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In 1993, Steve started his own locksmith business and continued to do contract work for Sandia. In 2000, he joined the Labs fulltime, while his wife and son continued to run the locksmith business. At Sandia he spent several years doing familiar, if demanding, locksmith duties — everything from rekeying buildings to responding to emergency calls to helping free a distraught employee who somehow locked himself in his office.

‘A challenge every day’

Eventually, with his growing expertise, Steve moved from day-to-day locksmithing chores to Sandia’s Access Delay and Structural Assessment organization. Steve recently completed course work and exams to become New Mexico’s only Certified Master Safe Technician.

Structural Assessment organization, which designs safeguard systems, to deny access to critical resources. With his broad and deep knowledge of locks and safes, Steve brought a unique real-world perspective to the team. He knows how locks work and he knows how the bad guys defeat them. He often red-teams security systems, helping the engineers identify vulnerabilities in their design.

Steve makes a couple of points about physical security. First, a secure system is about much more than a lock in a door; the lock is part of a more complex system. In a sophisticated system, defeating the lock may be the least of a bad guy’s problems. He’s going to find a lot of surprises on the other side of the lock, and not pleasant surprises.

Steve makes clear, too, that there is really no such thing as an impregnable system — that’s the premise behind access delay: You want to have a system that throws up barriers to entry, to slow down the bad guy long enough for a response team to foil the attempted breach. In fact, locks and safes are rated by just this factor: how long it takes a malefactor to defeat the lock using drills, acids, torches, or explosives without damaging or destroying the goods inside.

“It’s a challenge every day,” Steve says. “I never have boring days. A lot of guys come and consult with me. I love being involved in the design of physical security systems. That’s a wide realm and open to a lot of creativity. I love working with my team; they are some smart dudes.”

Realizing a long-time goal

As busy as he is, Steve recently completed what for him has been a decades-long goal: he earned his “Certified Master Safe Technician” (CMST) credential, a designation awarded by the Safe and Vault Technicians Association. It’s the PhD of the safe and lock world, with a daunting list of course requirements. Here’s a small sampling of the skills and knowledge a CMST must demonstrate: troubleshooting and dialing diagnostics; theory of manipulation; drilling; advanced borescope techniques; uncommon safes; high-security safe construction; and lots more.

“The ‘master’ certification is very tough to achieve,” Steve says. “I’m proud to be the only CMST in New Mexico, and I am a Sandian!” Steve reflects on that first fork in the road that led him to where he is. As a high school senior, he had an opportunity to apprentice in the hospitality industry at a local Holiday Inn but opted for the locksmith program.

Looking back, he’s glad he did. “It’s my living and my calling,” he says.

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STEVE HIGHLAND, who started at Sandia as a locksmith in 2000, is now part of the Labs’ Access Delay and Structural Assessment organization. Steve recently completed course work and exams to become New Mexico’s only Certified Master Safe Technician. (Photo by Randy Montoya)