Algae nutrient recycling a triple win

Sandia method cheaper, greener, cuts competition for fertilizer

By Patti Koning

Nitrogen and phosphate nutrients are among the biggest costs in cultivating algae for biofuels. Sandia molecular biologists Todd Lane (8633) and Ryan Davis (8624) have shown they can recycle about two-thirds of those critical nutrients, and aim to raise the recycling rate to close to 100 percent. Recycling nitrogen and phosphate has benefits that go far beyond cost. While nitrogen can be produced through a close to 100 percent. Sandia's telemetry work ramps up as weapons program intensifies

By Michael Padilla

As Sandia's nuclear weapons program continues to execute three full-scale engineering development programs to help extend the life of the stockpile, Sandia's Telemetry Systems departments have seen a dramatic increase in their work in designing, building, and testing high-performance instrumentation systems for ground and flight tests. These organizations are responsible for developing data instrumentation systems to support various nuclear weapons programs for the DoD and NNSA. The systems created at Sandia/California are used by weapon development and stockpile evaluation programs to collect weapon performance data, which is used in qualification activities and annual assessments.

WEAPON PERFORMANCE DATA COLLECTORS — Brett Chavez and Jerrod Peterson (both 8135) build and test high-performance instrumentation systems for ground and flight tests. (Photo by Dino Vournas) The next generation of telemetry systems

Since the early 1980s, Sandia/California has helped lead the telemetry systems work for the Joint Test (Continued on page 4)
Diversity and Inclusion: What’s in it for me?  
– One white male’s perspective

By Bert Debusschere

A few months ago, a visitor in our group who wanted to inject humor into the topic of computer model selection showed a slide with swimsuit models in a beauty pageant. Fortunately, no women were present. However, such messages contribute to an environment where women do not feel valued for their professional contributions. Indeed, the scientific community has a way to go yet when it comes to diversity (which I think of as the collection of all of our differences) and inclusion (valuing people for what makes them unique).

Truth is, a few years ago, I probably would have failed to pick up on this not-so-subtle message and would have chuckled along with everyone else in the room. Growing up in Belgium, in a very homogeneous society, I did not interact with many minorities. Further, being in a boys-only school from elementary level through high school and then going on to study in the male-dominated field of engineering did not help my comfort level around women, let alone my ability to relate to their perspectives. As such, for most of my life, I have been pretty disconnected from minorities and women.

On the surface, this did not seem to affect my technical career at Sandia too much. Being in a white male-dominated workforce, my unease around women and minorities was not openly a roadblock. Did I ever knowingly discriminate against or talk ill of women and minorities? Not that I am aware of. However, my discomfort with women and minorities left my implicit biases unchecked, which probably clouded my impressions of interview candidates, research collaborators, and others.

Over the past few years, however, I have participated in some in-depth personal development and diversity training opportunities at Sandia. Through many uncomfortable, but very enriching, conversations, I started seeing and facing my biases and fears. In the past, I was hesitant to discuss issues such as racism or sexism. For fear of exposing my ignorance or offending someone. By developing trusting relationships, we can have these conversations openly and grow in the process. Working through all of this with a diverse group of people built an enormous amount of interpersonal trust, which enabled me to develop some very deep connections with women and minorities.

I tend to work in teams that are much more diverse now. This does lead to uncomfortable situations occasionally, such as the time we worked with a group that kept using the term “master/slave model” for computer task management. Awkward? Yes! But as a group, we talk a lot about it, rather than ignoring it. By developing trusting relationships, we can have these conversations openly and grow in the process. Working through all of this with a diverse group of people built an enormous amount of interpersonal trust, which enabled me to develop some very deep connections with women and minorities.

Besides these obvious benefits to my work at Sandia, I have found that by being able to develop stronger connections with minorities and underrepresented groups, all of my other relationships have also improved substantially. Diversity and inclusion is not just about how we treat minorities and underrepresented groups, it’s about us treating everyone. A friend of mine recently commented that I tend to “smile more and seem happier. I am right. I am happier with my work and my life in general.”

What promise does a more diverse and inclusive environment hold for you?
Jill Hruby makes first visit to Sandia/California as Labs leader 'Lab is incredibly healthy,’ new Sandia president and Labs director reports at all-hands meeting

By Michael Padilla

"It’s great to be back in California," Jill Hruby told a standing-room-only crowd in the Combustion Research Facility auditorium during an all-hands meeting as part of her first official visit to Sandia/California as Sandia’s president and Laboratories director. "The Lab is incredibly healthy," Jill said. "We are in a really sweet spot right now in the Laboratories’ history — I’ve worked here a long time — we occasionally get sweet spots, and we are in one of them. The reason why we are in a sweet spot is because we have a very active, very challenging nuclear weapons program."

Jill highlighted the progress Sandia has made in strengthening its nuclear weapons program and discussed the efforts to ensure that the work is delivered on time, on schedule, and on cost. She mentioned the continued work on the B61 Life Extension Program and the work on the W80-4 executed in California. She also highlighted the recent, successful B61-12 Life Extension Program development flight test at Tonopah Test Range conducted this summer. The flight test consisted of hardware designed by Sandia.

"Our reputation is really high right now as a result of that," she said. "We need to be careful not to be oversold. There is a lot to do in New Mexico and in California, and we are doing it. I have great confidence that we will continue to deliver on all weapons programs."

When the nuclear weapons program is healthy, Jill said, the Laboratory is in great shape. She also emphasized the work Sandia does in cyber, space, advanced conventional weapons, intelligence work, energy, and bio.

"We have a lot of opportunities when the world is a complicated place, and right now the world is a complicated place," she said.

Jill noted that Sandia’s mission support activities are vital to the Laboratories’ well-being and emphasized that she wants to focus on mission work. She said Sandia’s new strategic plan — which will be released soon — will address the mission areas. She also mentioned the importance of safety and security at Sandia.

During the next couple of months, she said, the Laboratories will be engaged in the annual assessment of the US nuclear weapons stockpile, which will be submitted to the secretaries of Energy and Defense and the chairman of the Nuclear Weapons Council at the end of the fiscal year. Regarding the contract rebid for Sandia that ends April 30, 2017, Jill said she has a very simple message. "It’s all about the people," she said. "I’ve asked to please don’t mess with what matters to our workforce." She said she wants to make sure that Sandia can continue to deliver its mission and keep a healthy benefits program to encourage staff retention.

Questions concerning recruiting, retention, and pay differential for living in California were asked. She said that all these topics are being researched and that Sandia is doing its best to address those issues. Other questions and comments focused on ways to streamline processes and procedures at Sandia. Jill said that, as long as the Labs continues to meet the mission, she welcomes all suggestions.

She said she will continue to focus on listening to employees’ thoughts and "slowing down the train to ensure that the train remains on track."
Sandia's telemetry work kicks into high gear

“We have a bright future. We get to design, build, test, and deliver lots of hardware, which not everyone here onsite gets to do and we learn from each iteration. It's an exciting and challenging environment for our engineers.”

— Jennifer Clark (8135)

(Continued from page 1)

Assembly [JTA] program for the nuclear security enterprise. Currently, the California groups are working on several new telemetry systems to support the W88 ALT 370, B61-12, W80-4, and ML21 fuze program.

In addition to the high number of simultaneous development programs being supported, the amount of hardware being requested by these programs is at an all-time high. The telemetry groups do a large majority of this hardware development before transitioning it to the National Security Campus in Kansas City, Missouri. In today's environment of high-rigor qualification activities, the amount of hardware needed over the life of the program development to support their system-level test units has increased from a few handfuls in the past to today's steady stream of test units for the WBB ALT170 and B61-12.

Fully prototyped and proven operational

These newest telemetry (TM) designs also include new features. For example, earlier this year, the B61-12 telemetry team added a data recording capability to its instrumentation system design. The team's goal was to ensure all contact fusing end-event data will be captured during surveillance flight tests.

“This recorder — christened the HDR (hardened data recorder) — must be capable of recording all critical weapon scoring data in milliseconds while surviving free-fall ground impacts,” says Ryan Layton (8133). “A team of engineers from 8133 took on the challenge of building a smaller version of this HDR, leveraging the experience they gained building the B61 JTA modernization flight recorder.”

“The HDR is a small part of the B61-12 JTA telemetry system that plays a big role,” says Tim Kostka (8133). “Its job is to record and store data critical to assessing the reliability of the weapon.”

This is achieved by containing the electronics in a stainless steel housing and encapsulating them using dense, rigid foam. As part of the design process, the HDR will go through rigorous testing, including shock testing, before it is delivered and flown in the system.

The HDR has already been fully prototyped and proven operational during benchtop testing. From mid-August through September the product will undergo physical and thermal testing for performance at high temperatures, extreme cold temperatures, and a range of other environmental and mechanical conditions.

Development of new capabilities and technologies

Another challenge for these groups is finding ways to provide more and more data while still living within system-level design constraints.

The W88 ALT370 team recently successfully delivered units for an Environmental Development [JTA] (EDJTA). The purpose of the EDJTA flight bodies was to gather data as seen by the weapon throughout a typical flight profile. This information will be used to help create and validate environmental requirements for Weapon Reserve components. These units captured multiple channels of data from sensors located throughout the flight test body.

To be able to monitor the multiple channels of data at the requested sampling rate and transmission bandwidth needed by the W88 systems organization, the TM engineers needed to come up with a more efficient way of collecting and transmitting data.

They did this with two new design features. One was the implementation of a new compression algorithm, which allowed three times as many sensors to be monitored as would have been possible without compression.

“The algorithm allows transmission of the same or similar information in fewer numbers of bits,” says Bruce Brunett (8133). “In telemetry systems the goal is to balance between the amount of information conveyed and the bandwidth used in the transmission.”

There is a constant push to get more data from the units. But the limiting factor is the receiving assets on the ground that constrain the amount of information that is sent. The main objective was figuring out a way to get more information with fewer bits.

“The system was pretty challenging to implement,” says Jerrod Peterson (8135). “The work was driven by a real application, customer request, and also based on goals for the program. The challenge was placed on the team and we made leaps in capabilities.

The compression algorithm is also currently being used by other program telemetry teams as well. The second enabling feature in the W88 EDJTA bodies was the incorporation of a new transmitter that uses RF bandwidth more efficiently than the pulse code modulation — PCM — used in previous transmitter designs. Use of this modulation method allows a substantially greater percentage of data to be transmitted within the same RF bandwidth allocations.

A new battery pack

The W88 ALT TM also uses a new battery pack designed and developed by Sandia in Albuquerque. The new battery allows the TM to record environmental data prior to launch while the unit is still with the launch vehicle. This is a first for JTAs.

Typically a chemical battery is activated after launch and there is no way to collect in-tube data. Getting enough capacity in a small volume and getting certification for the battery to be flown during the test were two hurdles the group had to overcome. The battery went through extreme testing until approved for usage.

The telemetry groups work closely with organizations throughout the laboratories and rely on them to meet delivery of the products.

“Our work touches so many organizations including design engineering, shipping and receiving, test facilities, epoxy lab, and materials lab. All those people have done a wonderful job in supporting the telemetry systems groups in meeting their mission.”

Jennifer Clark (8135) adds, “We would not be able to fulfill our mission without them and because of these interdependencies, our engineers get to learn about the wide variety of capabilities and support that the laboratory has.”

The TM groups also interact with every weapon system since every system utilizes a TM system developed by these organizations. This gives these engineers a strong insight into the systems designs. “This makes TM a good stepping stone for designers wanting to eventually move into systems work,” says Jennifer.

In addition to this internal collaboration, the TM organizations work closely with partners at other DOE sites.

The future

There doesn’t appear to be any downturn in work for the telemetry groups any time soon. Within the next few years, as the current programs ramp down the W80-4 will be ramping up and several weapon systems groups are planning JTA refreshes.

In addition to this, the teams would like to invest in some new R&D activities including improved detonation monitoring and various kinds of optical sensing.

“We have a bright future,” says Jennifer. “We get to design, build, test, and deliver lots of hardware which not everyone here onsite gets to do and we learn from each iteration. It’s an exciting and challenging environment for our engineers.”
New opportunities for leadership and visibility in the DOE community

(Continued from page 1)

LN: What new perspective do you bring to Div. 8000 in the VP role?
MW: My deep background in energy includes experience in nuclear energy, fossil energy, environmental management, nuclear waste disposal, geothermal energy, and other areas that are relevant to Sandia’s energy programs. I’m also very familiar with leading diverse organizations that support multiple missions, which I believe is a useful skill for the California site.

LN: Do you think the California site has a recruitment and retention problem, and if so, how do you plan to address it?
MW: We have a great base of candidates from which to recruit in the Bay Area. However, retention is more challenging in California than New Mexico because the Bay Area has many more high-tech employers. As a result, our California site workforce experiences greater fluidity. Cost of living is an issue in California. The Human Resources department is addressing this issue, starting with adjustments to California salaries. Despite our efforts, we may still lose staff to private employers that can offer higher salaries and other benefits that Sandia can’t offer, like stock options. We need to plan for movement in our workforce and provide the best possible opportunities and experience so that those who leave are tempted to return and even bring others back with them.

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LN: In terms of opportunities, Secretary of Energy Ernest Moniz has been great for the energy side of DOE. He combined the Office of Science and Applied Energy programs under one umbrella to create a more efficient flow of basic research through application.

LN: How does Div. 8000 fit into Sandia’s mission area framework?
MW: Div. 8000 supports and is heavily involved in all four of Sandia’s mission areas. We play a vital role in nuclear weapons through the W80-4 Life Extension Program, Joint Test Assembly, and telemetry programs. The hydrogen program is rooted in California because of capabilities that were developed through gas transfer systems research. The California site also performs significant work in international nuclear security, radiation detection, transportation energy, bio energy and bio defense, and cyber.

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Gone phishing: LDRD project takes deep dive into exploring the user’s side

By Michael Padilla

Think before you click.

That is a key message Margot Kimura (IP666) wants people to remember before clicking on links, opening attachments, or responding with PII or other sensitive information in email. As part of an Early Career Laboratory Directed Research and Development (LDRD) project, Margot set out to understand email phishing and how people interact with their email.

One of the first tasks she did was to determine what phishing truly is.

To better define phishing, she looked at more than 100 phishing samples, and compared existing definitions against a set of four basic examples. She found that most definitions failed to capture the essence of the examples.

“I ran into a lot of problems where definitions were either over-specialized, or based on unsound assumptions,” Margot says. “I had to put a lot of effort into building a clear vocabulary to work with.”

She established that phishing is using electronic communication to covertly manipulate a target into doing something that is counter to the target’s interests.

To fight phishing, she wanted to examine it deeply and from a new context.

“In cybersecurity, there’s a tendency to view phishing as being solely a technology problem,” she says. “It’s not. Users are also a part of the system, and in ways that we often don’t think about.”

Phish versus spam

There is some confusion on the difference between phish and spam, she says. She differentiates the two by looking at the sender’s intent.

“People who send spam want you to buy or ‘buy into’ something. That could be a product or an idea such as a campaign ad,” she says. “Spam is advertisements. Spam is annoying, but it’s not intended to do harm.”

In contrast, Margot says, people who send phish generally want to steal your money or information, and intend to do harm.

A quick primer on phish

Classically, phishing emails contain a link to a compromised website, an attachment that is laced with malware, or a request for information in plain text.

“People who send phishing emails usually try to entice you to click before you think about the email too hard,” Margot says. “They may say your account is in danger of being closed, or that you’ve won a prize. They generally pretend to be someone trustworthy. Remember that it’s easy to forge the sender’s email address, and it’s possible to hack the real sender’s email account, so you shouldn’t trust email.”

“So, what should users do? “As a cybersecurity expert once told me, there is no ‘silver bullet,’” Margot says. “The best thing you can do is to be skeptical. Think about whether the subject of the email is plausible — you’re not going to win a sweepstakes that you didn’t enter. Think about whether the email looks and feels real — if your bank usually puts your name and last few digits of your account in the email, then if that information is missing or incorrect, the email probably is not from your bank.”

Margot says it is good practice to double-check the email’s authenticity before clicking. Advice is to call the sender on the phone if a personal contact, or by doing an online search to verify information in the email. Most legitimate companies have policies about what they do and do not do over email. Never give out personal information via email, and always question whether you really need to give someone the information they’re requesting.

Cross-disciplinary team

Margot says she wanted to pursue the LDRD project because of her interest in understanding how people use information and how they come to a decision and act on it. With a broad technical background and expertise in computation, dynamical systems, and group decision-making, she had a pretty good idea on how she wanted to attack the problem, but could also see where she’d need help from others to succeed.

“Luckily, many people at Sandia were happy to help. I found a really great team to work with on my LDRD,” she says. “It was really impressed by how many people were willing to participate in our study. Management, the Human

Studies Board, and Cybersecurity were extremely supportive.”

The team consisted of cognitive psychologist Ann Speed (now 1462), software developers JT McClain and Derek Trumbo (both 1462), and cyber security expert Michael Rosales (9544). (Photo by Dino Vournas)

A new perspective on users and phishing

There is a baseline assumption about phishing that she would like to see fixed.

“A lot of people assume that anyone who falls for a phish is an idiot,” Margot says. “That’s not true. Really smart people who know about phishing have fallen for at least one, so it’s clear that the problem is much more complex than many people think it is.”

What looks “suspicious” to one person might look totally normal to another. “I’ve seen many claims about what makes a phish hard or not, but I haven’t seen a definition that really holds up to close scrutiny,” she says. “There’s still a lot that we don’t know.”

Her theory is that this attitude issue is one of the drivers behind the popularity of the word “spearphishing.” This allows people to admit to falling for a phish without exposing themselves to accusations of incompetence. A spearphish is typically defined as being a phishing that is targeted at an individual, with identifiable information about the person such as employment information or other personal data.

“The idea that ‘people who fall for phish are stupid’ is actually counterproductive for building an effective security culture,” Margot says. “People don’t usually think about an organization’s security culture when they talk about combatting phishing, but it is important, and it’s another example of how people are a part of the system. That’s why it’s important to consider the system as a whole, and why I wanted to learn about users and how they use email.”

Phishing with a new hook — Margot Kimura (IP666), front, set out to understand email phishing and how people interact with their email. She teamed up via videoconferencing, left to right, with cognitive psychologist Ann Speed (1462), software developers JT McClain and Derek Trumbo (both 1462), and cyber security expert Michael Rosales (9544). (Photo by Dino Vournas)
W80-4

Sandia/California has major role in complex nuclear weapon Life Extension Program

By Sue Major Holmes

Sandia is doing what it hasn’t done in decades: extending the life of a nuclear warhead at the same time the US Air Force develops a replacement cruise missile that will carry the weapon.

The goal of the W80-4 Life Extension Program (LEP) is refurbishing the W80 warhead with replacement components for aging technology and components that have limited lifespans. Sandia’s California site is responsible for developing non-nuclear components and subsystems for a systems integration effort at the California site. The W80 was originally developed by Los Alamos and Sandia, with the first units fielded in 1982.

“Developing both at the same time requires a lot of cooperation and coordination between Sandia and the Air Force,” Paul says. “Sandia will also work with Pantex, Savannah River, and others. There will be lots of interactions to build on and grow.”

Teams shared resources necessary to succeed

After nuclear testing ended in 1992, the US began extending the life of existing warheads rather than developing new ones for the stockpile. Because many of those on the W80-4 team have been at Sandia for less than a decade, they will team with more experienced staff on the warhead program. The program also will take advantage of experience gained in other ongoing life extension programs at Sandia.

The W80-4 LEP requires Sandia to coordinate development work with the B61-12 LEP, the W88 ALT (Alteration) 370, and the Mark 21 Fuze Replacement programs. The four programs will share the Lab’s resources, everything from microchip fabrication at the Microsystems and Engineering Sciences Applications complex to computational simulations to large-scale testing at Sandia’s major environmental test facilities.

Teams shared resources necessary to succeed

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Two hands-on Cyber Technologies Academy teacher boot camps were recently held at Sandia California to help improve and promote cyber security education. Levi Lord (8965) says the boot camps are an excellent way to reach out to science, technology, engineering, and mathematics (STEM) teachers who want to broaden their cybersecurity curriculum. The boot camps provided teachers with cyber lessons and training exercises they can take back to classrooms, thus helping prepare students for careers in cybersecurity.

“We have been involved in cybersecurity education primarily focusing on students for quite a while,” says Levi. “We wanted to expand our focus and reach out to teachers to help engage students and get them interested in cybersecurity at an early age. Funded through Sandia’s corporate outreach program, the boot camps had more than 40 participants this summer. Teachers participating in the program came from across the state, including Fremont, Oakland, Sacramento, and southern California.

Jeremy Erickson (8965) says by reaching out to teachers, the CTA multiplies its outreach efforts. Because of space, time, and budget constraints, Sandia can only reach out to approximately 250 students per year, but by reaching out to teachers, they in turn can potentially reach more students, he says. “If 10 teachers each teach 50 or 100 students in their computer classes, we suddenly have expanded that reach to approximately 250 students per year, but by reaching out to teachers, they in turn can potentially reach more students, he says.

Part of the goal in establishing the teacher boot camp, Jeremy says, was to deliver enough material to the teachers so they can then replicate the material to students. “We are not educators,” he says. “We are scientists, researchers, and engineers. The idea was to partner up with professional educators who know how to teach and how to educate. We can provide the technical component that they may not be capable of doing.”

As part of the boot camp, Sandia provides teachers with a customizable learning platform in the form of a bootable Linux USB disk. This helps allow schools to boot directly from this Linux disk, leaving school systems able to stand alone.

Developing, strengthening collaborations

Last summer Sandia hosted several teachers from South Carolina and continues to strengthen its relationship with Project Lead The Way, a provider of K-12 STEM programs. Karin Kinnard, associate director of instruction with Project Lead The Way in Indiana, says the boot camp helped her better understand the ethical issues around cybersecurity, the Linux operating system as it applies to file structures and networking. She also said the boot camp helped her better understand how Internet protocols work, and the self-developing networking tools enabled her to protect some systems while exposing others to network information.

She says Project Lead The Way will be developing a cybersecurity course that will be partnering with high school computer science path.

“We are very interested in collaborating with Sandia, acknowledging that they are an industry leader in securing computer systems at all levels,” she says. “As bringing our national computer science curriculum to schools around the country, we are committed to staying relevant and timely, and we recognize cybersecurity is a pressing issue we all need to address.”

Chris Lorenz, instructor with Allied Health Academy at Valley View High School in Moreno Valley, California, says although the bootcamp was very challenging mentally, the Sandia instructors kept the teachers on track and answered all the questions to ensure they were successful.

“I would highly recommend this class to anyone who is interested in cybersecurity,” he says. “To actually work with industry professionals, as these folks from the Sandia Labs, was so helpful and encouraging. The instructors were very knowledgeable and very helpful to all students. I also was impressed by how they addressed each student’s needs from the most experienced to the beginner.”

Lorenz says having access to Sandia’s materials and classroom program is a huge plus. He says now he has the tools to return to the classroom and begin teaching.

“I also feel I have a huge support system from the Sandia instructors and other staff if I run into any problems,” he says.

Future teacher boot camps are being planned and as Sandia continues to partner with more schools, offerings will be refined to address school-specific constraints or concerns.

Recycling algae

(Continued from page 1)

By Michael Padilla

Costly artificial nitrogen fixation process using natural gas and atmospheric nitrogen, phosphorus is a limited natural resource that can be toxic at high concentration.

“We have a finite amount of phosphorus in the world, but it’s in high demand as both a fertilizer and a feedstock. Half of the phosphates that go into our crops in the form of fertilizer end up in the Gulf of Mexico, contributing to hypoxic zones,” says Todd. Better known as “dead zones,” hypoxic zones are areas of low oxygen concentration that kill or drive out marine life. This disrupts the internal structure of the cell and releases naturally occurring enzymes,” says Todd. “These enzymes chew up the cell and rapidly release phosphates.”

The next step is fermentation to convert the nitrogen, which is mostly in the form of amino acids, into ammonia. The phosphates and ammonia are then recombined — with help from magnesium, present in great quantities in the algal biomass — to form struvite, a solid salt. In 2014, a Sandia team proved the method with 20 weeks of continuous recycling and reuse of phosphates and nutrients. They were able to carry more than 60 to 80 percent of the nutrients from batch to batch.

Lipid extraction enables nutrient recycling

The algal nutrient recycling research is part of a larger project funded by DOE’s BioEnergy Technologies Office, part of the Energy Efficiency and Renewable Energy program. The Sandia team’s partners include Texas A&M AgLife Research, which grows marine strains of algae, and Texas-based OpenAlgae, which patented methods to lyse algal cells and recover algal lipids without using solvent. Recovered algal oils could be refined to address school-specific constraints or concerns.

“Panning for phosphate gold”

Todd and Ryan are working to further refine their method to recycle more of the nutrients, including a collaboration with James Liao of the University of California, Los Angeles, to genetically refine their fermentation strain to increase yield and extract different product fuels. Liao runs the Metabolic Engineering and Synthetic Biology Laboratory and is chair of the Metabolic and Biochemical Engineering and the department of bioengineering.

Another facet of the project is the development of a reactor system to capture the ammonia as the biomass is fermented to release phosphates. Currently, these steps are performed separately.

“The goal is a one-pot system,” says Ryan. “That will be the tipping point for scaling up our method. We grow 2 liters of algae in our 20-week test. The next step is to grow 3,000 liters in our raceways.” Later this year, Sandia will open one 3,000-liter raceway testbeds, shallow artificial ponds for algal cultivation.

Pond-side processing is another goal. A single module combining lipid extraction and nutrient recycling could separate biomass into nutrients and fuel at a cultivation facility.

Better and easier nutrient recycling

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LED Pulser: Laser-like performance, fraction of the cost

By Michael Padilla • Photo by Dino Vournas

When Chris Carlen (8362) developed an enthusiasm for flashlights containing high-power LEDs, he didn’t anticipate that his hobby interest would lead to the creation of a new, high-speed LED driver delivering lighting performance that exceeds that of conventional sources at a fraction of cost.

The Sandia LED Pulser provides high-brightness, rapidly pulsed, multi-color light for scientific, industrial, or commercial uses. In some cases, the LED Pulser can even displace lasers. “I had the idea a few years ago to see if high-powered multi-colored LEDs in flashlights could be turned on and off rapidly by an electronic circuit to produce short light pulses similar to that of a 10-nanosecond pulsed laser, or even down to one nanosecond depending on the LED,” Chris says. “It was more of a curiosity initially, but then something came up where a light source being used in a lab wasn’t working out, so I decided to try to make a quick prototype to pulse an LED, which worked out pretty good.”

Contributing to new scientific discoveries

The LED Pulser can be used in various science, engineering, and research and development applications that are otherwise possible only with far more expensive laser or arc-lamp light-sources and optics. It has already been used in several research studies that have helped Sandia take the lead in developing the science base needed by engineers to design and optimize cleaner, more efficient engines, thereby impacting local air quality and public health as well as global climate change.

In one of these studies, a high-speed backlit spray microscopy application, the LED Pulser delivered 50-m pulses at 200 kHz that “froze” the motion of liquid droplets and ligaments. This enabled high-resolution imaging of atomization in a high-pressure diesel fuel-spray. Spray atomization and mixing profoundly affects the combustion process in both spark-ignition and diesel engines, impacting both efficiency and emissions.

The LED Pulser was also used in a high-speed soot extinction imaging application. In this work, the LED Pulser generated high-intensity pulses matched to the camera exposure duration (2 microseconds) to enable quantitative evaluation of the evolution of diesel soot concentrations. The strong pulse intensity relative to combustion-generated light allowed full-field soot imaging at high frame rates, providing information needed to predict soot formation and oxidation processes.

A final example is the application of the Pulser for ignition detection via high-speed schlieren imaging. The small LED source allows for excellent light beam collimation, while the wide bandwidth relative to lasers enables speckle-free imaging. Work in this area has led to the unambiguous identification of first- and second-stage diesel ignition locations, leading to a better understanding of how pilot fuel injection strategies impact combustion and emissions formation.

A driving force

Using custom electronic circuitry, the LED Pulser drives high-power LEDs to generate light pulses with shorter duration, higher repetition frequency, and higher intensity than do commercial off-the-shelf LED drivers. The device’s ability to combine high intensity and short pulse duration is critical, as simply decreasing the pulse duration while maintaining the same intensity as a continuously powered LED would reduce the light energy delivered per pulse.

Increasing intensity with short pulses maintains the level of light energy delivered, which is essential for many applications. The LED Pulser can be an extremely economical replacement for lasers in some applications. Further, a single device can emit up to four different colors, each with independent pulse timing, from a nearly coincident source area. This capability should expand the range of optical applications, as well as enable new imaging techniques.

Moreover, the low cost of this device will allow much broader use of diagnostic techniques throughout the scientific and engineering communities, leading to faster progress in developing an understanding and ability to predict important physical processes.

Overcoming technical challenges

Chris is focusing on several technical challenges to improve the LED Pulser.

“There are still some things that can be done to try to make it better,” he says. “When dealing with extremely high currents in very short times, rather exotic techniques need to be used.”

Since the LED Pulser is designed to deliver as much power as possible, the circuits currently drive the LEDs to the brink of destruction. Failure rates with this design, while acceptable in a research environment, are not appropriate for the commercial market. Commercializing the device for applications outside of scientific research would require either reducing the delivered power to a level that yields an acceptable failure rate or improving the design to achieve a low failure rate even at the high delivered powers.

Chris is working on an LED Pulser that is 10 cubic inches in size and can produce 240 amps of drive current, for about 150W of peak optical power, depending on the LED used. “What’s interesting about the Pulser is the power density, i.e., how much power it can deliver compared to its size,” he says.

There are several areas he is focusing on to improve the LED Pulser. One area is to build a faster driver circuit and improve the connection between the driving board and the LEDs — driving toward pulse durations of less than 10 nanoseconds. Another area of consideration, key to potential commercialization, is to devise a protection circuit to greatly reduce the chances of destroying the LEDs.

“I didn’t anticipate the LED Pulser would become as popular as it has,” he says. “I’m just happy if it is helping to solve people’s problems.”
Sandia/California increases water conservation efforts as protracted state drought continues

By Michael Padilla

As California continues to battle extreme drought, Sandia/California has increased its efforts to aggressively explore water reduction strategies.

“It’s been a challenge,” says Robert Holland (8516), “but it’s doable.”

Robert, who is helping to spearhead efforts to increase water conservation projects throughout the site, says the California site has been meeting the challenge with landscape reduction, innovative ways to irrigate, and installation of new metering systems.

Laura Tidwell (8516) says the Environmental Management and Physical Operations Planning & Study departments (8516 and 8512) have been evaluating all options in ensuring that Sandia is looking for ways to conserve water while meeting the needs of the site.

Meeting state, federal mandated regulations

When California Gov. Jerry Brown issued an executive order in 2015 to increase water conservation requirements in California, Sandia was already in front of the issue. The challenge, however, was to reduce water usage by 25 percent from 2013 set by the order.

Since the order went into effect, Sandia has stopped irrigating most of the seven acres of turf at the site and reduced the irrigation of other areas to twice a week. For calendar year 2014, these efforts have helped the site reduce water use by more than 16 percent from 2013. The site is on track to meet the 25 percent reduction in 2015.

Laura says part of the challenge in meeting the state’s water conservation target is the site’s use of water in many other ways, including cooling towers that provide chilled water for buildings and lab equipment. Plans to reduce usage in areas such as cooling and processing water will require significant infrastructure modifications that have not yet been prioritized by the federal government.

For many DOE laboratories water reduction has been an active conservation activity for eight years. Sandia is on track to meet a federal regulation to reduce water usage by two percent per year from 2007 levels.

“We have been trimming down since 2007,” says Robert. “We get our water from San Francisco Public Utility and they have not imposed any water restrictions on the Labs. If they fall under the gun then we will have to follow their guidelines as well.”

Creative solutions

One of the latest measures to help conserve water at Sandia/California is installing smart water meters throughout the site. The meters can be read electronically and are more precise than what had been installed.

“One of the challenges we had was not having a strong metering system,” Laura says. “You have to have a reliable and accurate way to meter and monitor your usage in order to determine where you may have a problem and how to focus limited funding to reduce usage.”

While this may seem not particularly aggressive in a really bad drought, she says, “it’s actually a pretty important part of this puzzle and we may be out of this drought before we have it all done. It will be a really good investment for current and future water monitoring and usage reduction activities.”

Another effort has been to slightly increase the temperature in buildings following recently updated corporate guidelines. The key point is that each building will continue to run efficiently and these minor adjustments will not impact day-to-day operations.

“Sandia will gain some water savings with comfort cooling,” Laura says. “By raising the temperature in some buildings by one degree, we can save water.”

Robert says the site has an ongoing project to remodel bathrooms, updating water fixtures as needed. High-occupancy buildings have been updated and others will be updated as time and budget permit.

In addition, the site may further limit irrigation in terms of acreage, frequency, and duration. Irrigation systems will be shut off when the forecast calls for rain. Sandia will continue to keep up with the site’s aesthetics and will ensure that high-traffic areas are well maintained.

“We will also follow the priorities set by our master landscape plan for planting drought-resistant groundcover, plants, and trees and for managing storm water,” says Robert.

Education is crucial

Laura adds that education is key to ensure that the members of the workforce understand how to help conserve water.

An education campaign is underway to help people think of and implement creative ways to help conserve water.

“Simple tasks such as not running water when washing dishes at lunch or reporting unnecessary on-site water use is helpful,” Robert says. “Informing Facilities about broken pipes or broken sprinkler systems is also welcomed.”

In addition, a Water Reduction Working Group has been established to further explore water conservation projects, identify areas of water waste, and provide input to site management on water reduction opportunities.

Both Laura and Robert welcome any feedback, and encourage members of the workforce to call the Facilities Urgent Request Hotline at 925-294-6400 with ideas or concerns.

Arroyo Seco ready to rise to occasion

By Madeline Burchard

Some trees and plants at Sandia/California are still being watered, which seems to contradict the widespread calls for water conservation. To understand why, look back to the winter of 1997-1998 when California experienced unprecedented rain and flooding — the warmest and wettest in the 104-year record of temperatures and precipitation measurements.

Impact to Arroyo Seco

The January/February storms in 1998 were felt strongly in Livermore and at the California site. In those two months, nearly 13 inches of rain fell (compared to the 30-year mean of 5.41 inches in January and February). The runoff overwhelmed the Arroyo Seco watershed, which runs through the site, and flooded many areas including the East Avenue entrance. Significant erosion undermined the structural integrity of bridges and utilities crossing the Arroyo Seco.

Several trees came loose from the banks and threatened to compromise sewage pipes.

Since then, Sandia has been working in partnership with the Army Corps of Engineers to repair that damage via the Arroyo Seco Improvement Program (ASIP).

ASIP starts ASAP

“ASIP is intended to provide active channel improvements and stream zone management activities that will reduce current flood and erosion risk while providing additional and improved habitat for sensitive species,” says Robert Holland (8516), environmental technical professional with Environmental Management.

ASIP includes 18 projects along Arroyo Seco to boost the site’s resilience to major storm events. These projects included installing concrete reinforcement to support critical points of the stream; removing impediments to stream flow such as land bridges; and planting denuded banks with native grasses, shrubs, and trees. These plants, when established, will soak up water and keep the stream banks intact.

Watering during a drought

The most recent ASIP development is the creation of a flood plain with trees and native shrubs near Thunderbird Lane at the upstream end of Arroyo Seco. This flood plain will help slow runoff flow and provide habitat for sensitive species.

All active restoration will be completed by Sept. 30, but the site must ensure that a majority of the new plants will survive year to year. In a severe drought year, this means irrigation. Irrigation done in accordance with Sandia’s Corps of Engineers permit is not counted by federal agencies against water reduction targets. Even with tree irrigation factored into water usage estimates, Sandia is on track to meet the 25 percent water use reduction requested by the state.

“Survival of our trees and plants is mandated by our federal permit,” Robert says. “Our restoration efforts will be followed by both the US Army Corps of Engineers and ordered by the Corps of Engineers and the Regional Water Quality Board.”

Boosting resilience — Sandia is working with the US Army Corps of Engineers to repair on-site damage to Arroyo Seco caused by heavy rains in 1998. The runoff from a series of storms overwhelmed the Arroyo Seco watershed, the resulting erosion undermined the structural integrity of bridges and utilities crossing the arroyo. (Photo by Dino Vournas)

CONSERVATION MOTIVATION — Robert Holland (8516) says Sandia/California is aggressively exploring water reduction strategies by looking for innovative ways to irrigate the landscape and by installing new water metering systems. (Photo by Dino Vournas)
MISCELLANEOUS

TRIUMPH TRUETOP, w/case, excellent condition, $125; saxophone, alto, w/case, excellent condition, $275. Avila, 880-3473.

WEDDING RINGS, 9.4 white gold wedding bands, matching earrings set, carved band, 70, valued at $1,750, asking $1,250. Rambo, 503-229-5287.

HORSE TRAILER, ‘07 Essex 52x40, cherry condition, new tires, only used 2 seasons, see Craigslist photos, $8,500. Smith, 505-221-6821.

BED SET, king, beautiful, oak headboard w/bedside, frame, box spring, mattresses, 2 nightstands, yours, $375. Freshur, 505-301-2076.

WATER SOFTENER, Kenmore, model 30, #756, excellent cond., $4,000. Graham, 505-379-8798.

SATURN VUE, 3.5L, v6, AWD, black, OnStar/AM ready, ‘14 times, 95+ miles, $7,200 OBO. Graigo, 505-533-9199.

MAZDA MX-5 CONVERTIBLE, soft top, 38k miles, excellent cond., $11,500 OBO. Pratt, 256-7408.

FOSS F10104, supercab, V8, 4.4L, LV, AT, leather seats, running boards, gray shell, $15,500. Romero, 505-307-9819.

FORD RANGER, 3-pwd., air, heat, CD, multiple add-ons, new engine, 2006 miles, great condition, $5,000 OBO. Crosby, 260-1070.

BUCK PARK AVENUE, AT, AC, leather, 103k miles, good condition, $3,000. Graham, 505-379-8798.

RECREATION

100 MAXWELL 1900 SR BOAT, 19-ft., 5.7 mercury engine, 250-hp, bimini top, bow & cockpit cover, depth finder, fish finder, radio/stereo, 7k, Joseph, 505-515-5997.

13 ARCTIC FXS 811 TRUCK CAMPER, generator, solar panels, must see, $2,495. Romero, 505-314-6648.

1 VICTORY VISION TOUR, 7K miles, extended warranty, loaded, all options, perfect condition, $13,500 612-702-6688.

MOUNTAIN BIKES, ladies, 26-in., gel seat, bottle rack, owner’s manual, cream puff, $110. Murphy, 892-0280.

ELLIPTICAL BICYCLE, Eliproc-8C, green, like new, used 3 times, paid $2,400, asking $1,700. Schmeier, 505-275-3312.

04 CHEVROLET BLAZER, ZWZ, 4-dr., AT, 48K miles, excellent cond., $4,000. Graham, 505-379-8798.

05 SATURN VUE, 3.5L, v6, AWD, black, OnStar/AM ready, ‘14 times, 94-5 miles, $7,200 OBO. Graigo, 505-533-9199.

05 MAZDA MX-5 CONVERTIBLE, soft top, 38k miles, excellent cond., $11,500 OBO. Pratt, 256-7408.

05 FORD F10104, supercab, V8, 4.4L, LV, AT, leather seats, running boards, gray shell, $15,500. Romero, 505-307-9819.

01 BUCK PARK AVENUE, AT, AC, leather, 103K miles, good condition, $5,000 OBO. Crosby, 260-1070.

01 BUCK PARK AVENUE, AT, AC, leather, 103k miles, good condition, $3,000. Graham, 505-379-8798.


07 HONDA ODYSSEY, 4-dr., AT, 97K miles, like new, $9,000 OBO. Hoy, 303-271-3128.

03 FABERLOVE, 4-horse gooseneck, w/mangers, living quarter, AC, bathroom w/shower, mats, 5-45 gal oil tanks, $3,170. Davis, 286-4757.

REAL ESTATE

20 ACRES, beautifully wooded, East Mountain area, near 1-40, real estate contract considered, $7,500 acre. Heisey, 379-1147.

WANTED

HOST FAMILY, international student, attending Manual School, from Democratic Republic of Congo, email for info. Bolt, 505-341-7223, dibol09@gmail.com.

DIRECT/NANNY, drive 10 & 13-yr.-old girls to school-ages events, to Ne Heights. Salzinger, 257-2668.

OLD CARS, and counterparts, will haul away, photos requested, but call first. Carlson, 505-206-8837.


VOLUNTEERS, Fabulous Felinas, work with rescued cats, wants Fabulousfelines.org. Stubbiedki, 263-344-84, fabulousfelinas@comcast.net.
19 tons of marijuana in the back of a truck. Human smuggling at the busy border. On his first day on the Tijuana, on the southern US border, second largest binational metropolitan area, after San Diego—arates El Paso from Juarez, Mexico, making the region the western border of the United States with Mexico, encompasses El Paso and Juarez, Mexico. A town of about 25,000 people, North Haven is a suburb of New Haven, the second largest city in the state.

By Patti Koning

John Norden (BS11) may be new to Sandia, but not to national security. Protecting borders in El Paso, Texas, and West Berlin; working with a drug-sniffing dog at the Port of New Haven; keeping the skies safe as a Federal Air Marshal; and serving on the police force of his hometown in Connecticut — it’s all part of the rich and diverse background that John brings to his role in the emergency management coordinator at Sandia/California.

“My life on a piece of paper, that’s what I thought when I saw the job description,” says John. Dennis Baker (BS11), manager of the site’s security operations and John’s boss, was hoping to find a candidate with either first responder or military experience, preferably with a tactical background, and emergency management training. In John, he found all four.

“It’s rare to find someone who has been a first responder and is trained in emergency response,” says Dennis. “John is the complete package.”

John’s circuitous path to Sandia began when he enlisted in the US Army just after graduating from high school. He served four years as a tank gunner, including two years in battle in Europe, and was a first responder to emergencies in North Haven and surrounding communities.

“My job as an air marshal became increasingly tough on my family,” says John. “I had a family with two young children to consider.”

Then 9/11 happened. After two years in New Haven and the retirement of his service dog, John began considering his next career move. Then 9/11 happened. His first instinct was to return to the military. “I think practically every former service member wanted to reenlist at that time,” John says. “But I had a family with two young children to consider.”

He answered a different call and became a federal air marshal. Pre-9/11, there were only a few dozen active federal air marshals. Within a year of 9/11, that number jumped to the thousands. The Federal Air Marshal Service recruited people like John, targeting agencies like the Drug Enforcement Agency, FBI, and others.

As a federal air marshal, John’s primary responsibility was to counter terrorist attacks on airplanes. “An air marshal’s job is to blend in with the passengers and serve as the eyes and ears of security,” he says.

He logged thousands of hours on airplanes, traveling on everything from northeast corridor commuter routes to cross-country and cross-Atlantic flights. After five years of days lasting as long as 18 hours and shifting time off, it was time for another career change.

“My job as an air marshal became increasingly tough on my family,” says John. “I came down to the job versus my family.”

John took on a new role that required him to stay very close to home — he joined the police department of his hometown North Haven, Connecticut. A town of about 25,000 people, North Haven is a suburb of New Haven, the second largest city in the state.

North Haven’s police force was small, only about 45 officers during John’s time, which meant each officer filled multiple roles. John also served on the department’s SWAT team and was a first responder to emergencies in North Haven and surrounding communities.

“I was involved in many different investigations — domestic violence, sexual assault, narcotics, robberies — and carried them all the way through to the end,” he says. “On a larger police force the work would be much more segmented.”

Once his children were in high school, John began considering other ways to use his diverse skills. “I really enjoyed being a community police officer, but it’s a low-paid, stressful, and difficult job,” he says. “You spend much of your time focused on the dark side of humanity.

He completed a master’s degree in emergency management at the University of New Haven to build on his experience, which turned out to be the very thing Sandia was looking for. And he was looking for exactly what Sandia had to offer — a chance to apply his new skills and extensive experience to a different national security role.

He thinks his experience as a first responder will enable him to be an effective leader if an operational emergency occurs. “I’ve been in those situations, so it’s like second nature,” he says.

John is not the only new face in the California site’s emergency operations. Robert Pedersen (BS11), who previously served in the San Francisco Police Department, joined the Security Operations group not long after John. Dennis is looking to add a third emergency operations planner soon.

The site’s Emergency Operations Center (EOC) recently was redesigned to facilitate communication among the many different roles that contribute to emergency management. John is holding tabletop drills biweekly with a focus on different emergency management area each month.

One of John’s goals is to involve more members of the workforce in drills and increase the Community Emergency Response Team numbers. (Photo by Dino Vournas)