

Researchers measure reaction rates of second key atmospheric component

Work on Criegee intermediate published in *Science* magazine

By Mike Janes

Researchers at the Combustion Research Facility, the University of Manchester, Bristol University, University of Southampton, and Hong Kong Polytechnic have successfully measured reaction rates of a second Criegee intermediate, CH_3CHOO , and proved that the reactivity of the atmospheric chemical depends strongly on which way the molecule is twisted.

The measurements will provide further insight into hydrocarbon combustion and atmospheric chemistry. A paper describing the research findings titled "Direct Measurements of Conformer-Dependent Reactivity of the Criegee Intermediate CH_3CHOO " is featured in the April 12 edition of *Science* magazine.

Criegee intermediates — carbonyl oxides — are considered to be pivotal atmospheric reactants, but only indirect knowledge of their reaction kinetics had previously been available. Last year, Sandia and its UK-based partners reported, for the first time, direct measurements of reactions of the smallest gas-phase Criegee intermedi-

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SANDIA COMBUSTION RESEARCHER Craig Taatjes (8353) adjusts a Sandia-designed apparatus that uses light from a third-generation synchrotron user facility, Lawrence Berkeley National Laboratory's Advanced Light Source, to investigate chemical reactions that are critical in hydrocarbon oxidation. The intense tunable light from the synchrotron allows researchers to discern the formation and removal of different isomeric species — molecules that contain the same atoms but are arranged in different combinations. (Photo by Dino Vournas)

Choosing future warfighting vehicles

Army Ground Combat Systems adopts Sandia tool to help in decision-making process

By Heather Clark

Imagine trying to solve this complex problem: You have to modernize a fleet of combat vehicles, such as tanks, tracked howitzers, and infantry fighting vehicles, choosing from among



A SOFTWARE TOOL developed by Sandia and several partners helps the US Army's Ground Combat Systems make critical modernization decisions regarding its extensive fleet of fighting vehicles like this Paladin M109A6, a cannon artillery system. (US Army photo)

more than 50 ways to update them to meet future threats. Each modernization option can be configured differently to meet a variety of missions around the globe. You are constrained by fielding schedules and the costs of research and development, maintenance, and operations, and your budget can change without warning. A shift in the socio-political status of any country or the environment could have consequences that would require you to re-think your decision and, by the way, you're planning 30 years into the future.

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Sandia ranks high in *Woman Engineer* magazine's top employers list

By Nancy Salem

Sandia moved from No. 18 to No. 4 on *Woman Engineer* magazine's 22nd annual list of Top 20 Government Employers.

The list appears in the magazine's spring 2013 issue. About 400 readers of *Woman Engineer* selected the US companies they would most like to work for or that they believe would provide a positive working environment for female engineers. The annual reader survey is mailed to randomly selected readers of the magazine.

The survey includes questions about age, gender, geographic location, resources for learning about job openings, annual salary, career discipline, and others. "We ask readers to list their top three companies or government agencies," says Tamara Flaum-Dreyfuss, president and publisher of Equal Opportunity Publications Inc. "From that list, we weigh the answers based on their listing of first, second, and

third choice."

The top five finishers were NASA, US Department of Transportation, FBI, Sandia, and DOE. Last year Sandia was ranked 18 out of 20.

Pamela Hansen Hargan, VP of Human Resources and Communication Div. 3000, says the ranking reflects positively on Sandia. "It is an honor to be considered a top employer by the readers of *Woman Engineer*," she says. "This type of branding is critical to attracting top talent such as the subscribers of this magazine."

Recognition a powerful recruiting tool

Sheri Kennard (3555), who heads up student intern programs at the Labs, says the recognition is a powerful recruiting tool. "It shows we have a lot of diversity and a lot of opportunities

at Sandia," she says. "It acknowledges that this is a great place to work."

Esther Hernandez (3010), Sandia's chief diversity officer, says there is a consistent effort throughout the Labs to build a work environment where all individuals know they are important because they are valued, included, treated with respect and dignity, and are fully productive contributors to mission success.

"Sandia is an exceptional place to work," she says. "I am delighted that we are viewed as an employer of choice by the readers of *Woman Engineer*."

The magazine was launched in 1979 and is the country's most widely read recruitment publication for women engineers. It is read by more than 56,000 student, entry-level, and professional women engineers, and goes to the placement offices of all 296 accredited engineering schools, and to student and professional associations and societies.



WOMAN ENGINEER MAGAZINE



California Family and Friends Day

On April 20, nearly 600 people turned out for Family and Friends Day at Sandia/California. Story and photos on page 4.

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That's that

Do you think it ever occurred to the terrorists that their almost every move that horrible day in Boston was being watched? I don't think so.

Sure, like all of us they must have been aware that there are a lot of video systems out there, but did they know how many? Did they really figure on being nailed by a camera mounted on the side of a wall somewhere? Again, I don't think so.

To me, it's telling that after the attack, the bombers didn't head for the hills immediately. Rather, after murdering several people and seriously injuring scores more, they apparently tried to resume their "normal" lives. One of the alleged perpetrators even went to a party a couple of nights later. No, I don't think they counted on being caught. They didn't figure on the video.

When these kinds of terrible things happen, our law enforcement people, our intelligence folks, we average citizens – we all learn things. We'll be more careful and aware in public situations, and our security professionals will have new insights into the nature and intent of our enemies.

But we aren't the only ones drawing lessons. Those who wish us harm learned many things from the attacks. They watched closely. They saw the mistakes the attackers made and they saw the way we responded. They saw how the media reported the attacks and what the media respond to. They likely saw how the 24/7 media can be manipulated into passing along a lot of misinformation. All very useful intelligence for them.

Watching how this has played out, you could almost conclude the two perpetrators were set up – unwittingly – to be a probing force, testing our defenses. I'm not suggesting that's the case, of course. I have no privileged information on the matter.

One of the lessons here, one they surely learned, is that as monitoring technologies proliferate, as we all become increasingly connected in cyberspace, it is going to be harder and harder for them to hide for very long. They'll have to unplug.

Used to be that criminals, terrorists, wrongdoers, might leave little crumbs marking their trails. Well, today, those little trails of crumbs are getting easier to track; they're practically glowing in the dark. With tweets and IMs and emails and weblogs recording and remembering everything you do, and cameras watching everywhere, it's hard to hide. If you want to stay below the radar, you have to fly deeper and deeper below the cyber horizon.

Those who wish us harm will take that lesson to heart and plan accordingly.

* * *

I was browsing (just for fun) through the big dictionary I keep on a lectern in my office. Not seeking out any word in particular, just letting my eye fall on anything that looked interesting or different. So it was that I came across the word "scutch."

For the record, it means "To separate the valuable fibers of flax, for example, from the woody parts by beating" or "an implement used for scutching fiber." A great Scrabble word. Probably from the French word for "to beat out," which probably came from a Latin word, which probably came from somewhere even further back in time. But it ended up in my dictionary as "scutch."

As it happens, it's not so much the definition that interests me here, it's the word itself. Scutch. As I repeated it, I started to think about how weird and wonderful language is. All language. Every single word we use, in every language on the planet, had to be made up by some one person somewhere, somehow, sometime. And the word had to be good enough, right enough, that everybody who heard it used it, too. And passed it on to their kids.

* * *

No sooner had I started thinking about how words come into being than I got an email in which the writer used the word "unacceptable." Not "unexceptionable," a perfectly good word that means, basically, inoffensive or not open to objection. I was familiar with the latter, but I'd never heard of the former. Was I actually seeing a word being born? My heart beat a bit faster as I flipped feverishly through the dictionary. Not there. Not there!

In the context, it seemed clear that the writer meant "unacceptable." This was just a simple typo. But perhaps by such serendipitous and circuitous avenues does the language evolve. As I thought about it, it struck me that the word could stand on its own as a new word with its own definition. Unacceptable could mean "no excuses," "no fudging," or "no dodging responsibility."

Imagine the conversation: "Teacher, I would have finished my homework, except my dad made me scutch flax all weekend." To which Ms. Jones would reply, "Johnny, I told the class this assignment was unacceptable. Even during scutching season!"

See you next time.

– Bill Murphy (505-845-0845, MS 1468, wtmurph@sandia.gov)

Sandians Bill Hammetter, Paul Clem named Fellows of American Ceramic Society

Bill Hammetter and Paul Clem are among 18 researchers worldwide who have been named to the 2013 class of Fellows of the American Ceramic Society (ACerS).

The fellow designation recognizes ACerS members who have distinguished themselves through outstanding contributions to the ceramic arts or sciences, broad and productive scholarship in ceramic science and technology, conspicuous achievement in ceramic industry, or by outstanding service to the society.

Bill Hammetter, manager of Ceramic Processing and Inorganic Materials Dept. 1815, joined Sandia in 1978, where he worked in several departments that developed materials and processes for nuclear weapon applications, thermal batteries, energy projects, and other research areas. He earned his doctorate in materials science from Marquette University in 1981. Since 1993 he has been a manager for several Sandia departments.



BILL HAMMETTER

Among his professional activities, Bill recently completed a two-year term as president of KERAMOS, the National Professional Ceramic Engineering Fraternity. He is a fellow of ASTM International (formerly known as the American Society for Testing and Materials). He serves on the Engineering Advisory Board at Missouri University of Science and Technology (formerly University of Missouri at Rolla) and is an active member of several technical societies.

Says Bill of his career at Sandia, "I'd like to especially thank [former VP] Bob Eagan for encouraging his young staff — when I was young — to become active, contributing members of technical societies, for participating in technical meetings, publishing in relevant journals, and volunteering for assignments in these societies.

"Through his personal example and leadership," Bill adds, "Bob taught his staff that, as a Sandia scientist, part of our responsibility to advance science and technology is to participate in an open dialogue about our technical work. I have personally benefited greatly from his example and encouragement, from the continuing research environment at Sandia, and from my world class co-workers at Sandia."

Paul Clem, manager since 2011 of Electronic, Optical, and Nano Materials Dept. 1816, came to Sandia as a postdoc employee in 1996 after earning a doctorate in materials science from the University of Illinois.



PAUL CLEM

Among his research activities, Paul has played lead roles in the Labs research into superconductivity for electrical systems and was the LDRD team lead for research into optical metamaterials (dielectrics and custom low-loss infrared polymers). His research also

has included work on use of polymer-nanoferrite materials for wind turbine applications and the study of nanostructured inorganic materials for photovoltaics.

Paul is a past chairman of ACerS's Electronics Division and served as conference co-chairman of ACerS's 2010 Electronic Materials and Applications Conference in Orlando. He also was conference chairman of the IEEE 2008 International Symposium on Applications of Ferroelectrics in Santa Fe. He has served as associate editor of several professional journals and has been a reviewer for several peer-reviewed publications, including *Applied Physics Letters*, *Journal of Applied Physics*, *Journal of the American Ceramic Society*, and others.

Paul has more than 90 peer-reviewed publications that have garnered more than 1,300 citations.

Paul says he appreciates Sandia's support for professional society activities. In his own career, the Labs has supported his role in conference presentations, journal editorship, and serving as an officer for such organizations as IEEE, American Ceramic Society, American Chemical Society, and the American Institute of Physics.

"These activities," he says, "have been fruitful for maintaining state-of-the-art capabilities, recruiting, professional development, and building cross-institution relationships. In addition, the peer-review process supported by such volunteer-run societies and journals is a mechanism to improve technical rigor and quality, which can be inconsistent in for-profit and non-reviewed publications."



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Albuquerque, New Mexico 87185-1468

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Bill Murphy, Editor 505/845-0845

Randy Montoya, Photographer 505/844-5605

Mike Janes, California site contact 925/294-2447

Michael Lanigan, Production 505/844-2297

Contributors: Michelle Fleming (Ads, Milepost photos, 844-4902),

Neal Singer (845-7078), Patti Koning (925-294-4911), Stephanie Holinka

(284-9227), Darrick Hurst (844-8009), Stephanie Hobby (844-0948),

Heather Clark (844-3511), Sue Holmes (844-6362),

Nancy Salem (844-2739), Jennifer Awe (284-8997),

Cathy Ann Connelly (284-7676), Jim Danneskiold, manager (844-0587)

Lab News fax 505/844-0645

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Criegee

(Continued from page 1)

ate using photoionization mass spectrometry.

That research was featured in the Jan. 13, 2012, edition of *Science*. See also the Jan. 27, 2012, issue of *Sandia Lab News*.

New findings

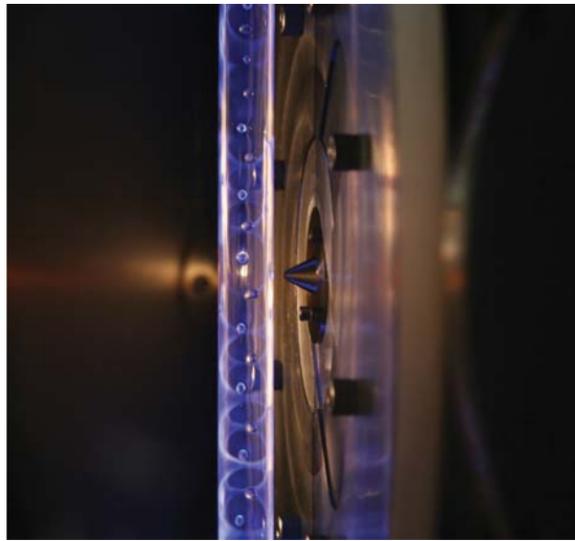
Sandia combustion chemist Craig Taatjes (8353), the lead author on the *Science* papers, says there are several significant aspects about the new research findings.

In particular, the measurements show that the reaction rate depends dramatically on whether the CH_3CHOO is bent, with the CH_3 - and $-\text{OO}$ ends pointing toward the same side, a conformation called “syn-” or more straightened, with the CH_3 - and $-\text{OO}$ ends pointing away from each other, called “anti-”.

“Observing conformer-dependent reactivity represents the first direct experimental test of theoretical predictions,” says Craig. “The work will be of tremendous importance in validating the theoretical methods that are needed to accurately predict the kinetics for reactions of Criegee intermediates that still cannot be measured directly.”

In fact, says Craig, the latest results supply one of the most critical targets for such validation. Because of the large concentration of water in Earth’s atmosphere, Criegee concentrations — and, hence, the tropospheric implications of all Criegee intermediate reactions — depend on knowing the rate constant for reaction with water.

Although the reactions for most Criegee intermediates, including the syn- conformer of CH_3CHOO , with water may simply be too slow to be measured by the research team’s methods, anti- CH_3CHOO has been predicted to have a vastly enhanced reactivity with water. Craig and his colleagues confirmed this prediction and made the first experimental determination of the reaction rate of a Criegee intermediate with water. “A Criegee intermediate’s reaction with water determines what the concentration of these intermediates in the atmosphere is going to be. This



THE CHEMICAL REACTIONS of Criegee intermediates were studied using an apparatus at Lawrence Berkeley Lab’s Advanced Light Source Beamline 9.0.2. A quartz reaction tube shows the faint blue luminescence from a 248-nm laser that creates a precursor reactant. A gas beam of the reactants and products exits the tube through a 600-µm pinhole facing the conical skimmer on the right, which collects the molecules for eventual ionization by vacuum ultraviolet photons from the ALS and detection by a mass spectrometer. (Caption information from *ALS Science Highlights*, Sandia photo by David Osborn)

is a significant benchmark,” he says.

Craig says one of the questions remaining after the first direct measurement of Criegee reactions was whether the remarkably fast reaction of CH_2OO with SO_2 was representative of other Criegee intermediates.

“This measurement of a second intermediate —

which we found to react just about as fast with sulfur dioxide as the intermediate we measured last year — supports the notion that the reactions of all Criegee intermediates with SO_2 will occur easily,” says Craig. “It also confirms that Criegee intermediate reactions are likely to make a contribution to sulfate and nitrate chemistry in the troposphere.” This increase in reactivity, he says, provides additional evidence that Criegee intermediates will play a significant role in the oxidation of sulfur dioxide in the atmosphere.

Unraveling mysteries, complexities of Criegee intermediates

Hydrocarbons re-emitted into Earth’s troposphere, either naturally or by humans, are removed by many reactive atmospheric species. For unsaturated hydrocarbons — molecules with at least one $\text{C}=\text{C}$ double bond — a prominent removal mechanism is reaction with ozone, called ozonolysis. It is accepted that ozonolysis produces other reactive species, including carbonyl oxides, which are known as Criegee intermediates. Rudolf Criegee, a German chemist, first proposed the mechanism of ozonolysis in the 1950s.

Because so much ozonolysis happens in the atmosphere, the reactions of Criegee intermediates are thought to be very important in a wide range of tropospheric processes like secondary organic aerosol formation and nighttime production of highly reactive OH radicals. As a result, the chemistry of these reactive Criegee intermediates has been the subject of intense investigation for decades, but without any direct measurement of their reaction rates until last year’s published work by Sandia and its collaborators.

The research was funded by DOE’s Office of Science and conducted using the Advanced Light Source at Lawrence Berkeley Laboratory, a scientific user facility also supported by the DOE Office of Science.

Sandia California News

Sandia’s Blake Simmons testifies to California Senate committee on technologies to reduce transportation carbon

By Holly Larsen

Upholding a longstanding Sandia tradition of providing unbiased information to help better inform policymakers, Blake Simmons (8630) was tapped March 19 by the California Senate Transportation and Housing Committee chaired by local state Sen. Mark DeSaulnier to testify at an information hearing on reducing the carbon footprint of light-duty cars and trucks.

The committee was specifically looking to Blake for an expert assessment of the innovative technologies that might enable these vehicles to meet the targets set by AB 32, California’s landmark greenhouse gas (GHG) reduction law. The committee also heard an independent critique from the Legislative Analyst’s Office, a progress report on the initiative from the Air Resources Board, and the perspectives of industry and environmental groups.

Wearing two relevant hats — Biofuels Program lead at Sandia and a vice president of the Joint BioEnergy Institute — Blake is well-suited to the task of assessing low-carbon transportation fuels. His testimony updated the Senate committee on promising new transportation technologies, including biofuels, batteries, and hydrogen fuel cells, as well as on concepts still in research and development that could dramatically reduce GHG emissions, not only in California, but across the nation.

Cautioning against picking technology winners

Overall, Blake’s assessment was positive. “Several technology scenarios could lead California to achieve targeted GHG reductions and should be considered under AB 32,” he said. Further, he recommended that the state continue its AB 32 implementation plan, noting that fundamental shifts in policy would increase the risks of deploying new technologies — and decrease the likelihood of achieving the targeted reductions.

He also cautioned against picking technology winners and losers up front, suggesting instead that the state encourage innovation by establishing clear performance and cost metrics and seeking scientific confirmation of results.

“Policy can benefit from empirical data and validated models informed by the best science for all the technology scenarios,” he said.

Blake’s testimony highlighted the promise and challenges facing new low-carbon transportation technologies. For example, he noted that while advanced biofuel production currently lags behind federal and state targets, more capacity is



BLAKE SIMMONS

coming online in 2013. He pointed to the significant boost provided by 23 integrated biorefinery projects funded by DOE and identified several private companies operating advanced biofuel facilities.

In the battery arena, Blake said technology advances had helped launch a commercial market for hybrid, plug-in hybrid, and battery-only electric vehicles (EVs) and that the sector is on track to meet Obama administration targets of putting 1 million EVs on the roads by 2015. He also expressed optimism for DOE projects aimed at achieving a twofold increase in the power and energy density of next-generation lithium-ion batteries, while decreasing their cost by 70 percent.

Fuel cells: Challenges and potential

Fuel cells, said Blake, offer the potential for a lower-cost EV with a range of more than 300 miles between refuelings. Despite uncertainties, automotive companies consistently maintain that they intend to produce some 50,000 vehicles in 2017, assuming infrastructure is available. Encouraging progress has been seen on the technology hurdle of reducing the catalyst loading in fuel cell stacks, but other challenges must also be addressed. These include developing more reliable compression and dispensing technologies, reducing the cost of hydrogen containment systems, and integrating renewables into the refueling cycle to lower overall carbon emissions.

To broaden the search for low-carbon solutions, Blake briefed the committee on upcoming innovations with tremendous potential. Several organizations are contributing to the Joint Center for Artificial Photosynthesis with the goal of developing a generator able to produce a useful chemical fuel using only sunlight, water, and carbon dioxide as inputs. Sandia, he added, is working on converting concentrated solar power into liquid fuels. Battery innovations underway at the Joint Center for Energy Storage could lead to more powerful batteries at lower cost, and direct conversion of methane to liquid fuels may be another cost-effective path to carbon reduction, he noted.

Improving internal combustion engines is also a critical step, given the predominant role of these engines in the current transportation system and the potential of a federal law that will require all light-duty vehicles sold in the US by 2025 to achieve a 54.5 miles-per-gallon standard. “Combining this new standard with increased electrification in the fleet and advanced, low-carbon biofuels will go a long way to reducing GHG emissions between 40 percent and 60 percent from today’s levels, even with the expected increase in the number of cars on the road,” Blake said.

Following his testimony, Blake responded to follow-up questions from the senators on technology readiness and appropriate metrics and methodologies to measure the outcomes of initiatives. Blake received praise for his testimony and responses from DeSaulnier and his staff — as well as from Catherine Dunwoody of the California Fuel Cell Partnership, who later wrote to Blake, “Your testimony yesterday was one of the best I’ve heard. DeSaulnier and the others clearly agreed.”

FAMILY AND FRIENDS DAY at Sandia/California

Story by Patti Koning

Photos by Dino Vournas

On Saturday, April 20, nearly 600 people — members of the workforce and their family and friends — turned out for Family and Friends Day at Sandia/California. With activities, tours, and demonstrations representing each of Sandia’s four mission areas, guests learned about the breadth and depth of the work that happens day in and day out at the site.

“Family and Friends Day was a tremendous success, filled with opportunities to inspire our future scientists and engineers and share the work we do each day with our loved ones,” says Div. 8000 VP Steve Rottler. “A high point of the day for me was having an activity from each of our mission areas — bio, cyber, energy, homeland security, and .”

In the Combustion Research Facility’s turbulent combustion laboratory, Adam Ruggles (8367) gave demonstrations of the hydrogen flame used to simulate and study unintended hydrogen releases. Then attendees stepped outside to learn about the hydrogen fuel cell bus from Aaron Harris (8367).

To inspire the next generation of computer scientists, Alf Morales (8131) taught a class on SCRATCH, a simple-to-learn programming language that makes it easy to create interactive stories, animations, games, music, and art while learning important mathematical



MIRA SUGAR, daughter of Josh Sugar (8656), adds her print to the Division Diversity Council handprint poster.



IN ONE OF THE MOST POPULAR DEMONSTRATIONS of the day, Adam Ruggles (8367) shows off a big flame in the turbulent combustion lab.



PAMELA LANE (8623) watches as Lilian Adams, niece of Miranda Frisch (8511), isolates DNA from a strawberry.

and computational ideas. For a wider perspective on computers, Keith Vanderveen (8961) led tours of the “million computers in a box” program.

Steve Costa (8247) and Rich Contreras (8247-2) shared the past and present of the nuclear weapons program with a B83 display.

In the Applied Biosciences Laboratory, attendees experienced the entire gamut of Sandia’s biology program from biodefense to biofuels research. Ken Patel (8125) demonstrated the microfluidics hub at the heart of RapTOR (Rapid Threat Organism Recognition) and the Battlefield Automated DNA Analysis System with a cool iPad app that allowed anyone to move droplets within the hub with the touch of a finger.

Pamela Lane and James Jaryenneh (both 8623) helped children extract DNA from a strawberry, which many proudly wore in necklaces for the rest of the day. Weihua Wu (8634) gave an overview of the biological research happening at the site. Dave Brekke (8537), who helped coordinate the activities, served as a tour guide for the building.

At the Livermore Valley Open Campus event pad, adults and children enjoyed Family Science Night activities, visiting the FlexLife booth, and learning about Alameda County Search and Rescue’s highly skilled search dogs and the FBI Mobile Crime Lab.

In case you missed Family and Friends Day, you can still experience the spirit of the event with the Division

Diversity Council’s handprint poster that will soon be on display. Many children and adults added their handprints to the poster with help from paintmasters Lynde Farhat (8365) and Danielle Oteri (8232).

The success of the day was due in large part to the core committee of Stephanie Beasley (8521), Robert Mariano (8005), Dennis Baker (8511), Rachel Bowles (8527), Meaghan Chelucci (8511), Michele Clark (8005), Melissa Harmon (8533), Carol James (8511), Dorrance McLean (8537), Jessica Matto (8522), Jaime McLeod (8511), John Paulson (21), David Paoletta (8516), and Linda Sager (8511) as well as the many volunteers and the safety, security, and facilities teams.



STEPHEN NELSON (8511), far right, heads to the Advanced Biosystems Laboratory with his fiancée, Monika Lament, and their son, Jaden Nelson.



FRANCES ROELFSEMA of Alameda County Search and Rescue demonstrates her dog Tioga’s searching-and-finding skill.

CPAT

(Continued from page 1)

Are you scratching your head yet? This is the daunting task faced by analysts working for the US Army's Program Executive Office Ground Combat Systems (PEO GCS), who help the nation's top generals decide which Army vehicles to modernize for future wars.

Sandia, working closely with the Army and other contractors, has developed key components of a software tool to help the PEO GCS analyze countless what-if scenarios that can be manipulated as technology advances and the global environment, the federal budget, or other factors change. Sandia calls this advanced combination of modeling, simulation, and optimization decision support software the Capability Portfolio Analysis Tool (CPAT).

Award-winning tool

CPAT won the 2012 Military Operations Research Society's Richard H. Barchi Prize, and its Sandia developers say senior Army leaders are expanding the use of the 2-year-old tool across a number of Army modernization programs.

The Sandia researchers envision adapting CPAT to help make a variety of complex decisions easier throughout the military and elsewhere.

"This has really revolutionized the way the Army thinks about things. It's been a big shift in paradigm for how they do analysis," says Liliana Shelton (6133), CPAT's technical lead and a Sandia computer scientist. "About a year after we started from a blank sheet of paper, it started getting used by people once they saw the capability and the questions we could answer."

Alan Nanco (6114), CPAT capability manager, says the tool that supports PEO GCS answers questions about ground combat vehicle modernization by combining optimization — mathematical formulae, software language, and a user interface that clarifies results — with a large number of choices that helps the Army leadership narrow millions of choices into a handful of options that best balance its goals while staying within budget, schedule, or other constraints.

"The beauty of the tool that we have developed in collaboration with the Army is it's better to evaluate how you're going to pick among such a huge array of options, if you have tools that will walk your equipment and your people through a scenario," Alan says.

Growing partnership with Army

The analytic support CPAT provides grew out of a partnership between Sandia and the Army that started

more than a decade ago. The Labs had been using modeling and simulation and systems-of-systems engineering to upgrade nuclear weapons systems by making choices of reliability, safety, and security, Alan says. The Defense Advanced Research Projects Agency teamed with the Army and wanted to use that expertise to support complex decisions for modernizing the Army's combat systems to create "modular brigade combat teams," Alan says.

For CPAT, Sandia worked closely with the Army to develop the structure of the models, the algorithms, the mathematical formulation for the optimization tool, and the software that makes CPAT user-friendly and displays the results so analysts can use them to brief decision-makers, Liliana says. Other contractors are responsible for data collection and feeding in assumptions made by the software.

Craig Lawton (6133), the lead for PEO GCS projects, says other contractors input specific requirements for each vehicle's capabilities. Then, those capabilities are matched to each mission, and CPAT takes into account the operating, maintenance, and research and development costs.

Liliana adds: "These are all the decisions you have to balance when you do an optimization run."

When PEO GCS calls Sandia, Liliana says she can get answers in days — a process that used to take weeks. The results are a variety of data and graphs that help analysts quickly compare what-if scenarios or choose the best path to modernize a vehicle or see where different choices fall in meeting the military's long-term goals. (Eventually, Sandia envisions training Army systems analysts to use CPAT themselves.)

In the real world, most choices are trade-offs, Liliana says.

"You look at different levels of modernization because at different budgets, you might not be able to afford the gold-plated solution. There's something in between, like a happy medium, that they can afford, so they can still improve the capability without breaking the bank," she says.

As the situation changes over time, Sandia and its



THE CAPABILITY PORTFOLIO ANALYSIS TOOL (CPAT) helps the US Army's Program Executive Office Ground Combat Systems analyze countless what-if scenarios that can be manipulated as technology advances and the global environment, the federal budget, or other factors change. The data can aid in decisions about which combat vehicles to modify or upgrade. The tool won the 2012 Military Operations Research Society's Richard H. Barchi Prize. (US Army photo)

partners can input new information into the underlying assumptions to show how various changes have an impact on the entire system, she says.

In its two-plus years of existence, CPAT already has shown its value by correcting a misconception as to whether two certain military vehicles could be modernized at the same time.

"The tool reported differently and bucked conventional wisdom, leading to its success," Craig says.

Other Sandia researchers working on the project include Stephen Henry, Matthew Hoffman, Hai Le, and Amanda Wachtel (all of 6133), Darryl Melander (9515), Gio Kao (5634), Jessica Mader (6923), and Robert Vander Meer (6114).

'Sky's the limit' for CPAT applications

CPAT has been so successful that the assistant secretary of the Army for Acquisition, Logistics, and Technology asked that it be briefed to other Army PEOs. As a result, Sandia is working with other Army PEOs, such as Enterprise Information Systems, to apply it to their complex decision-making processes. Sandia has taken action to meet anticipated future demand for the tool, Craig says.

Eventually, CPAT could be adapted to other military branches or applied to entirely different, complex decision-making processes in other large organizations.

"The challenge is each organization has different things that they are managing. Conceptually you are making decisions about how you invest your money, but the details of what goes into it are very, very different," Craig says, but he adds, "The sky's the limit."

What I found at ReApp . . .

Familiar radiation monitor at Sandia making way for miniaturized version

By Sue Major Holmes



DAVE SINTON (4121) displays the compact RadEye radiation monitor that will be rolled out at Sandia over the next year. It is replacing the unit shown on the table, the Eberline E600, a larger monitor that has been a workhorse at Sandia for a decade. Both use the same type of probe to detect alpha, beta, gamma, or neutron radiation. (Photo by Lloyd Wilson)

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

A familiar radiation monitor at Sandia is exiting the stage, making way for a new detector that's smaller, lighter, and easier to use.

The Eberline E600 Portable Radiation Monitor, which works with a variety of probes to detect alpha, beta, gamma, or neutron radiation, is nearing the end of its life, says Warren Lewis (4121). He says Sandia has used the E600s for about 15 years, and deployed an earlier instrument with similar technology in the decade before that. The E600s are destined for Reutilization and Disposition, and Warren hopes they'll someday continue their monitoring life elsewhere.

Sandia is already rolling out the replacement meter, which Warren's colleague Dave Sinton (4121) describes as looking like a fat pager with a rubber bumper around it. Dave says it will take about a year to fully change from old to new.

The E600's 4-by-9-inch aluminum box has a top-mounted handle and weighs 3.4

pounds. The instrument connects via a cable to a detector probe, and takes both hands to control. The operator uses one hand to move the probe over the surface where radiation is suspected and holds the reader in the other hand, observing the meter as the probe moves over the surface.

The fat pager, officially called a RadEye GX or SX, connects to the same type of probes. The RadEye is about 20 times smaller than the instrument it replaces, weighs mere ounces, and clamps to the probe so an operator can hold both meter and probe in one hand, Dave says.

"It's better ergonomically, lighter, more rugged, and it does the same job," he says.

The E600 had replaced a similarly shaped, heavier detector about the size of a small-caliber military ammunition box, bristling with switches and buttons and an analog readout. The E600 sports a dial that switches to various functions and has a digital readout. "But it's old, old digital," says Warren. He points to the RadEye's compact digital readout and programmable keys, and jokes that it's a radiation detection cell phone.

"That's kind of the industry trend. We've evolved over the years from big heavy solid pieces of equipment," Dave says as he returns one of the earlier instruments to a shelf in the Radiation Protection Instrumentation lab's calibration workshop. "Then you move to something like the E600, which is a little bit lighter but pretty much the same form with a handle and a place to connect your detector. So you've got a two-handed thing again. The industry is starting to go more toward this kind of a smart-type meter (the RadEye), where the electronics have gotten smaller."

Sandia will replace about 100 E600 monitors with about 200 RadEyes. The Labs had one E600 for every two probes, but will have one RadEye per probe, Dave and Warren say. That's because the RadEye lacks one thing the E600s had: smart probe technology. The E600 could read a chip in the probe to find out what type of probe it was, then reconfigure for that probe. Warren says the manufacturer is not using that technology anymore, so each RadEye must be configured and calibrated for a particular probe's voltage and efficiency.

Radiation Protection Instrumentation (RPI), which is certified by Sandia's Primary Standards Lab, is calibrating the new instruments before they hit the field, Warren says. RPI is responsible for a total of about 4,000 detection monitors of various types currently used throughout the Labs, he says.

"We're about measurement science," Warren says. "We're about improving our measurements, and with these newer instruments we get to better measurement capability and lower uncertainties, and it's easier for the customer to use."

Fighting back: One survivor's resolve to help other cancer patients

By Stephanie Hobby



BETH HANSON with nieces and nephew the year of her diagnosis. Today, she is healthy and active and giving back by raising funds for the Leukemia & Lymphoma Society.

In 2005, Beth Hanson (4121) was an active 34-year-old woman. She was a member of two softball teams, one volleyball team, an avid skier, and enjoyed hiking in the Sandia Mountains with her husband, Don (1387), and their two golden retrievers.

That fall, she developed a cough, but wrote it off to stress. During the holidays, the cough persisted, and family members urged her to seek medical attention. She was active and felt good, so when she went to the doctor, the last thing she thought she'd encounter was a cancer diagnosis. But five weeks later, doctors diagnosed her with stage 2B Hodgkins lymphoma. A grapefruit-sized tumor was wedged between her heart and lungs, making breathing difficult.

After three months of grueling chemotherapy and 21 days of radiation treatment, Beth was on the mend, but still had some hurdles to clear. The therapy had weakened her body and she lost a lot of muscle mass. Several weeks after treatment ended, she developed radiation pneumonitis, an inflammation of the lungs that affects between 5 and 15 percent of patients treated with radiation. A cough, low-grade fever, and weakness are common in patients. Three years later, doctors would find that the cancer had severed the nerve that controls diaphragm movements, and estimated she had lost about 20 percent of her lung function.

Beth remained determined, and made incredible strides to get back to her normal life. Today, eight years later, the nuclear analysis engineer is again playing softball and hiking through the Sandias with Don and her dogs, but laughs when she says she's a little slower now.

Resolved to help others who face the same disease,

Beth has become active in the Leukemia & Lymphoma Society and is helping to raise funds for more research. This year, her friend Lisa Goodman, a former LLS Woman of the Year candidate, nominated Beth for the campaign. When Lisa ran in 2011, she didn't have a direct connection to the cause, but started hearing stories from friends and co-workers about people they knew who had direct connections to blood cancers. Beth was one of those people.

"While I had known Beth and played softball with her for years, I didn't know she was a lymphoma survivor until my campaign," says Lisa. She invited Beth and Don to the Grand Finale Gala that year. "I had a conversation with them and they talked about how lucky they felt and how they wanted to give back. That's why I nominated Beth. The support of hundreds around me who donated to my campaign was life-changing. I learned that if I was committed, I could create a meaningful difference and I could lead others to join in my efforts. That sort of support feels amazing, and I hope that Beth feels that support throughout her campaign."

The annual LLS Man and Woman of the Year Campaign typically raises millions of dollars for blood cancers research, financial assistance for patients to cover

transportation, medication, and testing, educational materials, support programs, and comprehensive, personalized assistance. Candidates raise funds in various ways; Beth is having a fundraising volleyball tournament on Saturday, May 4, at Sneakerz. Every dollar raised counts as one vote, and the titles are awarded to the man and woman with the most votes by the Grand Finale Gala on Saturday, June 8. The gala will be held at the Hard Rock Hotel & Casino, and tickets can be purchased in support of Beth's campaign. The candidates will also have silent auction items available that will support their campaigns. Top local fundraisers in the country win national titles.

"I am excited by this opportunity to do something for the cause to eradicate cancer and the fear and suffering it causes. I also look at this as an opportunity to pay it forward, that is, do something nice for someone else in return for all the kindness that was shown me as I was undergoing treatment," says Beth. "The advances being made each year in cancer treatment are just amazing, and I'm looking forward to helping."

If you are interested in participating in or learning more about Beth's campaign, visit her website: <http://www.mwoy.org/pages/nm/nm13/bhansonjoc>.

NRC Chair Allison Macfarlane visits Sandia



NUCLEAR REGULATORY COMMISSION Chairman Allison Macfarlane, center right, was in Albuquerque this week to address a plenary session of the International High-Level Radioactive Waste Management Conference sponsored by the American Nuclear Society. Following her address, Macfarlane spent several hours at Sandia, where she received briefings about ongoing work Sandia is performing in support of the NRC. After being welcomed to the site by NNSA Sandia Field Office Manager Geoff Beausoleil, Macfarlane met with Labs Director Paul Hommert, center left. She joined several members of Sandia's senior management for a working lunch, which was followed by a presentation of a pressurized water reactor pre-ignition fire test conducted at the Cylindrical Boiling Facility at Sandia's Thermal Test Complex. Joining Paul and Macfarlane here are Div. 8000 VP Steve Rottler and Div. 6000 VP Jill Hruby. (Photo by Randy Montoya)

Sandia Serves Volunteer Breakfast recognizes hundreds

By Stephanie Hobby

Carol Eiffert (3600), Anna Barr (710), Sally Uebelacker (4250), Terry Walker (4251), and Damaris Hill (5417), in photo at right, were among the more than 300 Sandia employees, contractors, and retirees honored for their volunteer achievements at the annual Sandia Serves Volunteer Breakfast. In 2012, more than 1,000 Sandia volunteers logged a record-breaking 115,000 hours, or the equivalent of more than 13 years of continuous work.

This year, Sandia has a record 316 employees who earned the President's Volunteer Service Award, which recognizes individuals, families, and groups who have volunteered more than 100 hours. In addition, last year employees and retirees donated more than \$5.4 million to the United Way, and \$13,000 to Shoes for Kids, and Lockheed Martin Corporation donated more than \$1.4 million to the community on Sandia's behalf.

Those who logged volunteer hours with Sandia were given the opportunity to vote for a joint Sandia and Lockheed Martin Corp. corporate contribution in one of three strategic areas: education, supporting veterans, or meeting basic human needs. This year, volunteers voted for education, and Sandia will donate \$15,000 to Albuquerque Public Schools Horizon Classroom Grants. The grants will support things like Lego Mindstorm Robots, the Los Padillas Wildlife Sanctuary, model rockets, a greenhouse, and other innovative educational programs through APS. (Photo by Rachel Baros)



Sandia's Take Our Daughters and Sons to Work Day a big success

By Stephanie Hobby

More than 1,500 students joined Sandia employees and contractors for the annual Take Our Daughters and Sons to Work Day, which was combined with Sandia's Earth Day celebrations. Fifth-through 12th-grade students joined their parents and mentors at Sandia on Thursday, April 25, to learn more about the Labs' mission and career opportunities in science, technology, engineering, and math (STEM) fields.

Students had the opportunity to see demonstrations of high-performance computing, drive a brain-controlled robot, tour the Rocket Systems' facility, and check out the National Solar Thermal Test Facility. Other hands-on activities were planned for the lunch hour at Hardin Field and in the Steve Schiff Auditorium.

For the first time, Sandia hosted 50 students from Van Buren Middle School. The students are part of a new partnership between Sandia and the school to support student success and encourage students to consider careers in STEM. They are part of Van Buren's Advancement Via Individual Determination, or AVID, program, a rigorous academic elective course that emphasizes organization, note-taking skills, and critical thinking.

"Sandians embrace this event and it is very special to see the interactions that occur as a result of bringing our kids to work," says Pam Catanach (3652). "Career exploration is important to middle school students because it helps them see that what they are learning is relevant to jobs they might pursue in the future. Take Our Daughters and Sons to Work Day provides a unique opportunity for students to visit Sandia facilities, learn about our research, talk with our scientists and engineers, and see what careers are available in STEM disciplines."

Take Our Daughters and Sons to Work Day is a national organization founded in 1992. More than 37 million students and adults at more than 3.5 million workplaces were expected to participate this year.



(Photo by Norman Johnson)



(Photo by Rachel Baros)



(Photo by Rachel Baros)



(Photo by Rachel Baros)



(Photo by Rachel Baros)



(Photo by Norman Johnson)



(Photo by Rachel Baros)



(Photo by Rachel Baros)



(Photo by Norman Johnson)



(Photo by Norman Johnson)



(Photo by Norman Johnson)



(Photo by Norman Johnson)



(Photo by Rachel Baros)



(Photo by Rachel Baros)



(Photo by Jake Deuel)

Sandia celebrates Earth Day and Arbor Day

SANDIA LABS DIRECTOR Paul Hommert welcomed about 30 parents, children, and members of the workforce at a special tree-planting ceremony on the east side of Bldg. 729 on Thursday, April 25, in conjunction with Take Our Daughters and Sons to Work Day, Arbor Day (April 26), and Earth Day (April 22). Paul encouraged and happily assisted some eager children in shoveling some enriched soil on a new Oklahoma Redbud.

The ceremony was also an opportunity to tell the audience about the value of trees, and the proper method of planting and nurturing them, and to highlight spring tree and shrub planting efforts by the Facilities Grounds and Roads Maintenance team and the Facilities Infrastructure Team.



(Photo by Lloyd Wilson)