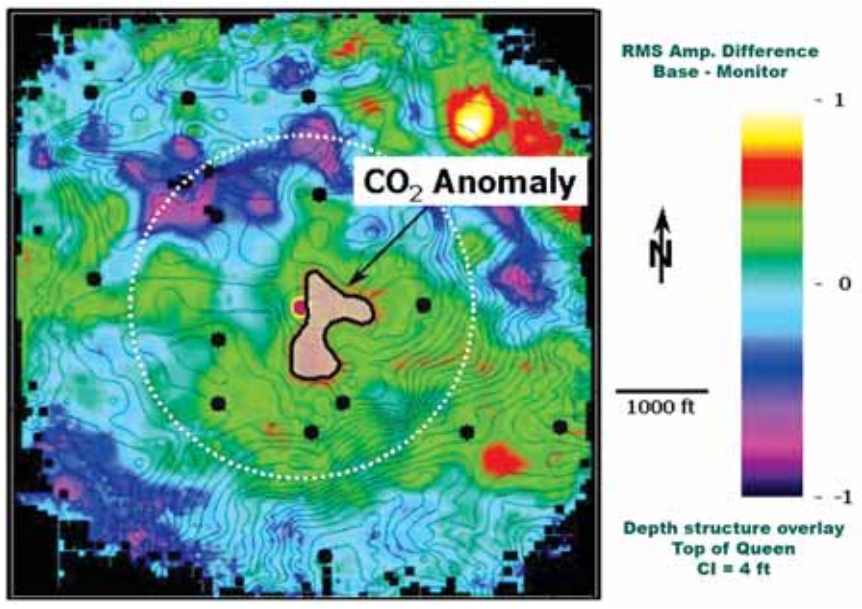
Carbon sequestration: Can we bury or store global-warming greenhouse gas underground?

By Will Keener

Can we pump carbon dioxide underground and store it there to avoid warming the atmosphere? That is the question researchers at Sandia, teaming with 40 industrial partners and 10 technical partners (including state geologists, oil conservation departments, geological surveys, and the like) will attempt to answer over the next several years.

Following a phase one study, which showed a number of potential storage sites in the Southwest region, work toward phase two demonstrations is now under way, says David Borns, manager of Sandia's Geotechnical and Engineering Dept. 6113. "Phase two will demonstrate at the field scale that sequestration really is possible with power plant outputs of CO_2 injected in several types of geologic environments. In fact, multiple projects are possible in the region," says David.

The Southwest Regional Partnership for Carbon Sequestration, which includes Arizona, New Mexico, Colorado, Utah, Texas, Oklahoma, Kansas, and Wyoming, has proposed a series of validation tests of the most promising sequestration technologies, including three major geologic tests and two terrestrial pilot tests.



WEST PEARL QUEEN — In studies of an oil field near Hobbs, N.M., Sandia and Los Alamos researchers found that absorption rates for injected CO_2 were lower than predicted. One possibility is that the CO_2 flowed to a different formation, shown as an anomaly on this map. The team concluded that extensive reservoir characterization would be necessary to really understand impact of CO_2 on storage reservoirs.

Storage options

Geologic options include pumping CO_2 into: (1) oil reservoirs to increase oil recovery rates, (2) coalbed methane zones where coal absorbs the carbon dioxide and releases methane gas, and (3) aquifers, where the CO_2 combines with water stored in pore spaces in the rock. Terrestrial tests will determine if natural photosynthesis activity can be increased to tie up more CO_2 from the atmosphere, David says.

DOE, spurred by a presidential goal of reducing carbon emissions by 18 percent, began an evaluation of sequestration two years ago, funding regional studies in seven regions. Three regions were selected for phase two projects. The Southwest regional project is funded at $16 million over four years, with New Mexico Tech acting as coordinator for the work.

"If carbon sequestration proves effective in managing global warming impacts, some of the first options are likely to coincide with existing CO_2 transportation infrastructure," says David. The Southwest region is home to an extensive CO_2 pipeline network, transporting more than 30 metric tons of natural CO_2 from the central Rockies to the Permian Basin, where it is used for enhanced oil recovery.

"Our phase one study concluded that the 'lowest hanging fruit' for sequestration would be to supplant the natural CO_2 with power-plant sourced CO_2," says David. The partnership's proposal includes:

- sequestration in a saline aquifer and enhanced oil recovery in Utah,
- enhancing coal bed methane production in the San Juan Basin in New Mexico,
- a two-year enhanced oil recovery project using CO_2 from a nearby power plant in West Texas, and
- a terrestrial pilot test in the San Juan Basin and a regional analysis of terrestrial options.

A complex issue

Technically speaking, CO_2 sequestration is a complex issue spanning a wide range of scientific, technological, economic, safety, and regulatory issues, says John Lorenz (6116). John and

(Continued on page 4)

Retired Sandia physicist Bob Graham studies crater shock physics

Retired Sandian Bob Graham has been studying a meteor impact crater near his South Texas home. He gave a presentation about it at the Labs recently. Read about it in Will Keener's story on **page 9**.

Sandia LabNews

Vol. 58, No. 2 January 20, 2006

Managed by Lockheed Martin for the National Nuclear Security Administration

Sandia National Laboratories

Sandia plans major changes to employee disciplinary policies

By Julie Hall

With some 10,000 employees and contractors, Sandia is bigger than a lot of New Mexico towns. And like in any small town, people don't always conduct themselves appropriately, leading to the need for corrective action.

Sometimes the misdeeds are unintentional, like accidentally carrying an unauthorized cell phone into a tech area. Others make headlines, like an incident several years ago in which an employee was terminated after losing his clearance, which in turn was linked to an ongoing investigation of theft of computer equipment from Sandia's property reapplication group.

Of particular concern are instances where failure to follow policies and procedures results in injuries to employees or potential damage to the environment.

"Sandians may not realize that failure to follow established safety practices can be grounds for disciplinary action, even if it is unintentional, especially if an injury is involved," says Julian Sanchez, senior manager, Human Resources, Partnerships, and Employee Relations. But, he adds, "Lack of intent isn't a defense in and of itself."

Sanchez and the Employee and Labor Rela-

(Continued on page 6)

Sandia researchers collaborate to understand key phenomena controlling PEM fuel cell performance, durability

By Chris Burroughs

Sandia researchers Ken S. Chen (1514) and Mike Hickner (6245) are working hand in hand to understand key phenomena that control hydrogen-fueled PEM (proton exchange membrane or polymer electrolyte membrane) fuel cells. Ken is developing computational models to describe the phenomena while Mike is performing physical experimentation.

Their work is internally funded through a three-year Laboratory Directed Research and Development (LDRD) grant to tackle several key technical challenges. Proper water management and performance degradation or durability must be addressed before PEM fuel cells can be used to routinely power automobiles and homes.

"A natural byproduct of using hydrogen and oxygen to produce electricity in a PEM fuel cell is water [with waste heat being the other]," Ken, project principal investigator, says. "One challenge is maintaining the proper amount of water in a PEM fuel cell. Sufficient water in the membrane is needed to maintain its conductivity, whereas too much liquid water can result in flooding the cathode gas diffusion layer, which prevents reactant oxygen from reaching catalytic sites and causes performance deterioration."

The work being done by Ken and Mike is leading to a better understanding of a couple of important areas, including how liquid water is produced, transported, and removed efficiently in PEM fuel cells and how PEM fuel cell performance degrades. A better understanding is key in finding ways to

(Continued on page 7)

What's what

One of the most prominent of the current Labs campaigns is "self assessment," an exercise that is cascading and rippling its way down the line from the quiet, carpeted executive suite to the dusty sites of Coyote Canyon and Tech Area 5, and on to Tonopah Test Range, Livermore, and beyond. It's serious business. Serious enough to move someone in our building to go around and check for obstructions in front of the electrical panels built into the walls, and in at least one case, affirm that that was, *indeed*, an electrical panel by asking a workmate warming up a bagel in a microwave oven, "Is that the electrical panel?"

With all this emphasis, we're surely going to cover every imaginable facet of lab life that needs to be assessed. There is so *much* emphasis on it, as a matter of fact, that the more dedicated among us will realize we need to assess our personal lives and surroundings, as well. And this could take on dramatic overtones.

Those New Year's resolutions, for example. If you resolved to go on a diet but the bagel schmear, Chinese restaurant buffets, and designer pizzas keep luring you away, just sigh and remember the wisdom of Scarlett O'Hara: "I can't think about that right now. . . . I'll think about that tomorrow. . . . After all, tomorrow *is* another day."

* * *

And maybe it was a revelation from all that self-assessing that led someone somewhere to issue instructions to all managers that all staff/department meetings must begin with ES&H matters at the top of the agenda. Also, the agendas must be saved and archived to prove to whoever might someday want to know that the meetings did begin with ES&H matters.

Some may grumble about yet another compliance thing, but before you trip over your flip-flops, think for a minute. This is a national security research and development lab, with lots of highly educated people doing really serious research — sometimes working on stuff you have to be really careful with. What kind of example would it set if some of our stuff didn't work? Or if we made a really big mess? Or if someone were needlessly hurt doing this important work?

It's all part of our work, and even though a very seasoned member of our staff is fond of saying, "It all pays the same," we're not quite that cynical. Still, if the next compliance requirement is to videotape the meetings to prove that ES&H really, truly, genuinely was discussed at the beginning, we might see a lot of flip-flops flying around.

* * *

Engineering and engineering excellence is very important to Labs Director Tom Hunter and Deputy Director John Stichman — and others, of course, including retiree Bob Woods.

"As proof that there is life after Sandia, you might be interested in the articles that I have been writing for *Mechanical Engineering* magazine since retiring eight years ago," Bob e-mailed recently. "The Capitol dome article was based on my experiences on Capitol Hill while I was a Sandia-sponsored Congressional Science Fellow with the American Society of Mechanical Engineers. It led to a series."

If you're interested in the list, e-mail me (address below) and I'll send it to you, along with URLs to each article.

— Howard Kercheval (844-7842, MS 0165, hckerch@sandia.gov)

Sandia LabNews

Sandia National Laboratories

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Sandia National Laboratories is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin company, for the US Department of Energy's National Nuclear Security Administration.

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Lab News fax 505/844-0645
Classified ads 505/844-4902

Published on alternate Fridays by Media Relations and Communications Dept. 3651, MS 0165

LOCKHEED MARTIN

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Six Sandians complete project management professional curriculum

Course completion a key step toward PMP certification

Six Sandians have completed the seven-course Project Manager Professional (PMP) curriculum offered by Corporate Education, Development, and Training (CEDT). Completing the curriculum is a key step in earning the prestigious PMP certification, a designator recognized worldwide as the professional project management professional gold standard and a highly sought-after credential.

The six Sandians are Lourdes Romero (2024), Deborah Montoya (3332), Greg Shirley (10533), James R. Stephens (3013), Lori Messex (5051), and Emily Sers (2027).

The CEDT-offered curriculum covers the six core areas of the Project Management Institute's (PMI) PMP Certification examination, with the seventh course being an application practicum in which all the knowledge learned is applied to a project to demonstrate a transfer of learning.

An added benefit of successful completion of the PMP curriculum with CEDT is that George Washington University issues a graduate certificate in project management. To become a certified PMP, the individual must then take the PMI certification exam and meet the PMI experience qualifications. Like most professional certifications, once you become a certified PMP, there are continuing education requirements to maintain the certification.

For information about the PMP curriculum or other CEDT course offerings, contact Linda Wilson, 844-8326.

Take Note

Tennis: A Junior Tennis Program at the Coronado Tennis Club courts started Jan. 15 and will run every Sunday for six weeks. The tennis program is available to all Sandia/Kirtland extended families. Membership in the CTC is not required for participation in Junior Tennis. For more information contact Linda Slutz, 299-3683.

Sandia News Briefs

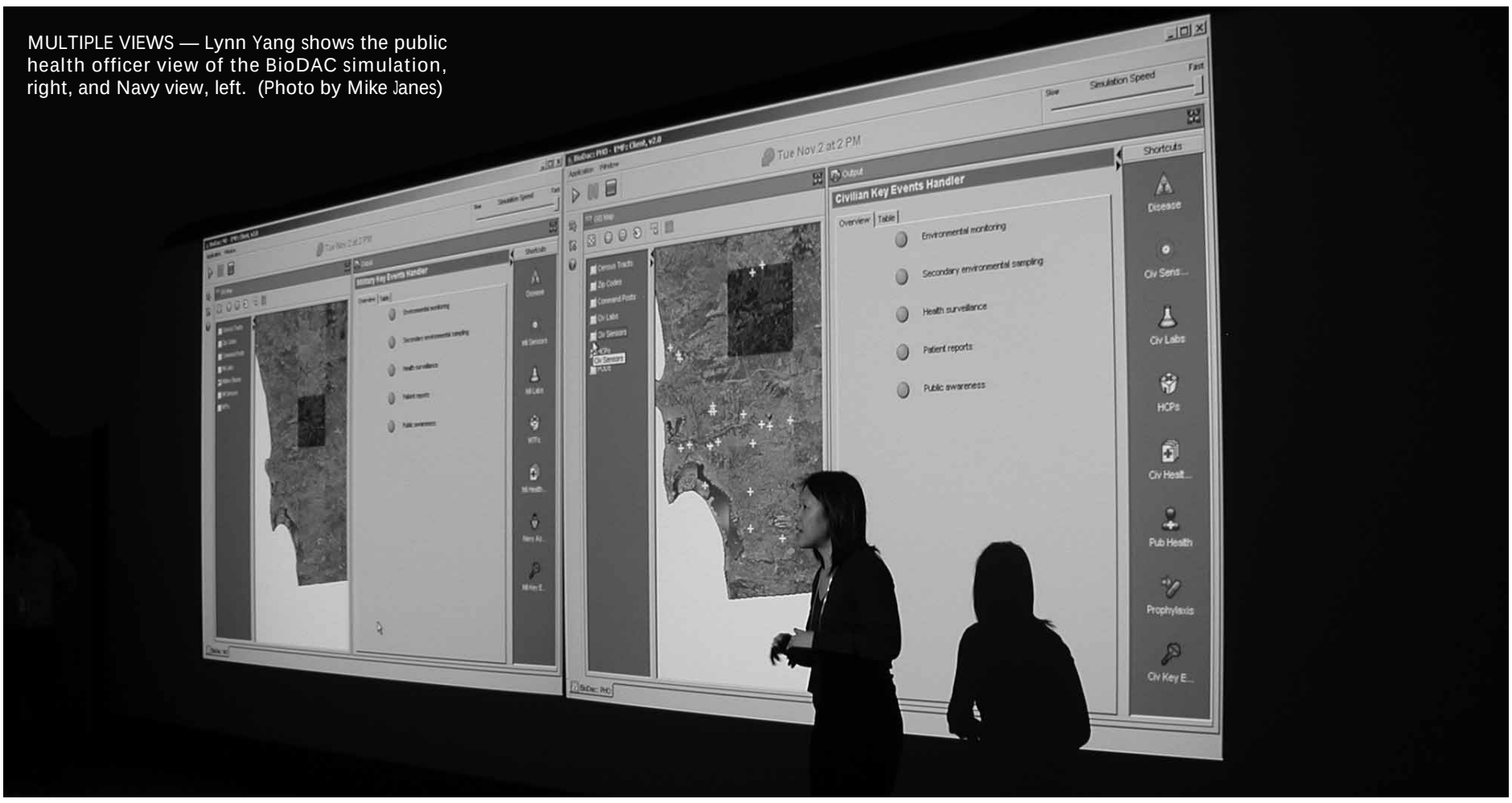
Arlin Cooper co-authors chapter in new edition of CRC Electrical Engineering

Arlin Cooper, Senior Scientist in Airworthiness Assurance Dept. 6252, and former Sandian Anna Johnston are authors of a chapter titled "Computers, Software Engineering, and Digital Devices" in the just-published *CRC Electrical Engineering Handbook*, Third Edition. This volume is part of a six-volume *Electrical Engineering Handbook* series. Tom Mancini (6218) is also listed as a chapter author in another volume, *Electronics, Power Electronics, Optoelectronics, Microwaves, Electromagnetics, and Radar.*

ARLIN COOPER

Retiree deaths

Kenneth L. Romine (age 84) . . . . . November 13
Lyle W. Newman (79) . . . . . December 1
B. R. Lorenzen (93) . . . . . December 2
Edith F. Milatzo (84) . . . . . December 10
Richard J. Dye (77) . . . . . December 12
Guy A. Coburn (89) . . . . . December 13
Harley D. Moody (91) . . . . . December 13
William C. Garcia (83) . . . . . December 15
Leon Worth Luke (91) . . . . . December 18
Lewis A. Faw (83) . . . . . December 21
C. E. Katzenberger (86) . . . . . December 22
Chester J. Smith (87) . . . . . December 25
George J. Torres (91) . . . . . December 28
James Brice Hilser (87) . . . . . December 31



MULTIPLE VIEWS — Lynn Yang shows the public health officer view of the BioDAC simulation, right, and Navy view, left. (Photo by Mike Janes)

Sandia-developed BioDAC simulation helps integrate military, civilian bioterror responses

By Nancy Garcia

Sandia CaliforniaNews

A role-playing simulation that enables emergency response officials to see how their decisions might play out in an event may be more important for bioterrorism than for other terrorist scenarios because it involves release of a biological agent whose effects may take days or weeks to appear, researcher Lynn Yang (8114) said during a briefing of California site managers earlier this month.

The BioDAC (Biological Decision Analysis Center), simulates a release of anthrax or smallpox in an urban area (San Diego County). It was developed by Sandia researchers through the BioNet Program. Funded by the Department of Homeland Security and executed by the Department of Defense, BioNet was a year-long $23 million program to integrate civilian and military biodefense capabilities to facilitate the generation of a unified consequence management plan for a bioterrorism event. This includes jointly detecting and characterizing an event, leading to early phases of the response.

Sandia provided systems modeling and analysis of the population, medical response infrastructure, detection system, and key assets. Role-playing exercises help participants develop countermeasures and responses to an incident.

Ben Wu (8124) presented along with Lynn. He said there are approximately 100,000 military personnel at major Navy facilities in San Diego County, and timing of decisions reflects military mission priorities.

On the other hand, Lynn indicated that the civilian public health officers tend to be fairly conservative in part because of potential risks associated with responses like prophylaxis.

The first indication of an attack may be picked up as an anthrax reading on an air sampling detector in a civilian environmental monitoring system called BioWatch. The positive reading must be confirmed as a true positive. If confirmed, various decision alternatives need to be considered, including when (or if) the public should be notified and when (or if) antibiotic prophylaxis should be distributed.

Although the Navy would make decisions independently, both sides now appreciate the inherent interdependencies of their responses.

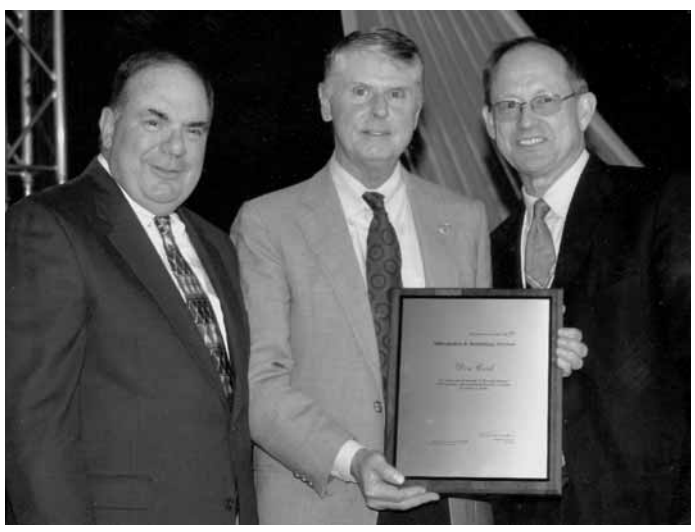
Using BioDAC, Navy and public health role players each had distinct views, including maps and other data showing resources and conditions impacting their role. The underlying scenario was visible to the analyst, which showed what Lynn called a "huge attack." Antibiotic treatment can reduce the impact of the attack if administered in time.

Since the area has about 80,000 tourists a day, she said a scenario involving exposure to smallpox, which is contagious, would be more complicated. The disease would potentially spread beyond the county because large numbers of exposed travelers would leave the area before being aware of being infected.

The simulation allows role players to identify and fill gaps in their concepts of operations. It is being evaluated as a possible tool for operations support and training. Insights gleaned from BioDAC contributed to ongoing discussions of the National Bio-Monitoring Architecture.

Don Cook receives Lockheed Martin sector recognition award for MESA work

Don Cook, former director of the MESA Program Center, has received formal recognition from Lockheed Martin Information and Technology Services Sector for his contributions to the success of the multiyear, nearly half-billion-dollar program. Don is now back at Sandia after serving with the Lockheed Martin team that sought the Los Alamos lab management contract.



LOCKHEED MARTIN I&TS Sector President Mike Camardo, left, presents Don Cook (center) with a recognition award for his work on MESA. Joining the two is Labs President Tom Hunter.

During the IT Services sector annual meeting in Palm Beach last month, Sector President Mike Camardo presented the award to Don. The citation reads: "For vision and leadership in directing Sandia's half-billion-dollar MESA Project and for untiring dedication to making the project a reality." Labs Director Tom Hunter joined Camardo during the presentation ceremony.

The award is a tradition at the sector annual meeting, where each year recognition awards are presented to individuals from Lockheed Martin's I&TS-managed sites. Each site is given the opportunity to recognize an individual for contributions to operations at its site.

The MESA capital project, now led by project manager Bill Jenkins and Michael Cieslak, Nuclear Weapons Infrastructure program director, is now more than 80 percent complete, still meeting all of its scope, schedule, and cost requirements.

Says Don, "It's been a true pleasure and a privilege to be associated with the MESA Project and the MESA team. MESA is the largest single capital project ever undertaken at Sandia, one that has been executed in an extraordinarily effective manner across many divisions of the Labs."

Riding the dimer: Straddling twin molecules provides Labs physicist unique view of their breakup

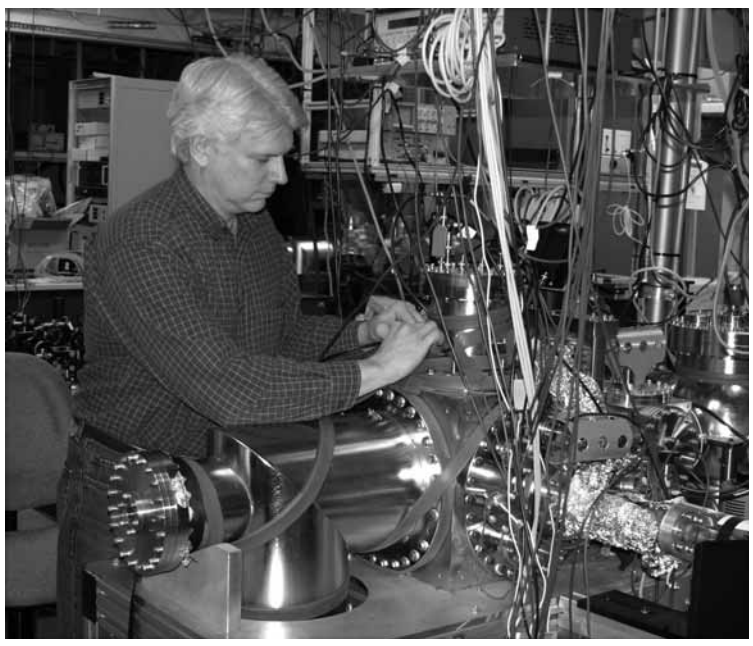
New view attained of electronic orbitals of separating molecules

By Neal Singer

Imagine you are standing, John Wayne style, on the backs of two runaway horses pulling a stagecoach. You try to bring the horses to a stop but instead the harnesses break, the horses separate, and an unlucky passenger gets thrown from the stage.

You've learned, first, you're not John Wayne (because he always prevailed). But also, because you were standing at the heart of the action, you saw exactly how the breakup occurred and the passenger was ejected.

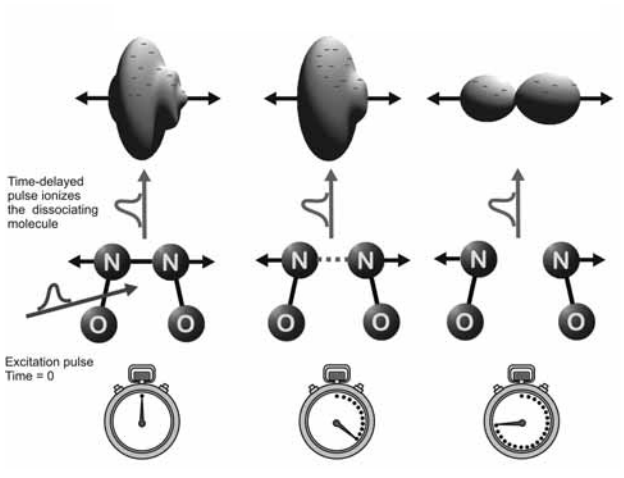
In work published in the Jan. 13 issue of *Science* magazine, a team of scientists from Sandia, the National Research Council in Ottawa, Canada, and elsewhere accomplished this trick scientifically by, in effect, standing on pair after pair of joined nitric oxide molecules (called NO dimers) and watching as each pair split after being excited by an ultrashort laser pulse.



FEMTO FOTO — Carl Hayden prepares to image separating dimers. (Photo by Lynda Hadley)

A Sandia team led by Carl Hayden (8353) not only measured the direction of each separating NO molecule but also the direction and energy of an electron spat out as each breakup occurred.

By using a computer to calculate back from the final speeds and angles, the researchers could reconstruct the event to "see" the exact path each electron and dimer fragment had taken, exactly as though they had ridden on the dimers as they split. The electron reveals the quantum energy levels of the dimer as it separates — a key component of the puzzle.



THE PATTERN of ejected electrons from the molecule's perspective.

The detailed experimental results are expected to provide tests for computational methods used by chemists to describe complex chemical processes in combustion and atmospheric chemistry involving the NO molecule.

With previous experimental techniques, scientists usually watched these events from the sidelines, their points of view external to the reactions — the so- called "laboratory frame of reference." Such methods can only average the results obtained from molecules oriented in all different directions, thus obscuring details of the reaction.

The new experiments reconstruct action from the molecules' perspective — the molecular frame of reference — and yield a more detailed view of reactions. This provides a stringent test of theoretical calculations.

"For those using computing to predict what happens in chemical reactions, without actually doing the experiments, the NO dimer is a very challenging system to calculate," says Carl.

Results showed that the dimers don't come apart smoothly, as had formerly been thought, but go through an intermediate step. About 150 femtoseconds after the initiating pulse (a femtosecond is a millionth of a nanosecond), a more diffuse but definite configuration known as a Rydberg state appears. That state dissociates in about 600 femtoseconds.

Understanding the dissociation process is not simple. "The number of possible electronic states is very large," says Carl. One purpose of the work is to determine which of these states are important during the dissociation.

The results were obtained by firing femtosecond laser excitation pulses at a beam of NO molecules made cold enough to allow NO dimers to form (about 20 degrees Kelvin). Firing only enough energy to disrupt one dimer with each laser pulse, the experiments were performed until as many as 500,000 dissociations had been observed.

A second femtosecond probe pulse, sent with a variable time delay after the excitation, ejected an electron from each dimer as it broke up, providing a "snapshot" of the progress of the dissociation.

The dimer fragments were analyzed by a tool developed at Sandia/California called a time-resolved, coincidence-imaging spectrometer. The spectrometer, which uses a flat detector, is able to capture electrons flying off in three dimensions through use of an electric field that bends the electrons' flight toward the detector.

"The ones that arrive latest have traveled the farthest from the point of ejection," says Carl. "The energy and angle is what we're looking for."

A similar process is used to simultaneously measure velocities of the ions and hence the NO molecular fragments produced.

The work was funded by DOE's Office of Basic Energy Sciences, Division of Chemical Sciences, Geosciences, and Biosciences.

Results were the product of an international collaboration. The measurements from the molecular perspective were done at Sandia, with complementary work to measure dimer intermediate state lifetimes achieved in Albert Stolow's group at the Steacie Institute for Molecular Sciences, at the National Research Council of Canada.

Quantum mechanical calculations were done by other groups in Canada and at the University of Southern California, while some of the modeling of the 3-D electron distributions was performed at the Open University in the United Kingdom.

Sequestration

(Continued from page 1)

a team of Sandians will conduct detailed studies on the long-term geologic impacts of CO_2 on the host reservoir to determine what characterization work will be needed before sequestration can be deployed.

"The overall objective of the project is to better understand CO_2 sequestration-related processes and to predict and monitor the migration and ultimate fate of CO_2 after it's injected into a reservoir," says John. Although saline aquifers, deep coal seams, depleted gas reservoirs and several other potential reservoirs are available, depleted oil reservoirs make an attractive option for immediate sequestration for a variety of reasons, says John.

A key reason is that many oil reservoirs have potential for incremental oil recovery with CO_2 injection that can improve the overall economics for sequestration projects. Geophysical and geochemical modeling after injection will demonstrate methods to monitor injections to make sure CO_2 stays in the ground. John, following up on the recently retired Norm Warpinski's work in this area, will be joined by Dave Aldridge, Bruce Engler (both 6116), and Jim Krumhansl (6118).

Peter Kobos (6010), has been at work developing a high-level computer model to analyze physical, economic, and policy requirements needed to understand carbon sequestration in the region. "We've got a prototype right now," says Peter. "We're trying to integrate all the information so that both experts and interested parties can understand how we assess a project. We've got geologists, regulators, academics, and people from industry all involved. The model is a way we can see all of the issues quickly and address them in an integrated way."

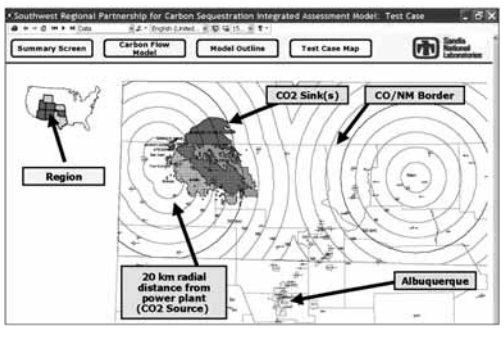
Model components

Len Malczynski (6115) is also a key player on the modeling project, developing much of the software that will tie large amounts of data from the Partnership team to the model itself. Several workshops developed the model's key parts. An example is screening criteria for underground storage of CO_2. A team of geologists helped identify what would be needed to create a successful storage reservoir, Peter said.

Identifying sources of CO_2 and how they would flow to these reservoirs, or "sinks," and some of the economics associated with the project were other model components. Currently, the team is working with a New Mexico test case, but Peter plans to expand it to a regional scope for the future.

"Our goal is an integrated assessment of the costs of the components parts," says David. "If

(Continued on next page)



INTEGRATED ASSESSMENT — This map, developed as part of a Sandia carbon sequestration modeling project, shows a number of potential CO_2 sequestration sites, or "sinks" within a 20-kilometer radius of Four Corners coal-fired power plants.

Provocative Feibelman talk discusses virtues of smelly substance for hydrogen distribution, storage

Ammonia: That other energy carrier

By Neal Singer

Ammonia, a molecule containing three hydrogen atoms and one nitrogen, is widely available: Approximately two percent of the world's energy goes to NH_3 synthesis. More than 3,000 miles of pipeline deliver ammonia to farmers, who use it as fertilizer and as a cattle feed additive.

So, among the low-carbon, high-energy fuels available for transportation, why look elsewhere? That was the question asked by Peter Feibelman (1114) in a provocative talk delivered at Sandia's Journal Club Seminar Series in November.

Chemical bonds do not need to be broken to store ammonia safely in a solid, he said. NH_3 can also be stored as a liquid at room temperature and modest pressure. Lighter than air, it disperses rapidly if inadvertently released. It combines readily with rain, and so is not a greenhouse gas.

In comparison, the energy wasted in forming hydrides — a favored idea for hydrogen storage — and freeing hydrogen from them is considerable, most researchers agree. Distribution and storage of pure hydrogen involves major engineering problems because hydrogen embrittles metals and must be stored at very high pressures to be a practical fuel.

Why not use ammonia to distribute and store hydrogen?

"People just don't like the stuff," Peter offered, in his explanation of why researchers pursue more difficult alternatives. "It smells bad, is toxic at high concentrations, and [scientifically, out of left field] is used in making methamphetamine."

Agreeing with Peter on ammonia's potential is Roland Stumpf (8761), an editor of a new Materials Research Society volume, *Materials for Hydrogen Storage (*see page 12*)*. Roland is also an ammonia proponent, though his book — which consists of papers delivered at an MRS symposium — contains no report of ammonia-related research.

"We would have accepted ammonia-related talks but there is no funding for ammonia as an energy carrier, in general," says Roland.

"If we hadn't had gasoline for a hundred years and someone came up with the idea to use it, it would be characterized as a carcinogen and highly flammable."

Peter Feibelman

Ammonia has been recognized for 50 years as a hydrogen carrier, he says, but that hasn't gotten it a lot of traction from funding agencies. People have a strong aversion to ammonia, he says: "Intelligent people discard the idea immediately without knowing any details. This is a typical reaction from the normally technically minded, and is ammonia's biggest roadblock. There is overwhelming evidence there should be a research effort to learn to handle and store it safely."

The fear, he says, is that people think ammonia will kill thousands or even millions of people. "There's generally less tolerance of risks today than in earlier days," he adds. "If we hadn't had gasoline for a hundred years and someone [today] came up with the idea to use it [for the first time], it would be characterized as a carcinogen and highly flammable."

Roland has already spent time studying ammonia's qualifications, plans on spending more, and currently believes the best idea is to burn ammonia directly in internal combustion engines, rather than cracking it to supply hydrogen for fuel cells.

There are doubters, however.

"Whenever a source is chosen, it behooves the nation to do the entire lifecycle analysis: how do you transport it, what's the efficiency," says one Sandian, who prefers not to be identified, but who favors producing hydrogen from next-generation nuclear reactors or from decomposition of materials like sulfuric acid. "Three thousand miles [of already-in-place pipeline] is nothing; what's needed are tens of thousands, not just the material itself."

Says Paul Pickard (6872), "Ammonia is a good storage medium because it has a lot of hydrogen and it's a liquid – easily pressurized, pumped, and shipped. But to make it, you need a source of hydrogen. The way we make it now is from natural gas. That means ammonia is not a solution to our energy problem, but a vehicle for storing or shipping hydrogen. It's just a way to save on infrastructure."

Peter agrees that getting hydrogen is fundamental to a "hydrogen economy," no matter how the hydrogen is later distributed and stored. Hydrogen production powered by ocean temperature gradients was demonstrated decades ago, he says, and production using "waste" heat from nuclear power stations is being researched. Hydrogen produced in these fossil-fuel-free ways can conveniently be stored by using it to make ammonia.

Sequestration

(Continued from preceding page)

someone proposes to site a power plant, they will know the costs of carbon sequestration going in. They can look at the infrastructure availability to connect the plant to the sequestration options to help determine the best place to put the plant."

The concept of carbon avoidance by industry is already being practiced in Europe and is catching on in the US, says David. Colorado has a $9/ton tax credit for CO_2 avoided. "This is something that can tip the scale on the type of power plant you might build," he says. More than 1,000 kilometers of pipeline cross northwestern New Mexico to eastern New Mexico and Texas, moving 25 tons of CO_2 a year across the state. This is equivalent to the carbon emissions of about five million people. "We inject and we move it now. The question is how much of a solution is it to the overall problem?"

Carbon sequestration poses national laboratories-scale issue

An estimated 30 percent of US carbon emissions come from power plants and other large "point sources," like industrial furnaces and refineries. Given the fact that fossil fuels are likely to remain the mainstay for energy production well into this century, most scientists believe that the exploration of "carbon sequestration," or terrestrial storage of carbon, merits attention.

This is what the President's Committee of Advisors on Science and Technology reported in a study of 21st-century challenges facing the nation. "A much larger science-based CO_2 sequestration program should be developed," the committee reported. "This is very high-risk, long-term R&D that will not be undertaken by industry alone without strong incentives or regulation, although industry experience and capabilities will be very useful."

Another approach to the problem is to reduce the carbon emissions from those working power plants through more efficient combustion processes. Sandia, through its Combustion Research Facility at Livermore, Calif., has a role in this approach as well. Sandia researcher Chris Shaddix (8367) and his colleagues are at work on concepts to allow coal-fired plants to burn cleaner, reducing CO_2 at the point of emissions instead of storing it. (See stories on clean-burning coal in the next issue of the *Lab News*.)

Global Warming: Evidence mounts

Global warming: fact or fiction? Although debate continues on this issue, many scientists now say that the preponderance of recent evidence is tipping the scales in favor of the existence of the phenomenon.

At the time of the American Revolution, Earth's atmosphere included about 280 carbon molecules for each million total air molecules. Today, each million molecules of atmosphere include about 380 molecules of carbon dioxide, a number that climbs about two or three molecules each year, according to a recent *Scientific American* report.

Recent evidence from the National Oceanic and Atmospheric Administration suggests that dissolved carbon dioxide in the world's oceans has increased acidity of the seas steadily over the past two centuries. One impact is a reduced ability of marine organisms to produce calcareous skeletons along reefs around the globe, scientists report.

Other scientists are now tracing how health effects related to increasing levels of CO_2 in the atmosphere impact humans. Children and the elderly in inner-city environments are particularly vulnerable when events such as summer heat waves combine with other health factors, often tied to increased levels of CO_2. "The problem is here today for these [urban] children, and it is only going to get worse," concludes a Harvard Medical School report.

In a recent visit to Sandia, Steve Koonin, chief scientist for BP Inc., one of the world's largest energy companies, told his audience there is a plausible connection between global warming and increases of CO_2 in the atmosphere. (See full story, *Lab News*, Jan. 5.) Although the scientific case is not overwhelming, Koonin said, "My bottom line and BP's as well, it that it is extraordinarily unwise to be putting this much CO_2 into the atmosphere and that the world should do something about it. . . . For CO_2, there are two technologies necessary to have a meaningful impact on emissions: nuclear power and carbon sequestration. Without those two, I don't think the world has a prayer."

Discipline

(Continued from page 1)

tions organization made a number of revisions last August to Sandia's discipline-related Corporate Process Requirement (CPR 300.4.3) (see "Discipline policy changes took effect in August" below right). A more comprehensive overhaul of the CPR is planned in the coming months to help assure consistent and fair application of disciplinary measures Labs-wide and to bring it in line with industry best practices and Lockheed Martin procedures.

"What's needed is a transformation in how we view and manage discipline and performance. This radical change will only occur with a more comprehensive overhaul of disciplinary and performance improvement policies and procedures," Julian says. "Another requirement is more proactive early intervention with respect to developing problems. Everyone involved in administering the policies [Employee and Labor Relations, Human Resource consultants, Legal, and ultimately the line managers] needs to focus more on early intervention and training.

"Our policies need to ensure that poor performance and discipline are addressed consistently across the Labs and its various sites, and in accordance with the severity of any violations. This hasn't always occurred in the past."

Discipline cases at Sandia

A discipline case at Sandia may arise from behavior or an incident taking place in or outside the workplace. For example, an arrest or illegal behavior must be reported to an employee's manager and may become cause for disciplinary action.

In FY2005, there were 255 disciplinary cases at Sandia, 110 of which resulted in "coaching and counseling," which until the recent policy change were reflected as disciplinary actions. Of the remaining 145 disciplinary actions, about 20 percent resulted in either termination or resignation in lieu of termination. The other 80 percent were resolved through other avenues, such as suspension without pay or written reprimand.

If you include coaching and counseling, about 70 percent of offenses in FY05 were security-related, and the leading infractions were bringing or using an unauthorized cell phone into a tech area or leaving classified documents unprotected. However, if you eliminate coaching and counseling, security-related infractions decline significantly to about 32 percent.

Offensive or threatening behavior, insubordination, and misuse of government property were the next most common types of discipline cases, followed by falsified records and statements.

Sandia's discipline philosophy

A new section in CPR 300.4.3 addresses the Labs' discipline philosophy and approach, which emphasize early intervention in performance and behavioral issues and "firm, fair, and consistent treatment of employees being disciplined." The section also asserts that coaching and counseling should be a routine management practice, whereas in the past this was the first level of disciplinary action.

"Now the first-level corrective action will be a verbal reprimand, which is documented and kept in an employee's personnel file and in a 'discipline database,'" says John McAuliffe, manager, Employee and Labor Relations. "In the past, when coaching and counseling was administered, the manager noted these discussions but documentation was not included in the employee's organizational file."

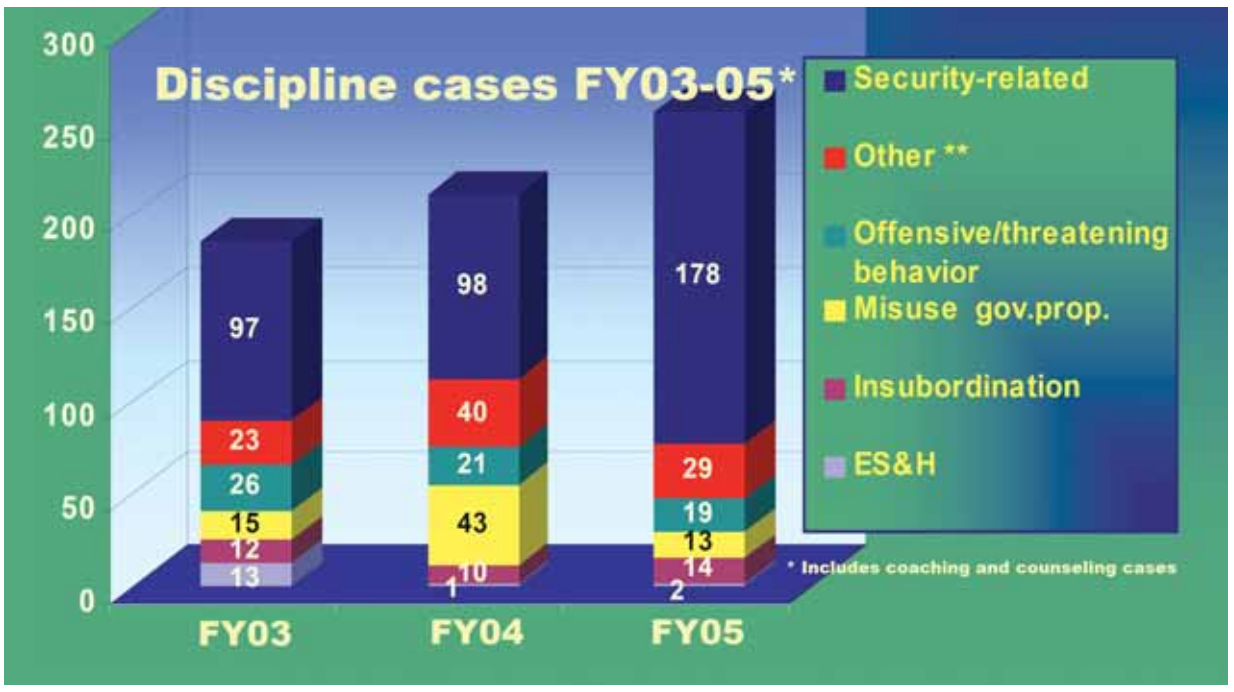
Other disciplinary actions, in order of increasing severity, include written reprimand, suspension without pay, and termination. Managers must consult with the Employee and Labor Relations Department in all cases involving disciplinary actions.

The Disciplinary Review Committee convenes to review serious cases that have broad impact, are precedent-setting, or could result in external scrutiny. It considered five cases in FY05: three involving misuse of government property, one involving falsification of records, and one case of insubordination.

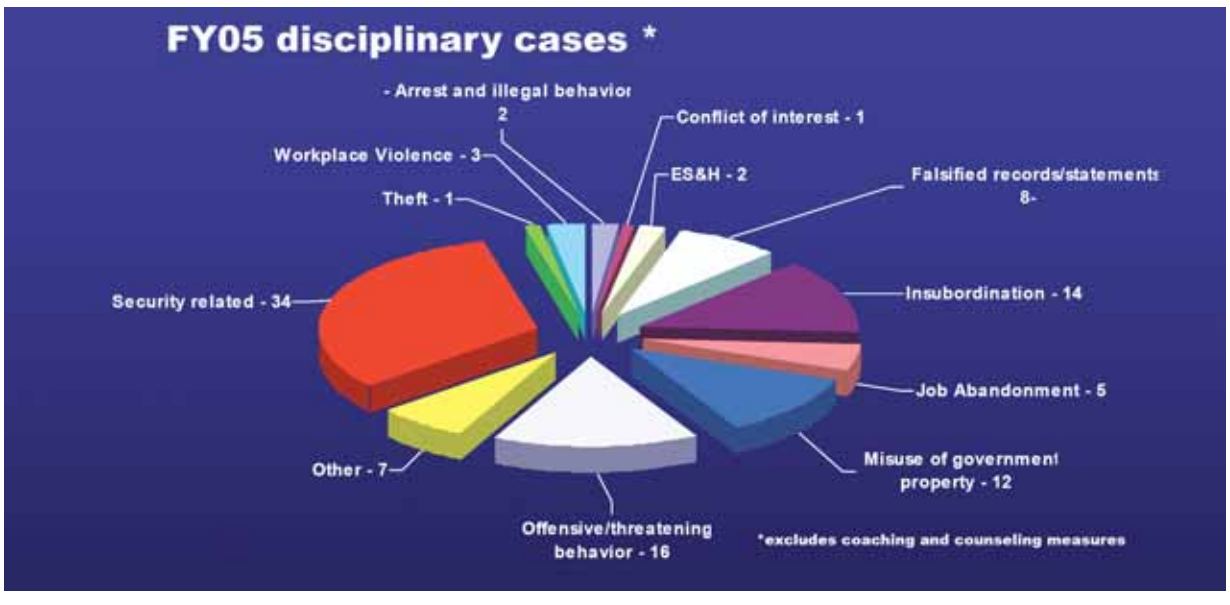
More changes to come

Part of the impetus for re-evaluating Sandia's discipline policies came about two years ago after a team of several directors identified eight systemic issues underlying a pattern of behaviors and attitudes related to security and discipline at Sandia. A special management team was formed to address the issues, which are being championed by several vice presidents.

A team led by Julian is looking into one of the systemic issues — "inconsistent accountability for actions" — and is recommending a complete overhaul of Sandia's disciplinary and performance improvement policies and a clear definition of the roles and responsibilities for key players including Employee & Labor Relations, Legal, the Human Resource consultants, and line management. Look for two Kaizen process-improvement events to be held early this year, followed by a rewrite of the policies and mandatory training for all managers.



DISCIPLINE CASES — ** "Other" category above includes theft, workplace violence, job abandonment, falsified records/statements, exposure, conflict of interest, probation terms violations, and arrest and illegal behavior.



Discipline policy changes took effect in August

Changes were made to Sandia's Employee Discipline and Corrective Action CPR 400.3.4 in August 2005. Here are some of the more significant changes:

• "Coaching and counseling" is no longer categorized as disciplinary action. The first step in Sandia's progressive disciplinary approach is now a verbal reprimand, which is documented in an employee's organizational file. As before, other disciplinary actions are written reprimand, suspension without pay, and termination.

• Managers must consult with the Employee and Labor Relations Department in all cases involving disciplinary actions. Previously, cases involving coaching and counseling or verbal reprimand were excluded.

• A decision to place an employee on administrative leave without pay or excused unpaid absence — sometimes done pending completion of an investigation of the incident — must be reviewed with the Employee and Labor Relations Department.

• If an employee is suspended without pay, his or her badge must be taken by management. Previously, this was at management's discretion.

• Several items were added to the list of examples of misconduct, which is provided for guidance and not intended to be comprehensive. Examples are categorized according to severity — minor, serious, and very serious. One addition is a section called "Failure to Manage." Lack of attention to management responsibilities, leading to organizational breakdown or employee misconduct; deliberate acts of misconduct; and failure to address employee misconduct and/or performance issues comprise this section. All are considered serious to very serious infractions.

• Managers are now responsible for providing documentation on all disciplinary cases to Employee and Labor Relations or Human Resources at Sandia/California. While use or possession of an unauthorized cell phone inside a limited area has always been grounds for disciplinary action, it has now been added to the misconduct examples list.

• Other items added to the list of examples are accessing sexually explicit material by telephone (serious) and improper use of proprietary information (very serious).

• Clarifying when the Disciplinary Review Committee (DRC) should be convened. The DRC's purpose is to provide comprehensive, cross-functional review of discipline cases in which the offense is very serious to determine the appropriate disciplinary action. It consists of the Employee & Labor Relations manager, the employee's director, and the director of Safeguards and Security or the director of Environment, Health, and Safety. Other members may be called to provide advice and information. DRC meetings are called when discipline cases are very serious, precedent setting, have broad impact, could result in external scrutiny, or are necessary to ensure "firm, fair, and consistent treatment."

For the full CPR, see http://www-irn.sandia.gov/hr/policies/Lr/disciplinary_actions.htm.

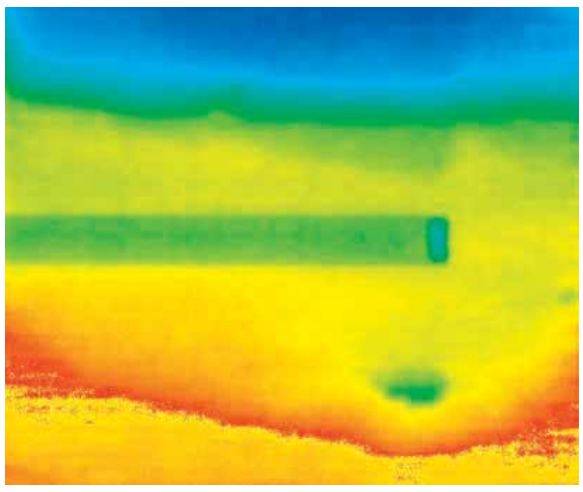
PEM fuel cell

(Continued from page 1)

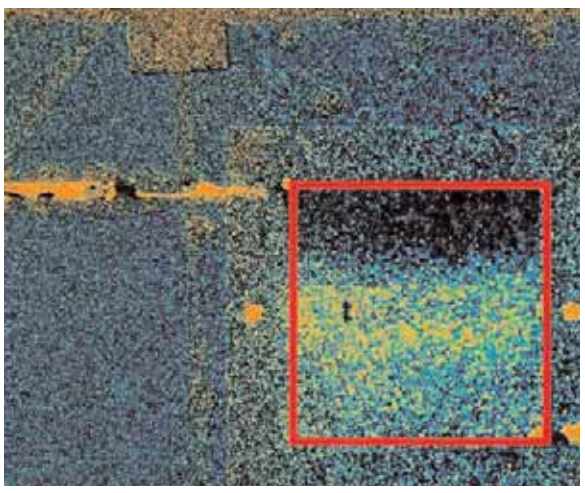
maintain the cells' long-term performance during normal and harsh (e.g., freezing) conditions and improve their durability.

The close teaming between Ken's modeling and Mike's experimental efforts has been quite helpful in meeting project objectives.

"Our approach in combining computational modeling with experiments is unique," Ken says.



LIQUID WATER content of an operating PEM fuel cell. Red color is more water, blue is less.



NEUTRON RADIOGRAPHY image of an operating PEM fuel cell. The active area is outlined in red.

"Typically, Mike would perform discovery experiments to gain physical insights. I would then develop a model to describe the observation or data that Mike has obtained. Mike would perform further experiments so I can validate the model I have developed."

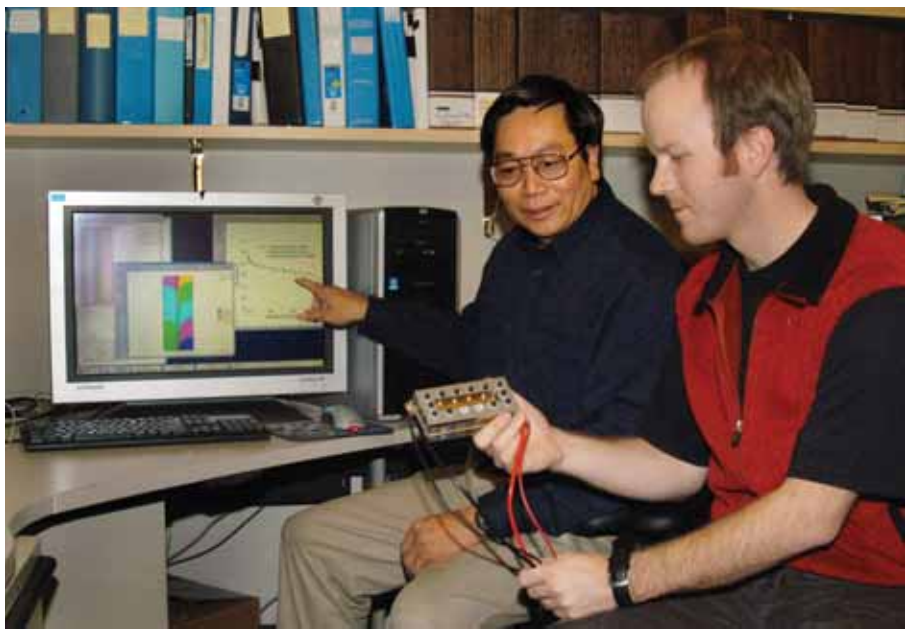
Mike says they've obtained some "nice feedback" between the experiments and analyses. The intent is to build a computational tool that can be used in designing fuel cells, eliminating the need to do experiments on every single part of them.

"We want to have all the small pieces worked out in the modeling process so we can concentrate on the larger issues with experiments," he says.

Ken has been using GOMA, a Sandia-developed multidimensional and multi-physics finite-element computer code, as the basic platform to develop 2-D performance models for PEM fuel cells. With the assistance of Nathan Siegel (6218), he is also exploring the development of quasi-3D PEM fuel cell models using FLUENT, a commercial computational fluid dynamic computer code. Ken emphasizes that the focus of this LDRD project is on understanding the key phenomena using experimental means and computational models, both simplified and multidimensional.

Joel Lash, manager of Multiphase Transport Processes Dept. 1514, concurs. "Sandia's state-of-the-art multi-physics codes, like GOMA, form the backbone from which simplified phenomena-centric models can be developed to explore complex behavior, such as occurs in operating PEM fuel cells," he says.

For the past couple of years Ken and Mike have focused mainly on liquid water transport, developing a PEM fuel cell model that can be employed to simulate a fuel cell's performance, and performing diagnostic tests on fuel cells for phenomena discovery and model validation. Next, Ken says, they will tackle the key technical issues of performance degradation or durability, including performance degradation under normal operating conditions and under freezing operating conditions.



PEM COLLABORATION — Ken S. Chen, left, and Mike Hickner are collaborating on their research to study PEM fuel cells. Ken is developing computational models to describe the phenomena while Mike is performing physical experimentation. (Photo by Michelle Fleming)

To date, the team — with contributions from Chris Cornelius (6245), David Ingersoll (2521), David Noble (1512), and Nathan Siegel (6218), as well as collaborations with Professor Chao-Yang Wang of Penn State University and researchers at the National Institute of Standards and Technology — has reported portions of its work in three refereed publications, four proceedings papers, and half a dozen technical presentations.

"People are taking notice of our work, and we are at the leading edge of understanding liquid water transport and removal in PEM fuel cells and becoming an important player in the PEM fuel cell research community," Mike says. "Our validation method is new and exciting and leading us to learn some things not well known previously."

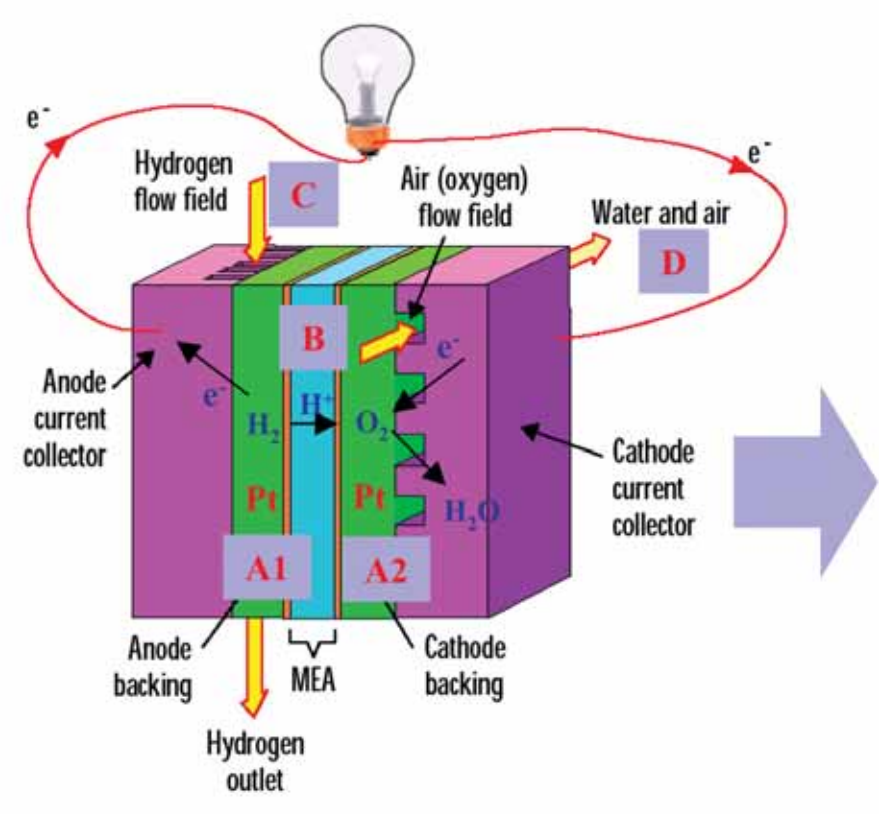
Bruce Kelley, project manager for the PEM Fuel Cell LDRD and manager of Chemical Biological Systems Dept. 6245, says the project was developed specifically to leverage Sandia's capabilities in multiphysics modeling and membrane materials to develop broader capabilities with applicability to fuel cells and other related technology areas. In doing so, Bruce says, "We have attracted significant industrial interest in the work, which is key to attracting DOE and other programmatic funding."

How a polymer electrolyte membrane — or PEM — fuel cell works

A hydrogen-fueled polymer electrolyte membrane (PEM) fuel cell uses hydrogen and oxygen to generate electricity by an electrochemical process in which electrons are produced in the anodic hydrogen-oxidation reaction and consumed in the cathodic oxygen-reduction reaction. A single fuel cell consists of the MEA (membrane electrode assembly), the anode and cathode GDLs (gas diffusion layers), and GFCs (gas flow channels).

The MEA is the heart of the fuel cell, which is fabricated by sandwiching the polymer electrolyte membrane (e.g., Nafion) between two electrodes. They are composed of conductive carbon support, catalytic platinum particles, and polymer electrolyte binder. Carbon papers or woven carbon cloths are typically used as GDLs. The GFCs are usually etched out of graphite or metal materials. To achieve the desired voltages, single cells are connected in series to produce a fuel cell stack.

In an operating PEM fuel cell, humidified hydrogen is fed to the anode GFCs whereas humidified air is forced through the cathode GFCs. Hydrogen and oxygen are then transported through the respective GDLs. Electrons produced in the anode are conducted through the electrical load to the cathode where they are consumed; protons from the hydrogen oxidation reaction are transported through the membrane. This movement of electrons is an electrical current that can be used to power an automobile or a home. Water and heat are generated in the cathodic oxygen-reduction reaction. The waste heat generated is mostly attributed to the efficiency loss (more specifically, loss due to various over-potentials) in converting chemical energy to electricity.



A single polymer electrolyte membrane fuel cell.

Dr. King's letter from jail resonates with truth of the ages

Editor's note: The following excerpt from Dr. Martin Luther King's widely published April 1963 "Letter from a Birmingham Jail" *spells out essential principles that guided his actions during the height of the American Civil Rights movement of the early 1960s. Under the leadership of Dr. King, and the moral authority he wielded, the US Congress passed landmark civil rights legislation that began the long, slow process of reversing — as Dr. King notes — more than 340 years of injustice. Dr. King was in jail as a result of nonviolent civil disobedience His letter was addressed to Birmingham clergy who had publicly complained about "outsiders" coming into their community.*

We have waited for more than 340 years for our constitutional and God- given rights. The nations of Asia and Africa are moving with jetlike speed toward gaining political independence, but we stiff creep at horse-and-buggy pace toward gaining a cup of coffee at a lunch counter. Perhaps it is easy for those who have never felt the stinging dark of segregation to say, "Wait." But when you have seen vicious mobs lynch your mothers and fathers at will and drown your sisters and brothers at whim; when you have seen hate-filled policemen curse, kick, and even kill your black brothers and sisters; when you see the vast majority of your twenty million Negro brothers smothering in an airtight cage of poverty in the midst of an affluent society; when you suddenly find your tongue twisted and your speech stammering as you seek to explain to your six-year-old daughter why she can't go to the public amusement park that has just been advertised on television, and see tears welling up in her eyes when she is told that Funtown is closed to colored children, and see ominous clouds of inferiority beginning to form in her little mental sky, and see her beginning to distort her personality by developing an unconscious bitterness toward white people; when you have to concoct an answer for a five-year-old son who is asking: "Daddy, why do white people treat colored people so mean?"; when you take a cross-county drive and find it necessary to sleep night after night in the uncomfortable corners of your automobile because no motel will accept you; when you are humiliated day in and day out by nagging signs reading "white" and "colored"; when your first name becomes "nigger," your middle name becomes "boy" (however old you are), and your last name becomes "John," and your wife and mother are never given the respected title "Mrs."; when you are harried by day and haunted by night by the fact that you are a Negro, living constantly at tiptoe stance, never quite knowing what to expect next, and are plagued with inner fears and outer resentments; when you are forever fighting a degenerating sense of "nobodiness" then you will understand why we find it difficult to wait. There comes a time when the cup of endurance runs over, and men are no longer willing to be plunged into the abyss of despair. I hope, sirs, you can understand our legitimate and unavoidable impatience.

Feedback

Readers question building temperatures, solar energy features, and building numbers

Q: *(To simplify and save space, this summary is being substituted for the original Feedback question.)*

In early December, Sandia/New Mexico announced that office and corridor spaces controlled by the centralized Facilities Control System had been changed to have a heating set point of 68 degrees F and a cooling set point of 78 degrees F. This was in response to a Presidential Directive and memo from the Secretary of Energy to reduce energy consumption in federally supported facilities. Associated thermostats were configured to disable any occupant control. Occupants of buildings not controlled by the centralized system were asked to control their temperatures accordingly.

Sandians were also asked in the name of safety and energy conservation not to order or use portable space heaters to compensate for the lower heat settings. A Sandian submitted a lengthy Feedback questioning the wisdom of these new measures, including the potential negative health effects, and asking why Sandia is building new facilities that lack solar energy features.

A: There are minimal adverse impacts on a normal healthy person being exposed to 68-degree temperatures in a controlled environment.

All indoor air quality regulations are being followed in this case. We are within the recommended OSHA temperature band on the low end and are only exceeding the upper band by 2 degrees. Again, this is only a recommended range provided by OSHA. On the other side of this equation is the Presidential Directive and subsequent memo from the Secretary of Energy requesting this change for the national good.

The general Sandia population was not consulted regarding this change since we have no "voting" mechanism and decisions had to be made quickly by those most knowledgeable about the corporate-wide energy saving options, renovation plans, and past energy savings measures. Unfortunately, this issue asks us to balance comfort with energy savings during this time of national need.

You question whether Sandia has done enough in other areas of energy reduction. Sandia is measured, per DOE Order 420.1a, on energy reduction. Since the 1985 energy baseline, Sandia has reduced energy use for office buildings by 40 percent through modifying systems to gain efficiencies. There are very few to no high return opportunities left for drastic energy reduction in office buildings, and we are examining options in major laboratory space.

It would be nice if everyone at Sandia were energy conscious and turned off lights, monitors, printers, copiers and computers when not in use. However, the ability to control and enforce a requirement involving over 11,000 individuals isn't achievable. All we can accomplish is to publish *Lab News* articles and issue reminders to all Sandians, which we do at least twice a year as part of our Energy Program.

The energy reduction competitions a few years ago were part of the Energy Nag program, which is still ongoing in most buildings. If you would like to volunteer as an Energy Nag for your facility please go to www-irn.sandia.gov/esh /p2/nag.htm and let one our point of contacts work with you on how to get started.

New facilities being erected are compliant with LEED (Leadership in Energy and Environmental Design) concepts. Solar energy features are incorporated into designs of these facilities with light harvesting and solar energy gains. However, sometimes some of these design features are traded off to allow for additional square footage due to the current corporate high-risk issue of inadequate space for mission work.

Other interesting issues concerning energy and forthcoming requirements are: 1) the Presidential Directive requires an energy reduction of 10 percent from baseline 2004 usage levels, 2) DOE Order 420.1a requires a 35 percent reduction from baseline 1985 usage levels, and 3) the new Energy Bill requires a reduction of 2 percent per year from a baseline 2000 usage level.

Energy reduction within the federal complex is a big issue and will remain so in the future. Our ability to meet these new requirements on energy reduction will be a significant challenge to the laboratory. Based on efforts already taken we have addressed the large-payback items, and large returns for energy reduction will not be easily achievable in the future.

I fully acknowledge that reducing building thermostat settings is a controversial issue and may be an inconvenience or a potential discomfort to those affected. All I would ask is that we all consider this potential discomfort in comparison to losing a home from a hurricane or being unable to afford heating for our homes due to natural gas demands driving gas prices to over four times the cost during the summer. I believe we need to do all we can to support this federal directive. *— Lynnwood Dukes (10860)*

Q: *What process is used to determine building numbers for new buildings? It seems fairly random. One example is the new Bldg. 729, which is flanked by buildings numbered 821, 823, 827, 856, and 869. Surely there was a number in the 800s available for use that could have better reflected the proximity of the new building to its neighbors. At best, the discrepancy is curious, but the apparent lack of consistency in building numbering logic also makes navigating the tech area increasingly difficult.*

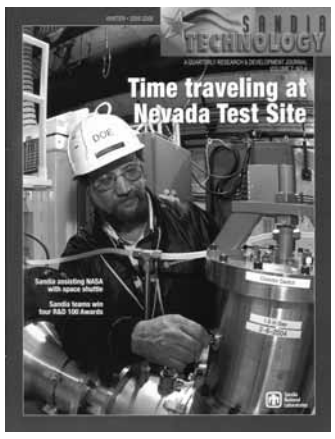
A: The Facilities master building table assigns building numbers during the design phase of a project; the numbers are assigned by geographical area.

The DOE FIMS system (Facilities Information Management System) does not let us reuse building numbers. This is because all 200 data fields in FIMS associated with that building are archived in the DOE system.

The entire 800 series of building numbers is complete and full. There are no more 800 building numbers to be selected. *— Stan Harrison (10850)*

New *Sandia Technology* now available

The latest edition of *Sandia Technology*, with features on the Nevada Test Site and Sandia's work on the shuttle with NASA, is now available on the internal and external web and in hard copy.



"Time traveling at the Nevada Test Site" is an article by Bill Murphy with photos from *Lab News* photographer Randy Montoya. It reviews some of the history of the test site from the viewpoint of an engineer, Tom Hunter, who is now Labs president. It also gives insights into the current mission and importance of the site. (This article was based on earlier award-winning coverage of the test site in the Dec. 9, 2004, *Lab News*.)

Michael Padilla's coverage of Sandia's work with NASA in connection with the "return to flight" effort for the space shuttle is also featured. This article looks at Sandia's 3-D imaging sensor, used to inspect the orbiter for critical damage, as well as a number of other Sandia-NASA efforts.

Sandia Technology is a quarterly publication designed primarily for external audiences. Interested Sandians can find current and past issues in the News Center on the internal web. Issues can also be found on the external web at: http://www.sandia.gov/news-center/publications/sandia-technology/index.html.

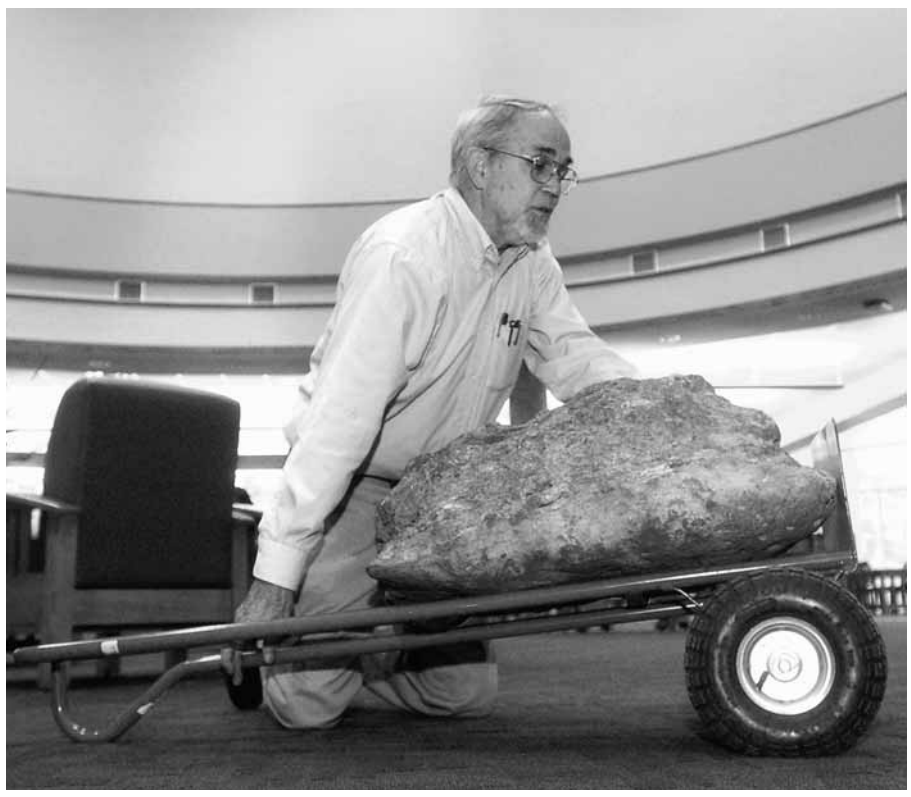
Earth science: Communicating about meteor craters from billionths of a second to billions of years

By Will Keener

Retired Sandia physicist Bob Graham has a message for his colleagues in the world of shock physics: "If you don't understand the problem posed in other shock regimes, you don't understand shock physics." At a recent Sandia colloquium Bob illustrated his point by discussing a meteor impact crater he is studying near his South Texas home. "We can learn from meteor impact scientists and they can learn from us," he said.

Bob, who retired from the Labs in 1996, attracted more than 40 of his colleagues, former colleagues, and some new shock researchers to his November talk. Arriving at Sandia in 1958, Bob pursued a career in which he proved to be a prolific author and pioneer in shock physics concepts, including piezoelectric gauges. He is credited with helping organize the topical shock physics group within the American Physical Society. Currently there are about 550 members of the topical group, according to Lalit Chhabildas (1647), who hosted Bob's talk.

Bob reviewed his field studies of the Bee Bluff Structure, near Uvalde, Texas. The feature currently is not listed as a meteor crater in the Earth and Impact Database by geologic authorities at the University of New Brunswick, Canada, but it certainly is a crater, Bob emphasized. One of his goals is to get the site listed as a meteor crater, but he has a higher goal. "It's time for field geologists with ideas about billions of years of Earth history to start talking about the nanoseconds involved in these crater impacts with their shock physics colleagues," Bob said.



DIFFERENT SCALES — Bob Graham and his Uvalde, Texas, version of the Rosetta Stone. Bob believes the stone holds secrets to understanding a nearby meteor crater from a shock physics standpoint.

(Photo by Robert McLeroy, San Antonio *Express News*)

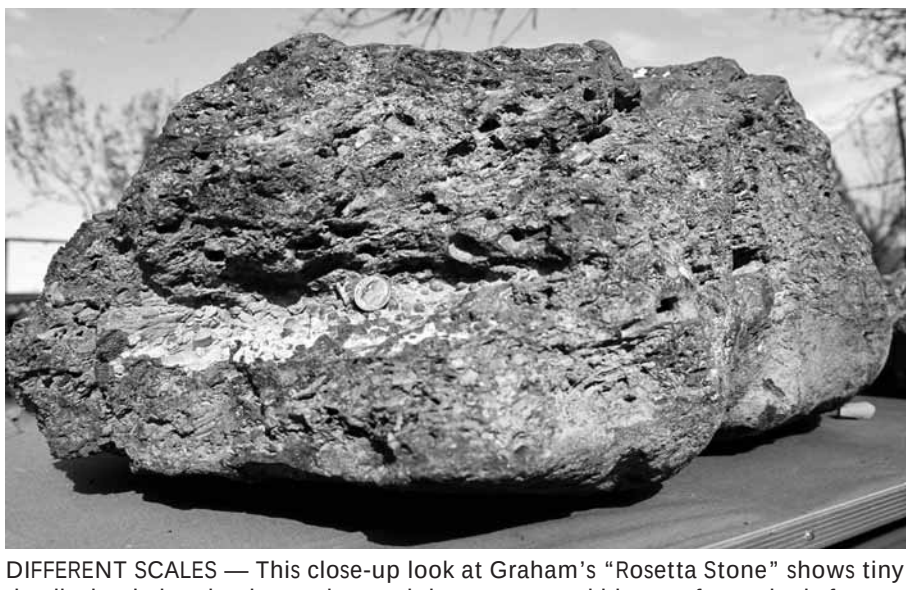
"There are a huge number of possibilities with different rock types, impact objects, direction, size, and speed of objects. Every impact structure is going to be different in terms of age, erosion, and other factors. That's not surprising." **— Mark Boslough**

Big time, small time

Bob has investigated the site on his own, with the help of local geologists, local agricultural scientists, and associates at Sandia and Georgia Tech. "It's big-time science on a small-time budget," he joked. After moving around the two-kilometer-wide crater site collecting samples, Bob developed a detailed story of how the meteorite collision occurred. He proceeded on the approach that determining shock compression information would lead to an explanation of the big picture of the impact. Bob found evidence of the venting of some calcium carbonate minerals in the form of a heated vapor south of the impact crater. He observed that goethite, a hydrous iron oxide mineral, occurred more frequently in the altered sandstone samples he collected as he moved toward the center of the impact area.

His major find, which he refers to as his "Rosetta Stone," is a 75-kilogram rock with an intact collection of shocked sandstone and siltstone materials and other features revealing the nanosecond history of the actual impact event. Discovered a kilometer from the impact's "ground zero," the large stone was tossed away in the impact, Bob believes.

He noted differences in regional rocks and their impacted counterparts, renaming some of them, including one he calls "Sandia Ironstone." Using microscopy taken at the Uvalde Texas Agricultural Science Center, scanning electromicrographs taken by Prof. Naresh Thadhani at Georgia Tech, X-ray diffraction analysis by Bruno Morosin (Sandia retiree) and Ralph Tissot (1822) — all parts of his "beg, borrow, and steal" mode of operation — Bob observed voids and steam bubbles that helped him piece together the story of the crater.



DIFFERENT SCALES — This close-up look at Graham's "Rosetta Stone" shows tiny details that help scientists understand the nanosecond history of a geologic feature that is two miles wide. (Photo courtesy of Bob Graham)

Crater computer code

With his rock evidence and advice from his Sandia colleagues, Bob used an online computer code developed at the University of Arizona to estimate the size and velocity of the meteorite. He described the impact of an iron meteorite at a velocity of 7.5 kilometers/second that produced pressures of about 250 GPa. The wave compressed the underlying sandstone and siltstone layers at different rates. Part of the wave rebounded from underlying geological strata, passing upward through the formations. The impact resulted in a "bottom up" crater in Bob's words, where some material was crushed and welded, a smaller amount thrown outward, and other material vaporized.

Although different from the more typical "top down" type crater, Bee Bluff is a meteor impact structure, Bob concluded. The site provides an opportunity to meld shock physics and geologic science to the benefit of both, he said.

Horton Newsom, research professor and curator of the Institute of Meteoritics at the University of New Mexico, attended the talk and agrees that more cooperation between the two groups can be valuable. "We have already been talking about how to encourage more collaboration, and I am interested in helping Bob with his study of the Bee Bluff Structure," he said. One of Horton's graduate students also is interested in working with Sandia researchers on some shock experiments relevant to her study of the giant Chicxulub crater, Horton added. That crater, associated with the post-Cretaceous mass extinction event, is now buried beneath a kilometer-thick sequence of ocean sediments off Mexico's Yucatan Peninsula. It is one of Earth's largest impact structures.

Cautious approach

Impact crater scientists approach identification of a site cautiously, said Sandia's Mark Boslough (1433). "This looks like an impact structure, although some of the shock lamellae used to identify shocked quartz aren't there....There are a huge number of possibilities with different rock types, impact objects, direction, size, and speed of objects. Every impact structure is going to be different in terms of age, erosion, and other factors. That's not surprising."

Mark, who worked with Bob when he first arrived at Sandia, sees value in this type of collaboration. "It's good to have someone like Bob keeping an eye on a project like this. [Since he's retired,] he may not have all the scientific tools he needs every time, but his enthusiasm counts for a lot. It's a good lesson."

"Right now there are probably only a few people who understand the details of what's happening in the shock process and the link between the microsecond and how it relates to the long-term picture," said Dave Crawford (1516), who also attended the talk. "The terrestrial impact community tends to focus on field mapping, and they aren't generally trained in shock wave physics, although there have been some collaborations over the years. We're looking at understanding the importance of a hand sample with melt veins and cracks in it and what that means to the formation of the crater.

"That means going from the micron and centimeter scale to the kilometer scale," said Dave. "My personal feeling is that studying the small-scale details as Bob is doing will finally enable us to answer the question of why craters look like they do. The details matter even at very small scales for such a large structure. It's going to be up to our generation to bridge that gap."

Mileposts

New Mexico photos by Michelle Fleming

Robert Axline
30 5711

Wayland Bell
30 5742

Ernest Garcia
30 2614

William Ling
30 243

John Matter
30 6923

Mark Montavon
30 5424

Andrew Rogulich
30 225

Jeffrey Romine
30 5536

Mike Stone
30 1527

Henry Abeyta
25 3820

Alicia Cloer
25 7000

Jeffrey Everett
25 12300

Gary Froehlich
25 5345

Thomas Gutierrez
25 10843

Teresa Jordan-Culler
25 5422

Kevin Linker
25 6418

Shirley Ann Mayer
25 10872

Evelyn Moore
25 10872

David Myers
25 1702

Roger Adams
20 4338

Arnold Augustoni
20 1128

Mark Dickinson
20 224

Timothy Drummond
20 5917

Michael Gilbert
20 5423

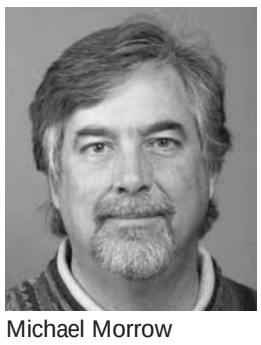
Ronald Hoskie
20 10842

Spencer Luker
20 1384

Leonard Martinez
20 1653

Timothy Mitchell
20 24312

Jeffrey Morgan
20 2663



Michael Morrow
20 5918

Michael Saavedra
20 2455

Brent Sims
20 5425

Joe Weatherby
20 5526

Douglas Weiss
20 5353

Judith Borrowdale
15 10100

Christine Chavez
15 38151

Sharon Deland
15 6221

Pauline Duran
15 12800

Linda Konkel
15 5925

Mary Wendt
15 3655

Sandia Classified Ads

How to submit classified ads

DEADLINE: Friday noon before week of publication unless changed by holiday. Submit by one of these methods:

- **E-MAIL: Michelle Fleming (classads@sandia.gov)**
- **FAX: 844-0645**
- **MAIL: MS 0165 (Dept. 12651)**
- **DELIVER: Bldg. 811 Lobby**
- **INTERNAL WEB: On Internal Web homepage, click on News Center, then on *Lab News* frame, and then on the very top of the *Lab News* homepage "Submit a Classified Ad." If you have questions, call Michelle at 844-4902.**

Ad rules

1. Limit 18 words, including last name and home phone (If you include a web or e-mail address, it will count as two or three words, depending on length of the address.)
2. Include organization and full name with the ad submission.
3. Submit ad in writing. No phone-ins.
4. Type or print ad legibly; use accepted abbreviations.
5. **One ad per issue.**
6. We will not run the same ad more than twice.
7. No "for rent" ads except for employees on temporary assignment.
8. No commercial ads.
9. For active and retired Sandians and DOE employees.
10. Housing listed for sale is available without regard to race, creed, color, or national origin.
11. Work Wanted ads limited to student-aged children of employees.
12. **We reserve the right not to publish an ad.**

MISCELLANEOUS

HDTV, Sony, 60-in. LCD, 2-yr. warranty, 1080i component inputs, vivid picture, $1,600; matching metal stand, $130. Dybwad, 296-9047.

UPRIGHT FREEZER, Signature, 21-cu. ft., excellent working condition, $100; antique pump organ, $65. Richardson, 877-2731.

ION HAIR DRYER, portable, like new, $15; Health Rider exerciser, $50. Barton, 268-7349 or djabezbarton@msn.com.

OIL FILTERS, 2 Fram #2, new, free. Kidner, 281-5229.

LABRADOODLE PUPPIES, paper-trained, 1st shots, socialized w/children & trusted helpers, available 2/4, reserve now. Castillo, 899-1956 or 453-2970.

COMPUTER DESK, oak, 72-in. printer/copier pedestal, 3-drawer pedestal, rollout keyboard tray, $450 new, asking $85. Moody, 301-6278.

TIMESHARE, Winter Park condo, Indian Peaks, 2-bdr., 2-bath, kitchen, Jacuzzi, 1/20-1/27, resort charges $1,952, asking $1,000. Law, 235-3331.

WASHER & DRYER, stackable, GE, heavy-duty, good condition, $300 OBO. Sandoval, 321-2025.

TIRES & RIMS, 4, new Firestone Destination M/T, LT265/75R16, on 8-hole Ford rims, make offer. Lucero, 861-5499.

BOXER PUPPY, female, 14 wks., 1st shots, $200 OBO. Ramirez, 715-9117.

FURNITURE: couch & chair, $120; round table, w/4 chairs, $80; queen bed, 2 yrs. old, excellent condition, $350. Dargaville, 715-8952.

EXERCISE BIKE, VitaMaster Air Advantage, good shape, $50. Hunter, 865-5745.

SLEEPER SOFA, red, $350; butcher-block kitchen cart, $130; 17-in. CRT monitor, $50; computer stand, $100. Garza, 271-0522.

DRESSER, w/removable mirror-hutch top, maple color, 56"L x 18"W, $125. Steiner, 401-8114.

CRIB, dark wood, $75 OBO; air compressor, 8-gal., $25; Thule roof rack, gutter-style, $25. Robertson, 217-9286.

CAT DOOR, 4-way locking w/tunnel, ~7" x 7", $25 OBO; locking ski rack, fits SUV luggage rack, holds 6 pair w/poles, $35. Barnard, 771-4620.

ELECTRIC RANGE, freestanding, GE, white, black door, great condition, $100. Schumacher, 286-1143.

BABY CRIB, swing, playpen, jogger, bike trailer, backpack-stroller, all excellent condition; firewood, 1/3 cord, split, stacked, delivered, $95. Dechant, 980-6360.

SINGLE-BED, wooden, platform (Captain's) frame, w/3 wooden drawers below, good condition, $60. Peters, 293-6356.

TABLE, oak, w/leaf, 48" x 60", $100; Robo-Raptor, new, paid $100, asking $75 OBO; Dell laptop case, $25. Cocain, 281-2282.

NORDIC WARE COOKWARE, 19-pc., w/wok, fry, sauté, sauce, stock pans, used, good condition, $100 OBO. Lojek, 898-2979.

CHINA CABINET, Thomasville, lighted, glass shelves, beveled glass doors, 68"L x 86"H x 19"D, excellent condition, $800. Hart, 286-1349.

P.A. PORTABLE LECTERN, w/folding stand, full electronic connections, AC/DC, $850. Manning, 884-3272.

GRACO STROLLER, infant car seat w/base, light plaid green, gently used, <2 yrs., $90. Kettleborough, 293-4503.

'94 FORD F150 PARTS: auto-transfer case, $1,000; split-front bench & rear seat, $200; 15-in. rims, new tires, $500. Zamora, 235-0529.

GARMIN GPS III PLUS, handheld/mobile receiver, power & data cables, dashboard mounts, map CD, $125. Hale, 298-1545.

NINTENDO 64/2, w/memory card, $30; PlayStation2, games, $50; 25-in. screen console TV/cable, $50. Crosby, 260-1070.

HARD DRIVE, 100GB, SATA150, 7,200-rpm, retail pkg., used, clean, flawless performance, $40. Clem, 379-0475.

VACATION WEEK, Mexico, Mayan Palace Luxury Oceanfront resorts, Jan.-Dec. 2006, 5 locations, 2-bdr., $700. Wilsey, 237-8614.

COMPUTER MEMORY: 2, 64MB PC100 SDRAM; 2. 64MB EDO 60ns 166pin; 2, 32MB EDO 60ns 166pin, below market. Miller, 292-2746.

GRACO PACK-N-PLAY, $30; 1/6-hp electric motor, like new, $50; Hoover steam cleaner, $20. Mounho, 299-0883.

CAR BRAS: '79 Firebird TransAm; Fiero; Hoover Windtunnel vacuum, 12-amp, $100. Martinez, 907-2632.

CARPET CLEANING UNIT, Rainbow/Aqua Mate, uses water-based filtration system, works extremely well, $150. Pitts, 293-5481.

LANDSCAPING ROCK, red, 5/8-in., fill dirt, ~ 1-cu. yards. ea., you haul, free. Lindblom, 271-4520.

WASHER & DRYER, Kenmore, $125; bunk bed, w/queen, $80; twin bed, $25; table, w/6 chairs, $60. Barraza, 839-3934.

GPS GARMIN ETREX, new, $80; Gore-tex desert camo jacket, new, XL, $75; Leupold VariX-IIc 3x9 scope, $175. Leong, 892-1564.

DINING ROOM SET, 7-pc., $150. Graham, 293-7302.

TOTAL GYM PRO, complete w/accessories & video, excellent condition, $100. Carpenter, 286-9174.

COLOR TV, 25-in., Sanyo, w/remote, excellent condition. Scharrer, 867-4109.

SAFE, $100; NordicTrack, $95; Chevy Rancho shocks, $95. Black, 350-8565.

CHILD CAR SEAT, Summit Deluxe high-back booster, 20-100-lbs., new, unused, everything but the box, $40. Klem, 332-9184.

PORTABLE SWAMP COOLER, $20; Mac Tools, 7-drawer sidebox, 15" x 18" x 30", $20. Armstrong, 271-8302.

CUSTOM WHEELS, 4, 16x8, Konig, universal bolt pattern; full-size pickup saddle tool boxes, 2, make offer. Underhill, 294-5774.

SOFA & LOVE SEAT, contemporary style, excellent condition, $350. McMahon, 822-1301.

TRAILER, made from truck bed, $300; RV vinyl windshield cover, $20. Schneider, 400-9143, ask for Casey.

ENTERTAINMENT CENTER, oak, 7'x 6', smoked glass doors, 2 side cabinets, $300. LaDuca, 292-6745.

CAMERA LENSES & FLASH, Olympus 35mm SLR, call for more information. Poulter, 291-0607.

LAVA ROCKS, 10", for landscaping, ~170 total, you pick up, you haul. Ellis, 292-4075.

ROLL-TOP DESK, oak, $600; entertainment center, 2-tower, oak, $500. Bobbe, 899-8768.

NORDICTRACK SEQUOIA, w/electronic monitor, like new, $85. Dandini, 296-4975.

CHILD BICYCLE SEAT, Kettler Teddy, great condition, $35. Dwyer, 271-1328.

CHAIRS, 2, antique replica Morris, w/leather cushions, $400 ea. Olbin, 275-2681.

CHIHUAHUA, chocolate male, short hair, 6 mos. old, 4-5-lbs., neutered, vaccination record, $350. Gallegos, 804-1985, ask for Tanya.

ENTERTAINMENT CENTER, 2-pc., oak, pull-out shelves, glass doors, excellent condition, $300. Sorenson, 298-1593.

HOUSE PLANT, 5-ft. Norfolk pine, w/decorative pot, free. Blaine, 856-2988, ask for Jennifer.

CELL PHONES, 2, Nokia, no contract, no mo. fees, car & house chargers, hands free, cases, manuals, $40. Horton, 883-7504.

REMODELING SALE: cabinets; side-by-side refrigerator; cook top & oven, dishwasher, entertainment center, dining table, more. Olona, 830-6577.

TIMESHARE, 1 wk. you name the place, must use by April 1, $500. Walters, 857-9767.

SONY TRINITRON TV, 36-in., high definition ready, digital 1080i, 720p, 480p, bought in '01 for $2,250, asking $500. Denney, 877-9788.

WATERBED MATTRESS, queen, foam, tubes, baffles, good condition, $75. Quintana, 220-7747, ask for Shelly.

PRINTERS: HP Laser 4P, black & white, $20; HP Inkjet Color 750PSC, printer/scanner/copier, $20. Brower, 850-5719.

GARAGE SHELVES, 5-shelf unit, grey hard rubber, 34" x 14" x 72", $20. Dockerty, 828-0745.

PARROT PLAY STAND, small/med. bird, swing, toys, ladders, food/water dishes, seldom used, pictures available, $50. Maze, 298-0617.

ORGAN, Hammond BV, $700 OBO; weight bench, $100 OBO; programmable stepper, $50; TV, white finish, $10. Weeks, 238-5544.

NORDICTRACK, Sequoia model, used, great shape, $50 OBO. Loudermilk, 299-4621.

BICYCLE TRAILER, Bell Deluxe, seats 2, used lightly, $50; play yard, like new, only used a few times, $15. Trujillo, 293-8568.

SUBWOOFER, for home entertainment systems, 150-W, $175; 5-pc. drum set, $135; Sears cargo luggage carrier, $40. Barba, 507-1461.

WEDDING GOWN, VEIL & TIARA, Demetrios, never worn, size 8, unaltered, ivory, worth $1,900+, asking $800. Pollice, 217-2320.

STEREO RECEIVER, NAD 7000, excellent for listening to music, paid ~$600, asking $125. Bastian, 296-4620.

DELL MP3 PLAYER, 20GB capacity, 2 mos. old, great condition, $200. Campbell, 294-1380, ask for Peter.

CHINA HUTCH, 3 shelves, 3 doors, for extra storage, good condition, $150 OBO. Sanchez, 292-1982 or 459-5539.

WROUGHT-IRON BIRD CAGE, large, attractive, 60" x 24", stand or hang, $100 OBO. McCampbell, 797-1979.

DINING ROOM TABLE, 2 arm chairs, 4 side chairs, upholstered, 60" x 42" w/extension, $400. Little, 883-9329.

GLASS SHOWER DOOR, clear, Form-Cove, 60"W x 72"H, white metal frame, $55. Lewis, 275-3370 or 385-3415.

DOUBLE JOGGER, w/canopy, Kool Stride, minimally used, garage stored, $150. Giersch, 899-6005.

FILE CABINET, 5-drawer, heavy-duty, $50; computer desk, $65; roll-top desk, $65. Dean, 299-3281.

NORDICTRACK ELLIPTICAL MACHINE, CX990, excellent condition, $400; Giant Ukon mountain bike, good condition, $200. Millard, 298-4764.

WEDDING DRESS, white, simply elegant, size 6/8, removable train, happily married, call for more details, $125. Ahlen, 321-0235.

FABRIC STASH, lots of variety, yardage & small pieces, Sat. 1/28, 11 a.m.-4 p.m., good prices. Smith, 265-0551.

SNOWBOARD & BINDINGS, 17cm or 58", used once, $175. Ruby, 821-0982.

TABLE SAW, Makita, 8.25", medium duty, w/stand, excellent condition, $75. Laskar, 856-7806.

MAGNEPLANAR SPEAKERS, SMGa Ribbon, white fabric, light wood, excellent condition, $200/pair. Hatley, 830-0469.

EAGLE TACT VEST, black, medium, adjustable, fits large auto, many pockets, new, $90. Williams, 896-2405.

HUNTING TROPHIES, moose, caribou, antelope, deer, negotiable; inflatable boat, seats 4, outboard motor, $100. Vaughn, 822-0206.

TIRES, 4, Bridgestone Potenza, 225/45R 17, new, never used. Anderson, 271-0854.

WOOD/BRUSH CHIPPER, Sears Craftsman, 10-hp, like new, $500 OBO. Ghormley, 293-6466.

SNOW TIRES, Magnagrip-HT, 185/70R14, used 1 season, $20/pair OBO. Maenchen, 856-6559.

BABY ITEMS: high chair, $30; stroller, $40; changing table, $20; crib, $40; playpen, $40; swing, $30. Howard, 873-3038.

STETSON HATS, 6-7/8, 7-1/2; 32-ft. extension ladder w/stabilizer; radio control parts, fermentation crock, 13W hiking boots. Dobias, 856-7841.

TV/DVD COMBO, filing cabinet, dinette set, more, call for list, free. Holzrichter, 298-5695.

PC MEMORY, 512MB RAM, PC-133, 1 stick, $50. Goodson, 286-1267.

TRANSPORTATION

'03 GMC SIERRA 1500, 2WD, V8, extended cab, loaded, white, tonneau, dual alarms, 22K miles, $25,000. Giachino, 821-6351.

'03 HONDA ELEMENT EX, AT, orange, hitch, 22K miles, like new, $15,650 OBO. Campbell, 294-6000 or 620-5369.

'98 LAND ROVER, black, leather, good condition, $11,000 OBO. Brown, 270-7442.

'95 FORD T-BIRD, V8, 124K miles, good condition, $2,100. Salas, 294-5863.

'02 BMW X5 3.0i SUV, 5-spd., cold weather pkg., leather, moonroof, 47K miles, immaculate, wholesale-priced, $26,300. Lifke, 822-8741.

'97 TOYOTA TACOMA SR5, 4WD, V6, extended cab, 110K miles, works great, $5,000 OBO. Trever, 294-7364.

'03 TOYOTA AVALON XL, AT, fully loaded, leather, 8K miles, excellent condition, $23,000. Carrillo, 877-2129.

'95 PONTIAC FIREBIRD CONVERTIBLE, 350-V8, standard transmission, all power, runs great, $7,500. Padilla, 292-8936.

'95 CHEVROLET ASTRO CONVERSION VAN, Captain's chairs, folding bed, AC, new tires, $4,000. Apodaca, 865-8314, ask for Casey.

'01 FORD F150 XLT, SuperCrew, 4x4, 5.4L, loaded, 6-disc CD, tow pkg., new tires/brakes, 64K miles, $16,900 OBO. Harrison, 867-6459.

'93 FORD F150 XLT, 4x4, 174K miles, everything works, runs great, $5,000. Sander, 281-7384, ask for Stan.

'05 PONTIAC SUNFIRE, AC, PS, PW, tilt, cruise, sun roof, AM/FM/CD/MP3, <1,500 miles, like new, excellent condition, $11,995. Harris, 797-3597.

'93 VOLVO 940, 4-dr. sedan, navy blue, 145K miles, impeccably maintained, $2,400. Cygan, 298-5126.

'86 JEEP CHEROKEE, 6-cyl., H/L 4WD, 145K miles, very good tires, current emissions, runs well, $999. Lundgren, 281-1564.

'98 FORD F150, w/camper shell, 5.4L, V8, fully loaded, power, AT, tow pkg., AC, 64K miles, $7,900. Zelnio, 877-1465.

'93 NISSAN ALTIMA GLE, 4-dr., all power, sunroof, leather, great condition, runs great, $2,500 OBO. Schultz, 321-2618.

'98 FORD CONTOUR, V6, 78K miles, 1 owner, $2,500 OBO. Sigman, 256-8020.

'91 GMC SONOMA, new tires, theft-proof radio, 1 owner, fiberglass shell, extra TLC, excellent condition, beauty, $1,850. Epperson, 271-9880.

'01 TOYOTA CAMRY CE, manual, beige, 44K miles, excellent condition, $9,000 OBO. Smith, 858-2494.

'00 CHEVROLET IMPALA, 3.6L V6, AT, PW, PS, CD, leather, heated seats, 73K miles, below NADA, $6,900. Lucero, 899-0521.

'01 NISSAN MAXIMA, AT, ABS, airbag, Homelink, all power, 70K miles, $9,990. Bui, 440-2010.

'96 FORD MUSTANG, red, body in good shape, engine needs work, 130K miles, $1,000. Claudet, 856-1690.

'00 PONTIAC FIREBIRD, Formula V8, all power, T-top, midnight blue, 58K miles, excellent condition. Jewell, 363-9158, ask for Chris.

'98 SATURN SL2, AT, 4-dr., AC, airbags, 63K miles, pristine condition, runs like new, $6,500 OBO. Armijo, 552-9762.

'97 FORD PROBE, standard transmission, red, 34-mpg, 1 owner, 70K miles, $5,000 OBO. Alderete, 449-8082.

'90 TOYOTA 4RUNNER SR5, V6, AT, 4WD, all power, silver, 220+K miles, $2,400 OBO. Schell, 507-6092.

'01 SATURN SC2, 3-dr., AT, all power, cassette/CD, sunroof, blue, great on gas, 40K miles, $9,500. Ortiz, 293-4775.

'99 FORD MUSTANG SVR COBRA, 4.6L, V8, 5-spd., green, new Michelin tires, 48.5K miles, $16,500. Kaye, 292-4242.

'00 MERCURY MOUNTAINEER, AWD, V8, all options, leather, tow pkg., all records, excellent condition, $8,800 OBO. King, 250-4426.

'01 DODGE DURANGO, 4WD, V8, AT, AC, cruise, AM/FM/CD, 3rd seat, information center, 62K miles, $13,500 OBO. Vigil, 898-7662.

'77 GMC SIERRA, 3-in. lift, 35-in. tires, alloy rims, needs rear end, rebuilt 350 engine, $2,000 OBO. Baca, 550-1238.

'88 1/2-TON SUBURBAN, 4WD, new non-Freon AC, 1 owner, 144K miles, very clean, $3,000. Weaver, 296-0992.

'98 GMC SAFARI SLE MINIVAN, AWD, loaded, seats 8, only 33K miles, excellent condition, $9,000. Hillman, 275-3896.

'02 EXPLORER XLT, PL, PW, PS, leather, alarm, CD, tow, gold/tan, 49K miles, $14,600 OBO. Suo-Anttila, 275-8373.

'95 FORD BRONCO XLT, 4x4, 5.0L, PW, PL, cruise, alarm, new paint, 70K miles, $6,000. Dudley, 352-5442.

'98 DODGE DURANGO, 4x4, rear AC, full power, new tires, 115K miles, like new, $7,200. Wymer, 281-0424.

'00 GMC JIMMY, 4x4, white, tan interior, <40K miles, good condition, $9,000 OBO. Beets, 271-2826.

'99 MIATA, AC, cruise, alarm, silver, tan leather, roll bar, custom wheels, 31K miles, excellent condition, $9,500. Bova, 280-7810.

'06 INFINITI M35, AT, all options, silver, <5K miles, only 6 mos. old, $46,000 firm. Smith, 797-9358.

'59 CHEVROLET CORVETTE, a classic, call for info/website. Atcitty, 453-8780.

RECREATIONAL

'03 POLARIS 90 ATVs, 2, 1 red, 1 grey, both in good condition, $900 ea. or $1,600 both. Montoya, 797-4226, ask for Eric.

'87 KAWASAKI NINJA 750R, black, 19.5K miles, excellent condition, $1,750. Frederick, 450-3198.

'05 SUZUKI GSXR 600, blue/white, frame sliders, Akrapolvic exhaust, other upgrades, 4K miles, $6,900 OBO. Walton, 507-4489.

'00 POLARIS GEMINI JET SKI BOAT, like new, $6,000. Anderson, 232-2167 or smander@cnsp.com.

'00 MONACO M-32 MOTOR HOME, slide-out, many extras, comfortable, ready for the road. $35,000. Cronin, 299-6747, ask for John.

REAL ESTATE

TWO 3-ACRE LOTS, north of Edgewood, utilities at line, w/Estranosa water membership, no mobiles, $45,000. Huppertz, 286-3287.

3-BDR. HOME, 1-3/4 baths, 1,780 sq. ft., passive solar, greenhouse, new paint & carpet, corner lot, fenced, NW Albuquerque, $148,000. Garcia, 836-5196.

10-ACRE LOT, San Pedro Creek Estates, beautiful views, build your dream home, beat spring rush, $220,000. Cash, 271-2376.

3-BDR. HOME, 2-1/2 baths, 1,800 sq. ft., corner lot, Sivage Thomas home, far NE Heights, $265,000 OBO. Malik, 856-5882.

2-BDR. MOBILE HOME, 2 baths, single-wide, 1 acre of land, Belen area, great condition, $73,000 OBO. Gabaldon, 417-6199.

10-ACRE LOT, San Pedro Creek, East Mountains, views of Paako golf club & ski area, $240,000. Kessel, 234-9877.

WANTED

PART-TIME TUTORS, for children w/dyslexia, Scottish Rite Language Program, send resume to Mesa Charity Corp, P.O. Box 94596, Albuquerque 87199. Puckett, 344-8526.

HOUSEMATE, private, furnished apartment, Four Hills, separate entrance, convenient to Sandia, $350/mo. Smith, 298-7365 or 292-1976.

RECUMBENT BIKE, new or used. Chavez, 281-1646.

FRONT END PARTS, '94-'97 Dodge Intrepid, hood, radiator & radiator support. Emms, 710-1251.

GOOD HOME, Cocker Spaniel, male, 6 yrs. old, neutered, trained, very affectionate, not for young kids. Kappelman, 352-0251.

HOUSE SITTER/CHILD CARE, responsible college-age female, oversee 12 yr. old activities when parents on travel, references requested. Madrid, 450-1054.

VACATION RENTAL, Angel Fire, must sleep 14, 6/26-6/30. Lauben, 275-7466.

SCRAP ALUMINUM TUBING, 1/8" or 1/16" square or round, Robotics competition, donate to South Valley Academy. Gutierrez, 459-7786, ask for Luis.

ROSETTA STONE SPANISH, home school levels 1 & 2, to buy or borrow, also need workbooks. Dotson, 281-8335.

PIANO, good condition, for mom & dad to teach daughters, will pick up. Klingler, 553-9564.

PROJECT CAR, not running OK, will tow, prefer electrical/mechanical problems over bodywork, must have title, cheap/free. Barker, 899-2018.

2-BDR. HOME TO RENT, for retired Sandian, can pay $700-$800/mo. Lujan, 822-0205.

LAPTOP, capable of running Windows XP & MS Office, prefer 1 GHz, 256MB, no software required. Whalen, 792-9549.

SUPER 8MM FILM PROJECTOR, to borrow or buy. Wifall, 292-1747.

US COINS & COIN COLLECTIONS, any quantity or condition. Borders, 271-8107.

GOOD HOME, Hound Terrier, sweet dog, 40-lbs., 7 yrs. old, yard too small. McReaken, 293-1227.

METAL DETECTOR, good working condition. Johnson, 241-9258.

GOOD HOME, lazy old male cat, friendly, de-clawed, neutered, current shots, good health, hates dogs. Perrine, 293-1429.

GOOD HOME, 4 kittens, 1 adult female cat, 1-1/2 yrs. old (she must be only pet). Tapia, 292-7043.

SEWING MATERIAL SCRAPS. Essenmacher, 865-7941.

OLD LAPTOP, to run DOS. Zanner, 281-1789.

PORT-A-CRIB, clothing, other infant care equipment, for foster home use, good condition, reasonably priced. Hughes, 296-8940.

ROTOTILLER, good condition. Jones, 203-2338.

Unbroken chains, unexplored challenges draw Sandians to each other for mentoring

By Iris Aboytes

"I have had each of my mentees read *Tuesdays with Morrie*," says Phil Montoya (10508). "It gives us a common denominator to start. I share my expectations with my mentee and listen as my mentee's expectations are shared with me. I take my role as mentor very seriously."

The Sandia Corporate Mentor program recently celebrated its tenth anniversary. The program has a number of events and activities that will go on throughout the month of January to celebrate National Mentoring Month. The pilot program that began with 68 participants has grown to its current enrollment of 650. The program was designed to provide a mechanism for developing people who can respond to changing requirements and complex customer needs.

Participation in the program does not guarantee a promotion. What it does provide is an opportunity for Sandians to improve employee contribution through increased knowledge of Sandia's culture, strategy, and programmatic directions.

"I can relate better to the people I work with, as I offer no blame but reconciliation."
—Philip Montoya

What all that means is Sandians are willing to help each other through networking, sharing of experiences and knowledge, support, encouragement, and giving of themselves. The program strives to match Sandians with mutual interests so together they can grow and become stronger.

"I feel that I have become a better human being," says Phil. "I can relate better to the people I work with, as I offer no blame but reconciliation. Growing up, our hearts were open as our grandparents and parents offered us lessons in life. So at Sandia, the experiences and knowledge possessed by its employees — that chain must not be broken. Phil says his favorite mentors and role models were his mother, who shared her wisdom, and his children, who speak from the heart with innocence."

Derius Swinton talks about soaring beyond limitations

Sponsored by the Diversity Leadership Program and Mentoring Program, motivational speaker Derius Swinton spoke at a mentoring luncheon in December. He talked about the many lifestyles, but said we all have only one life.

He offered three "A's to positive approaches: awareness, attitude, and action. Only you can make it happen," said Swinton. "Don't give anyone permission to hold you back. You have the power.

"Your expectations need to be realistic and you need to be proactive," he said. "Take time and write your own mission statement. Focus on one common purpose and be future oriented. You can then proceed from there."

Swinton talked about having a trusted friend/mentor to keep you going when you want to give up. "You can make it happen," he said.

Seventy-four percent of last year's participants rated the program as worth the time investment. Sixty-five percent felt their goals and objectives had been met.

"My mentorship has offered me a great opportunity to learn about Sandia."
—Jerilyn Moore

Here are excerpts from comments by participants in the program:

• "I have a mentor who is dedicated to the program and making a difference for others. It was wonderful sharing my mentor's experience and insight of changes at the corporate level."

• "In my mentor I have someone to talk to and bounce ideas — someone to offer support and suggestions."

• "This program gave me a contact I could talk with honestly about issues and gain a deeper understanding. I felt I could ask and not worry about any repercussions of personality or culture retaliations. My mentor was able to give me advice and guidance."

• "I believe my mentor's guidance and his connections have impacted my career."

"My mentorship has offered me a great opportunity to learn about Sandia," says Jerilyn Moore (3012). "My mentor, Phil Montoya, has always made himself available to me, providing support, guidance, and friendship. Phil also challenges me to work on areas in my own life, while sharing experiences from his life. The mentoring partnership has been a very positive and invaluable experience for me."

"Mentees are committed to continuous self-assessment," says program administrator Rebecca Burt (3522). "Mentors are more development-minded and savvy about the business. Mentees are willing to experiment, grow, and share as mentors are more authentic and share their own story. Together they fill the mentee's thirsty appetite."

"We offer monthly luncheons with great speakers that participants can attend alone or as a team," says Rebecca.

For more information on the program, you can contact any of the coordinators on the list go to: https://hrprod.sandia.gov/cfdocs/prod/hris/ctd/apps/cedtweb/blmd/programs/mentorhome.

Mentoring coordinators

Burt, Rebecca	04000
Bruce, Edwin A.	02100
Bryce, Edwin	02300
Bryce, Edwin	02400
Bryce, Edwin	02500
Chavez, Frank	02800
Chavez, Frank	02700
Chavez, Frank	02600
Chavez, Frank	02900
Franks, Regina	01000
Frederick, Diana J.O.	05000
Hollis, Charles	10800
Howell, Carrie	15000
Kelley, Beverly	08000
Piatt, Goldie	06000
Smallwood, Sandra	03000
Tidwell, Mary	10000

Recent Retirees

Norm Corlis
43 5419

Jim Kwak
27 2541

Gila Yaniv
27 3011

Jerry Biedscheid
24 2951

Cecilia Olmstead
13 5993

Hydrogen: Don't leave home without it

Roland Stumpf helps edit MRS volume on hydrogen storage

One of Sandia's favorite organizations, the Materials Research Society (five Sandians have served as presidents), has published a timely volume on the subject of hydrogen storage.

The book, edited by Roland Stumpf (8761) and three other researchers, is titled *Materials for Hydrogen Storage - 2004*, and consists of 21 papers delivered at a symposium held December 2004 at the annual MRS meeting in Boston.

The 153-page hardcover volume covers a range of materials proposed for hydrogen storage, including simple and complex metal hydrides, chemical hydrides, and carbon-based systems.

Among other topics, the volume examines the quality and amount of hydrogen storage possible in nanostructured materials, as well as their thermodynamics and kinetics, and discusses tools used to examine the results.

Other topics include a discussion of catalysts for reversible hydrogen storage with complex metal hydrides, oxides and heterogenous adsorbents such as zeolites, metal-organic frameworks, solid state reactions, bulk and surface diffusion, and the relationship between material structure and hydrogen binding energies.

The volume is available free on the MRS web site (www.mrs.org) for members of the Society. All others pay $93. (The book is available for $81 to MRS members wanting a hard copy.) — *N.S.*

Sandia's Diversity Cinema wins Best Practices Award

Sandia's Diversity Cinema Program was recently announced a winner of the 2005 US Department of Energy EEO/Diversity Best Practices Awards by the Office of Economic Impact and Diversity.

Since April 2001 Sandia has hosted the monthly Diversity Cinema during lunch hour. The program convenes participants to view videos on diversity issues, with time to discuss the issues in a group setting. Videos are loaned out, on request. Response to the program has been overwhelmingly positive.

The program has been benchmarked by other Lockheed Martin business units. DOE/NNSA Services Center in Albuquerque and Los Alamos National Laboratory have implemented their own version of Diversity Cinema, recognizing Sandia as the impetus and model for their programs.

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