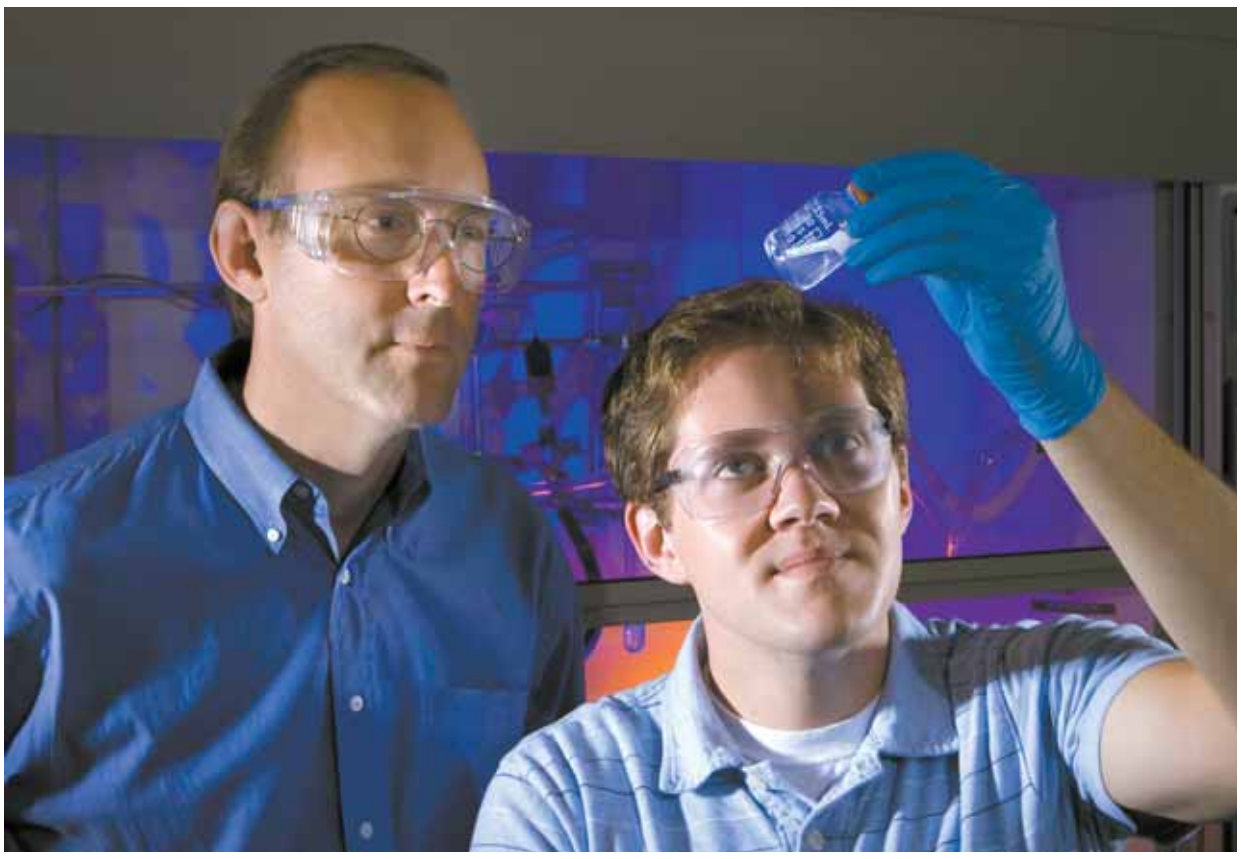
Little building blocks yield grand results



EVERY CHEMIST'S DREAM — As Mark Allendorf (8324) looks on, postdoc Ron Houk (8755) examines new fluorescent metal-organic frameworks — MOFs — synthesized for use in chemical and radiation detection. (Photo by Randy Wong)

By Patti Koning

It's every chemist's dream — arranging and rearranging molecular pieces into controlled structures. Mark Allendorf (8324) and other chemists at Sandia have made that dream a reality through a highly successful Laboratory Directed Research and Development project that has yielded exciting results and a few surprises.

Those molecular tinker toys are metal-organic frameworks or MOFs, a new class of nanoporous materials. "For many years people have tried to make porous materials out of a combination of organic and inorganic pieces but were never able to achieve permanent porosity," says Mark.

Then came MOFs. These materials, formed from seemingly modest chemical components, have generated big results for Mark and his team. An LDRD project to study MOFs as a discovery platform for confined space chemistry has, in less than three years, resulted in outside funding, two patent applications, six publications with more in submission, and three major findings.

MOFs were discovered in 1999 by Omar Yaghi, who was a professor at the University of Michigan at the time (he has been at UCLA since 2006). MOFs are positively charged metal cations that are linked to anionic organic groups, which are called a coordination bond. Yaghi learned that by properly selecting the structure of the organic component and the coordination geometry of the metal, he could condense them into crystals with specific morphologies that preserve their porosity.

(Continued on page 4)

W87 team reaches key milestone with JTA4 first production unit

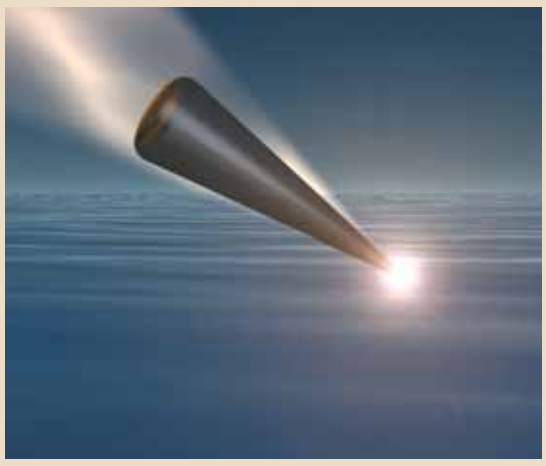
By Mike Janes

The California site's W87 team reached an important milestone recently with the completion of the JTA4's first production unit (FPU), culminating a multiyear development effort. It marks the first time the new suite of instruments, parts, and equipment from the refurbished W87 has been produced and assembled into a flight test vehicle through the Nuclear Weapons Council's production agencies.

The FPU has been fully built, tested, prepared for flight, and accepted by NNSA. Soon it will be delivered to the Air Force for a future flight test.

"Today's mantra is 'better, faster, cheaper,' and this achievement is special because it allows collection of more test data than ever before, even though there are fewer flights being conducted," says Kurt Berger (8231).

The W87 warhead was originally carried aboard the Peacekeeper ICBM, which has since been retired in favor of Minuteman ICBMs under the Safety Enhanced Reentry Vehicle (SERV) program. Whereas Peacekeeper carried up to 10 reentry vehicles (RV) with W87 warheads, the delivery mechanism and RV capacity have now been converted down to a single missile and RV.



THIS ARTIST'S RENDERING depicts a W87 joint test assembly RV reentering the earth's atmosphere during a US Air Force flight test.

Joint test assemblies, or JTAs, are instrumented test models of a weapon used for flight testing. Though these flight tests include an inert physics package containing no special nuclear material, they are considered critical to the stewardship and maintenance of the weapons stockpile.

"We put a lot of functionality into this package," says Kurt. "We look at the fuze, we look at flight dynamics, we look at flight environments, and we look at diagnostic information on trajectories and separations."

The data is vital, Kurt says, as it offers insight into whether the weapon would have flown and performed properly in wartime conditions. "We can explain in detail how this RV has reentered and performed. Though that may sound easy, you have to remember that it's analogous to a bullet traveling some 5,000 miles to reach its target."

"JTA4 is really the test assembly of the future, and as such will be the source of all the test flight information that helps us understand the stockpile and its components," says Ben Markel (8231).

A side benefit to the JTA4 effort, he says, was the close interaction, information sharing, and overall cooperation throughout the process with Lawrence Livermore, DoD, and several production agencies. "Our relationships with those organizations have all been strengthened because of JTA4, and that can only bode well for the future," Ben says.

The JTA4 first production unit is scheduled to fly this November out of Vandenberg Air Force Base.

California Sandia LabNews

Vol. 60, No. 17 August 29, 2008

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Sandia National Laboratories

Highlights of your 2009 benefits plan changes

A new, more modern dental care plan featuring significantly improved levels of reimbursement for many dental services (with a modest premium) is among the benefits changes coming in 2009 for nonrepresented employee and retirees. The changes go into effect Jan. 1, 2009.

Div. 3000 VP John Slipke says the plan changes, approved recently by Sandia's Board of Directors, are part of a long-term strategy.

"These upcoming changes are an illustration of how we are moving toward — how we must move toward — a modern, more market-driven benefits plan that offers improved services to employees at a lower cost, more like those offered today in both government research labs and

(Continued on page 3)

CHANGE @ SANDIA

Inside . . .

JOE LEWIS "composes" a book on web design. Story on page 8.

Sandia CaliforniaNews

For the second year in a row, this special edition of the *Lab News* is dedicated largely to the work being done today at Sandia/California. The issue's guest editors are Mike Janes and Patti Koning (pictured at left). For last year's California edition, see the Aug. 17, 2007, *Lab News*.

Spare change in Oz

By guest columnist Jim Simmons (8528)
Office of Community and Civic Relations, Sandia/California

It is the famous words of Elphaba (aka the Wicked Witch of the West) that often return to me these days, although not so much in her tone of lament as in the more straightforward recitation of the facts. "Wotta world, wotta world," she decried, as her very substance swirled down into a pile of nothingness gathered at her admitted poorly shod feet.


JIM SIMMONS

Because in a feat of bio-immolation worthy of being replicated in one of our very own labs or Sandia shops, you'll recall that young Dorothy had pitched a bucket of dihydrogen monoxide in an heroic fire suppression attempt only to miss the switchgrass scarecrow and solidly douse the algae-hued one and thereby begin the wicked witch deconstruction.

Elphaba's final words, then, often seem to sum up the sense of some these days as so many seem faced with the plethora of possibilities that potentially face us all.

What a world, indeed! We have in front of us so much that will not remain the same. Our republic's chief executive is on that list. Also there are retail gasoline prices, and a pre-green society, and the inexorable march of changing technology.

We have some matters before us, which upon inescapable reflection, may see no change at all. We must keep a civil society, and we mustn't lose our freedom to make political decisions or the vital need for a nimble, dynamic Sandia, and keep strong the imperative to move to alternative, even renewable, sources of energy.

Emitting an out-loud audible like "wotta world, wotta world" could also be an exclamation of excitement and exuberance. Sensing a presence as big as consternation is just as big a job as is sensing a presence of enchantment. For, fortunately, with the great swarm of possibility swirling all around, we might eschew every negative vibration, and immerse ourselves in the positive. And there is so much of that, so very much, that we here in California, at the tip of the spear piercing the cloak of the future, can barely restrain ourselves and not just thrust and rip and tear with great vigor into that too-full future waiting just around the edge of the calendar.

How many other workplaces can boast of convening a group of co-workers, complete with web presence, helping to confront and steer the impact of change. What other lab would be the designated hitter for the threshold of change? And like Elphaba with lightning balls at her fingertips querying the antibrainiac strawman with the immortal "Wanna play ball, scarecrow?" we California Sandians have seen a recent demonstration by an emeritus VP working at the very edge of new energy research, extreme ball lightning. Say what? Extreme ball lightning! Oh my stars! What a world!

We are, again, here in the Golden State, humans used to change. One day in California is never like the last. While the future here may not be what it used to be, change is still our constant companion. We're used to it. We're good at it. We like it. People everywhere count on us Californians for it. It's not hard. It's fun. It's one of the wonders of California. That makes some shake their head, sometimes drop their jaw.

So, yeah, what a world. But we handle it well. We put Sam Cooke's "A Change is Gonna Come" on our cassettes, and Bob Dylan's "The Times They Are A-Changin'" on our Walkmans, and David Bowie's "Ch-Ch-Changes" on our iPods. And even our panhandlers handle it right calling out for spare change.

So, count me in too... gimme some spare change... will take all you got!

— *James Edward Simmons (925-294-2912, 9114, jamsimm@sandia.gov)*

Sandia LabNews

Sandia National Laboratories

http://www.sandia.gov/LabNews

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LOCKHEED MARTIN

Retiree deaths

Wilkerson M. Howard (age 89) . . . . . June 8
James C. Mashburn (88) . . . . . June 11
Ruth L. Farley (90) . . . . . June 27
Alice R. Morgan (74) . . . . . July 2
Robert I. Peterson (78) . . . . . July 6
Lois H. Wade (78) . . . . . July 7
John L. Cawlfield (71) . . . . . July 8
Manuel A. Moya (88) . . . . . July 13
Ronald C. Wishart (92) . . . . . July 14
K.E. Helmstadter (84) . . . . . July 14
Merle J. O'Keeffe (81) . . . . . July 18
Carl Edward Oliver (65) . . . . . July 22
Donald S. Dreesen (89) . . . . . July 26
Paul Charles House (87) . . . . . July 26
Edna J. Bierner (86) . . . . . July 28
William E. Seaburn (86) . . . . . July 28

Lab News Reader Service

The *Sandia Lab News* is distributed in-house to all Sandia employees and on-site contractors and mailed to all Sandia retirees. It is also mailed to individuals in industry, government, academia, nonprofit organizations, media, and private life who request it.

Retirees (only):

To notify of changes in address, contact Benefits Dept. 3332, Customer Service, at 505-844-4237, or Mail Stop 1021, Sandia National Laboratories, Albuquerque, NM 87185-1021.

Employee death

From his service in the military to his service at Sandia, David Paul was a true patriot

David Paul (2552) died Aug. 3 at age 59. He had been at Sandia 34 years. David was a member of the Explosives Technologies Group, commonly referred to as the gun site.

"He was an irreplaceable resource as the site armorer," says his manager, Michael Kaneshige (2552). "He participated in firearms tests that continue to protect our national assets and those charged with transporting them. David was always eager to help out on any project or assignment. His positive attitude and sense of humor were an inspiration to all of us."


DAVID PAUL, left, and Brian Melof prepare a shaped charge for a test. David is spooling out the shock tube, which is used to set off the explosive shaped charge for the test.

"Dave enjoyed laughing and especially liked to make people around him laugh," says Michael Deveney (1734). "Dave once told me that when he was young, after he had accidentally broken something, his grandfather looked at him and said, 'Kid, you could break an anvil.' I believe this may have been a factor in his career choice, which he always described as 'blowing things up.'"

"Dave loved to bowl," says Dennis Johnson (5335). "He was in a league for several years. Most of his fellow bowlers would agree he was not a very good bowler, but he was consistently not good. Perhaps the reason for his low but consistent average could be traced to his bowling ball. About the second year we were in a league, Dave showed up with a clear plastic ball with a skull embedded in it. The new ball not only helped him improve his average slightly, it gave the team and competition something to talk about each week."

"When Take Our Kids to Work Day came along, Dave always wanted to participate," says Marc Hagan (2554). "We used to have a 105 mm gun mounted on what looked like a tank. There was room in the back for six to eight kids. Dave would load them up and drive them around the fields near the gun site."

"Dave was enthusiastic about his work and truly got a kick out of discovering something new or helping solve a difficult problem," says Brian Melof (5434). "He was relentless and dedicated to serve his country," adds Brian. "As a Marine, he proudly served two tours of duty in Vietnam. His wartime duties ranged from radio operator to forward observer and artillery gunner. Dave was present at Khe Sanh during the infamous siege in which a 77-day battle resulted in more than 400 US deaths and countless casualties."

"Dave was a member of the ground forces," says Kevin Fleming (2554). "The horrors of napalm drops and fierce ground conflict tax even the strongest man's fortitude. Dave chose to stay in the battle because, as he said many times, 'Lots of soldiers died before me to protect our freedom, so who am I to quit fighting.'"

Dave was awarded at least one Purple Heart during his military service.

"From his service as a Marine to his service at Sandia," says Michael, "David was a true patriot."

— *Iris Aboytes*

Recent Patents

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

Anup Singh (8321): Planar Micromixer (Patent No. 7,344,681)

Gregory Jamison (5918), David Wheeler (1714), Blake Simmons (8755), Kamyar Rahimian (1716), and Chad Staiger (6338): Metathesis Depolymerizable Surfactants (Patent No. 7,358,221)

Benefits plan changes

(Continued from page 1)

comparable high-tech companies throughout the country." (See *Lab News*, July 18, 2008, page 1, "Changing nature of employer total benefits plans.")

Highlights of changes this year

Some benefits change highlights for nonrepresented active employees follow; full details will be available during Sandia's Open Enrollment period, Oct. 20-Nov. 10:

• Modernizing Sandia's dental care plan with improved reimbursement levels for many services while introducing a modest premium (about $10/month for a single employee). The current fixed-fee reimbursement schedule that pays a set fee for a given dental service will be replaced with reimbursement levels based on a percentage of the cost of the service. (For example, fillings will be covered at 80 percent of the cost of the service rather than at a set dollar figure.) Overall this change is expected to be cost-neutral to employees who access dental services, and reimbursement levels will automatically keep pace with any increase in dentist's fees, says Linda Duffy, director of Health, Benefits, & Employee Services 3300.

• Opening an on-site pharmacy at Sandia/New Mexico. An on-site clinic with an on-site pharmacy is more convenient for employees, saves overall employee and employer costs, and improves health outcomes through a dedicated pharmacist who can provide patient counseling and education, she says.

• Increasing some medical plan copays. (For example, copays will go from $15 to $20 for primary care physician visits and $25 to $35 for specialist visits under the PPO plans.) Generally, office visit copay amounts Sandians pay are below national averages.

• Eliminating the CIGNA Premier PPO Plan, the least-used and most redundant of Sandia's current five medical plan offerings. In 2008 fewer than 400 Sandians enrolled in this plan. Eliminating the plan reduces Sandia's administrative costs while maintaining a range of health plan options, Linda says. (Details about what CIGNA Premier-enrolled employees need to do to elect an alternate plan will be available during Open Enrollment.)

• Increasing the Health Care Flexible Spending Account maximum from $4,000 to $5,000. (Note: The name is changing from the Health Care Reimbursement Spending Account to be consistent with the terminology used in industry.) More information will be available during Open Enrollment.

• Reducing employee extended sickness absence benefits from 52 weeks to 26 weeks with full pay regardless of years of service, while maintaining Sandia's long-term disability (LTD) plan as an employer-paid benefit. Employer-paid LTD plans are no longer commonly offered among DOE labs and US companies, says Linda, and full-year/full-pay sickness absence benefits are rare as well.

• Introducing a defined contribution pension plan rather than a defined benefit pension plan for new employees hired after Dec. 31, 2008, as announced in the July 18 *Lab News*.

Employees will see an increase in their health care contributions due to an increase in health care costs and an increase in premium sharing. Employee premium costs will depend on the plan selected and the employee's salary tier.

Double-digit health care cost increases are the norm nationwide for the past several years. Linda notes that Sandia subsidizes on average more than 80 percent of the cost of employee and family health care, compared to the national average of 77 percent. For a typical family of four enrolled in the UnitedHealthcare PPO, the Sandia subsidy amounts to more than $11,000 annually.

Changes to the medical and dental plan design for retired covered employees will be similar to those for on-roll nonrepresented employees. (Note that while current retired covered employees will not pay a premium for the new dental plan, employees who retire after Dec. 31, 2008, will pay the same amount as on-roll employees.)

Changes in benefits packages for represented employees are negotiated during collective bargaining.

Open enrollment coming soon

Additional details about the upcoming changes will be provided in a variety of ways during the coming weeks and will culminate with benefits fairs for employees and retirees during the annual Open Enrollment period scheduled for Oct. 20-Nov. 10, 2008. (See "2009 Open Enrollment Benefits Fairs, presentation schedules," above).

Look for your Open Enrollment newsletter (new this year — a link will be sent electronically to all employees at work) around mid-October. The Medical Plan Comparison Charts will still be mailed to your mailstop. It is very important to review this information to become familiar with all of the health plan changes that will be forthcoming.

Frequently asked questions and answers will be posted at hbe.sandia.gov.

2009 Open Enrollment Benefit Fairs, presentation schedules

Employees

Albuquerque Benefit Fairs – Employees (Mountain Time)		
Benefits Choices 2009		
Oct. 22 (Wednesday)	Steve Schiff Auditorium, Bldg. 825	10 a.m.-2 p.m.
Oct. 23 (Thursday) Employee/Spouse Fair	Winrock Theatre 201 Winrock Center, Albuquerque	1-2 p.m.
Oct. 29 (Wednesday)	Steve Schiff Auditorium, Bldg. 825	10 a.m.-2 p.m.
Nov. 4 (Tuesday)	Steve Schiff Auditorium, Bldg. 825	10 a.m.-2 p.m.
Livermore Benefit Fair – Employees (Pacific Time)		
Oct. 27 (Monday)	Bldg. 905 Mezzanine	10 a.m.-2 p.m.

Retirees

Albuquerque (Mountain Time)		
Benefits Choices 2009 – NON-Medicare Presentations w/Benefit Fairs		
Oct. 23 (Thursday)	Winrock Theatre 201 Winrock Center, Albuquerque	8:30-9:30 a.m.
Nov. 5 (Wednesday)	Winrock Theatre 201 Winrock Center, Albuquerque	10:30-11:30 a.m.
Benefits Choices 2009 – Medicare-Primary Presentations w/Benefit Fairs		
Oct. 23 (Thursday)	Winrock Theatre 201 Winrock Center, Albuquerque	10-11:30 a.m.
Nov. 5 (Wednesday)	Winrock Theatre 201 Winrock Center, Albuquerque	8:30-10 a.m.
Nov. 5 (Wednesday)	Winrock Theatre 201 Winrock Center, Albuquerque	1-2:30 p.m.
Livermore (Pacific Time)		
Benefits Choices 2009 – NON-Medicare Presentation w/Benefit Fair		
Oct. 28 (Tuesday)	Doubletree Club Hotel/Livermore 720 Las Flores Road	8-9:30 a.m.
Benefits Choices 2009 – Medicare-Primary Presentation w/Benefit Fair		
Oct. 28 (Tuesday)	Doubletree Club Hotel/Livermore 720 Las Flores Road	10-11:30 a.m.

'Nano-solder' technique named a top-50 winner by ***Nanotech Briefs***

By Neal Singer

You should have so much patience to solder nanowires to nanoelectrodes. Talk about fine work. (A nanometer is a billionth of a meter.)

That's why a new electroplating process that simultaneously joins many silicon nanowires to many prepatterned electrodes was selected for a 2008 Nano 50 Award by *Nanotech Briefs*.

The process removes many difficulties.

"All of the electroplating is done in parallel," says Sean Hearne (1132), a Sandia researcher at the Center for Integrated Technologies (CINT). "Everywhere there's a metal contact, the electroplated nickel grows over the nanowire, capturing it."

CINT is a DOE Office of Science nanotechnology center led by Sandia and Los Alamos National Laboratory.

Previous methods connected electrodes to nanowires one contact at a time. That kind of service may sound great in stockbroker ads; in a lab, it's merely tedious.

Other methods required complex processes that included masking, metal deposition, and stripping, which often damaged the nanowires.

The process could be important for commercial applications of semiconducting nanowires used in electronic sensor arrays, because it allows for the parallel processing of millions of nanowires on a single wafer at lower cost than previous lithographic techniques.

In the team's approach, microarrays of composite gold electrodes were lithographically formed on oxidized silicon substrates, followed by electric-field-assisted alignment of silicon nanowires between the electrodes.

The nanowire ends were then embedded in nickel by selective electrodeposition over the prepatterned electrodes. Annealing to 300 °C provided good electrical contacts for the doped nanowires.

The approach provides a parallel, maskless method to establish metal contacts to nanowires without need of high-resolution electron beam lithography for electrical and mechanical applications.

Sean, who developed the electroplating process, worked with Arizona State University research leads and Tom Picraux, CINT chief scientist at Los Alamos National Laboratory. The overall work was led by former ASU School of Materials student Sarang Ingole, an advisee of Picraux. It was part of an ASU User Proposal with CINT titled "Doped SiGe Nanowires for Functional Nanodevices." The subject was proposed by principal investigator Steve Goodnick and coprincipal investigator Clarence Tracy, both at ASU.

The work, titled "Directed Assembly of Nanowire-Metal Contacts," was chiefly conducted at CINT's Los Alamos and Albuquerque sites. It appeared in a July 2007 issue of *Applied Physics Letters* as both a letter and a cover image.

The Nano 50 will be presented at a special awards dinner to be held during the *NASA Tech Briefs* National Nano Engineering Conference in Boston Nov. 12-13.

Winners are judged by a team of nanotechnology experts. They select the top 50 technologies, products, and innovators that have significantly impacted — or are expected to impact — the state of the art in nanotechnology.

The 2008 Awards are posted at: www.nanotechbriefs.com/nano50/nano50_winners_08.html.

Dealing with the aftermath of a bioattack

Demonstration project examines methodologies, tools for bio-restoration planning in wide areas

By Mike Janes

Sandia has proven to be a leading research authority when it comes to the protection of transportation hubs and large facilities against chemical or biological attack. Projects involving San Francisco International Airport and McAfee Stadium come to mind, among others.

But a terrorist event of this nature, particularly of the biological sort, could be even more catastrophic if it were carried out over a wide area, such as a large city or metropolitan region. That's one of the main reasons why Sandia's systems analysts and decontamination and restoration experts have been engaged in a four-year, Department of Homeland Security (DHS) and DoD-funded effort to help authorities deal with the aftermath of a biological attack.

The Interagency Biological Restoration Demonstration (IBRD) is a collaborative program to develop policies, plans, and technologies required to restore large urban areas in the event of a wide-area biological release, with a focus on civilian-military interfaces. This program is initially using the Seattle/Tacoma urban area and local military bases, such as Fort Lewis and McChord Air Force Base, in a case study. Study findings and results could potentially be applied nationally to biological restoration policy and programs.

Sandians at both the New Mexico and California sites are involved in the IBRD effort, along with key partners from Lawrence Livermore and Pacific Northwest national laboratories and oversight from DHS' Directorate for Science and Technology (S&T) and DoD's Defense Threat Reduction Agency (DTRA) program offices.

IBRD TEAM — Reviewing maps and blueprints of the Seattle IBRD case study are team members, left to right, Wayne Einfeld, Lynn Yang, Donna Edwards, and Dave Franco. (Photo by Randy Wong)

Gaps need to be addressed

"An anthrax attack would obviously present a huge problem for any city," says systems analyst Lynn Yang (8114), who notes that Seattle and the surrounding Puget Sound region has been the focus of the IBRD team's initial efforts.

"You're talking about potentially hundreds of buildings and tens of square miles. Some regions may face a general lack of resources available to fulfill all the restoration demands in a timely fashion," Lynn says.

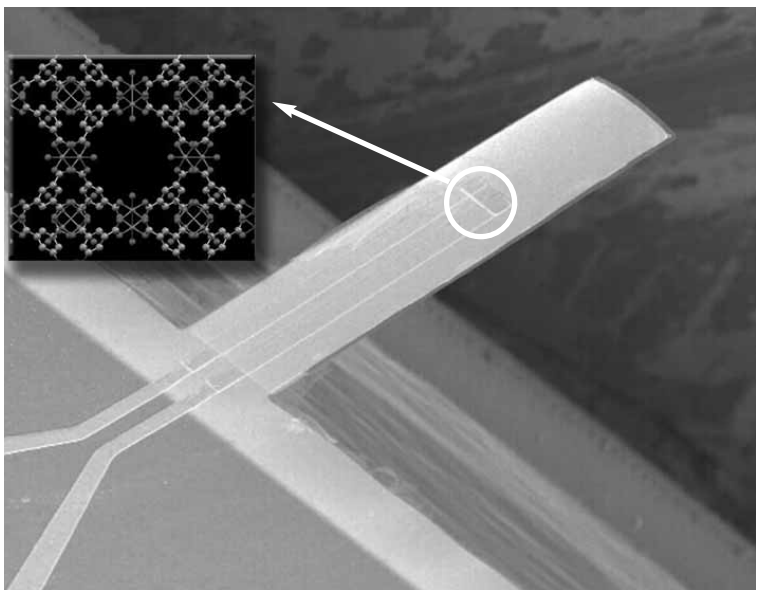
Sandia and the rest of the IBRD team have been tackling the problem for about a year now. One of the initial "knowledge gaps" identified by the analysis team was that authorities currently do not know whether a contaminated outdoor area would need to be actively decontaminated, or if natural attenuation from rain and ultraviolet exposure would be sufficient. The team also has made recommendations in planning and decision making. For example, in a wide-area contamination scenario, authorities would greatly benefit from formal, agreed-upon processes to determine what buildings need attention, and in what order.

Without such processes, a city hit by an anthrax attack might attempt to clean up buildings and infrastructure in an inefficient manner. Sandia analysts have recommended that decision prioritization for cleanup should be informed by many factors, includ-

(Continued on next page)

MOFs: Metal-organic frameworks

(Continued from page 1)



MICROCANTILEVER DEVICE coated with a 100-nm-thick MOF layer. When exposed to various analytes, stress induced at the MOF-cantilever interface creates a change in resistance that can be detected.

"The first MOF that Yaghi reported was pretty spectacular. It has a surface area more than three times that of industrial-grade molecular sieves, such as zeolites," says Mark. "It really does look like tinker toys."

In late 2005, with a little less than $500,000 in annual LDRD funding for three years, Mark, Blake Simmons (8755), Jeffery Greathouse (6316), and several postdocs began brainstorming research avenues to pursue. The problem was not coming up with ideas, but finding the resources to pursue all of their ideas.

"We felt like kids in a candy store, with all of this low-hanging fruit," Mark adds.

A new class of scintillators

One of the first areas they pursued was a fluorescent framework, which could be used as a sensing mechanism. Postdoc Christina Bauer created two new MOFs, both of which were fluorescent and one of which was porous, a result that Mark says was satisfying in its own right.

Then, at a talk she gave on the new MOFs, Patrick Doty (8772) observed that they contain stilbene, a well-known scintillator. This got him wondering if the new MOFs could be used as a scintillator.

Patrick tested the MOFs and the results were better than anyone had anticipated. They not only scintillated, but they performed so well that they turned out to be the first truly new class of scintillators found in decades.

"What is really exciting is that these structures have scintillation built into the framework, but because they are porous you can add other materials," says Mark. "For example, you could shift the wavelength of the scintillation light to a more convenient area, making it easier to detect, or add helium-3 (He-3) gas to make radiation detection more efficient."

Once again, the researchers had that kid-in-a-candy-store feeling, as the new scintillators opened up a whole raft of ideas that would be difficult to pursue with other materials. Earlier this year, the Defense Threat Reduction Agency (DTRA) agreed to fund a Sandia proposal to build a better understanding of the fundamental processes controlling neutron-generated scintillation in MOFs. This is a particularly important research area because neutrons are emitted by fissionable material but are difficult to detect using current materials that can only detect the highest energy or slowest neutrons.

"In less than three years, the original LDRD had already pulled in outside funding, which is pretty unusual," Mark says.

Microcantilevers springboard chemical detection

Another big result was in chemical detection. Some MOFs can shrink by up to 10 percent when water is added without actually changing their crystal structure.

"For a sensor, if you take a material that changes its dimension when it absorbs something and mate it with another material, the absorption will create a stress at the interface between the two materials," explains Mark. "You can then detect that stress using a piezo resistance sensor."

He formed a collaboration with Peter Hesketh, a mechanical engineering professor at Georgia Tech who works on microcantilevers (approximately 40 microns wide by 100-300 microns long) machined using MEMS technology. As Mark explains, the challenge of microcantilevers is making them responsive to specific stimuli. One method is to put organic polymers on top of the microcantilever, but those materials are not porous.

"MOFs are porous and rigid in comparison with an organic polymer. We hypothesized that if we could glue an MOF layer onto the microcantilever surface so that there was no slip, then we would be able to very sensitively detect absorbed molecules," he says.

After nearly two years of work, the researchers were able to apply a uniform layer of MOFs onto the microcantilever. It then took several months to prove that they had indeed accomplished their task. The small size of microcantilevers means that most analytical techniques don't work.

The results, again, were stunning. The MOF-coated microcantilever responds in less than a second to water vapor, ethanol, and methanol and does so differentially, meaning that the response is unique to the chemical detected. The researchers also found that if they baked out the water, they opened up binding sites in the MOF and turned on sensitivity to carbon dioxide.

"We see resistance changes in these sensors that are very fast and extremely reversible — almost square-wave type behavior," says Mark. "As far as I know, this is the first time anyone has ever integrated an MOF with a real device. We not only built a sensor, but we also proved it responds reversibly and that it has actual selectivity by controlling the hydration state of the layer."

The team submitted a patent application and a journal article describing the results is currently being reviewed.

A potential application is for breath analysis. A symptom of pulmonary distress, especially in children, is increased levels of nitric oxide and carbon monoxide in the breath. Mark envisions a device based on an MOF microcantilever that could detect dangerous levels in a doctor's office or even at home. The team has submitted proposals to pursue this application to the National Institutes of Health.

Force-field modeling

Jeffery led the third major accomplishment from the original MOF LDRD — development of a computational tool that enables prediction of how MOFs would react when they adsorb gases. As Mark explains, this had been done before but always under the approximation that the framework atoms were fixed at their crystallographic coordinates.

Jeffery wanted to look at reactivity so he invented a flexible force field to allow MOF atoms to move during the simulation and to reproduce the structural changes that result from adsorption of various molecules.

"Our force-field approach has led to new insight into the physical and mechanical properties of MOFs, such as the unusual trend of negative thermal expansion," he says.

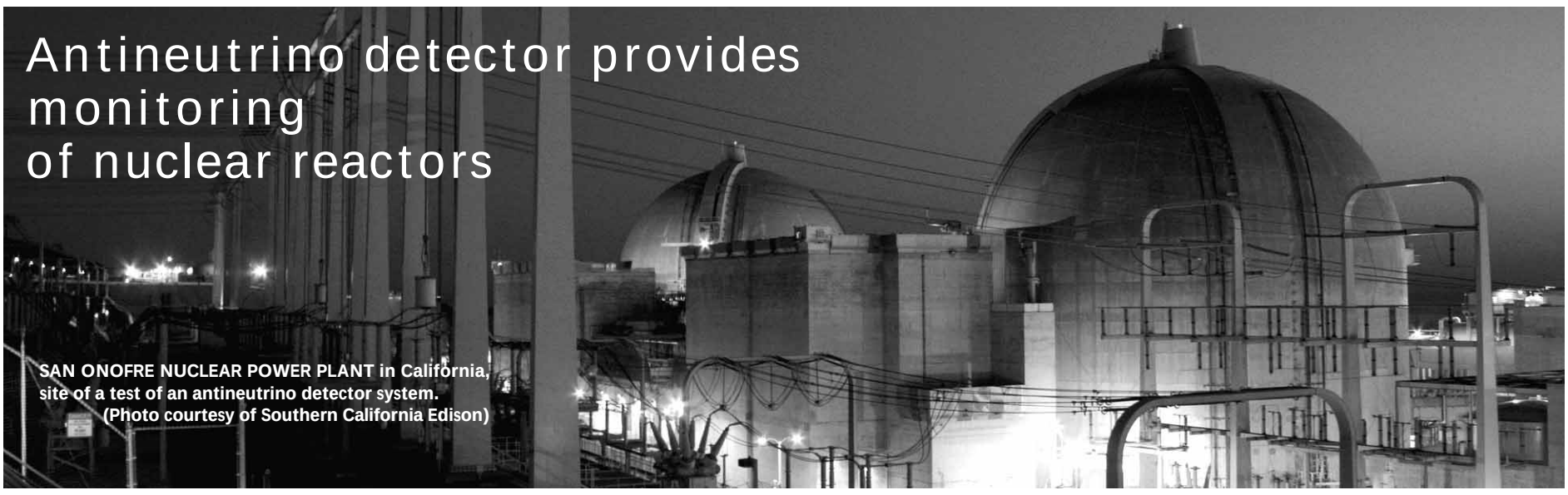
The project team has published several papers, including two in the *Journal of the American Chemical Society*. The first paper, on water reactivity with MOFs, had 17 citations within the first 18 months of publication.

A bright future

The potential applications for MOFs seem to be limited only by the imagination of the researchers. Research is underway on chemical separations, other gas storage that could include CO^2 sequestration, and catalysts. More distant applications include drug delivery devices, since some MOFs react with water and fall apart in aqueous solutions, and personal exposure monitors.

"This is the first time in my 22-year career that I've been involved in really hot science," says Mark. "It's pretty fun."

Antineutrino detector provides monitoring of nuclear reactors



SAN ONOFRE NUCLEAR POWER PLANT in California, site of a test of an antineutrino detector system. (Photo courtesy of Southern California Edison)

By Patti Koning

A new tool under development by Sandia researchers promises to transform the way nuclear reactors are monitored. The antineutrino detector, a joint project by Sandia and Lawrence Livermore National Laboratory (LLNL), has already proven it can perform continuous and independent monitoring of the operational status and thermal power of reactors.

Antineutrinos are the antiparticles of neutrinos — fast-moving elementary particles produced in nuclear decay with minuscule mass that pass through ordinary matter undisturbed. They are difficult to detect, but the sheer number a nuclear reactor emits is so large that a cubic-meter scale detector can record hundreds or even thousands per day.

In simple terms, the antineutrino detector tracks the rate of antineutrinos emanating from a reactor and provides direct measurement of the operational status (on/off) of the reactor, measures the reactor's thermal power, and places a direct constraint on the fissile inventory of the reactor throughout its life cycle.

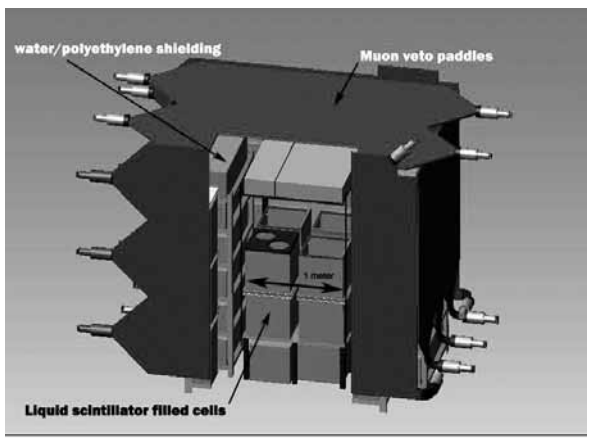
"You can't fake the signal," says Lorraine Sadler (8132), one of the Sandia researchers leading the effort. "The only source that produces a strong antineutrino signal is a nuclear reactor."

David Reyna (8132), Sandia's principal investigator on the project, describes neutrinos as annoying because they rarely interact with ordinary matter and can't be shielded. "But this fact means you can sit outside the reactor itself, where the neutrinos are still flowing unobstructed, so it is a pure monitor of what exactly is happening inside without doing secondary measurements of temperature and back calculating," he adds.

Joining David and Lorraine on the project are Adam Bernstein, the LLNL principal investigator, and his colleagues Nathaniel Bowden, Steven Dazeley and Robert Svoboda, along with professor Todd Palmer and graduate student Alex Misner at Oregon State University. Other Sandia contributors are Jim Brennan (8321), who performed the mechanical design of the detectors and assisted with assembly; John Steele (8227), who played a major role in the design of the electronics readout for the detector system, particularly the field-programmable gate-array (FPGA)-based trigger; Stan Mrowka (8132), who helped implement much of the software for the electronic readout; Kevin Krenz (8132), who designed and fabricated the gadolinium neutron absorbers in the recent plastic detector; and Jason Zaha (8132), who assisted with the design and fabrication of the electronic readout.

The antineutrino detector addresses a critical issue as more countries begin seeking nuclear power — that nuclear reactors and nuclear weapons use very similar fuels. The best-known and most challenging role of the International Atomic Energy Agency (IAEA) is verifying that nuclear states comply with their commitments under the Nuclear Non-Proliferation Treaty and other nonproliferation agreements, to use nuclear material and facilities only for peaceful purposes.

While IAEA nuclear weapons inspectors are "physicists, chemists, and engineers with decades of experience in nuclear weapons research and development, nuclear material safeguards, and intrusive international inspection," according to IAEA Director General Mohamed El Baradei, they still face a daunting task. Today, monitoring occurs infrequently, usually every 18 months, and depends on administrative information provided by operators within nuclear facilities.



ARTIST'S RENDERING of antineutrino detector.

"The antineutrino detector provides a completely independent way of verifying what is happening inside a nuclear reactor," says Lorraine. "This type of monitoring could make nuclear power a viable option to emerging societies."

This spring researchers from Sandia and LLNL wrapped up a field test of the detector at the San Onofre Nuclear Generating Station, located midway between Los Angeles and San Diego. The antineutrino detector was placed in the tendon gallery of the reactor, outside the containment dome and about 25 meters from the core.

"The test was completely unobtrusive to the power plant, which is very important from the operators' perspective," says Lorraine. "Besides our direct contacts at the plant, other employees were even shocked when we told them we were still there."

Once the detector is in place, the agency doing the monitoring, most likely the IAEA, can acquire data without any intervention or support from the reactor operator. While this test was a complete success, less than half of the reactors worldwide have a tendon gallery design. Work is already underway on detectors that can operate above ground.

"Above ground is a whole different monster," says Lorraine. "Underground you are shielded from cosmic background, but above ground without the earth's shielding, your background noise increases by orders of magnitude."

The researchers currently are working on two separate projects. The first replaces half of the original underground detector, made from a liquid scintillator, with a plastic scintillator. A liquid scintillator poses some safety hazards, so if the same results can be achieved using a plastic scintillator, the technology would be ultimately easier to deploy.

A second set of experiments focuses on aboveground deployment by exploring two avenues: segmenting the existing detector materials to better distinguish external background from signal events, and a new high-sensitivity germanium-based detector technology that would be 1,000 times more sensitive to neutrino interactions by looking for a different signature.

"I'm confident we can get the same results above ground, but the technology hasn't been tested yet," says David.

The target application for the antineutrino detector is cooperative monitoring, but there is also a potential for far field monitoring. The current focus, says David, is on making the detector smaller and less invasive while maintaining consistent performance.

The antineutrino detector will likely be tested in more reactors soon. David says he is talking to the Columbia Generating Station in Washington and the Advanced Test Reactor at Idaho National Laboratory. Internationally, testing could occur in Canada and Brazil.

David and Lorraine, in collaboration with physics professor Juan Collar at the University of Chicago, are also investigating a new physical process called coherent neutrino-nucleus scattering for detecting antineutrinos that could potentially lead to large sensitivity gains in their antineutrino detector. This summer they have begun an experiment at San Onofre to verify this new antineutrino detection technique.

They say they're pleased with the results so far and excited about the potential of the antineutrino detector. Plus, adds Lorraine, its nice to know that neutrinos have a purpose.

Bioattack

(Continued from preceding page)

ing the overall objective for restoration (e.g., maximum reoccupation in minimum amount of time), an understanding of what infrastructure is critical, and other local considerations.

To address the wide-area dilemma, Sandia has further recommended to its sponsors that they improve the technologies available to "scope" the problem more rapidly following an event.

Wayne Einfeld (6327), along with others in Sandia's systems analysis group in California, is leading a study that is making specific recommendations to the program sponsors as to which technologies should be considered for development and what capabilities would be most beneficial. "As is usually the case, federal resources are limited, so program managers must carefully choose where to invest in technology development and application to make the biggest impact in the restoration process," says Wayne. The analysis team is using a variety of analytical tools to provide quantitative justification for the various development options.

The IBRD team at Sandia, led by principal investigator Mark Tucker (6327), is also involved in technology development. Mark has a long history in restoration technology, having led the development of the Labs' well-known decontamination formulation that has since been commercialized and widely used in both military and domestic applications.

Managing contaminated waste

One piece of technology that's already been used to a large degree, Mark says, is the Sandia-developed Analyzer for Wide-Area Restoration Effectiveness, or AWARE. Currently in spreadsheet format, AWARE is a tool that looks across the full spectrum of restoration activities and analyzes each phase in terms of resources and timelines. It explores the answers to questions such as, how many teams are required to take samples in a given location. If a certain technology is introduced, does it improve or speed up the process?

Another area of focus for IBRD, Lynn says, has been how best to manage the equipment and other items in contaminated zones. Given the quantity and variation of items, including cars, furniture, and other pieces of personal property and goods that may be present, policies need to be developed that help decide what items should be disposed of (versus decontaminated). Other issues faced by decision makers include which technologies will be used to decontaminate the various categories of items and the approved protocols for transporting and handling contaminated solid waste.

Mark, Lynn, Wayne, and the other IBRD team members, including Julie Fruetel (8125), David Franco (8125), Donna Edwards (8114), Bob Knowlton (6327), Rita Betty (6327), and John Brockmann (1532), now into their second year of the program, continue to write plans, develop technology recommendations, and develop new technologies and methods for the program sponsors. Independent working groups will be considering inputs from Sandia's investigations as well as other interagency concerns to help DoD and DHS select technologies to pursue further under the IBRD program.

Going ***really*** green: Algae could fuel future

LDRD project examines suite of technologies that will optimize slimy green stuff for fuel production

By Mike Janes

Algae is one of several potential fuel sources being looked at to help solve the global energy crisis. It is attractive on several fronts: It's easy to produce, it can be grown in regions that aren't used for food, and it doesn't need to compete with the same water used in crop irrigation. Most important, algae is rich in oils that can be used in biodiesel production.

"Biofuels derived from algae present an opportunity to dramatically impact US energy needs for transportation," says Grant Heffelfinger (8330), who leads Sandia's biofuels program.

It turns out, though, that for every advantage, there are disadvantages. For starters, understanding and characterizing the finicky mixture of oils, proteins, and hydrocarbons found in various species of microalgae is an enormous challenge. Second, the extraction of oils from the algae and their subsequent conversion into biodiesel fuels in an economically feasible way represent additional barriers.

Those challenges, however, are in the crosshairs of Sandia researchers involved in a Laboratory Directed Research and Development (LDRD) effort titled "Microalgal Biodiesel, Feedstock Improvement by Metabolic Engineering." Led by molecular biologist Todd Lane (8321) and using advanced molecular biology techniques largely unavailable in years past, the effort's aim is to create more effective harvesting, extraction, and conversion techniques for algae and the fuel-friendly oils they produce.

GREEN GOLD — Eizadora Yu injects a sample of extracted algal oil into a mass spectrometer for analysis of molecular species. (Photo by Randy Wong)

Starving algae

Algae, Todd says, yields the same kind of oils produced by certain vegetables and plants used for biodiesel conversion (as well as animal fats). The chemical composition of these oils includes triacylglyceride, or TAG, which is the key to the conversion to biofuel.

But algae only produces TAGs under very specific environmental conditions, or triggers, a scientific challenge that Todd and his colleagues are addressing.

"Algae only produce TAGs when they need to, basically as a storage defense mechanism, much like humans store fat," says Todd. "We're trying to trick the algae into thinking it's continually experiencing starvation conditions so it will produce oils without interruption." Once that hurdle is overcome, he says, "you've then opened the door to many possible growth and recovery techniques."

Sandia has been looking at two microalgal organisms, *Phaeodactylum tricornutum* and *Thalassiosira pseudonana*, the genomes of which were recently sequenced by DOE's Joint Genome Institute in northern California. The LDRD project's intent, says Todd, is to take advantage of the new genetic information to better understand the processes involved in the formation of oils, then eventually to manipulate those processes to produce larger quantities of those oils.

Characterizing the oils, says Todd, involves both proteomic analysis (where the organisms are taken apart and the proteins separated onto gels) and transcriptional analysis (looking at the genes that are expressed even before the organism transitions into starvation conditions). Todd calls this important work the "molecular fingerprinting" of the oils contained in the algae, with the hope that researchers can soon use the information to engineer larger quantities of oil.

The LDRD team has recently completed a significant milestone where it compared the different metabolic routes of oil production in multiple strains of algae by tracking their accumulation as a function of time and environment. The results have produced new insight into the mechanisms of nutrient starvation in algae, and will serve as the basis for engineering the algae into robust oil producers. These findings were presented at an international conference on phycology (the scientific study of algae), and the team has just submitted a paper to the *Journal of Applied Phycology* that summarizes their conclusions.

Extraction: squeezing the oil out

There are several tried and true methods for extracting oils from algae, including mechanical, chemical, thermochemical, plasma, and microwave techniques. Most traditional methods are not considered to be long-term solutions. The mechanical approach, for example — which involves pressing algae to squeeze out the oil, much like the process for producing olive oils from olives — is highly power intensive and not scalable.

Sandia, Todd says, is mostly focused on the chemical approach, whereby solvents with a biological affinity toward oils are used, acting somewhat like a chemical sponge to "pull" the oils from the algae. This approach, which Sandia believes may be scalable, is fraught with its own obstacles, most notably the fact that the most effective solvents aren't particularly good for the environment.

But a closed and highly controlled facility, similar to an oil refinery, might be able to handle the operation at an industrial level. "Refineries already produce these kinds of chemicals," says Todd, "and we'd also be taking advantage of existing chemical engineering and systems engineering infrastructure." Using the same technology by which hydrocarbons are distilled and separated to separate oils from algae and create "bio crude," he says, would be a logical and easier way to move toward algae-based transportation fuels.

Another focus of the microalgal LDRD project is the "dewatering," or drying, of the algae, an important consideration since this step — necessary for the conversion into fuel — is highly energy intensive and thus estimated to represent nearly 50 percent of the current processing cost. Sandia is also examining ways by which algae can be grown and harvested in the first place.

"Algae is easy enough to grow, but it's expensive to do in a way that's robust and scalable," says Todd.

Two years into the three-year microalgal LDRD project, Todd says he and his colleagues have already come to a vastly better understanding of the starvation process that is so critical for the efficient production of oils derived from algae. These results will help build the genomic and biotechnology toolboxes that will be required for the optimization of algal oil production at the massive commercial scales required to meet the transportation fuel demands of the US.

"The simple goal with this project is to improve the yield of oil in these organisms (*P. tricornutum* and *T. pseudonana*), then go back and analyze what we've done and see if we can apply it to other organisms," says Todd. Such an achievement, he says, could then be applied to other, more commercially viable organisms, adding considerably to the scientific knowledge base necessary for long-term algae-to-biofuels production.

About algae

Algae (according to a Wikipedia entry) is a large and diverse group of simple, typically autotrophic organisms, ranging from unicellular to multicellular forms. (The algae under study at Sandia is microscopic; at the other end of the size scale is seaweed, also a form of algae.) There are thousands of species of algae worldwide and they play an astonishingly wide and important role in the environment.

Although various forms of algae are already being used in biofuel and biomass applications, Sandia's work promises to make the use of algae in these and other applications more efficient and effective.

(Photo by Mark DiMenna, Albuquerque Environmental Health Department)

Sandia examines biofuels issues for transportation partner

With findings due in October, Sandia is nearing the end of an FY08 study with a commercial transportation partner that aims to uncover unanswered questions about biofuels and their viability as an alternative energy option.

The project draws heavily upon Sandia's expertise in both energy and systems analysis, says Chris Moen, manager of Thermal/Fluid Science and Engineering Dept. 8757.

"We knew we could offer some added value here and complete a study that fills in a lot of details that are lacking in much of the current biofuels research," adds Todd West (8114), a Sandia systems analyst leading that portion of the study.

DOE has a stated goal of seeing US production of ethanol increase to 90 billion gallons by 2030 (which, due to the energy density of ethanol, would equal about 60 billion gallons of gasoline). In 2006, the nation used roughly 20 percent of its corn crop to make just 4.8 billion gallons, which would seem to indicate it has a long way to go to reach the 60 billion gallon goal. In 2008, projections point to eight or nine billion gallons of ethanol, almost all of which will be derived from corn.

The industrial processes by which nonfood forms of biomass are turned into cellulosic ethanol and converted into sugars suitable for production of biofuels is one of the main focuses of the Sandia study.

Sandia works routinely on a variety of automotive research activities. Center 8700 is engaged in several hydrogen-related projects (such as those involving the Metal Hydride Center of Excellence and other storage programs), and research programs at the world-renowned Combustion Research Facility for more than 25 years have paved the way for the fuel efficiencies and combustion processes found in today's vehicles.

Sandia also plays a major role in the Joint BioEnergy Institute (JBEI) and several other transportation energy and biofuels projects.

Shiny new tool shows Internet activity

Sandia-developed 'SHINI' tool offers real-time geotemporal visualization of web traffic

CYBER DEFENDERS MENTORS Steve Hurd, left, and Randy McClelland-Bane, center, along with student intern Scott Crawford, work on a demonstration of SHINI's capabilities. (Photo by Randy Wong)

By Mike Janes

During a presentation one afternoon to a group of external customers, Sandia network security manager Ed Talbot (8965) noticed that the attendees were far more fascinated with "shiny" objects than raw data and words on a screen. Understandably, Ed started to ponder how visuals could tell his department's story more effectively. Next thing you know, a couple of his college interns had come up with a solution. They even figured out an appropriately catchy acronym.

The Sandia Heuristic Intelligent Network Imaging tool — or, SHINI (as in "shiny") — is a computer program that uses geotemporal visualization for security log data. Working largely in conjunction with the popular Google Earth™ application, it displays network activity in a variety of colorful and eye-catching forms. The initial version of SHINI was developed last summer by Sandia interns working in the Labs' Center for Cyber Defenders (CCD), a popular program that allows students interested in information protection to perform safe and properly guided experiments on defending computer systems from ill intent.

Seeing is believing

"Intrusion detection professionals are always trying to figure out ways to take the data we work with and make it more visual," says computer scientist Steve Hurd (8965), who oversees the project along with Sandia colleague Randy McClelland-Bane (8965). "We're usually in the weeds, looking at command lines, header information, and enormous quantities of data and numbers that aren't particularly visual by nature. But we recognize that good graphics can be very important as a communications tool."

Internet-connected computers, says Steve, are subject to attacks at all hours of the day and night, from anywhere in the world. Intrusion detection analysts at Sandia and other organizations are keenly interested in such activity and other related information, such as when and where network connections originate, the IP addresses of those connections, and any patterns that can be identified.

THIS SHINI POINT MAP focuses on North America; the rays depict the connection between source and destination locations.

But as vital as the work is to Sandia and its constituents, network security staff have had difficulty at times showing their customers what they've learned in an easy, visually appealing manner. So after hearing his boss lament the lack of "shiny" objects at their disposal, Steve decided to turn a couple of CCD interns loose to see what they could come up with. The solution needed to be relatively inexpensive — several feature-rich but very costly geovisualization programs are already available — yet effective and easy to use.

SHINI impresses, but . . .

The interns, Scott Crawford and Andrew Schran, first checked out existing, commercially available products and concluded that Google Earth might be suitable as the foundation of a new Sandia-developed software program. Google Earth allows users to view satellite imagery, maps, terrain, and 3-D buildings, among other features, but Sandia first needed to work on the "back end" so that lab data could be fed into the program and tagged with the appropriate geolocation information.

The Sandia interns then created a "heat map" of sorts, similar to a weather map, where the color of a country is determined by the current number of connections from that country. The heat map can either display real-time log information or display a time-lapse visualization, enabling analysts to view data from a period of days, weeks, or months in just a matter of minutes. Users can also view a "point map," where each network connection is represented by a point on a map that looks similar to an airline route map.

When unveiled for the first time near the end of last summer, SHINI was a smashing success.

"Everyone's jaw was on the ground," says Steve. An on-site representative from a well-known government agency received a demonstration, he says, and was "practically drooling" over the program's ability to visually depict massive quantities of important information and make it easy to understand for lay people.

There were, however, some hiccups with SHINI that led the program to crash on occasion. The problem could likely be traced back to the enormous volumes of data Sandia is asking Google Earth to swallow ("It's not built to do this kind of thing," says Steve), or it could be related to memory utilization. In any event, the interns returned to school and SHINI was shelved for the time being, but Steve says a new intern (in addition to a returning student who worked on SHINI previously) have been tasked with looking into the technical issues this summer with the aim of either fixing the problems or engaging Google for its assistance. Steve says products other than Google Earth might also be considered as well, such as NASA's open source World Wind program.

Open-source availability possible

SHINI's usefulness may not be limited to network security. "Though it's currently constructed to accept network logs as input, it can be easily modified to accommodate virtually any data files that include time and location information," says Steve. Public health officials might be able to more efficiently identify and treat victims of a flu outbreak or even a terrorist attack, for example, by getting a faster read on the concentration of affected individuals.

AN EXAMPLE of a SHINI heat map focused on Europe. As shown in the color legend in the top left corner of the picture, colors used for each country correspond to the number of distinct connections from that country during the specified time period.

Long-term, Steve says SHINI may be an excellent candidate for open-source software, meaning it would be made available on the Internet for network security professionals to tinker with for their own specific needs. It's not currently viewed as a potential revenue stream (i.e., a candidate for commercial licensing), though that's always a possibility. Steve says it's more likely that Sandia would provide the basic tool, and users could then purchase other products that would allow for customization.

Sandia web developer 'composes' new book

By Mike Janes

When Sandia lead web developer Joe Lewis is writing code for a webpage, he says he finds himself "in the same head space" as when he's composing music.

As a former professional musician with an advanced degree from the renowned New England Conservatory, he should know.

Joe has enjoyed two seemingly different yet surprisingly similar careers and has drawn upon the skill sets of both to coauthor his first book, *Foundation Website Creation with CSS, XHTML, and JavaScript*. Despite the alphabet soup title that doesn't quite roll off the tongue, Joe says its intent is rather simple: to help web design practitioners learn how to create websites in a competent, professional way.

Ostensibly, the story of Joe's first book began when he was contacted by a technical editor, Clay Andres, through the popular business networking site LinkedIn. Andres had reviewed some of Joe's writing and web work and asked him to team on a book project about web design techniques (the fact that Andres' son is a music major at Yale didn't hurt the editor's chances). Though most of Joe's free time was being spent researching and writing his thesis for yet another degree — an MS in computer information systems he's since earned from the University of Denver — he saw the book deal as too good an opportunity to pass up. In a nod to the late rocker Warren Zevon, Joe jokes, "I'll sleep when I'm dead." His wife (a musician herself who teaches piano) and two sons can attest to Joe's lack of slumber during this period.

The book's real genesis, however, may have been back in the early 1990s when Joe was completing his master's degree at the Conservatory and embarking on a music career playing the double bass.

FOUNDATION WEBSITE CREATION, by Joe Lewis, Meitar Moscovitz, and Jonathan Lane. (Photo by Dino Vournas)

It was his music training, says Joe, that honed the leadership and self-discipline skills he applied on a daily basis as principal bassist for various orchestras. In that role, he typically led up to seven other performers, basically serving as the "middle manager" between the orchestra's conductor and the bass section.

Though Joe no longer plays professionally (he left the industry in 1996 to pursue web design full time), he still considers music and the lessons it's taught him to be a big part of his life.

"When you're practicing music, you're massaging the same parts of your brain that process math and scientific thought," Joe asserts. Writing code for a web page, he says, is very similar to music composition. "In Java, for instance, you have classes, variables, loops, arrays. In music you have similar constructs — notes and melodies, which could be thought of as classes; repeats, which are similar to loops; and tempo, which might be considered a type of variable. Plus, you have orchestration in both disciplines, where either the software engineer or the composer is writing instructions for what to do and at what times."

Not surprisingly, Joe says a lot of scientists and technologists are also good musicians.

The principles in *Foundation Website Creation*, he says, will help web developers take more ownership of the code writing that goes into their work, in turn making their jobs easier.

"A lot of web designers just don't want to get their hands dirty with writing code," Joe says. "They would rather design websites solely relying on the visual design features in Dreamweaver [a common software tool] and allow it to generate the code for them. Dreamweaver is an excellent productivity tool, but understanding what is happening underneath the hood will save a lot of time and heartache down the road."

Though primarily meant for new professional web developers, Joe says the book may have value to a number of Sandia staff members.

A WEB OF MUSIC — Sandia lead web developer Joe Lewis has found that skills he honed in his formal music training — he has a master's degree from the New England Conservatory — have applicability to web design. (Photo by Dino Vournas)

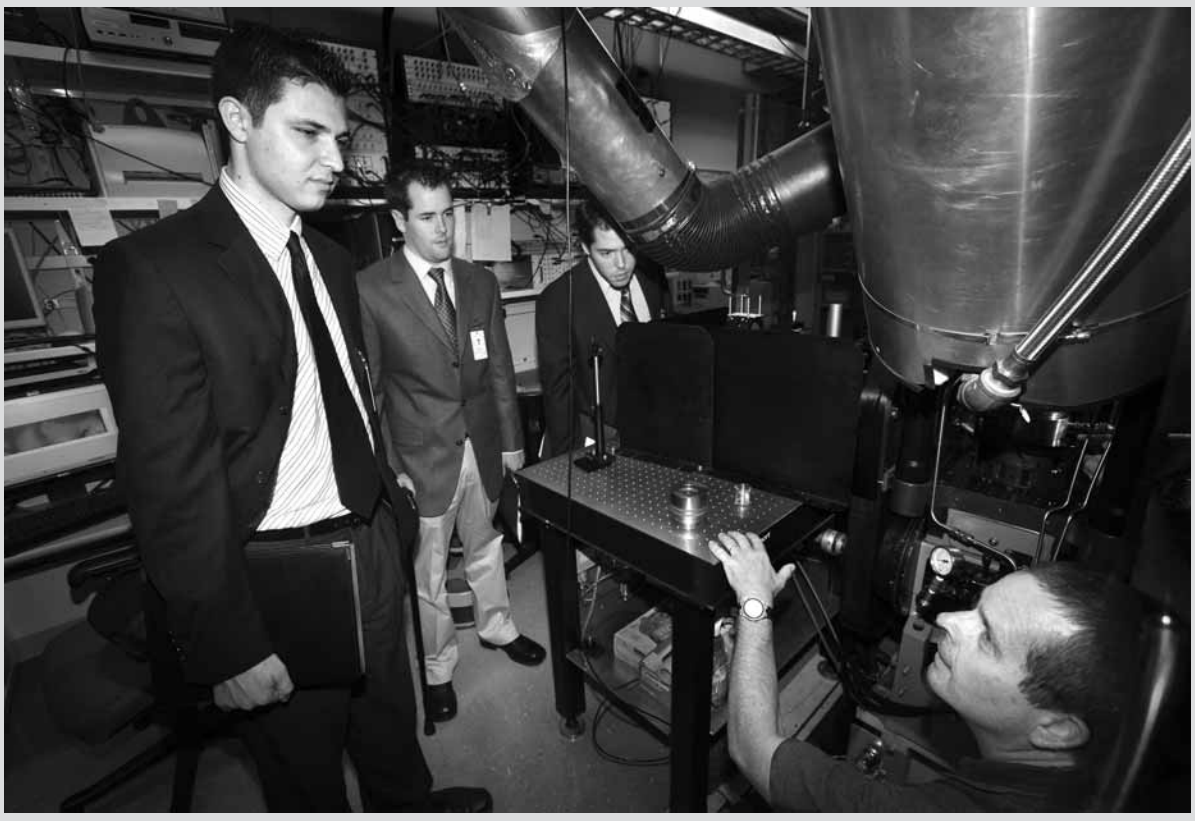
"It's a book I wish I had written when I first came to Sandia," he says, noting that many of the questions he has received since then are discussed in the book. Joe points to one chapter in particular, "Testing, Launching, and Maintaining Web Content," as addressing issues that are very relevant to Sandia.

"In the past, we've not thought enough about quality assurance, the testing process, or the life cycle management of our websites," he says. The book also delves into assistive technologies for the disabled, and accessibility issues, such as how to develop webpages that work regardless of the mobile device or browser version one uses. "Using standards-based web design will make it easier to transition to mobile devices," says Joe, not an insignificant consideration given the continued emergence of web-capable "smart" devices such as the iPhone and the Blackberry.

Even though *Foundation Website Creation* has only just hit bookstores, Joe and his collaborators are already developing concepts for a follow-up. A proposal for a book on advanced CSS (cascading style sheets) and semantic web development is in the works, and Joe expects writing to commence in the fall. He predicts the book will be completed next summer, or hedging his bets, "maybe next fall." Now Joe sounds like a real author!

Congressional staff view Labs' work

Paul Hommert hosts visit from Rep. Jerry McNerney's staff



IN LATE JULY, Div. 8000 VP Paul Hommert hosted three staffers from Rep. Jerry McNerney's local office. The focus of the briefing was the Labs' energy program, with an emphasis on renewable energy, a specific interest of McNerney, D-Calif. Close to a third of Sandia/California's employees live in McNerney's (11th) district. Seen here from left to right are: Vincent Rocha, field representative for McNerney; student intern Christopher Mahoney; and Christopher Magana, McNerney's director of Constituent Services. At bottom right is CRF engine researcher Paul Miles (8362). (Photo by Dino Vournas)

Terry Michalske takes on special NEII assignment

National Energy Innovation Initiative harnesses vast body of Labs' energy R&D

By Mike Janes

A front-page story in the April 11 edition of *Lab News* described a "big idea" proposal being funded by Sandia's Energy, Resources, and Nonproliferation (ERN) Strategic Management Unit. This is just one example of the Labs' efforts to "engage a broad community and influence national decision makers to lead the country down the path of American competitiveness, energy security, and environmental stability."

Now, Sandia has moved a step closer to that objective by assigning Terry Michalske (8300, now temporarily 6100) to the newly created Energy Innovations Initiatives office. The special assignment, which began in mid-June and is expected to last for a year, aims to redefine Sandia's role as a national leader in energy security.

"This is the right thing to do for the nation. We think we can be helpful."

— Terry Michalske

The National Energy Innovation Initiative (NEII), says Terry, harnesses the vast body of energy-related work and capabilities developed at Sandia over the years and, combined with the laboratory's unique experience and standing with industrial partners, hopes to catalyze a presidential-level energy initiative. Its key feature would be a national energy road map involving government, academia, and the private sector.

"It's a tall order, one that Sandia can't make happen all by itself," Terry acknowledges. The Labs can, however, enable and influence such an undertaking by leveraging its wide constituency of industrial partners and other stakeholders. "We have very strong long-term relationships and credibility with automakers, energy companies, and other key commercial entities," he says. "We need to work closely with those partners to provide real solutions to our nation's energy problems."

TERRY MICHALSKE takes on a new assignment in the newly created National Energy Innovation Initiatives office. (Photo by Randy Wong)

To successfully influence a national outcome and inspire national shareholders to champion and fund energy activities and models, Terry says, Sandia will need to transform its own business practices to be consistent with the principles it is advocating.

"If we're going to be leaders in this (international energy security) field, we need to be able to model how it can work," he says. Open information sharing, leading-edge science, implementing innovative energy solutions in our own community, and commercial partnerships are all part of the model the NEII is advocating, but an element of information security is also a key component. "We can't disregard the importance of working across boundaries of open and secure information, a tenet that sets us apart from other national laboratories and allows us to operate and contribute in a unique way."

Terry says the NEII is one of a small set of laboratory strategic initiatives being developed at Sandia. These initiatives are selected based on their potential to transform Sandia into a 21st-century national security laboratory, requiring laboratory-level decisions on investments and priorities.

A core team has been identified to work on the National Energy Innovation Initiative, including Ron Stoltz (8302) Erik Webb (12151) and Carmen Good (6100). A VP-level steering committee, including Les Shephard (6000), Rick Stulen (1000), Paul Hommert (8000), and Joe Polito (9000) is also in place.

"The NEII core team is in the process of developing ways to engage people across the Laboratories' energy capabilities and programs, as well as colleagues throughout the operations, infrastructure, and partnerships elements of the Labs," Terry says. "This is the right thing to do for the nation. We think we can be helpful."

Passage

(Continued from page 12)

Each summer, teams from the US will visit the village to conduct medical clinics, do construction and landscaping, and work with the kids. Last summer, a team held a medical clinic in which 750 local villagers were treated, many of whom had never been to a doctor or dentist.

The second phase of construction, which will add a dining hall and home for the headmaster, is underway. Within three years, the entire project should be complete with guest housing, a community center, and medical facility. At that time, the orphanage will be at capacity, serving 100 children.

The goal is to make the orphanage self-sustaining. To that end, they'll plant crops and raise animals as a food source and as a means of income. Carolyn is working on a conceptual design for solar and wind to provide backup power. She explains that power in India is very unreliable, with dropouts of 12 hours being fairly common, sometimes lasting for as long as three days.

CHILDREN who have come under the care of the Little Flock Children's Home watch grand opening festivities in 2006.

"We are hoping that in 10 years, the orphanage will be self-sustaining," she says. "Then it will be a good working model that can be transferred to future projects. Our intention was to start one or more orphanages in southern India and possibly go on to other locations."

INDIAN GIRLS perform a traditional dance for visitors at the Little Flock Children's Home.

Along the way there has been a learning curve, especially with educating the orphanage's children. The idea was to send the kids to a nearby school, but so far the Little Flock organizers have not found the right match. The first school enforced the caste system, which is contrary to the orphanage's philosophy of raising the kids to have a full sense of their self-worth. Another school was not teaching English consistently.

"A top priority is for these children to learn English," says Carolyn. "It's a strong part of the entrée into India's economy."

She's been spending about a month each year in India, but envisions that might increase to six months a year in the future. She says knowing the orphanage needed her active involvement did play a part in her decision to retire two years ago.

Carolyn is quite clear about the rewards she's gained from involvement in Little Flock. "I've never been married, and have no children or siblings. It's really different for me to be around this many kids. I never would have guessed I'd have all these different relationships with all these children," she says. "I've become a different kind of mother."

CAROLYN PURA and local villagers near Chennai, India, talk about the goals of the Little Flock Children's Home.

Mileposts

New Mexico photos by Michelle Fleming

Jose Martinez
40 4840

Mark Bleck
30 2126

Thomas Gutierrez
30 2431

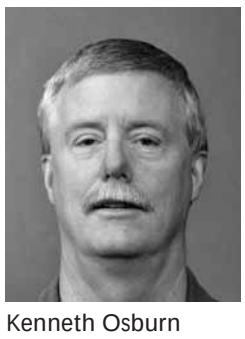
Recent Retirees

Craig Tyner
31 1031

John Hogan
30 5201

Ronald Olsberg
30 5629

Kathleen Olsberg
25 5761



Kenneth Osburn
30 9515

Robert Patton
30 2555

Anne Cosbey
18 9342

Mary Trump
30 4857

Paul Demmie
25 1435

Stephen Foiles
25 1814

Richard Givler
25 1514

John Maenchen
25 1212

Marjorie McCornack
25 5535

Bonnie Apodaca
20 10600

Charles Robino
20 1813

Lonnie Atencio
15 4241

Carla Busick
15 2715

Rebecca Campbell
15 6034

Wu-Ching Cheng
15 1384

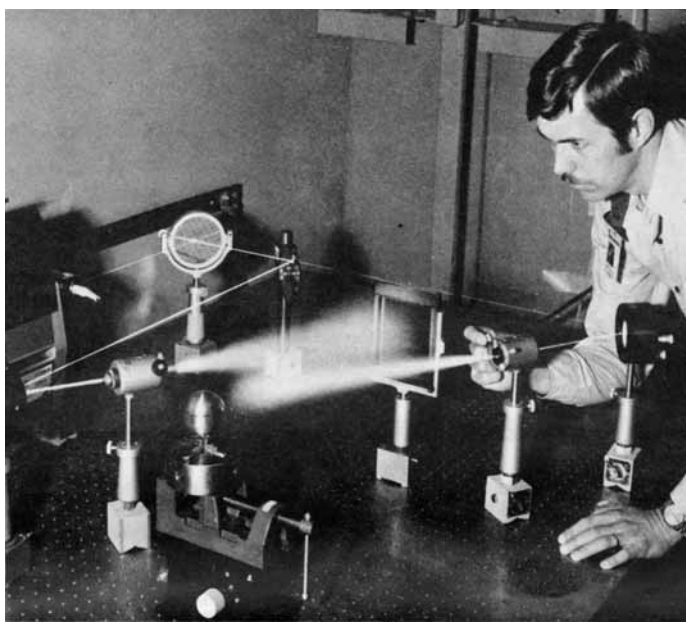
Richard Crotwell
15 4842

Jonathan Custer
15 1824

50 years ago . . . Atomic energy opened a road in Livermore earlier this month. The occasion was the official ribbon cutting ceremony dedicating the new Vasco Road, which now connects the Livermore Branch and University of California Radiation Laboratory with the Highway 50 freeway. To cut the ribbon, ordinary table salt was made radioactive by the new pool-type reactor at UCRL and then enclosed in a sort of wand. The wand was waved in front of an electronic device, the radiation closed a circuit, and a powder charge exploded, cutting the ribbon.

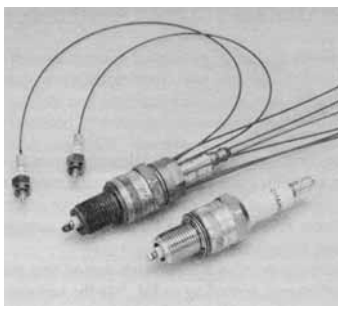
LIVERMORE DISPLAY at Alameda County Fair was well received by visitors. Sandia Corporation's part in the nation's atomic weapons program was explained in the exhibit by slides and cartoons. Earle Paxton, left, is shown with a visitor. This was the second year Sandia participated.

30 years ago . . . Like a "before" picture superimposed on an "after," **a new Labs holographic technique helps weed out defective pressure vessels.** The traditional test, by mechanical gauging, is less sensitive and less complete than the holographic interferometry (or holometry) used in the Acceptance Technology Division. One holographic exposure is made before the test vessel is pressurized and, on the same photographic plate, another after it has been pressurized and vented — a deliberate double exposure. The result is two superimposed holographic images that interfere (hence holographic interferometry) with each other. The alternating bright and dark lines, or fringes, create a sort of topographic map, revealing pressure-induced deformations in the vessel.



LABORATORY ARRANGEMENT for obtaining holograms. Dan Tichenor focuses beam on target, the spherical vessel on the left of center.

20 years ago . . . A spark plug fitted with fiber-optic "eyes" allows researchers at the Combustion Research Facility to probe combustion problems inside unmodified auto engines while they're running. The new optical probe is a standard spark plug in which eight holes have been drilled through the threaded metal housing so 1-mm optical fibers can be inserted. The fibers — light guides that can transmit light with high efficiency — connect to light detectors that measure the amount of light produced during ignition and allow the light from this "flame kernel" to be precisely located in the cylinder.



PAIR OF PLUGS — The new optical probe (top) is a standard spark plug in which eight holes have been drilled through the threaded housing so 1 mm optical fibers can be inserted.

10 years ago . . . East meets West in a lab-to-lab program that is building relationships between scientists and engineers from Sandia and two other national laboratories and their counterparts in China. A visit by several Sandia vice presidents to Chinese nuclear facilities in May and a July demonstration in Beijing by Sandia, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, and two Chinese laboratories showing modern nuclear materials safeguards systems are among the most recent round of activities bridging the two countries. The program started in 1994 following a request by Deputy Assistant Secretary of State Robert Einhorn that DOE establish scientific interactions with China in support of US arms control and nonproliferation policy.

Passage to India

Carolyn Pura builds a brighter future for Indian orphans

NAP TIME — Indian orphans take an afternoon nap at the Little Flock Children's Home in Chennai, India. Sandia retiree Carolyn Pura helped establish the home, laying the groundwork for it about five years ago.

Story by Patti Koning ***Photos courtesy of Carolyn Pura***

In her nearly 30-year career at Sandia, Carolyn Pura (8112) led the W89 test program, helped stand up the Department of Homeland Security's nuclear countermeasures program, headed up Sandia's conceptual design of Strategic Defense Initiative (SDI) platforms, and worked in Washington, D.C., supporting arms control negotiations, nonproliferation, and treaty development.

Carolyn's impressive professional résumé is matched by her personal accomplishments. She retired from Sandia at the end of 2006, but continues to consult for NNSA on arms control and nuclear nonproliferation. About five years ago, she helped found Little Flock Children's Homes (www.littleflockhomes.org), a nonprofit organization that has opened an orphanage in Chennai, India, with plans to establish more orphanages in the future.

THE LITTLE FLOCK CHILDREN'S HOME in Chennai, India.

"Carolyn's ability to organize and get any number of impossible things done coupled with her generosity of spirit were not unique to her activities outside of work," says Mim John, who retired as the vice president of Div. 8000 at Sandia/California in 2006. "In my many years working with her, she brought that same approach to her Sandia assignments. I knew that I could count on her for whatever we asked of her and that she would create teams and relationships that were exemplary in the process — both inside and outside of the lab."

India, despite its booming economy, has an orphan crisis. It has been reported that India is home to the largest number of AIDS orphans in the world, and that number is expected to rise over the next 10-20 years. Intense poverty, famine, drought, natural disasters, and malaria are also contributing factors.

"Half of India lives on a dollar a day or less, which is really subsistence living. If either parent becomes disabled or dies, the kids are on the street," says Carolyn. "There is so little social safety net that there is often no place for these kids to go. So they end up living on the street with inadequate food, shelter, and access to education."

DURING A MEDICAL CLINIC at the orphanage, children and villagers receive the latest in medical and dental care.

About five years ago, Carolyn was presented with the opportunity to do something about it. She met Viji Cammauf, a native of India and resident of Oakland, Calif., at a Christian conference. She invited Carolyn and several other friends to join her on a quest to start an orphanage near her hometown of Chennai (formerly known as Madras), which is located in the southeastern part of the subcontinent on the Bay of Bengal.

"This project made a lot of sense to me. I've always been interested in other cultures and love to travel," Carolyn explains. "The first time I went to India, I made contact with kids at other orphanages, but then I had to drive away. It just didn't feel right. With this orphanage there is a real way of committing to these kids long-term. They have a relationship with me now, and I can have an impact on their lives as they grow up."

In the summer of 2004, Carolyn traveled to Chennai as part of a research team that spent three weeks visiting orphanages and training centers. She says the orphanages they visited were stressed to the limit caring for large numbers of children in small quarters. "The situation is much better than living on the street, but it's still not optimal by a long shot," she adds.

After that trip, the team knew they wanted to build an orphanage modeled on the concept of a small village. The orphans would live in groups of 10 with a house parent in small cottages and the village would have a dining hall, community center, house for the headmaster, and guest housing.

"We would commit to raising those children — to get them into local schools and give them the chance they need at life, with clothing, three square meals a day, and a social scene among themselves and the village," says Carolyn.

The team planned to continue its research in the summer of 2005 and develop a network with churches and other agencies that were already involved in this work. Those plans flew out the window when a tsunami hit southern India at the end of 2004.

Carolyn says the team realized that they needed to move faster. Cammauf made several trips to India that winter and in March 2005 purchased eight acres of land near Chennai.

It took about a year to complete the first phase of the orphanage, and the first children arrived in May 2006. Carolyn was there to see them arrive. She led a group of women from her church who painted animal murals in each of the cottages.

"It was really clear that these kids had either been on the street or shuttled from relative to relative. So there was some skepticism among the kids — they weren't sure how long the situation would last," she recalls.

She says that when she returned in November 2006 for the orphanage's dedication, there was a striking change in the children's demeanor.

"There was a settledness about them, a real joy. The doubt and distrust in their eyes had gone. Between the structure and regular routine in their lives and having a place where they felt safe, these were now happy, trusting kids. They were just healing. It was great to see," she says.

(Continued on page 9)

LABOR OF LOVE — Sandia retiree Carolyn Pura paints a mural inside one of the villas at the Little Flock Children's Home. Carolyn has found that she is spending more time each year volunteering at the home.